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Green Finance: A Systematic Review

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Abstract

According to the United Nations Environment Programme (UNEP), green finance is the increasing flow of financial resources (banking, microcredit, insurance, and investment) from the public, private, and non-profit sectors to sustainable development priorities. Green finance is also defined as financial support that aims to achieve green growth by significantly reducing greenhouse gas emissions and pollution. Green finance is a global trend with the organizations, governments of countries, and financial systems of each country and region. Therefore, green finance plays a very important role in the sustainable development goals of not only Vietnam but also countries around the world. The purpose of this study is to systematize previous studies on green finance, statistics, and evaluations by authors, the most influential studies in green finance research. The research data was collected and analyzed from Google Scholar data on VOSviewer 1.6.19 software with 500 articles for the keyword "green finance" filtered in abstract. The results show that research on green finance in the past 10 years has always been a topic of interest and research. The study also identifies the most influential authors in terms of the number of articles and citations. The research results have contributed to synthesizing a system of research documents on green finance.

Keywords: Green Finance, Vosviewer

1. Introduction

Ozili, P. K. (2022) [3], has researched green finance around the world. This paper reviewed the existing research on green finance. It identifies the important themes in the green finance literature, particularly the strategies to increase green financing, efforts to make green investment profitable, promoting green financing using technology and policy, the role of regulators and financial institutions in the green finance agenda, and the challenges of green financing. Several cross-country observations about the challenges of green finance and solutions to green finance issues are documented. The findings show that green finance has the potential to make a significant difference in the environment, society, and climate change mitigation, but many challenges abound, such as a lack of awareness about green finance, inconsistent definitions of green finance, a lack of policy coordination for green financing, inconsistent policies, and a lack of profitable incentives to investors and financial institutions who are willing to invest in climate change mitigation.

Akomea-Frimpong, I., Kukah, A. S., Jin, X., Osei-Kyei, R., & Pariafsai, F. (2022) [1] had researched green finance for green buildings. Recent world events have put a spotlight on inclusive project financing models that tackle climate change and reduce carbon emissions in the construction and management of buildings. A cardinal example of such models is green finance, an inclusive term that integrates environmental protection and social justice with economic profits in green buildings. This paper probes into the terminology and links the concept of green finance to green buildings. The study utilizes a systematic literature review methodology to analyze and synthesize existing literature. The outcomes of the study show that increased economic returns, clear regulations, and awareness creation drive its acceptance in the built environment. However, as a developing concept, the major challenge is the contradictions of what constitutes green finance for green buildings. The results of this study draw the attention of key stakeholders to develop and merge the two concepts in research and practice to attain ecological balance in the financial market and the built environment.

Sachs, J. D., Woo, W. T., Yoshino, N., & Taghizadeh-Hesary, F. (2019) [4] researched why green finance is important? In 2017, global investment in renewables and energy efficiency declined by 3%, and there is a risk that it will slow further; clearly, fossil fuels still dominate energy investment. This could threaten the expansion of green energy needed to provide energy security and meet climate and clean air goals. Several developed and developing economies are still following pro-coal energy policies, and the extra CO2 generated by new coal-fired power plants could more than wipe out any reductions in

emissions made by other nations. Finance is the engine of the development of infrastructure projects, including energy projects. Generally, financial institutions show more interest in fossil fuel projects than green projects, mainly because there are still several risks associated with these new technologies and they offer a lower rate of return. If we want to achieve sustainable development goals, we need to open a new file for green projects and scale up the financing of investments that provide environmental benefits through new financial instruments and new policies, such as green bonds, green banks, carbon market instruments, fiscal policy, green central banking, financial technologies, community-based green funds, etc., which are collectively known as "green finance.".

