

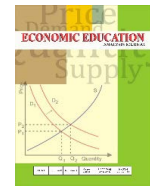


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Environmental Accounting System Model in the Era Artificial Intelligence and Blockchain Technology: A Bibliometric Analysis

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Abstract

Environmental accounting in the era artificial intelligence and blockchain technology is also being considered as a new direction. Artificial intelligence and blockchain technology have revolutionized how organizations carry out transactions and store information. This research aims to describe publication activity evolution, broaden the knowledge, identify the most representative authors and journals, and offer insight into potential new directions, especially regarding environmental accounting system model in the era artificial intelligence and blockchain technology. This research follows a process of systematic literature review. The publications used in this study are from 2009 to 2023. The data used in this study came from 77 sources in the form of 27 articles, 7 book chapters, 24 conference papers, 5 conference reviews, 13 editorials, and 1 short survey from 2018 to 2023. Network visualization result shows research related to the influence of these technologies has not been done much and works analyzing these influences are scarce especially about environmental accounting model recently. The findings of this study serve as a reference and provide direction for future researchers and provide mapping related to environmental accounting system model in the era artificial intelligence and blockchain technology. More research on the influence of these technologies are needed.

How to Cite

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INTRODUCTION

Accounting practice has a great impact on society and society due to its diverse forms and characteristics. Accounting practices influence what is valued and deemed valuable by individuals, organizations, markets and society (Kornberger et al, 2017). Financial statement or information as accounting process result influence what types of options are chosen at various levels of decision making. But traditional accounting practices are driving the current environmental crisis. The complexity of the business environment as well as the concerns and awareness of the environmental problems by society, which has led firms to confront with environmental issues to manage and reduce their activities' environmental impact (Saeidi et al, 2011). These characteristics combine to make it generally accepted that traditional accounting is problematic from an environmental perspective. One remedy is the development of a wealth of research and practice on environmental accounting (Tregidga and Laine, 2022; Xianliang, 2018).

Environmental accounting is an important area of accounting development and is also the result of socio- economic development (B, 2022). In environmental accounting concept reflect not only environmental cost but also environmental revenue (Visintin, 2014). Environmental accounting is also being considered as a new direction. Environmental accounting as a new accounting direction has been raised to a new height, which also points out the direction for the development of environmental accounting. In this context, as the focus of environmental accounting work, environmental accounting information disclosure has become a hot issue, how to combine it with artificial intelligence (B, 2022).

In the 21st century, artificial intelligence will appear due to the development of information technology. Artificial Intelligence (AI) has the potential to address these societal problems including sustainability. The climate crisis and the degradation of the physical en-

vironment are complex problems that require the most innovative and advanced solutions (Abdalmuttaleb et al, 2022).

The effective use of artificial intelligence technology can promote the organization and analysis of environmental accounting information, and improve the objectivity and reliability of accounting information disclosure through data analysis and information feedback. The implications of AI in accounting for achieving several Sustainable Development Goals (SDGs). AI-driven automation can restructure financial activities, reducing time and resource consumption, and contributing to SDG 8 (Decent Work and Economic Growth). In addition, by providing real-time data analysis, AI empowers businesses to make sustainable decisions based on real-time data, aligning with SDG 9 (Industry, Innovation, and Infrastructure) and SDG-16 (Peace, Justice, and Strong Institutions) and SDG 17 (Partnerships for the Goals) (Peng et al, 2023).

The development of accounting is being promoted in line with changes in social structure due to the development of information technology, and the role of companies in promoting accounting is extremely important. Based on the development of artificial intelligence and environmental accounting, intelligent environmental accounting, which is the basis of traditional environmental accounting, also places higher demands on the professional competence of employees. Anyone working as an environmental accountant not only has a strong professional base, including basic financial knowledge (B, 2022).

First proposed in the 1940s, artificial intelligence is a product of computer development. Computers and important subfields. In essence, this technology requires artificial intelligence Computers simulate human thoughts and actions and help humans perfect them. There are activities that only humans can do to increase productivity. In the 1990s, Artificial intelligence technology has developed rapidly and has become widely applied in the financial field Accounting, marketing, cor-

porate management, financial data analysis, etc. It has been proven in just a few decades and has achieved excellent application efficacy in practice (B, 2022).

That’s not only artificial intelligence, blockchain technology also plays an important role in today’s digital world. Blockchain is a technology that allows processing without an intermediary (third party). In other words, blockchain technology is a valuable database designed to solve third-party problems in regular systems. Blockchain can also be defined as a distributed database solution agreed upon by users participating in the network, and as a collection of regularly growing data sets or data recording technologies that record transactions and distribute them peer-to-peer (Ghosh et al. Blockchain can be defined as the technology that enables the cryptocurrency Bitcoin. The reason is that blockchain technology first appeared in Bitcoin. Blockchain is still most commonly used by Bitcoin. With this technology, each piece of data is generated, verified, and cryptographically blocked, thus preventing humans from solving the algorithms they create forever. In other words, in blockchain technology, each block created is created with additional underlying data, and each transaction is recorded and cannot be erased (Ghosh et al. 2023).

On the other hand, blockchain technology also creates a safe, transparent, and accountable environment with a 'trust protocol' Jannah at all (2023). The increased security

offered by blockchain comes from how the technology works. Blockchain keeps an immutable record of transactions with end-to-end encryption, which shuts out fraudulent access and unauthorized activity. In addition, data on the blockchain is stored across computer networks, making it nearly impossible to hack (unlike conventional computer systems, which store data together on servers) (Habib et al, 2022; Adam et al, 2020; Rakshit et al, 2022).

The subject of blockchain technology was first encountered in Satoshi Nakamoto’s 2009 work titled 'Bitcoin: A Peer-to-Peer Electronic Cash System. In Nakamoto’s work, the blockchain structure is shown in Figure 1.

As shown in Figure 1, Each blocked transaction is signed using cryptographic signatures or encryption. It is almost impossible to crack the encryption process developed by cryptography. Transactions recorded on the blockchain are immutable as they cannot be deleted or changed. Before a “block” of transactions can be added to the blockchain, network participants must agree that the transaction is valid through a consensus process.

