

## Internet of Things, Blockchain, and Artificial Intelligence for Green Governance – A Proposed Model

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### Article Information

#### Article history:

No. 1066

Rec. October 03, 2025

Rev. October 24, 2025

Acc. October 30, 2025

Pub. October 30, 2025

Page. 1086 – 1096

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#### Keywords:

- Green Governance
- Internet of Things
- Blockchain
- Artificial Intelligence
- Bibliometrix

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### ABSTRACT

Global climate change remains a significant challenge that occurs in numerous regions worldwide. Countries are persistently undertaking various steps, including the development of green governance model to address this issue. Nonetheless, the implementation of these eco-friendly goods encounters numerous challenges, one of which is to the precision of data regarding green products. Conversely, substantial study has been conducted on three burgeoning technologies—blockchain, the Internet of Things (IoT), and artificial intelligence (AI)—which are progressively employed to enhance the green governance model. This qualitative study aims to conduct an in-depth exploration using 809 documents from the Scopus database, with articles from the past 10 years, and employs Biblioshiny techniques for data analysis to form a model that leverages these three technologies as a framework for governing and implementing green insurance products. These three technologies provide distinct qualities that can synergistically enhance the development of green data products. This research significantly aids the implementation of the green governance model across various industries and sectors, while also supporting governmental monitoring.

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#### How to Cite:

Surjandy, S., & Fernando, E. (2025). Internet of Things, Blockchain, and Artificial Intelligence for Green Governance – A Proposed Model. *Jurnal Teknologi Informasi Dan Pendidikan*, 18(2), 1086-1096. <https://doi.org/10.24036/jtip.v18i2.1066>

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## 1. INTRODUCTION

Climate change is an enormous issue that all governments need to deal with, and it is extremely crucial for the survival of all people. There are many ways to solve this problem,

and Green Insurance is one of them [1] [2]. However, the deployment of green products continues to encounter a lot of problems, such as unreliable data and monitoring methods, which means that solutions need to be found to make these problems less severe [3] [4]. Presently, numerous technologies that are extensively examined, like the Internet of Things (IoT), blockchain, and artificial intelligence (AI), have been employed in research pertaining to green products. Prior research has demonstrated that these technologies can address challenges in the deployment of sustainable products. Nonetheless, alongside advanced technology, a framework (model) for its execution is equally essential. This serves as the foundation for the investigation. Presently, numerous technologies that are extensively examined, like the Internet of Things (IoT), blockchain, and artificial intelligence (AI), have been employed in research pertaining to green products. Prior research has demonstrated that these technologies can address challenges in the deployment of sustainable products. Nonetheless, alongside advanced technology, a framework (model) for its execution is equally essential. This serves as the foundation for the investigation. This qualitative study examined 809 articles from the Scopus database, utilizing the Biblioshiny approach from R statistical program. The analysis was performed throughout the last decade (2015–2025). The investigation's results show that there is a lot of research going on right now about environmentally friendly items. China is the country that makes the most scholarly articles on this subject. China's dominance in global clean energy and emissions is driven not only by the sheer scale of its industrial activity and significant reliance on coal, but also by its intensive and centralized green industrial policies that position it as a major global producer of clean technologies (Li et al., 2025; Cai et al., 2025). This transformation trend has two important implications for green policy: first, that the accelerated adoption of clean energy opens up space for industrial policy reform and more aggressive allocation of green finance (Zhang, 2023); second, that without a drastic and rapid reduction in coal capacity through retirement of old units, retrofits, and restrictions on new construction green transition efforts will face major structural blocks in the energy and industrial sectors (Xie & Zhang, 2025).

Previous studies have produced numerous papers examining the individual roles of three recent technologies in the utilization of green products. This research identifies gaps, particularly the absence of a model or framework that integrates three technologies into a robust platform. The Internet of Things (IoT) serves as an initial indicator for data input regarding the implementation of green products. This data will be stored using blockchain technology, which is characterized by its transparency, security, and high level of data protection. The consensus among various parties ensures that the data remains unaltered and reliable, thereby enhancing its accuracy. Artificial intelligence (AI) is utilized for data processing, enabling it to make accurate predictions and assist in delivering precise decision-making solutions due to its data-driven nature. AI technology will facilitate the emergence of additional innovations [5][6][7][8][9].