Huang, Y., Chen, C., Lei, L., & Zhang, Y. (2022) [2] had researched the impacts of green finance on green innovation. This paper provides an in-depth understanding of the mechanisms of green finance for green innovation, focusing on their spatial and non-linear relationships. Using panel data from 30 provinces in China during the period 2009–2017, a green finance index is constructed, and the spatial Durbin model and panel threshold model are used. The results reveal that: (1) green finance and green innovation had significant positive autocorrelation, and the development of green finance in the provinces of central and western China was still in the lower-level range. (2) The coefficients of the direct effect and indirect effect of green finance on green innovation were significantly positive, which indicated that green finance was conducive to enhancing green innovation in local and adjacent provinces during the research period. (3) Double threshold effects of green finance on green innovation were observed, which demonstrated that the driving effect of green finance decreased with the raising intensity of environmental regulation. The implication of these results is that the government should make full use of the radiation and trickle-down functions of green finance and green innovation to narrow regional gaps in sustainable development while maintaining a moderate intensity of environmental regulation. Autocorrelation, indirect effect, sustainable development.

Wang, Y., Zhao, N., Lei, X., & Long, R. (2021) [5] had researched green finance innovation and regional green development. The fixed-base range entropy weight method was used to find the level of green development in the region. Thirty provincial panel datasets covering the years 2013–2017 were used to build the regional green development indicator system. The difference-in-differences model was used to test the policy effect, the mechanism of the establishment of the green financial reform, and the innovation pilot zone on green development. The findings showed that: (1) creating the pilot zone encourages green development across regions and reveals differences between regions; (2) provinces that create the pilot zone have an impact on the level of green development across regions, mainly by improving the structure of industries and coming up with new technologies; and (3) a lot of money is being spent on environmental protection and market development, which will help the The results of this article indicated that China should continue to expand the scope of green finance reform and innovation pilot zones and make reasonable arrangements among regions according to local conditions to explore new ways of promoting green development. At the same time, the government should actively play the role

of green finance in the pilot zone to promote industrial structure upgrading and technological innovation and guide market players to establish green development concepts to gradually build an environmentally friendly, circular model economy to enhance the overall green development capacity of the region.

Therefore, this study helps readers grasp the development and quality of green finance information through the frequency of keyword usage, the number of citations, and the number of times authors are cited over time. At the same time, it helps future researchers to know the trend of this topic over time.

2. The concept of green finance

Green finance is a global trend with the participation of international financial organizations, governments of countries, and financial systems of each country and region. Therefore, green finance plays a very important role in achieving sustainable development goals. In recent years, solutions to green finance have gradually received more attention, research, and discussion. The research review shows that there are many different definitions of "green finance." According to Chowdhury *et al.* (2013), green finance is a financial policy that aims to motivate businesses and consumers to change their production and consumption behaviors to be more environmentally friendly. More specifically, according to the European Investment Bank (2017), green finance is defined as financial services provided for economic activities to support environmental improvement, climate change mitigation, and more efficient use of resources. These activities include financing, operating management, and risk management of projects aimed at environmental protection, energy savings, clean energy, green transportation, and green construction. Accordingly, in general, green finance can be understood according to the definition of the UNEP: Green finance is a solution towards sustainable development and climate change adaptation through financial products and services provided by financial institutions. In other words, green finance is understood as increasing the flow of financial resources (from banks, microcredit, insurance, and investment) from many sources (public sector, private sector, and non-profit organizations) for sustainable development priorities and climate change adaptation. From there, negative externalities in the environment and society are effectively addressed. Funded projects not only aim for profit but also create environmental benefits. At the same time, accountability is also required to be higher.

According to UNEP, compared to previous approaches, green finance solutions involve multi-faceted coordination between government, businesses, and people, as described in Diagram 1. In which the government plays an important role in applying, regulating, and orienting green finance solutions in many different ways. At the national level, public finance solutions can be promoted through changes in the legal framework of countries, harmonizing public finance solutions, and enhancing green finance solutions from different sectors. Meanwhile, local authorities play an important role in adjusting the financial decision-making process of businesses, encouraging the private sector to pay more attention to environmental aspects in line with regional sustainable development goals, increasing investment in clean sectors and green technologies, and funding the green economy based on sustainable natural resources.

3. Research methods

The authors synthesize previously published overview documents related to green finance from data sources on Google Scholar. Overview studies will aim to explain the urgency of the research and indicate research gaps. The authors use VOSviewer 1.6.19 software to filter data with the keyword "green finance" filtered in the abstract of the Google Scholar database, accessed on January 30, 2023. The results show 496 related articles in the selected category out of 500 articles. The collected data is used to analyze and answer the following research questions:

Q1: Research on green finance from 2014 to December 2023.
Q2: The most influential authors in terms of the number of articles and the number of citations in green finance publications.
Q3: Which keywords are grouped into which topics?