Artificial intelligence offers a proactive and effective solution to traditional surveillance techniques. Machine learning algorithms derive from historical data and make them more accurate. Artificial intelligence can be important in enhancing blockchain analytics in several ways (D. Bron, 2023). However, to date, research related to the influence of the-

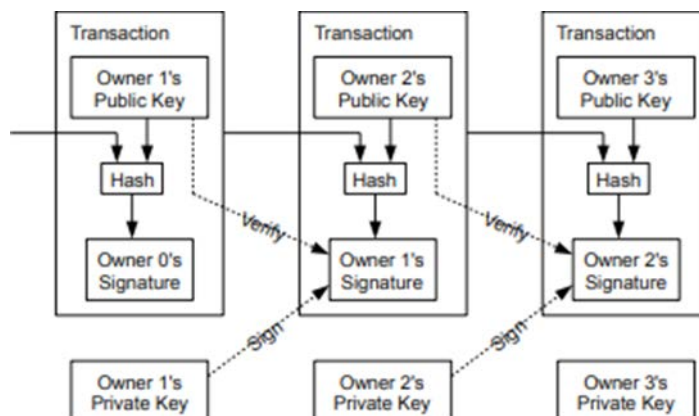


Figure 1. Blockchain Structure
Source: Nakamoto, 2009

se technologies has not been done much and works analyzing these influences are scarce especially about environmental accounting model. The reliability assurance mechanism of the accounting information system based on blockchain technology can greatly ensure the reliability of the accounting information system, effectively suppress accounting fraud, and improve the transparency of information (Zhang and Zhu, 2022; Minhang, 2019). Then adoption of blockchain technology improves accounting information quality by strengthening corporate governance, realizing synergies with large audit firms, and enhancing companies' financing behavior and overall firm value (Bashaer et al, 2023).

This paper aims to broaden the knowledge of this research, describe the evolution of publication activity, and identify the most representative authors and journals. This study also offers insight into potential new directions, how far the research has been carried out and what kind of research it will be in the future must be explained.

METHODS

To explain the evolution of this research trend and to understand its future direction, this article develops a bibliographic analysis to identify various research areas relevant to this emerging topic. The bibliographic data is then processed using R-Biblioshiny to display citation matrices and create and visualize bibliographic networks. In addition, an additional analysis was performed, namely a sensitivity analysis using Vos Viewer. This study was performed quantitatively using bibliographic analysis. Bibliographic data provide insight into all key elements at the macro-study level, such as author name, publication date (journal source), descriptive characteristics, citation analysis, and are made accessible through the communication process (Rahmawati and Subardjo, 2022). Bibliometrics is also an instrument for ascertaining the purpose of publication data, which is often used as easy-

to-understand mathematical and statistical performance data (Glanzel, 2003).

This bibliometric analysis used the Scopus database to collect documentary data related to environmental accounting system model in the era artificial intelligence and blockchain technology. This data is then filtered again, processed with R-Biblioshiny, and additional analysis is carried out, namely, sensitivity analysis using the Vos Viewer. The result is the evolution of publishing activity and identifying the most representative authors and journals related to. The population of this study is articles published in the Scopus database from 2009-2023.

Research Stage

This bibliometric analysis used the Scopus database to collect document data with the topic of environmental accounting system model in the era artificial intelligence and blockchain technology. Scopus is an extensive multidisciplinary database of publications. Citations and abstracts from various types of publications, such as peer-reviewed papers, journals, books, patents, and conference publications, can be viewed on Scopus. Scopus also has filters such as access type, author name, year, and document type to language, which can be used to make searching easier. In addition, Scopus offers tools for storing document data in the form of citation and bibliographic information and abstracts and keywords in RIS, CSV, BibTeX, and plain text formats (Elsevier, 2014).

Document data retrieval uses the keywords environmental accounting system model in the era artificial intelligence and blockchain technology. The data was taken in June 2023. This data was then filtered again, only articles in the journal type, open access, were published in english and were in the final stage. Keywords are used to make it easier to find documents with the topic of environmental accounting system model in the era artificial intelligence and blockchain technology. The bibliometric data is then processed using

R- biblioshiny to show the citation matrix and create and visualize the bibliometric network. In addition, an additional analysis was also carried out, namely sensitivity analysis using the Vos Viewer.

RESULTS AND DISCUSSION

The data shows that the youngest year is 2018, which discusses environmental accounting system model in the era artificial intelligence and blockchain technology. The data used in this study came from 77 sources in the form of 27 articles, 7 book chapters, 24 conference papers, 5 conference reviews, 13 editorials, and 1 short survey from 2018 to 2023. R Biblioshiny in this research was for analysis and data visualization. Furthermore, additional analysis was also carried out using the Vos Viewer. From the network visualization, research related to the influence of these technologies has not been done much and works analyzing these influences are scarce, especially about the environmental accounting model.

The findings of this study serve as a reference and provide direction for future researchers and provide mapping related to environmental accounting system model in the era artificial intelligence and blockchain technology. More research on the influence of these technologies in this field and works analyzing these influences are needed moreover about future environmental and sustainability impact. The findings of this study serve as a reference and provide direction for future researchers and provide mapping related to environmental accounting system model in the era artificial intelligence and blockchain technology. More research on the influence of these technologies in this field and works analyzing these influences are needed moreover about future environmental and sustainability impact in accounting scope.

Main Information

The publications used in this study are from 2009 to 2023. However, the data shows that the youngest year is 2018, which discus-

ses environmental accounting system model in the era artificial intelligence and blockchain technology. The data used in this study came from 77 sources in the form of 27 articles, 7 book chapters, 24 conference papers, 5 conference reviews, 13 editorials, and 1 short survey from 2018 to 2023. More complete data can be seen in Table 1.

