International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 12s,2025
https://theaspd.com/index.php

A Study On Research Trends Of Green Banking Through Bibliometric Analysis Using Scopus Database

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Abstract:
Green banking has become a crucial foundation for advancing sustainable financial practices that support environmental stewardship and economic resilience. Green banking incorporates ecological considerations into banking practices, therefore tackling climate change and promoting sustainable growth within the financial system. This Bibliometric Analysis examines the patterns, partnerships, and thematic development of research in Green Banking from 2013 to 2023, using data from Scopus-indexed journals. The investigation started with a targeted search using five TITLE-ABS-KEY- "Green Banking" OR "Green Portfolio" OR "Sustainable Banking" OR "Sustainability Banking Practices" OR "Eco-Friendly Banking" yielding a total of 480 papers. Following the application of inclusion criteria, 350 publications were identified, focussing on areas like Social Sciences like Business Management, Economics, and Environmental Science, which were further refined to 225 articles explicitly pertaining to Green Banking activities. The use of Bibliometric analysis, facilitated by sophisticated software such as Gephi and VOSviewer, has for an in-depth analysis of co-authorship networks and citation dynamics in this rapidly expanding domain. These findings reveal enhanced publication production, and particularly in the past few years contributing to the notion of expanding interest and collaboration among scholars across. This study elucidates the status quo of Green Banking research and forecasts future trends, indicating the significance of Bibliometric Analysis in notifying the strategic approaches towards green and sustainable banking practices.

Keywords: *Green Banking, Bibliometric Analysis, Sustainable Development, Research Trends, Exponential Growth Model*

1. INTRODUCTION:

Innovative financial services and products across globe and, at specific nationals thriving their best to confront and overcome environmental challenges viz., waste disposal, pollution control, climate change, emission of greenhouse gases, and protection of the environment (Nachaal & Kalsi, 2023). To this effort, the banking sector plays a key role as it forms part of the financial system, infrastructure and contributes towards the growth of the economy as well as advancement (Suhas & Ramesh, 2021). The banking sector has shifted focus on environmental aspects into their sustainable business strategies and service delivery system, which is termed as “Green Banking”. It involves integration of environment with the banking and financial operations (Sarath Chandran, Sathiyabama & Santhoshkumar, 2024). Green banking, or Ecological banking, entails financial sectors, dedicating themselves towards the Sustainable development by integrating environmental concerns into their operations and services to limit the environmental effects and foster economic growth (Tran N. Sa & Ha T. T. Dao, 2023. Adopting Green banking principles, financial institutions aim at reducing their emission, encouraging environmentally friendly investment and encouraging sustainable practices. This include promoting environmentally friendly activities, supporting use of green energy, reducing on the use of papers, offering online financial services, and responsible disposal of waste. In general, Green Banking leads to sustainable economic development

and conservation of the natural resource (Nachaal & Kalsi, 2023). The study used 5 terminology viz., Green Banking, Green Portfolio, Sustainable Banking, Sustainability Banking Practice, Eco-friendly banking which develop similar practices conserving environment (Dufays, 2012; Sanctuary et.al 2024; Islam et.al, 2021; Salim et.al 2023).In light of the increasing scope of research avenues inclined towards Green Banking and related themes, Bibliometric analysis has become an essential instrument for measuring and evaluating the burgeoning trend of this phenomena and its associated issues. Bibliometric analysis has surged in popularity within the study domain, becoming as a favoured technique for academics investigating several subjects (Tran N. Sa & Ha T. T. Dao, 2023). This approach provides a rigorous and methodical assessment, aiding academics in comprehending the evolution of literature within a certain domain, such as Green Banking. Bibliometric analysis enables researchers to get precise information on a study subject, delineate its attributes, and monitor the developmental trajectory of scientific material within that domain (Amirbagheri et al., 2018). It serves as a potent instrument for scholars to examine disciplinary hotspots and trends across diverse fields. (Donthu et al. 2022) used Bibliometric to assess the influence and contributions of the Journal of Business Research (JBR) over a span of 50 years. Additionally, (Dwekat et al.2020) conducted a Bibliometric study using VOSviewer (Khan, M. H., & Muktar, S. N. 2020) to investigate the correlations among board characteristics, corporate social responsibility (CSR), and corporate social responsibility disclosure (CSRD). The study will focus on assessing the antecedent factors and tackling essential research enquiries pertaining to Green Banking. The following questions are essential to the investigation: To what extent are the research developments and trends related to green banking apparent and what conclusions arise from a Bibliometric Analysis of this field? Responding to these enquiries will enhance comprehension of Green Banking while serving as a foundation for further research initiatives. This proposed research aims to examine several critical aspects: year-wise paper publication, contributions from leading nations, notable sources or journals in the field, leading authors, and significant affiliations related to green practices and their effects on sustainability objectives. The analysis seeks to find the primary authors with the high citation counts in this field. The study will analyse the important terms related to Green Banking, pinpointing the main areas within Green Banking scholarship (Khan & Muktar, 2020). The research will use an exponential growth model to appropriately illustrate the rapid growth patterns in publication of research articles for Green Banking and related themes (used in the study) from 2024 to 2027.

