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Research Article

Green Financing for Sustainable Development: A Bibliometrics Analysis

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ABSTRACT

Green finance has emerged as a key facilitator in mitigating the risks associated with climate change and the degradation of the environment. Moreover, it creates a solid basis for sustained growth & sustainable development. The study identifies green financing studies from 2010-2023, identifies relevant sources, authors, keywords, documents, and trending topics, and uses thematic map analysis to identify future research areas. The study identifies key keywords such as CO2 emissions, carbon emissions, growth, and economic growth, but also highlights the underdevelopment of other fields like impact, determinants, policy, sustainability, innovation, finance, investment, carbon emissions, and economic growth. The research contributes to the existing knowledge on green financing by compiling data on important authors, relevant journals, and frequently referenced works, and providing keywords for future studies. establishing a common strategy for ESG investments, green regulations, and financial products, defining responsibilities for public and private sectors, bankers, and asset managers, accelerating green finance compliance, and promoting sustainable growth.

Keywords - Bibliometrics, Biblioshiny, green finance, Sustainability.

1. INTRODUCTION

Green finance has emerged as a key facilitator in mitigating the risks associated with climate change and the degradation of the environment. Moreover, it creates a solid basis for sustained growth & sustainable development (Taghizadeh-Hesary & Yoshino, 2019). Dobes et al., 2014 identified the largest market failure and a particular economic problem as being caused by climate change. The idea of a "green economy" can be used to trace the history of green financing (Barbier, 2013), originally discussed the term "green economy" in the paper "The Blueprint of Green Economy" in the late 1980s. Western nations, who were the first to observe the effects of fast industrialization on the environment and climate, are the origins of the concept. Numerous industrialized nations and international organizations are moving towards sustainable economic development as a result of growing concerns about mitigating climate change and protecting the environment. Numerous international platform practices have been implemented in recent years to support Green Finance and associated activities (Bhatnagar & Sharma, 2022).

The financial consequences of environmental risks and the promotion of green investment have emerged as crucial concerns for firms, investors, NGOs, financial regulators, and legislators. In terms of climate change, the Intergovernmental Panel on Climate Change estimates that to keep the global temperature rise to 1.5°C, the energy industry alone will need to invest an average of US$ 2.4 trillion annually over the next ten years (not including transportation) (IPCC, 2022), (Climate Change 2022).
Yet, there is a significant funding gap, with current estimates of the amount of money going toward climate adaptation and mitigation (referred to here as "global climate finance") estimated to be $ 632 billion in 2019-2020, the majority of this money is going toward mitigation/transition finance, which is expected to receive US$ 571 billion, as opposed to adaptation/physical risk finance, which is expected to receive US$ 46 billion. Developing Asia accounted for approximately US$ 322 billion of worldwide climate finance in 2019-2020, highlighting the region's significance on a global scale (Buchner et al., 2019). The majority of this global climate money is allocated to clean energy systems like wind and solar electricity generation, primarily for mitigation.

Despite the growing and comparatively large numbers, climate financing needs to be scaled up globally to invest in energy transition, energy efficiency, and renewable energy technologies as well as to develop related financial products like sustainability-linked bonds. Conversely, investors, financial institutions, and the financial system as a whole face real risks and difficulties as a result of physical climate change. These risks must be acknowledged and managed, which increases the demand for adaptation funding (Diaz-Rainey et al., 2023).

1.1. Green financing in India

In 2020, green finance also saw a notable uptick, and in 2021, this trend is expected to continue. Asia's regulators are working harder to encourage the expansion of green finance to ensure a sustainable future. Money flows into Environmental, Social, and Governance (ESG) investment surged significantly in 2020 compared to 2019. The value of green finance bonds reached a record high of $544.3 billion during 2020, while the assets under management of ESG funds in Asia exceeded $60 billion by the end of December 2020, more than double the amount in 2019.

The International Green Building Council claims that green buildings save natural resources, generate less waste, use less water, are more energy-efficient, and give their occupants healthier surroundings. In India, certified green buildings can reduce energy use by up to 20–30% and water use by 30–50%. Commercial and residential structures account for about 37% of the nation's electrical energy use. Therefore, India has a promising need for and future potential for the construction of green buildings (Shah, 2023).

Unfortunately, there is presently no information available on the percentage of sustainable home loans to total housing credit, and the range and kind of products supplied by retail financial institutions in India are limited to green mortgages or home loans. To hasten the shift to green buildings and significantly support the sustainable growth strategy, retail banks can start by integrating green value into various construction loans through creative products and procedures.

For FY 2019- 2020, India's green financing flows come to $ 44 billion annually. This is a total annual increase from FY 2017- 2018 of $ 25 billion. In addition to the rise of financial flows, the increase can also be attributed to a deeper and more numerous ranges of sectors within the economy14. By incorporating more granular sources, the increased sector coverage not only made monitoring easier but also gave researchers a deeper comprehension of the causes of the flows (Khanna & Purkayastha, 2022).