Table 1. Main Data Information

| Description | Results |
|--|-----------|
| Main Information About the Data | |
| Timespan | 2018:2023 |
| Sources (Journals, Books, etc.) | 70 |
| Documents | 77 |
| Average years from publication | 1.6 |
| Average citations per document | 9.584 |
| Average citations per year per doc | 2.898 |
| References | 4517 |
| Document Types | |
| article | 27 |
| book chapter | 7 |
| conference paper | 24 |
| conference review | 5 |
| editorial | 13 |
| Short survey | 1 |
| Document Contents | |
| Keywords Plus (ID) | 597 |
| Author's Keywords (DE) | 292 |
| Authors | |
| Authors | 286 |
| Author Appearances | 303 |
| Authors of single-authored docs. | 8 |
| Authors of multi-authored documents | 278 |
| Author Collaboration | |
| Single-authored documents | 8 |
| Documents per Author | 0.269 |
| Authors per Document | 3.71 |
| Co-Authors per Documents | 3.94 |
| Collaboration Index | 4.34 |

Publications and Citation Trends

The earliest publication on Scopus using the keywords environmental accounting system model in the era artificial intelligence and blockchain technology was in 2018 and continues to increase until 2023 (Figure 2). Publications with the topic of environmental accounting system model in the era artificial intelligence and blockchain technology are the most widely available in 2022. The average publication trend growth with this topic is 1.6.

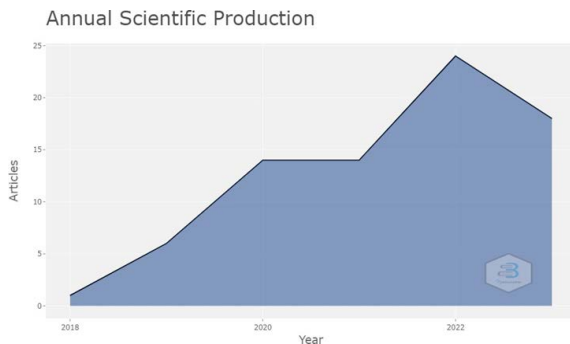


Figure 2. Average Scientific Production

The trend of publications on environmental accounting system model in the era artificial intelligence and blockchain technology is increasing from 2018 to 2020. There were as many citations with an average of more than 10, but in 2020-2021 it decreased with an average of less than 5.0. There was increasing from 2021 to 2022 with average citations per year more than 5.0 (Figure 3).

Average Article Citations per Year

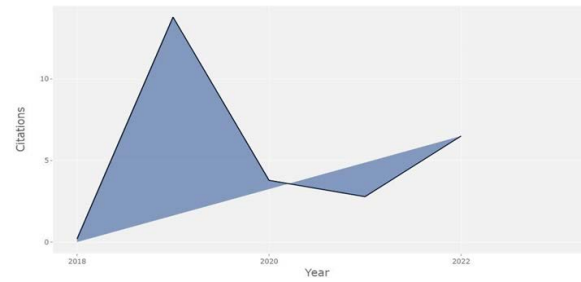


Figure 3. Average Citations per Year

Most Relevant Affiliations and Most Citations

Related to the most affiliation conducted by University of Waterloo and Uttaranchal University, as many as 8 documents. Next was carried out by Research and Development Department as many as 7 documents; King Faisal University and Menoufia University, as many as 5 documents. The rest ranged from 3-4 documents (Figure 4).

Based on Figure 4, it can be seen that the most influential publications in terms of the number of global citations are articles courtesy of Tang CS published in 2019 on Transp Res Part E Logist Trans Rev as many as 220. The order of the two articles that were the most widely cited globally also acquired Publitz FM published in 2019 on Int Environ Res Public Health with 70 citations, Demstichas published in 2020 on Sustainability with 62 citations (Figure 5).