2. Significance of Study and Literature Review:-

Green Banking is becoming an increasingly important component of sustainable banking, which aims to provide environmental preservation with long-term economic development. The relevance of researching green banking resides in the fact that its importance is expanding. Green banking has gained momentum as a vital method for tackling the negative environmental repercussions of imbalanced industrialisation during the last several decades (Islam et al., 2020; Rehman Khan & Yu, 2021). These implications include climate change, pollution, and the deterioration of ecosystems. Some of the mechanisms that have gained support include green banking. Green banking, as described by academics, is not only an abstract notion but rather an all-encompassing system that incorporates ecological issues into banking operations. Nonetheless, this system provides substantial economic development, also promotes practices that are more ecologically appropriate (Mozib Lalon, 2015).To put it another way, Green Banking functions on two significant dimensions, such as: first, as for the processes or operations used in banking; second, as for the localization of the funds used in the bank, ensuring that the money is being invested into more 'Green' industries (Sarma & Roy, 2021). The fact that those institutions more actively use the element of sustainable practices in their business solutions and investment management make it possible to declare they are taking a more crucial position in the fight against environmental deterioration and development

of green financing. This transition is required since banking also plays an important role in the promotion of long-term stability of overall financial environment. Studies, (Sarker et al. 2019; Stephens & Skinner, 2013) have stressed on the need of green banking techniques and their adoption by financial institutions in order to limit the consequences of the climate change and protect the integrity of the environment. However, the concept of Green Banking can be a part of green finance (apart from green or sustainable practices), which is a broader term that includes various financial activities geared at enhancing the environmental efficiency and applying measures to prevent adverse impacts of climate change. Ecological goods and services are at the centre of green banking. Such investments not only allow financial institutions to achieve better conditions in terms of environmental sustainability, but at the same time make a contribution to economic stability (Lindenberg & Volz, 2016). The financial institutions that are integrating environmental issues into their operations now are preparing themselves for the role of helping facilitate a transition to an economy that is more sustainable. Green banking has become a critical part of green financial systems in the present world in view of its major focus of conservation of the environment and economic growth.There has been lots of attention from many economic stakeholders such as academic learners, policy makers, and economic institutions hence increasing the importance of undertaking research on Green Banking from the perspective of research. By studying its details, the development, global spread, and literature sources of the subject, the aim of this paper is to evaluate and identify the current state of research on green banking. The results of the current research will help academics to continue the steady development of green banking and also help policymakers find ways to implement green banking legislation successfully. Furthermore, the outcome of this research will be of interest to all the communities around the world as it will enhance their understanding on how to enhance environmental sensitive practices in banks to support economic development.Researchers are more shifting towards Bibliometric analysis as a strategic tool and method for statistically evaluating and assessing trends in variety of domains, evolving Green Banking. According to (Tran N. Sa and Ha T. T. Dao, 2023), Bibliometric analysis determine the most potent contributors, leading countries, and key journals in the field of Green Banking. Another (Kinan Salim et al. 2023) focused on the research question of how environmentally responsible banking practices affect the stability of banks. They established that those with green policies for banks are likely to be in a better place to increasingly risk and maintain good financial stability. For financial institutions to reduce their risks to regulatory and reputational trouble and at the same time contribute to the achievement of macro sustainability initiatives, they may need to align their operations with environmental sustainability. The outcome of this study supports, other literature that examined the links between green banking, financial sustainability, and sustainable development. With regard to the concrete implications, Green Banking offers numerous opportunities and benefits for banking organisations and society in general and the populace at large. Institutions that adopt environmental friendly banking policies may possibly reduce on their cost of operation while gaining the much needed reputation of being environmentally friendly to many conscious consumers and investors. Currently banks are capable of positively contribute to the achievement of global sustainable goals for instance, the United Nations Sustainable Development goals (SDGs) by availing funds to support sustainable projects. These projects involve efforts to build sustainable infrastructure as well as renewable energy projects. Additionally, Green Banking stimulates financial institutions to take instrumental participation in tackling environmental concerns that helps to cultivate culture that is sustainable within the business.The increasing volume of literatures on the Green Banking sheds a reflection of the growing awareness for the need of banking industry to adopt practices that are sustainable. To emphasize the significance of the concept of responsible banking, (Dufays 2012) have prepared a list of guidelines that assist banks on, when they try to be environmentally friendly. One of these is the integration of social and environmental factors in the carrying out of banking activities.