This study analysed quantitative information from several chosen articles using the bibliometric R-package. This research has the following objectives-

- To identify the studies involving green financing during a selected period (2010-2023).
- This study also attempted to identify the most relevant sources, authors, keywords, documents, and trending topics on green financing.
- To find out future research areas based on thematic map analysis.

2. METHODOLOGY

The terms listed in **Table 1** were applied in all fields in the keywords section as selection criteria. We used the Web of Science database to gather the necessary information. The database generated 28,311 articles after the following keywords entered every field. After analyzing, we continued our study with 394 articles.

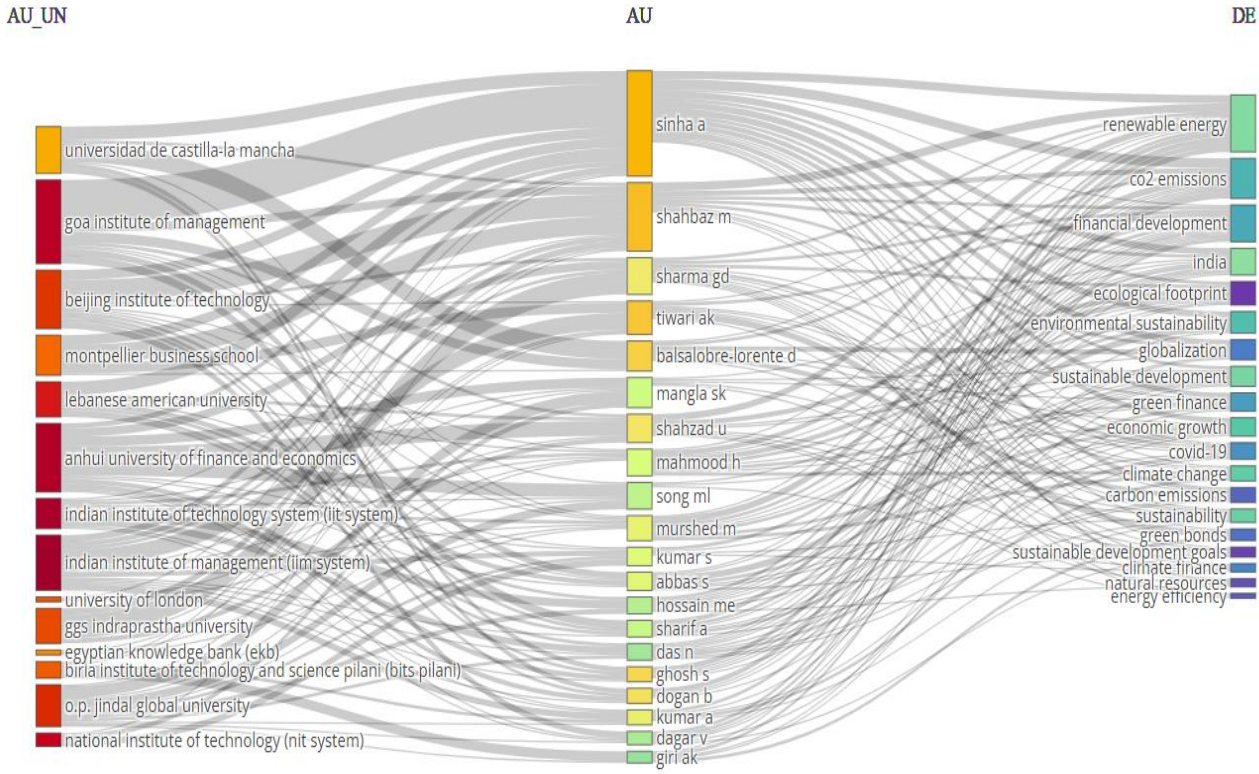
Table 1. Systematic Review of Search Process

Particular	Filters	No. of articles remains after applying filters
Keywords	(Green finance) or (sustainable finance)	n=28,311
Document Type	Articles only	n =25,016
Region	India	n=643
Time frame	2010,2011,2012,2013,2014,2015,2016,2017,2018,2019,2020,2021, 2022,2023	n = 540
Language	English	n =540
Category	Environmental science, green sustainable science technology, environmental studies, economics, business, business finance, management, multidisciplinary science, ecology.	n =394
Research areas	All types	n= 394

3. RESULTS

This section covers a brief description of the whole data that is selected for our study purpose and three field plots. Data has been gathered from the last ten years i.e., 2010 -2023. It has been concluded that a total of 394 documents selected for the study contain 148 Sources such as books, journals, etc, the total number of authors is 2585, and Single-authored documents have 22 authors. Total references are 23078, researchers' keywords are 1376, and 1050 total keyword pluses. **Figure 1** shows three field plots of authors, keywords, and affiliations. Names of the top ten authors are displayed in the middle field; the left-field represents the affiliations (n20) and the right field shows the keywords. Sinha A, Sharma GD, Tiwari AK, Mangla SK, and other renowned authors have written many articles on selected topics. The top working affiliations include the Goa Institute of Management, the Beijing Institute of Technology, the University of London, and OP. Jindal Global University etc. The top author's keywords revealed various terms which include renewable energy, green finance, economic growth, sustainable development, etc.