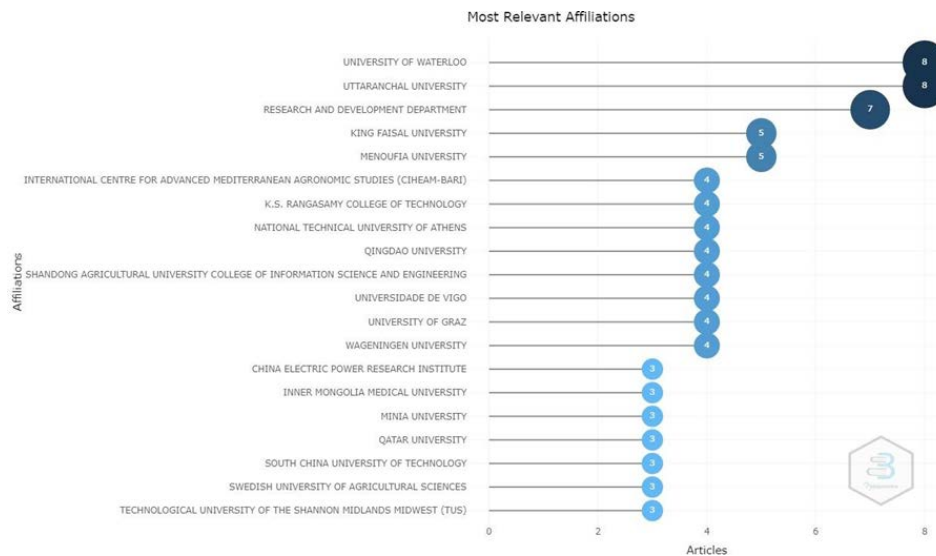


Figure 4. Most Relevant Affiliations

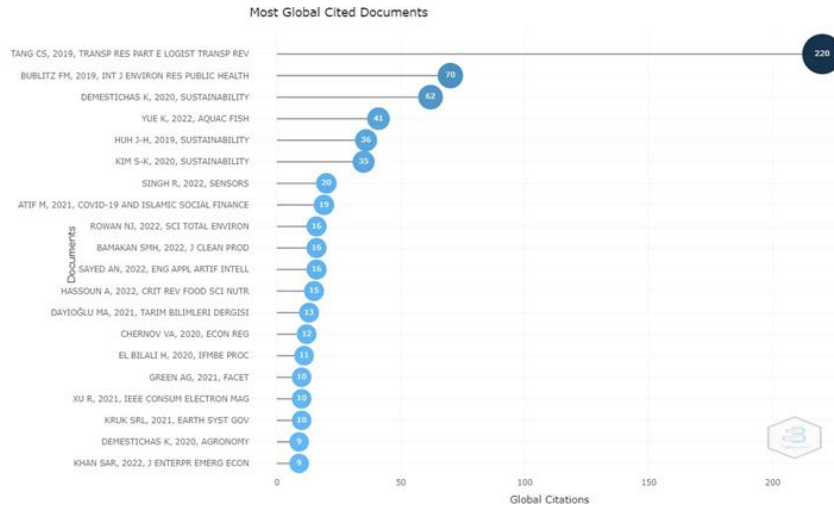


Figure 5. Most Global Cited Documents

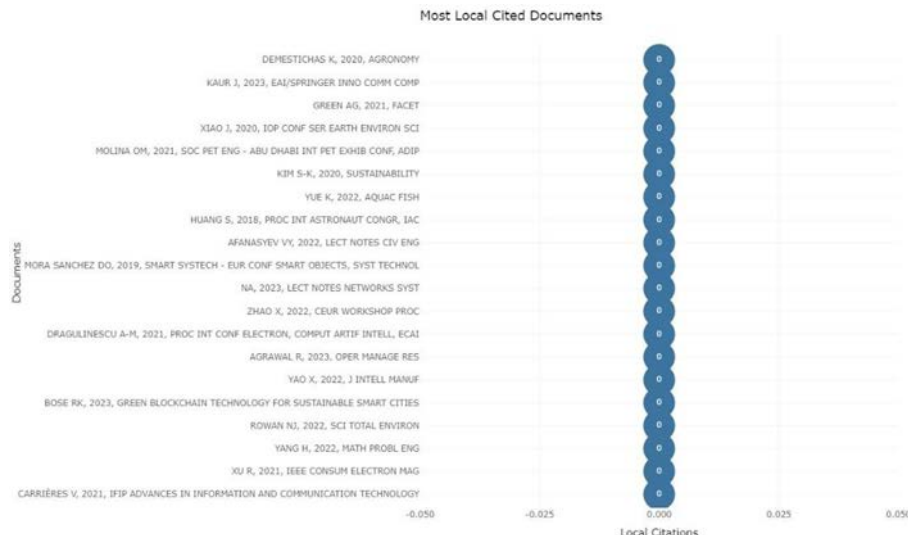


Figure 6. Most Local Cited Documents

Based on Figure 5, it can be seen that publications related to environmental accounting system model in the era artificial intelligence and blockchain technology as seen from the number of local citations, are still 0.

Most Relevant Sources

The journals that publish the most articles on the topic of environmental accounting system model in the era artificial intelligence and blockchain technology are the Journals of Sustainability with 4 articles, and continue with Advances in Intelligent Systems and Computing, Green Blockchain Techno-

logy for Sustainable Smart, IFIP Advances in Information and Communication Tec with 2 articles each. The rest journals that publish with 1 article each (Figure 7, 8, 9, 10).

Meanwhile, Figure 7 shows the most relevant journals based on the total number of citations locally. The most widely cited journal locally is Hassoun A with 18 citations; Han Haihui, Jagtap S, Kshetri N, Wang G F, Yao X with as many as 10; Himeur Y with 9 papers; Klerkx L, Liu Y, Zhang Y with 8 journals. Meanwhile, other journals are cited in the range of 6-7 times.