This study presents a novel approach by integrating three innovative technologies to build a more resilient, adaptive, and data-driven governance framework for the implementation of environmentally friendly products. This approach focuses not only on regulation but also offers a collaborative model between the government and the industrial sector in developing performance-based green policies. The novelty of this study lies in the simultaneous application of these three technologies to create a green governance system capable of monitoring environmental compliance in real time, while also providing a scientific basis for the government in designing performance-based incentive policies for organizations that consistently implement sustainable practices. Thus, this study contributes to the development of a more responsive and measurable environmental green governance model, which has the potential to accelerate the transition to a sustainable green economy.

## **2. LITERATURE REVIEW**

### **2.1. Biblioshiny**

Qualitative research frequently utilizes the Biblioshiny technique [10], as illustrated in this investigation on green products [11]. This method helps you see data and also gives you a place to start building models or frameworks. The examination of the articles demonstrates that the amalgamation of three modern technologies illustrates a convergence in which these technologies collectively augment one another, resulting in the formulation of a governance model for the deployment of green products.

### **2.2. Green Product**

Green products are those that are made to help the environment by encouraging eco-friendly habits and reducing any environmental dangers and risks. Programs that promote renewable energy and technology that makes energy use more efficient are two examples of green products [1] [12] [13].

### **2.3. Internet of Things, Blockchain, and Artificial Intelligence for Green Product**

The Internet of Things (IoT) is a term for smart devices that work on their own and are directly connected to the internet. Smart gadgets can send signals to the Internet of Things (IoT), which can then provide data. These devices can look at data on their own and respond to orders that have already been set. IoT gadgets that work on their own don't need people to work [5] [6].

Blockchain technology has unique features, such as clear information that lets everyone see all recorded transactions, peer-to-peer functionality that makes it easier to track each transaction by making sure there is a clear counterpart, and strong data

protection that uses one-way encryption and the Merkle tree model to stop fake transactions. Also, data can't be changed or taken away. This feature greatly helps make sure that captured data is reliable and real. This technology makes it easier to keep track of green product transactions, especially for safely and honestly storing data sent by IoT devices [7][8].

AI technology can be used in many areas, such as managing green product data (forecast) [6]. This technology will make it easier to analyse data and give you more options for making decisions. AI will make it easier to look at green product reports and make decisions faster. This technology will help manage environmental risks and encourage the creation of new, eco-friendly insurance options that are good for the environment [9][14].

### 3. RESEARCH METHOD

This qualitative investigation began by utilizing Bibliometrix in conjunction with the Biblioshiny function within the R application [10]. The literature identifies substantial factors that can be employed to develop a model, as depicted in Figure 1.

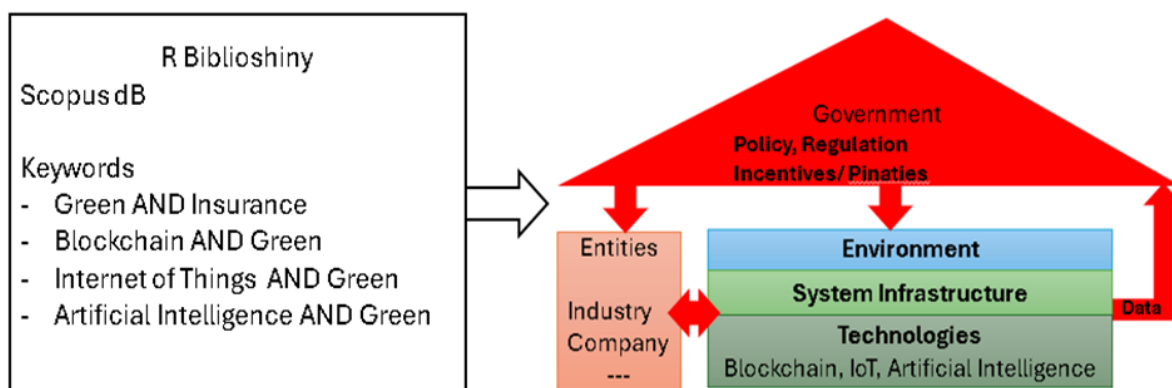


Figure 1. Research Stages

The Bibliometrix method involves five steps: defining the study's goal, finding keywords, searching the literature, evaluating the data, and finally reporting or showing the results [10]. The search terms for articles are:

- Green AND Insurance
- Blockchain AND Green
- (Internet of Things OR IoT) AND Green
- (Artificial Intelligence OR AI) AND Green

The search used the Scopus database, which covers the last ten years (2015–2025).

## 4. RESULTS AND DISCUSSION

### 4.1. Data Resources

This qualitative study examined 809 papers obtained from the Scopus database, covering the period from 2015 to August, 2025, and containing 2,189 writers associated with 385 different publishers. Figure 2 displays the whole data.