Figure 1. Three-Field Plot Analysis

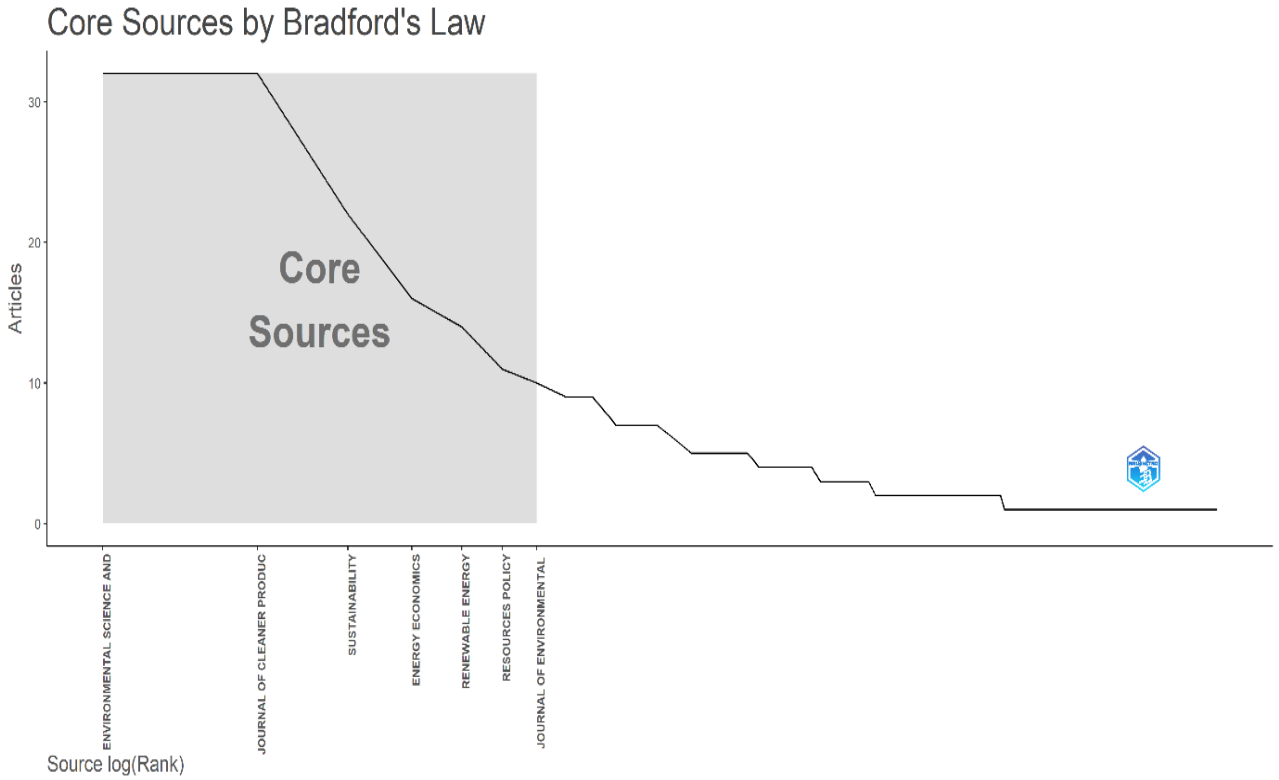


(Source- Biblioshiny software)

3.1. Sources information

This section discusses the top relevant journals in general and according to Bradford's law during the selected time frame. Bradford's law is used to display various journals under different zones. Journals like Sustainability, Renewable Energy, Sustainable Development, Journal of Cleaner Production, etc fall under Zone One journals (i.e. Core journals), and the rest fall under the secondary journals category. **Table 2** shares information rigorously about the most ten relevant sources over the period which include Environmental science and pollution research, the Journal of Cleaner Production, Sustainability, Energy Economics, the Journal of Environmental Management, and so on.