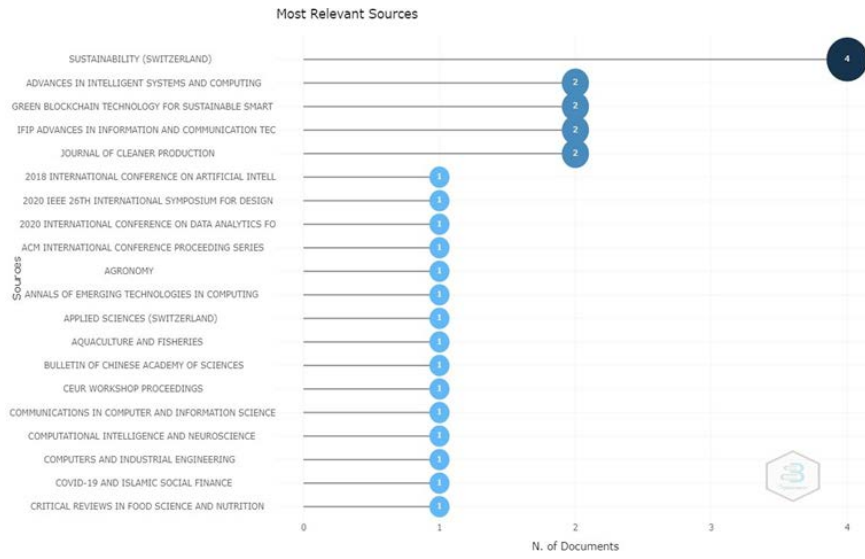


Figure 7. Most Relevant Sources

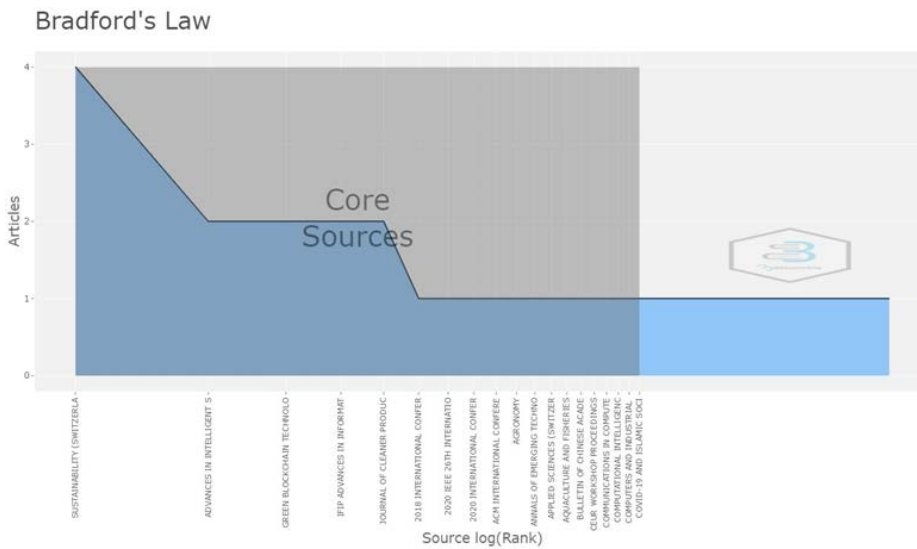


Figure 8. Brandford's Law

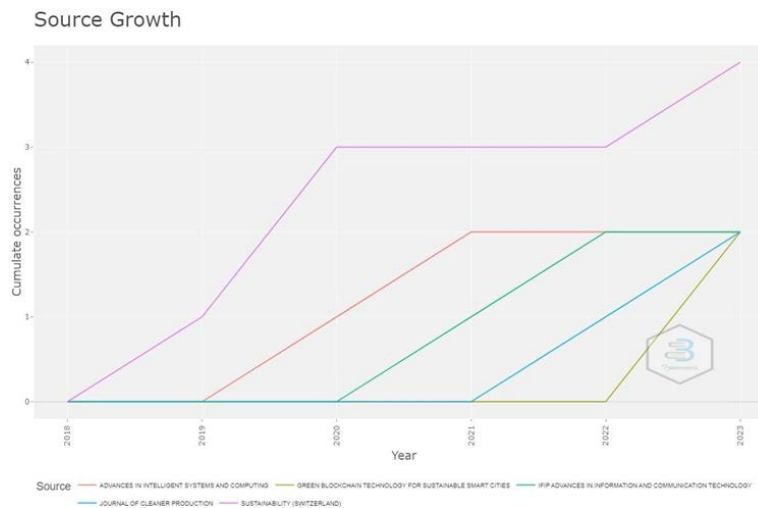


Figure 9. Source Growth

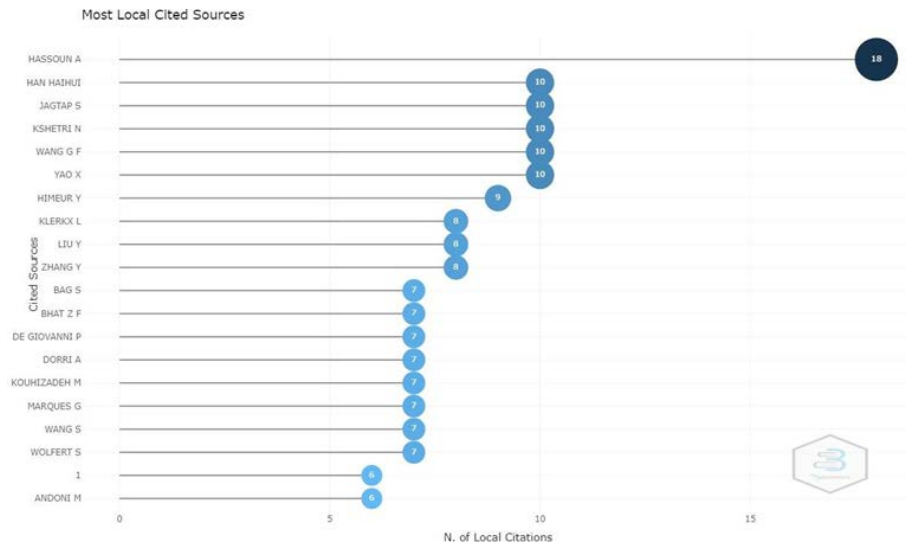


Figure 10. Most Local Cited Sources

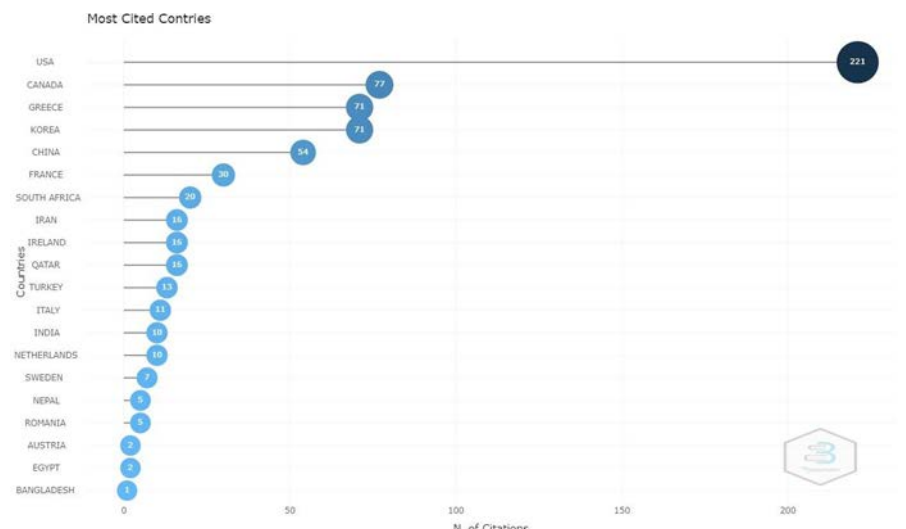


Figure 11. Most Cited Countries

Most Cited Countries

Related to the most influential countries (most citations), led by the USA with 221 citations, followed by Canada with 77 citations, Greece and Korea with 71 citations, China with 54 citations, and France with 30 citations. Meanwhile, other countries are only quoted with a range of 1-20. Information is shown in Figure 11.

Corresponding Author's Country

Related to figure 12 related to the corresponding author, it was found that most

were from China, France, India, Canada, and Greece. Followed by Germany, Italy, Korea, Portugal, Sweden, USA, Austria, Bangladesh, Egypt, Iran, Ireland, Nepal, Netherlands, Nigeria, and Pakistan. In general, it appears that authors collaborate with other authors in the same country, known as Single Country Publication (SCP), rather than Multiple Country Publication (MCP). India, Greece, Italy, Korea, Austria, Bangladesh, Iran, Netherlands and Nigeria are dominated by the SCP, while Egypt, Ireland, Nepal, Pakistan are dominated by the MCP.