Figure 2. Data Sources

### 4.2. Data Visualization

Biblioshiny processes data and makes many different outputs. These results support the research findings, which are explained in more detail below.

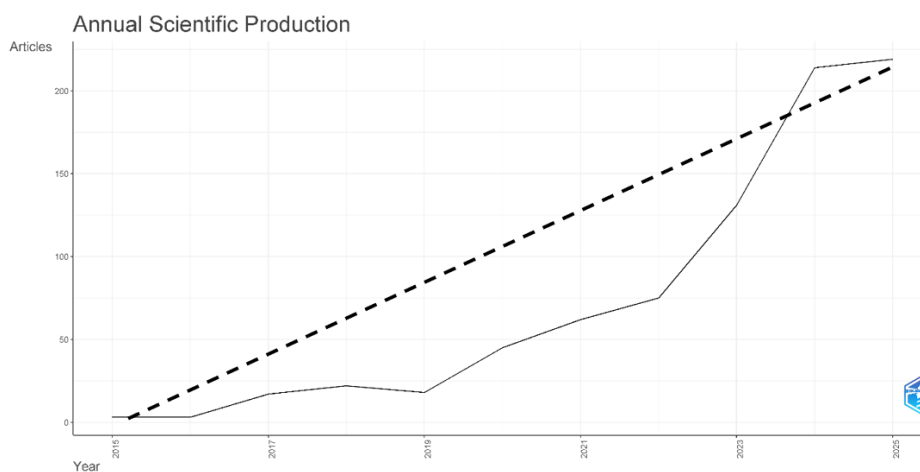


Figure 3. Research Trend

Figure 3 shows the trend in research based on 809 articles found, which shows that there are more studies about green technologies. Research began in 2016, intensified in 2017 and 2019, and had rapid expansion until 2025. Figure 3 shows how important the subject of green technologies is.

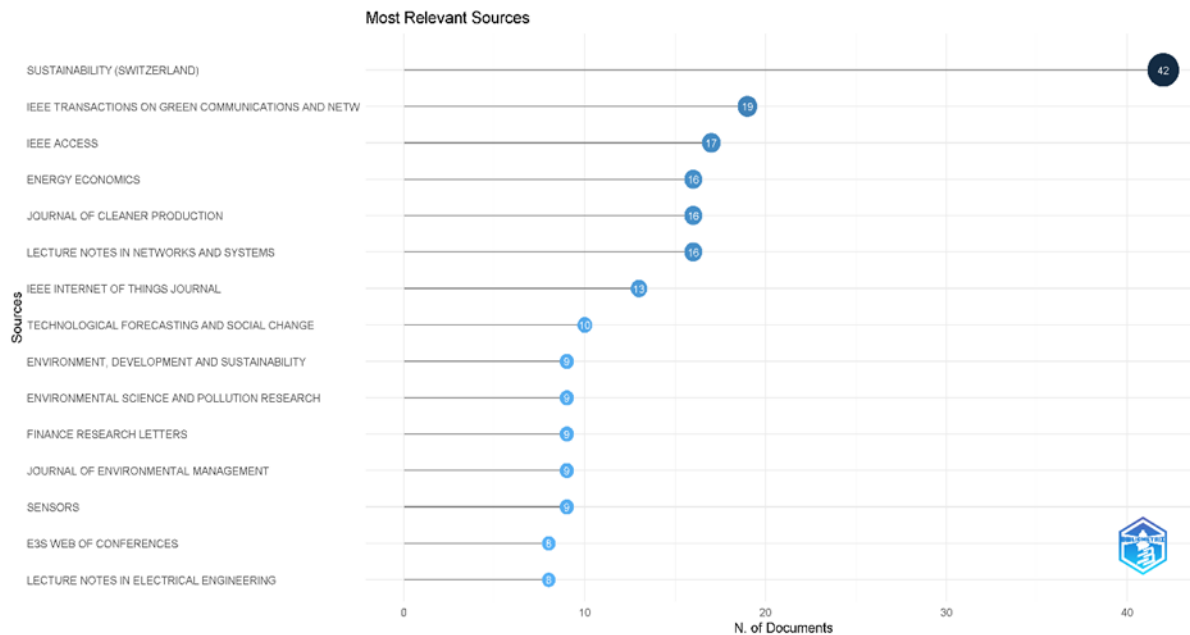


Figure 4. Relevant Sources

Figure 4 presents the 15 primary sources based on 809 articles relevant to this research, beginning with:

- Sustainability (Switzerland) comprises 42 articles, accounting for 5.2% of the total.
- IEEE Transactions on Green Communications and Networks published 19 articles, representing 2.3% of the total.
- IEEE Access, Journal of Cleaner Production, and Lecture Notes in Networks and Systems published 16 articles, accounting for 2.0% of the total.
- The IEEE Internet of Things Journal published 13 articles, accounting for 1.6% of the total.
- Technological Forecasting and Social Change comprises 10 articles, accounting for 1.2% of the total.
- Environment, Development, and Sustainability; Environment Development and Sustainability; Environmental Science and Pollution Research; Finance Research Letters; Journal of Environmental Management; and Sensors: 9 articles (1.1%)
- E3S Web of Conferences and Lecture Notes in Electrical Engineering: 8 articles (0.99%)

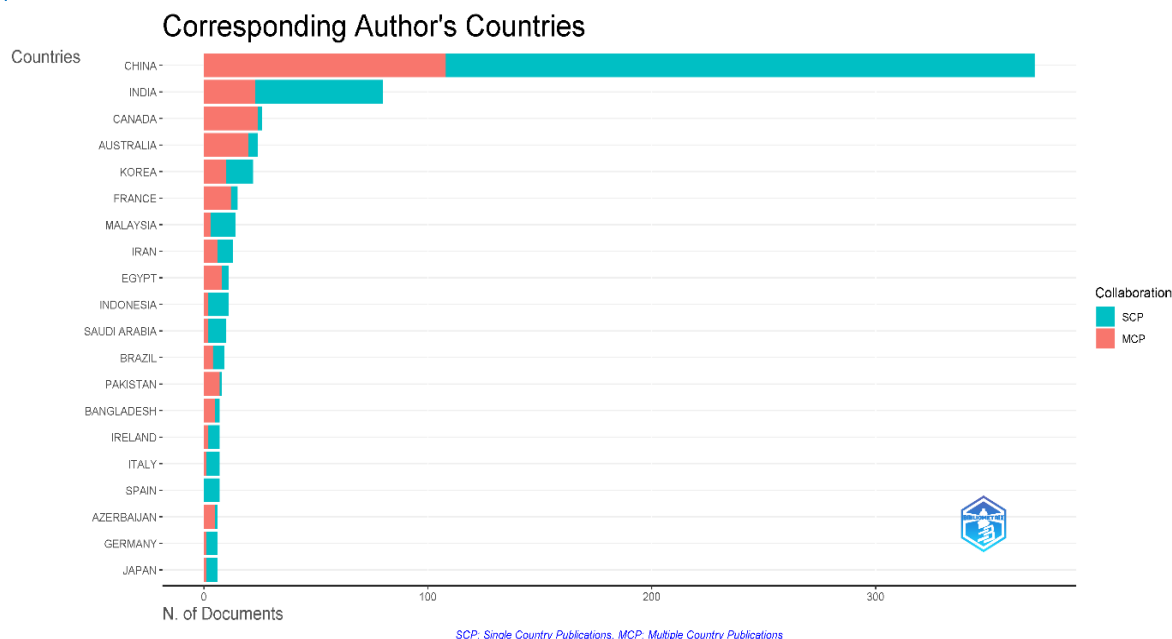


Figure 5. Corresponding Author's Countries

Figure 5 shows based on 809 articles found, the twenty countries with the most authors. India has the second most authors after China. After that, Canada, Australia, Korea, France, Malaysia, Iran, Egypt, Indonesia, Saudi Arabia, Brazil, Pakistan, Bangladesh, Ireland, Italy, Spain, Azerbaijan, Germany, and finally Japan has the most authors.

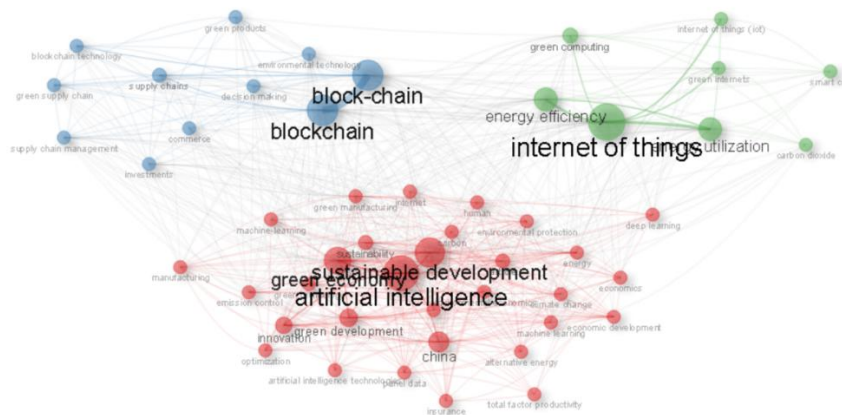


Figure 6. Clustering

Figure 6 shows the three main areas of research: blockchain technology, the Internet of Things (IoT), and artificial intelligence (AI). In each of these groups, the focus is on green products.