Figure 2. Sources Evaluation through Bradford's Law



(Source- Biblioshiny software)

Table 2. Top relevant Sources

Journal Name	No. of articles published
ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH	32
JOURNAL OF CLEANER PRODUCTION	32
SUSTAINABILITY	22
ENERGY ECONOMICS	16
RENEWABLE ENERGY	14
RESOURCES POLICY	11
JOURNAL OF ENVIRONMENTAL MANAGEMENT	10
SUSTAINABLE DEVELOPMENT	9
TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE	9
CLIMATE POLICY	7

3.2. Authors Productivity Analysis

This section includes information about the top authors who published articles on green finance. **Figure 3** shows the top ten authors that includes Sinha A, Shahbaz M, Tiwari AK, Ghosh S, Dogan B and so on. **Figure 4** depicts the productivity of an author using Lotka's law. The graph of the top documents written by various authors is displayed in the picture. It reveals that only 1 document has been published by 2366 authors. There are only 2 documents authored by 138 authors, 3 documents by 38 authors, and so on. **Figure 5** shows the most cited countries in the world related to green financing. It includes China, India, Spain, USA, the UK, Turkey, etc and so on.

Figure 3. Most relevant Authors

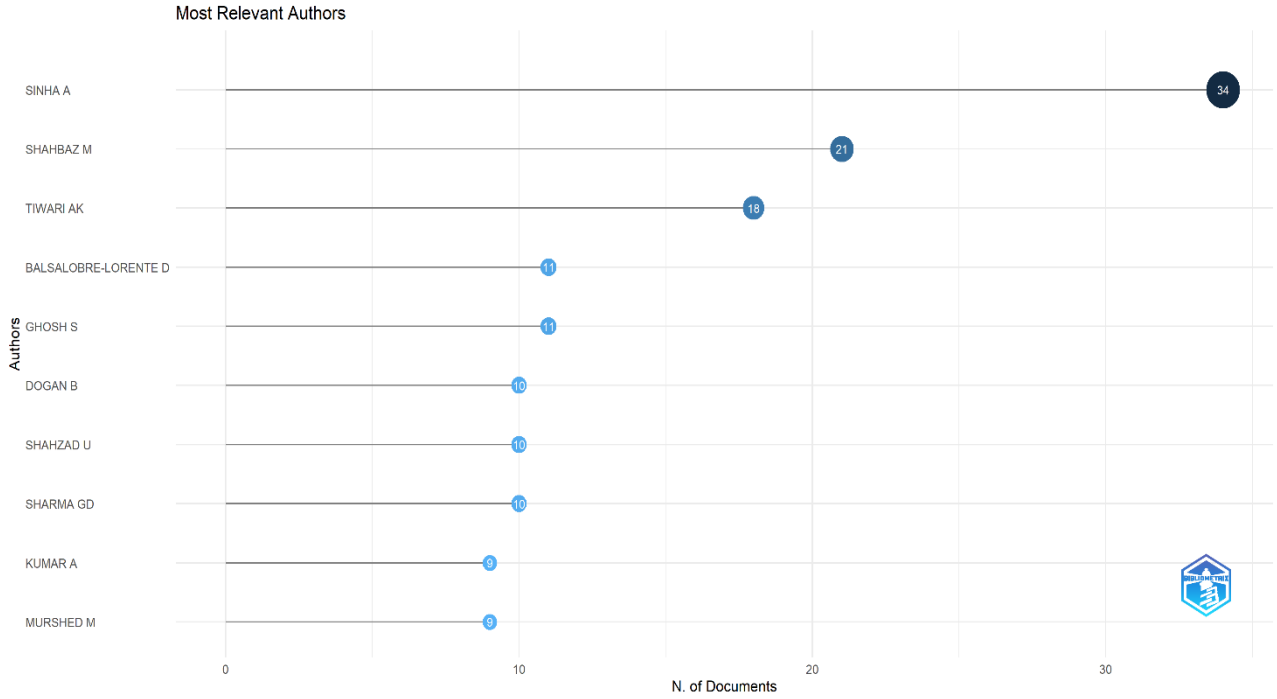


Figure 4. Author's productivity through Lotka law

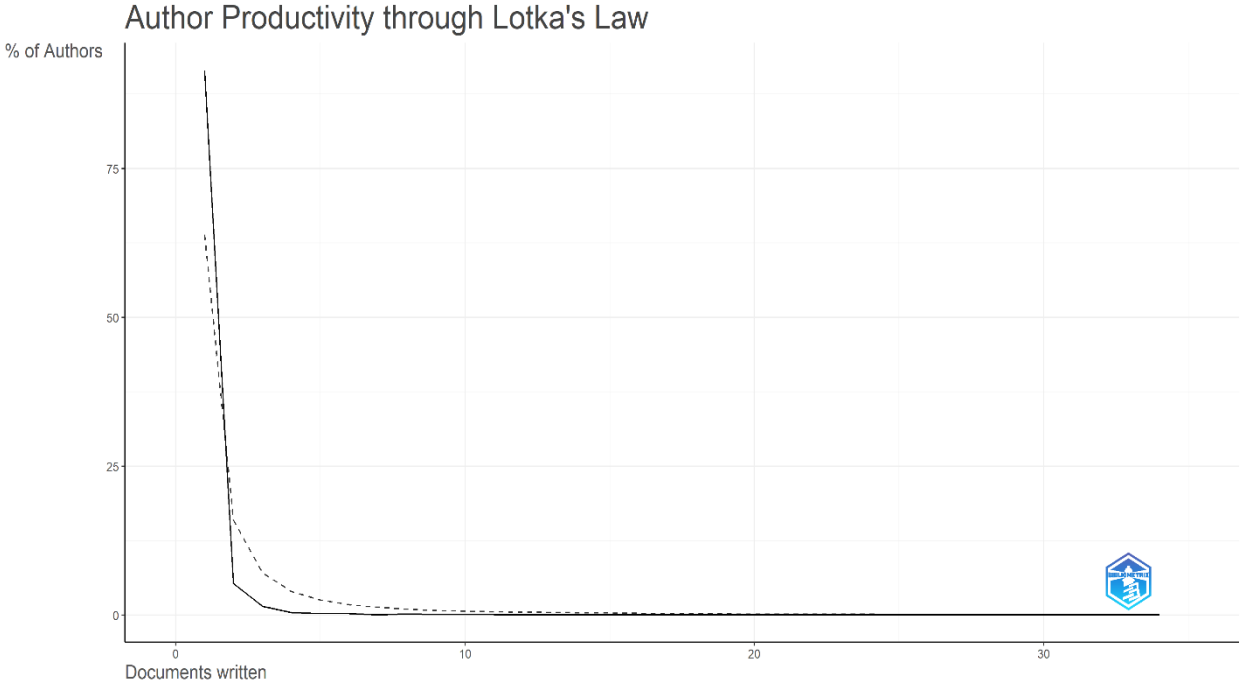
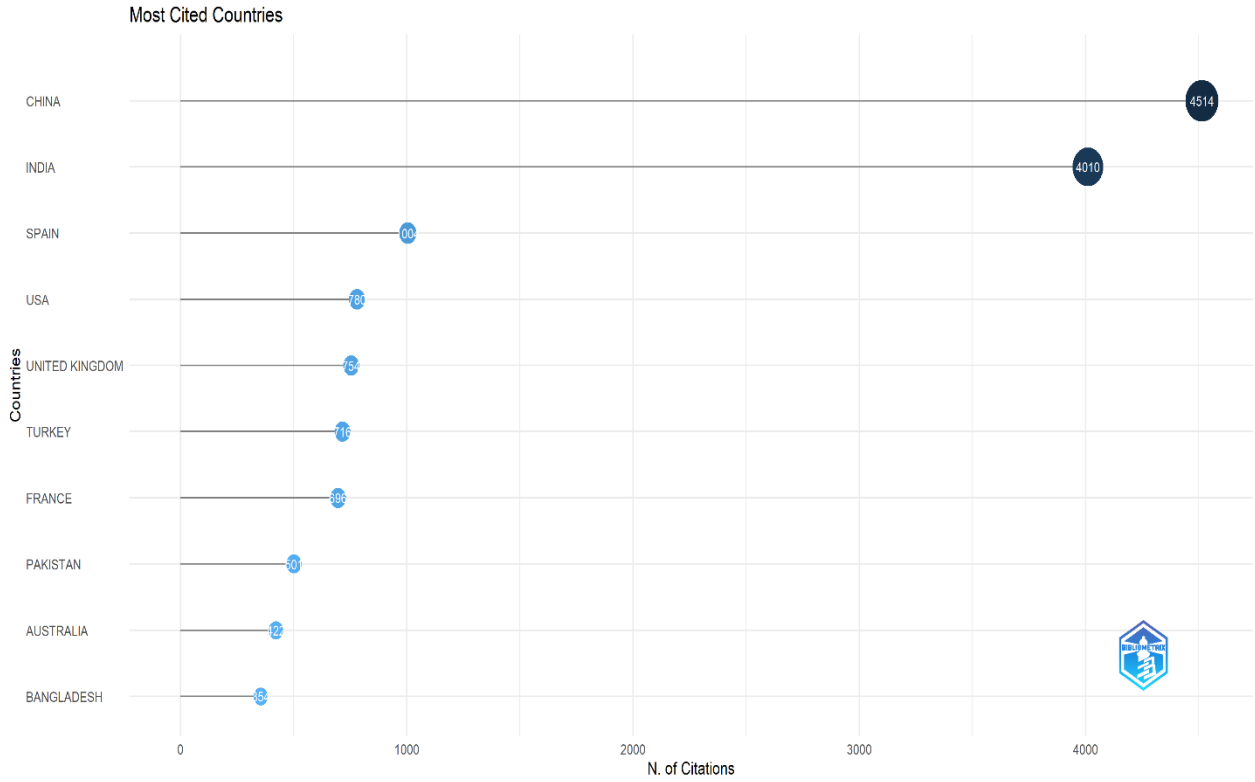