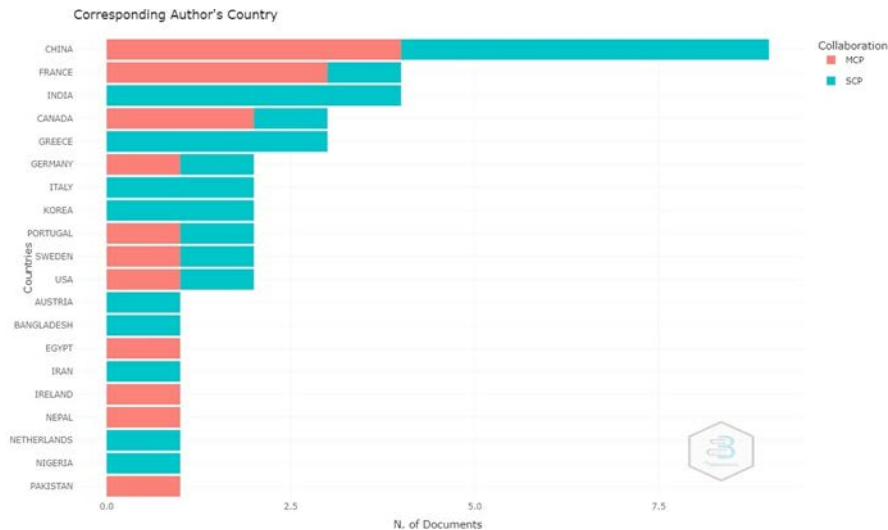


Figure 12. Corresponding Author's Country

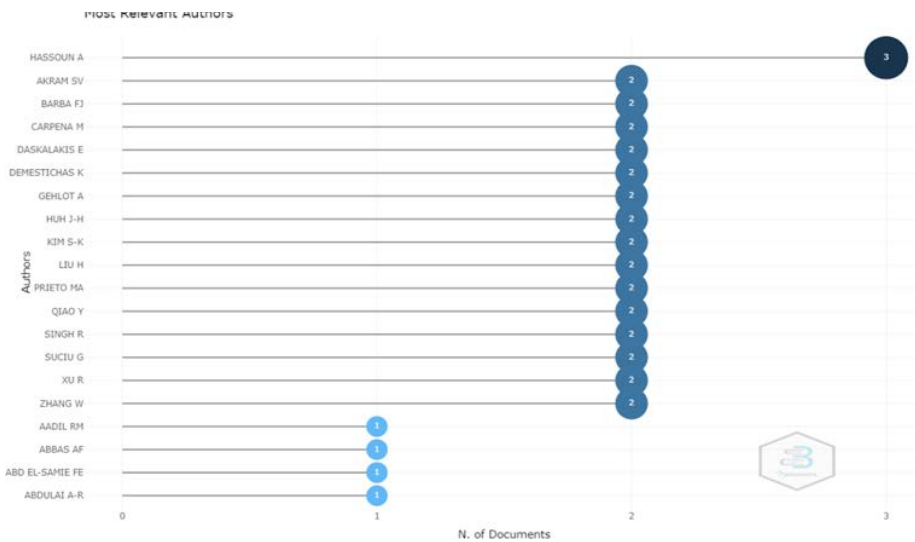


Figure 13. Most Relevant Authors

Most Relevant Author

Figure 13 shows the twenty most prolific authors of articles with the key topic of environmental accounting system model in the era artificial intelligence and blockchain technology. The blue dot shows the number of publications; the bigger the circle size, the more the number of publications. Meanwhile, the color density shows the number of citations; the darker the color, the more citations. The author's productivity picture shows that the top rank is occupied by Hassoun A, followed by Akram SV until Abdulai A-R.

Figure 14 and 15 provide a more detailed picture about author. Hassoun A is the most productive author, having publications from 2021 to 2023. Then there are Akram SV, Barba FJ, Carpena M, Daskalakis E, Demestichas K with a total of each publication from 2020 to 2022. Furthermore, Huh J h, Kim S K is a Researcher in 2019. Liu H, Suci G, Xu R, Zhang W were noted to have started writing articles on key topics of environmental accounting system model in the era artificial intelligence and blockchain technology in 2020.