4. Results

Statistics on green finance publications

From 2014 to 2023, the authors searched with a maximum condition of 500 articles and found 496 articles on green finance indexed in Google Scholar. The authors excluded articles that were books and citations. On average, 49.6 articles were published each year. This shows that the issue of green finance is currently of concern to researchers.
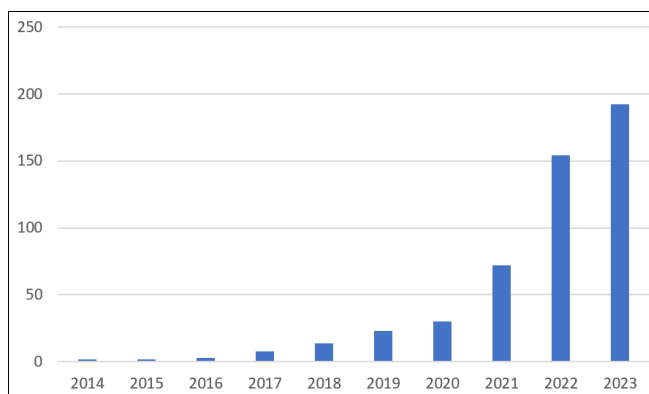

Fig 1: Graph of the number of studies over the years

Statistics on the most influential authors in green finance research

To assess the most influential authors in green finance research, we consider the number of citations in the article (Table 1), the number of articles by the authors (Table 2).

Highest citations by documents

Table 1 shows the number of citations in the article by the authors Y Wang and Q Zhi (2016), The Role of Green Finance in Environmental Protection: Two Aspects of Market Mechanisms and Policies, have the highest number of citations (543), followed by D Zhang, M Mohsin, AK Rasheed, and Y Chang. (2021) public spending and green economic growth in the BRI region: The mediating role of green finance, with 526 citations. CH Yu, X Wu, D Zhang, S Chen, and J Zhao (2021), Demand for Green Finance: Resolving Financing Constraints on Green Innovation in China, has 522 citations. The remaining articles have all been cited more than 200 times.

Table 1: Frequency of the highest citation by documents

Documents	Cites
Y Wang, Q Zhi (2016)	543
D Zhang, M Mohsin, AK Rasheed, Y Chang…(2021)	526
CH Yu, X Wu, D Zhang, S Chen, J Zhao (2021)	522
CC Lee, CC Lee (2022)	514
F Taghizadeh-Hesary, N Yoshino (2019)	512
D Zhang, Z Zhang, S Managi (2019)	457
X Zhou, X Tang, R Zhang (2020)	374
M Irfan, A Razzaq, A Sharif, X Yang (2022)	324
X Ren, Q Shao, R Zhong (2020)	314
S Zhang, Z Wu, Y Wang, Y Hao (2021)	306
N Lindenberg (2014)	249
I Akomea-Frimpong, D Adeabah, D Ofosu… (2022)	237
C Jiakui, J Abbas, H Najam, J Liu, J Abbas (2023)	234
P Soundarrajan, N Vivek (2016)	230
CZ Li, M Umair (2023)	220
Y Yang, X Su, S Yao (2021)	217
C Lv, B Bian, CC Lee, Z He (2021)	215
S Dikau, U Volz (2018)	211
S Hafner, A Jones, A Anger-Kraavi, J Pohl (2020)	208
X Wang, Q Wang (2021)	208

Source: Authors compiled from VOSviewer software

The highest documents by authors

Table 2: Frequency of the highest documents by authors

| Selected	Author	Documents
✓	taghizadeh-hesary, f	15
✓	wang, j	9
✓	dong, k	7
✓	liu, z	9
✓	wang, y	18
✓	liu, y	6
✓	mohsin, m	6
✓	wang, h	6
✓	wang, x	11
✓	zhang, d	8
✓	zhang, y	14
✓	chen, z	5
✓	gu, x	5
✓	wang, f	7
✓	wu, h	6
✓	yoshino, n	5
✓	li, y	7
✓	wang, r	5
✓	zhang, z	9
✓	lee, cc	6

Source: Authors compiled from VOSviewer software

The authors with the most articles on green finance are Wang, Y, with 18 articles, and Taghizadeh-hesary.F with 15 articles, Zhang. With 14 articles. The remaining authors have at least 5 articles out of a total of 31 authors with the most articles.