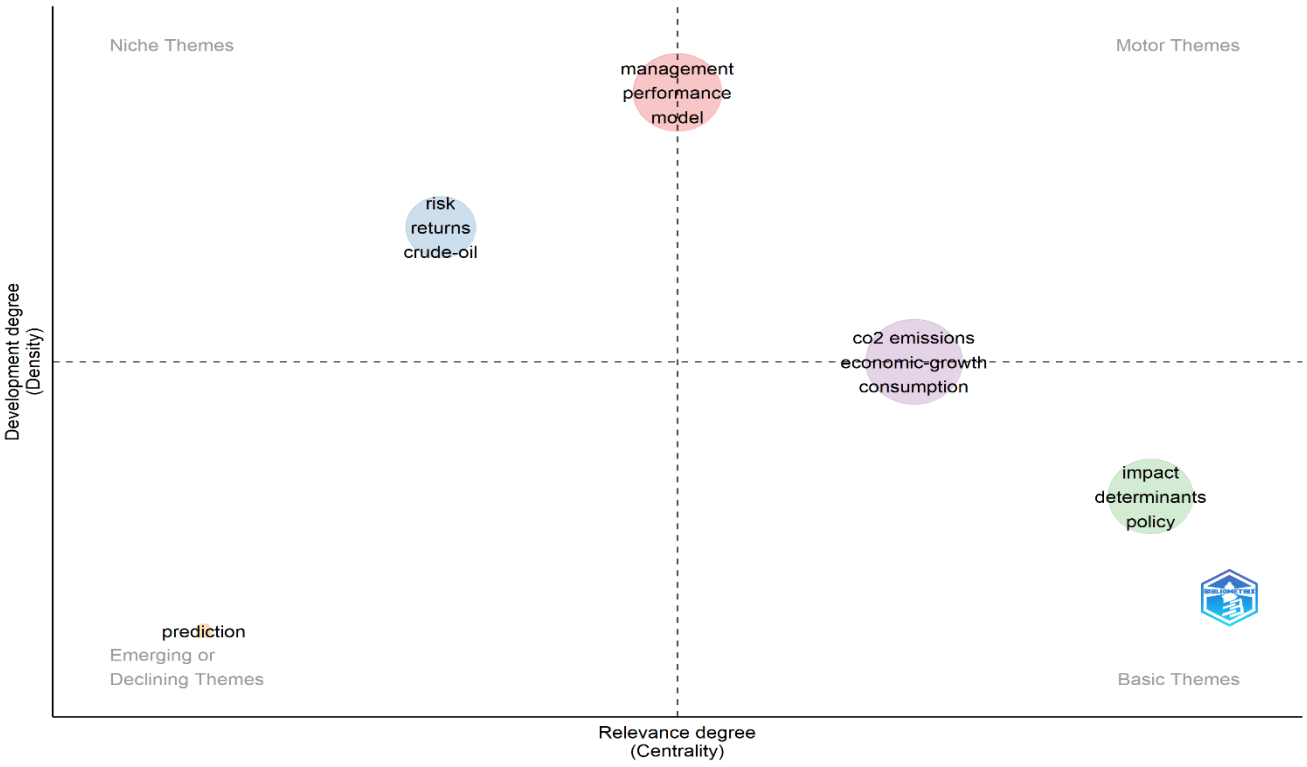
Figure 5. Most cited countries



3.3 Conceptual Structure and Social Structure

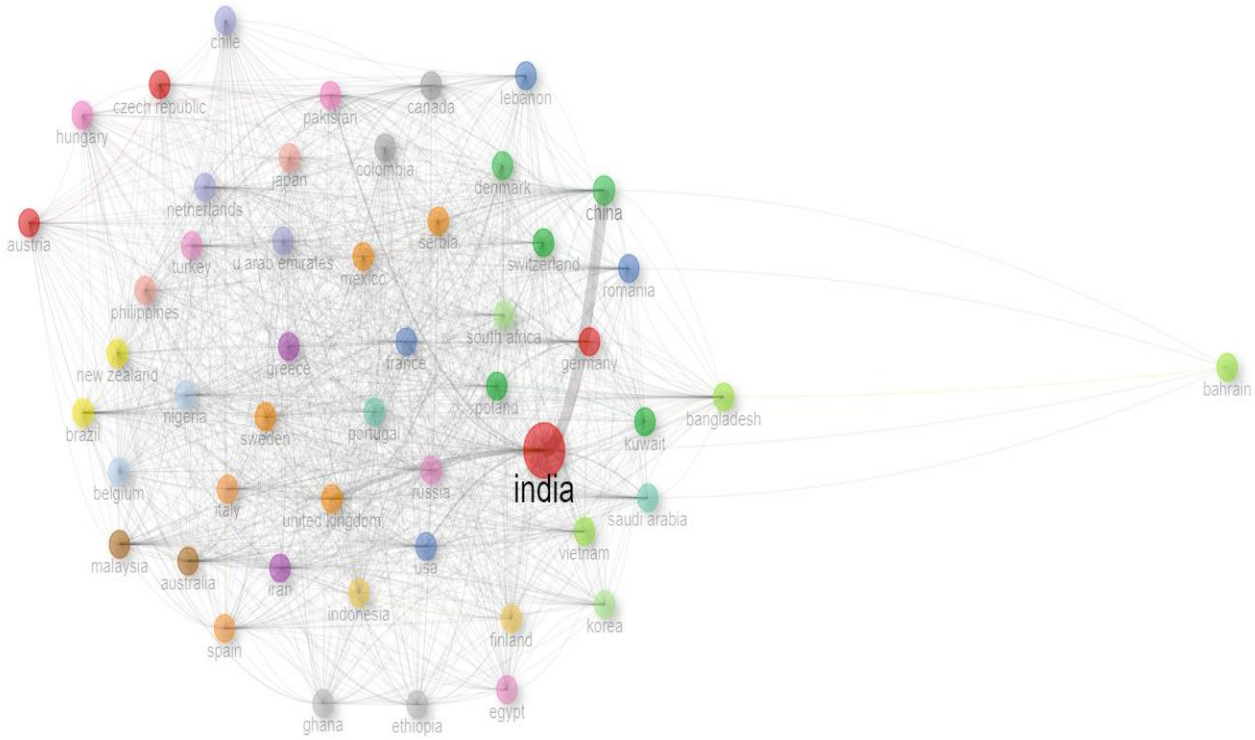
This section includes Thematic Map Analysis on the basis of keywords plus the help of biblioshiny. **Figure 6** identifies a thematic map made up of various clusters from 2010 to 2023. According to thematic map analysis, future research areas include various developing and relevant themes (i.e., impact, determinants, policy, sustainability, innovation, finance, investment, carbon emissions, economic growth, etc). **Figure 7** shows different collaborations among different nations on green financing. India and Germany (cluster 1), USA and France (cluster 2), China and Denmark (cluster 3), and so on among various nations that have collaborated.

Figure 6. Thematic Map Analysis



(Source- Biblioshiny software)