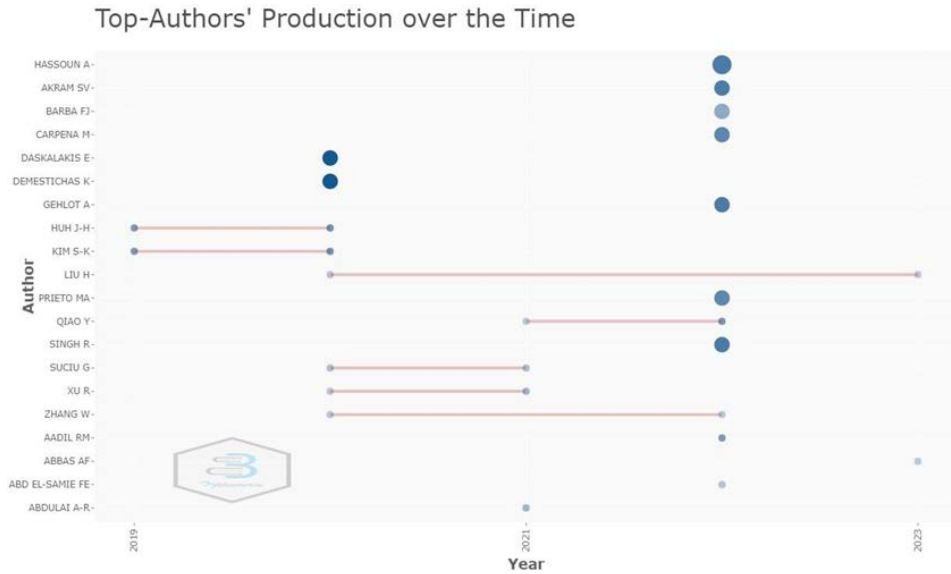


Figure 14. Top Author’s Production Over the Time

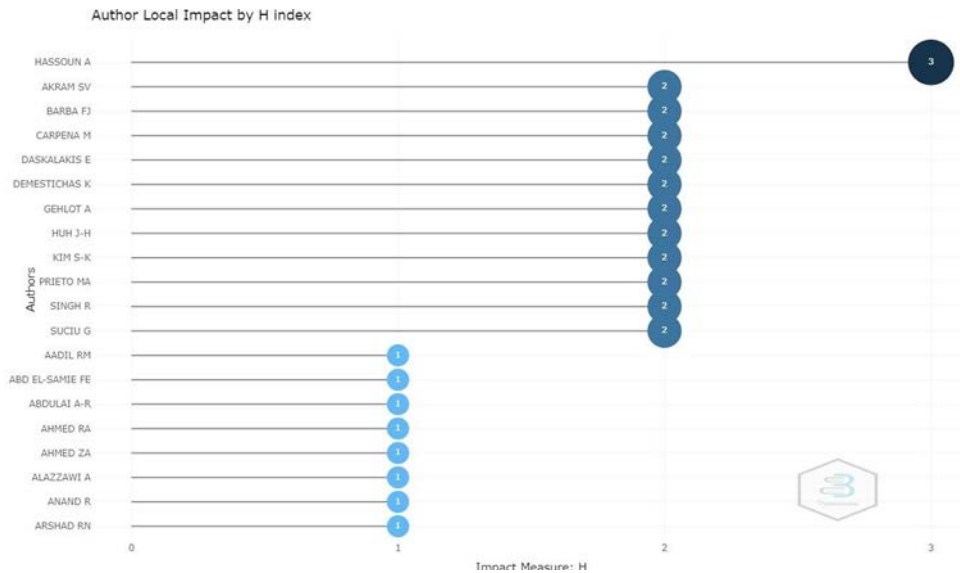


Figure 15. Author Local Impact by H Index

Trend Topics

Figure 16 shows that there has been trend topics between 2019 until 2023. Data analytics became trend topics in 2022 until 2023. Blockchain, sustainable development 2021 till 2022, internet of things from 2020 till 2022 and followed trend topics of artificial intelligence, information management, risk assessment, environmental management. Environmental impact, environmental monitoring from 2019 until 2021.

Keywords

In Figures 17 and 18 show that the keywords that are widely used are artificial intelligence as many as 37 articles, then blockchain 27 articles, then internet of things and sustainable development as many as 19 articles, then big data as many as 10 articles, and agriculture, environmental technology, information management as many as 9 articles, and climate change as many as 8 articles.

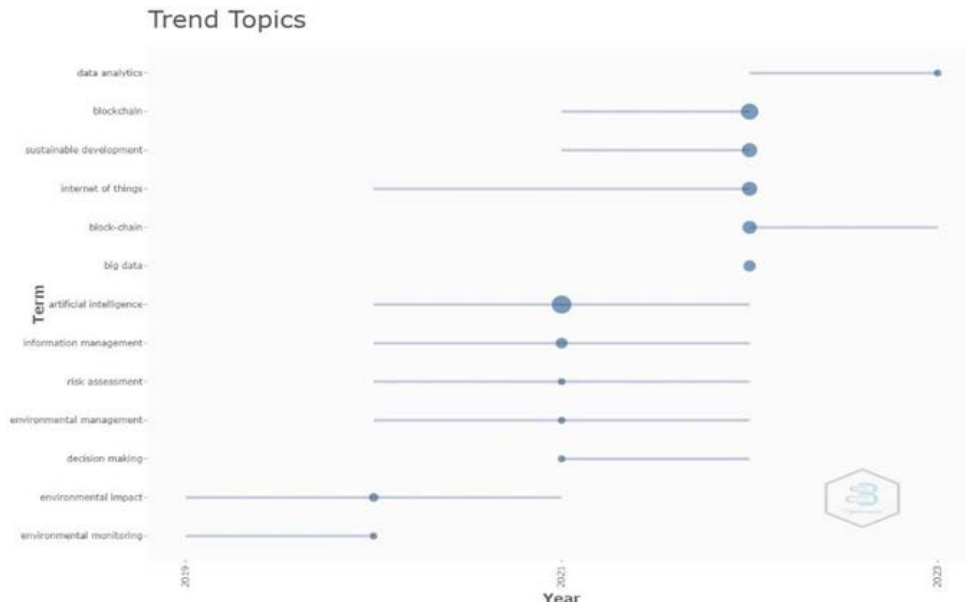


Figure 16. Trend Topics

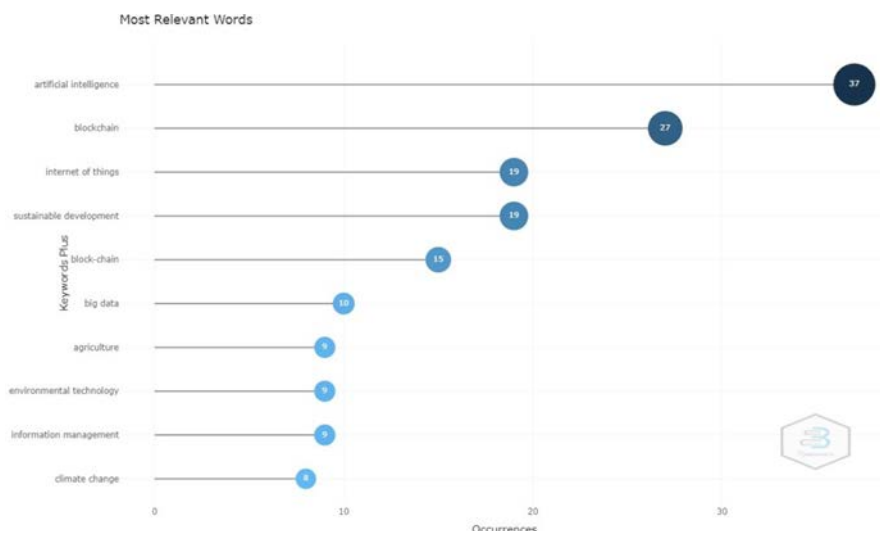


Figure 17. Most Relevant Words

Conceptual Structure

Furthermore, additional analysis was also carried out using the Vos Viewer. The research results show artificial intelligence and blockchain technology is still an interesting topic to research until now, as indicated by the trend of annual publications. However, specific research directions show that environmental accounting in the era artificial intelligence and blockchain technology is still very rare. Even though the relationship between artificial intelligence and blockchain technology towards sustainability and environmen-

tal management has been studied before. The bigger the keyword writing, it shows that the keyword has various associations with other keywords (Figure 19).