Figure 7. Word Cloud

Figure 7 shows what takes place when you use a word cloud to visualize data. It's clear that the green sector uses a lot of AI, IoT, and blockchain technologies. This means that these three technologies have been looked into in great detail as possible options for green products.

### 4.3. Proposed Model

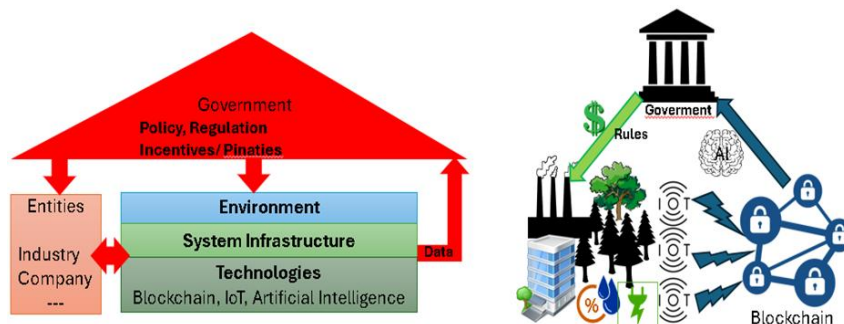


Figure 8. Proposed Model of Green Governance

Figure 8 shows the suggested model that came from looking at the literature. It shows that the government is the main body in charge of making rules and laws. The government can provide people rewards or punishments for using green items. The government will be able to get important data and information from third parties and the

environment about all aspects of green products, such as carbon [15] and its connection to AI [16], green energy products [17] [18] [19], and the use of AI and IoT. This will be possible because of the combination of blockchain technology, the Internet of Things (IoT), and Artificial Intelligence (AI). Blockchain technology also makes transaction data safer [20] [21] [22] [23]. Artificial intelligence and blockchain technologies make it easier to detect environmental hazards [8] and connect with the Internet of Things [7]. Using these three strategies, wastewater management can also guess how it will affect the environment [24] [25].

Thus, it can be deduced that blockchain, IoT, and AI can be employed for sustainable governance in the implementation of eco-friendly insurance products. Using IoT to gather data will cause the least number of mistakes, and the data will be quickly saved in blockchain technology, which will make sure that the recorded information is reliable and legitimate, as is the case with blockchain. Everyone involved gets a copy of the information stored on the blockchain, which makes sure that everyone is on the same page. After that, artificial intelligence will look at the data, which will let you see or show the findings from IoT right away. This will make it easier to make quick and accurate decisions based on facts.

However, there are certain significant issues to think about when implementing the green governance model into operation, such as the range of infrastructure it covers, which is a big problem because the area is so large. Model validation has been performed in collaboration with experienced professionals, and the suggested model has garnered approval.

## 5. CONCLUSIONS

This study concludes that the analysis of 809 publications from the Scopus database for the period 2015– August 2025 shows a significant increase in research focused on the application of the Internet of Things (IoT), blockchain, and Artificial Intelligence (AI) in the governance of environmentally friendly products. The analysis identified 2,189 authors from 385 publishers across various countries, with China and India as the largest contributors, followed by Canada, Australia, Korea, France, Malaysia, and Indonesia. Meanwhile, the Swiss journal Sustainability emerged as the primary source with 42 publications (5.2%), confirming that the topic of integrating digital technology into green policy is becoming an increasingly important focus in the global academic landscape.

The study concludes that the integration of IoT, blockchain, and AI can create a robust, transparent, and efficient environmental governance framework. IoT plays a role in collecting data directly from the environment, blockchain ensures the authenticity and security of the data through an immutable recording system, and AI processes the data to generate evidence-based analysis and policy recommendations. This approach significantly improves the efficiency, accuracy, and speed of government decision-making in designing

green policies, while simultaneously promoting accountability through performance-based reward and sanction mechanisms.

However, this study still has limitations in terms of testing the technical specifications of the devices, the system architecture design, and the variations in network infrastructure at each implementation location. Therefore, future research is recommended to expand the analysis to include technical aspects and system interoperability, as well as conduct cross-sector and cross-country studies to test the effectiveness and scalability of this green governance model in different industrial contexts. Thus, the results of this further research are expected to strengthen scientific and practical contributions to building an intelligent, adaptive, and sustainable environmental governance ecosystem in the era of global digital transformation.

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