Figure 7. Collaborations among nations

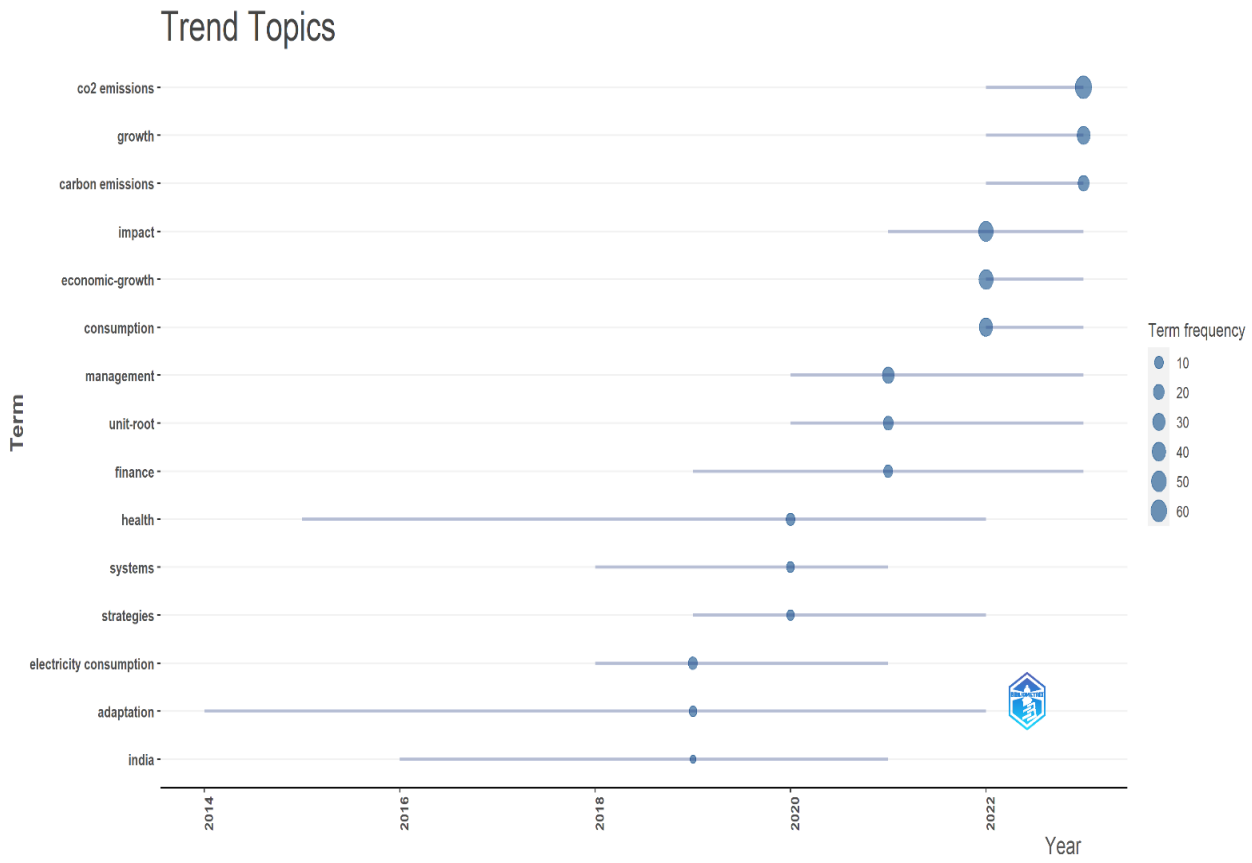


3.4 Keywords Analysis

Biblioshiny's Wordcloud, based on keywords plus, is displayed in **Figure 8.** Terms like CO_2 emissions, impact, economic growth, consumption, growth, financial development, etc are underlined in the image. **Figure 9** shows trending topics from the year 2010 to 2023 related to green financing. Areas include CO2 emissions, carbon emissions, growth (2023), Impact, economic growth, consumption (2022), management, unit-root, finance (2021), health, systems, strategies (2020), and so on.

Figure 8. Word cloud Map

Figure 9. The trending topic in the selected Years (2010-2023)



4. DISCUSSIONS AND CONCLUSIONS

The objective of this bibliometric review was to study the area of green financing specifically restricted to India only. To identify significant problems in the aforementioned subject, this research mostly studies articles from 2010 to 2023. It has been examined through three field plot analyses of authors, keywords, and institutions: Goa Institute of Management, the Beijing Institute of Technology, the University of London, and OP. Jindal Global University etc. and the top author's keywords include terms like renewable energy, green finance, economic growth, sustainable development, etc. According to the study's sources section, many reputable sources have published several publications on green financing. These journals include Sustainability, Renewable Energy, Sustainable Development, and Journal of Cleaner Production considered core journals according to Bradford's law analysis. Using Lotka's law to measure author productivity, we can see that only 1 document has been published by 2366 authors. There are only 2 documents authored by 138 authors, 3 documents by 38 authors, and so on have been published. The examination of trending keywords from 2010 to 2023 showed that CO2 emissions, carbon emissions, growth (2023), Impact, economic growth, consumption (2022), management, unit-root, finance (2021), health, systems, strategies (2020), and so on. were the most popular terms during this period. Impact, determinants, policy, sustainability, innovation, finance, investment, carbon emissions, economic growth, and other fields are very relevant yet currently underdeveloped, according to a thematic map analysis built using keywords plus.

This study adds to the body of knowledge now available by compiling data on the most important authors, relevant journals, and often referenced works, as well as by creating keywords in research on green financing. Furthermore, by providing keywords (impact, determinants, policy, sustainability, innovation, finance, investment, carbon emissions, and economic growth) that will aid researchers in subsequent studies, it adds to the body of literature on sustainable financing.

To meet the objectives of the Sustainable Development Goals & prevent the worst effects of climate change, we must increase the financing of investments that benefit the environment through novel financial tools and new policies, or "green finance." Examples of these include green bonds, community-based green funds, green banks, carbon market devices, fiscal regulation, green central banking, "fintech," and others.

India is facing a tight time frame to meet its climate targets, and going green in all aspects of finance has taken precedence. This necessitates a coordinated strategy, tangible actions, and a common goal by regulators, legislators, and financial industry players. All of this needs to be accomplished while monitoring the socioeconomic aspects of the nation. The best course of action is to intensify the conversation at the highest tiers & introduce a paradigm change in narratives, with a particular focus on sustainable financing.

In upcoming days, more information about how India Inc.'s business aims would fit to the national objectives would be disclosed, given the considerable commitment India has made to both the Paris Accord and the SDGs program. As a result, we need to create a common strategy for ESG investments, green regulations, and financial products, and define the responsibilities of the public and private sectors as well as bankers & asset managers. This will not only accelerate efforts to bring the entire financial system into compliance with green finance, but it will also power the nation's engine of sustainable growth.

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