Network Visualization

Furthermore, additional analysis was also carried out using the Vos Viewer. The research results show that environmental accounting system model, in artificial intelligence and blockchain technology era are still hot topics interesting to study until now, indicated by the limited number of researchers studying

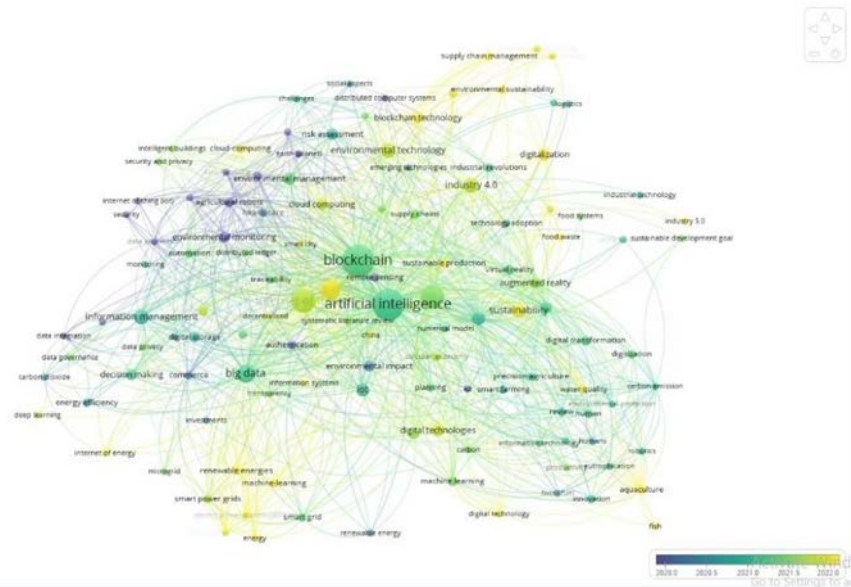


Figure 20. Network Visualization Vos Viewer (Co Occurance)

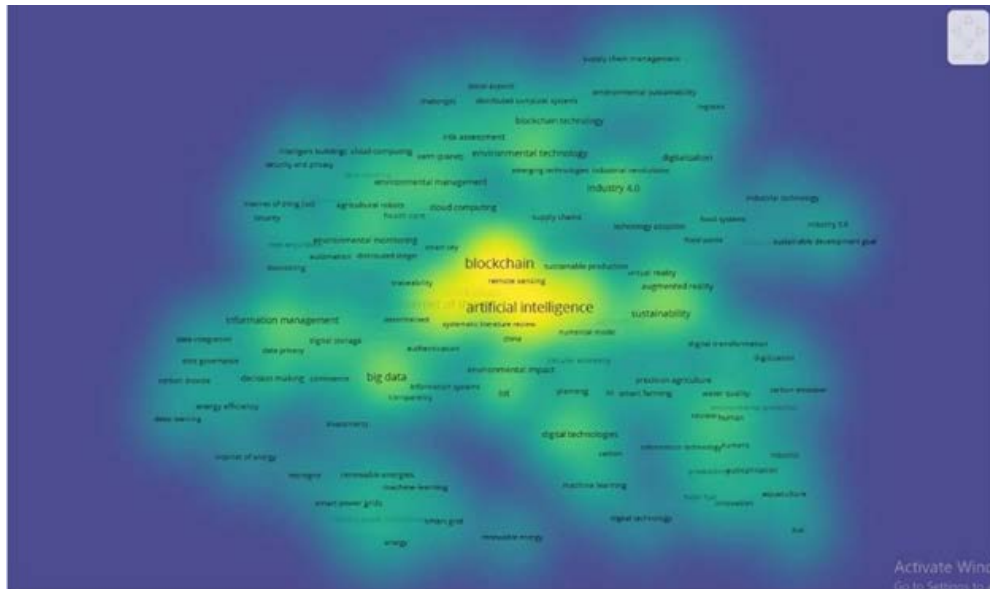


Figure 21. Network Visualization Vos Viewer (Co Occurance)

CONCLUSION

Articles with the topic of environmental accounting system model in the era artificial intelligence and blockchain technology were published in The publications used in this study are from 2009 to 2023. However, the data shows that the youngest year is 2018, which discusses environmental accounting system model in the era artificial intelligence and blockchain technology. The data used in this study came from 77 sources in the form of 27 articles, 7 book chapters, 24 conferen-

ce papers, 5 conference reviews, 13 editorials, and 1 short survey from 2018 to 2023. R Biblioshiny in this research was for analysis and data visualization. Furthermore, additional analysis was also carried out using the Vos Viewer. The research results show artificial intelligence and blockchain technology is still an interesting topic to research until now, as indicated by the trend of annual publications. The research about environmental accounting system model in the era artificial intelligence and blockchain technology has not been done much. Specific research directions show that

environmental accounting in the era artificial intelligence and blockchain technology is still very rare. Even though the relationship between artificial intelligence and blockchain technology towards sustainability and environmental management has been studied before.

This research topic still has many opportunities to be carried out within the scope of the accounting and finance journal. So, this research is expected to be able to provide references, especially for Indonesian Researchers who will conduct international publications on similar topics. Limitations this research is mostly based on data processing keywords that are not accompanied by reasons for selecting these keywords. In addition, the data used is limited to articles published on Scopus. Indonesian Researchers are advised to collaborate with more researchers from other countries with very productive researchers related to this topic. Opportunities for international publications will also be bigger if the publication targets journals that have published many works from Indonesian Researchers.

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