Co-author analysis

To understand the trend of cooperation in green finance research, this study conducted an analysis of co-authorship relationships between individual authors. According to Benoit *et al.* (2018), the results of the analysis help to improve understanding of research collaboration and also help to identify influential researchers. Fig 2 presents the co-authorship network map. The link between the two nodes represents the cooperative relationship between the two authors, and the thickness of the link represents the intensity of the cooperation. The authors who collaborate most closely are the ones shown in the figure below. This is a

group of co-authors who have published many articles over the years.
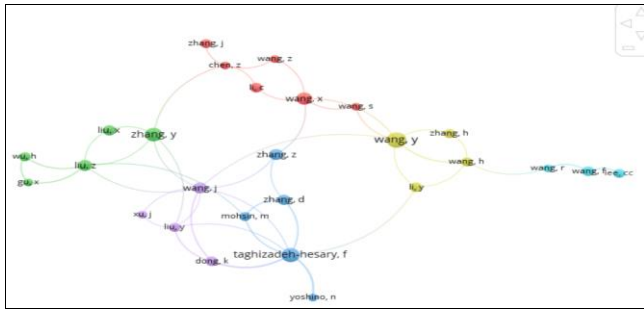
Source: Authors compiled from VOSviewer software

Fig 2: Co-authorship network

Keyword analysis results

In the keyword analysis section, the study selects keywords that appear 20 times or more. Based on the quantity of occurrences and overall link strength, the software evaluates keywords. The results of the keyword analysis can be exported as an image file. The result of the keyword analysis is as follows:
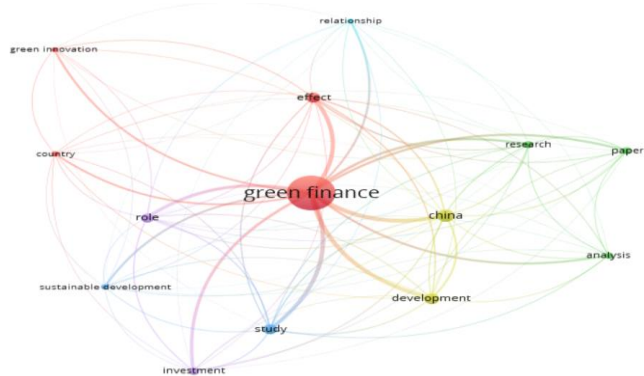

Fig 3: Co-occurrence networks and keyword networks

Related keywords are grouped into groups; each group has a separate color. Looking at the image, it can be seen that the keywords are divided into six groups. Group 1 is represented by red links combined with 4 keywords, including country, effect, green finance, and green innovation, with the central keyword being "green finance" with 13 links and a total link strength of 3212. This keyword appears 1448 times. Group 2 is represented by green links combined with 3 keywords: Analysis, paper, and research, in which the central keyword is "research" with 13 links and a total link strength of 337 and appears 69 times. Group 3 is represented by blue links, including the keywords study and sustainable development, with the central keyword being study, with 13 links and a total link strength of 583, appearing 123 times. Group 4 is represented by a yellow link including 2 keywords: China and development, with the central keyword being China with 13 links and a total link strength of 878, appearing 185 times. Group 5 is represented by purple links, including the keywords investment and role, with the central keyword being role with 13 links and a total link strength of 503, appearing 102 times. Group 6 is represented by green links, including the keyword relationship, with 13 links and a total link strength of 160, appearing 31 times. With six research directions and 14 popular keywords, the results provide an overview of green

finance. Future research can use this as a basis for choosing research directions to fill the gap or for further analysis.

5. Conclusion

In this study, we conducted a systematic review of green finance studies indexed in the Google Scholar database. These studies were published in the last 10 years, from 2014 to 2023, to provide insights into the number of publications, authors' citation frequency, citations of studies, networks of keywords, etc. The results of the study have contributed to the general theoretical basis, serving as a basis for reference studies on green finance. Data collected from richer sources, such as Scopus and OpenAlex, are also suggestions for further research in the future.

6. References

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