Other concepts are the concepts such as accountability and openness. To this end, the principles provide an appropriate course of action that may enable the financial institutions to make a huge contribution towards enhancing the process of moving towards a sustainable economy. Green banking has a potential for innovation within a financial industry and has overall, positive effects of the economy and the environment. Banks can connect with developing markets and create value for their stockholders and society as they proceed to build new products and services promoting sustainability for the achievement of sustainability goals. For instance, (Sanctuary, Lavenius & Parlato 2024) surveyed on the distribution of green European equity funds. They established how banks, other financial organisations could align the portfolios of investment with environmental goals. The kinds of innovation here, do contribute positively to the protection of the environment; they also help the banking sectored to sustain its competitiveness in the long run.However, the study of 'Green Banking' is paramount for numerous reasons i.e., it has the capability to create a strong economic growth in the long-run and at the same time, address some of the most daunting environmental issues. Proposed paper submits that it is feasible for the financial institutions to mitigate its impact on environment, support the green investment and pay its part for the attainment of sustainable development goals globally if the principles of sustainability are integrated in their operations. For the purpose of assessing the status quo of research publications in green banking, Bibliometric analysis is a prominent method that will insights into important trends, contributors, and research gaps. Further, the study will concentrate on evaluating the novel approaches that financial institutions and sector as whole, may use to improve their strategies and to facilitate the transition and transformation toward more sustainable finance system in relation to Green Banking. The study paves the way to create a platform for future research initiatives that are targeted at improving sustainability within the banking industry.

3. METHODS AND APPROACH:

3.1 Method Adopted- Bibliometric Analysis

Bibliometric analysis is utilized to comprehend the growing concept of Green Banking and its related theme. Specifically in Business Research, it has acquired immense popularity in in recent years (Donthu, Kumar, & Pattnaik, 2020b; Donthu, Kumar, Pattnaik, & Lim, 2021; Khan et al., 2021). Popularity of this can be attributed due to two factors: (1) the availability, accessibility and development of Bibliometric software such as Biblioshiny, Gephi, Leximancer, and VOSviewer that generates visual presentation of data; (2) Cross-disciplinary pollination of the Bibliometric methodology towards Business research from information science; and (3) availability of scientific databases such as Scopus and Web of Science. It is more significant to note that the popularity of Bibliometric analysis in business research is not a passing trend but rather a reflection of its usefulness in (1) managing vast amounts of scientific data and (2) achieving high research impact (Donthu, N., et.al 2021). Scholars across globe have contributed to the publication of the associated study findings in a significant number of publications (Khan, M. H., & Muktar, S. N. 2020). A Bibliometric analysis will performed on in this proposed study considering 5 keywords, retrieved from Scopus databases for the years 2013 and 2023, analyse them using MS Excel, Biblioshiny and VOSviewer.

3.2 Database for the Study: - Scopus

Accurate and relevant data sources in required for having comprehensive analysis and informed decision-making (Rueda et al., 2007). To this efforts Google Scholar, ISI, Web Of Science, and Scopus are trusted for their accuracy and effectiveness. It starts with selecting a reliable database for analysis (Albort-Morant, G., et al. 2017) that forms the first step for the study. The comparability and durability of statistical data from Scopus (Salmerón-Manzano, E., et al. 2017) are being discussed. The suggested analysis (Cobo, M.J., et al. 2011) used Elsevier's Scopus scientific database for Bibliometric analysis. Scopus, according to

Elsevier, is a massive peer-reviewed literature database (Briones-Bitar, J., et al. 2020). Many academics have approached this database for Bibliometric analysis in multdisciplinary domains (López-Illescas, C., et al. 2008; Sánchez, A.D., et al. 2017). Scopus has more than 69 million entries and covers several disciplines, so the analysis was done using the Scopus Index, a recognised and reliable database that's used by scholars worldwide.

3.3 Search Criteria:-

Sl. No.	Syntax	Number of documents
1	TITLE-ABS-KEY ("Green Banking" OR "Green Portfolio" OR "Sustainable Banking" OR "Sustainability Banking Practices" OR "Eco-Friendly Banking")	480
2	TITLE-ABS-KEY ("Green Banking" OR "Green Portfolio" OR "Sustainable Banking" OR "Sustainability Banking Practices" OR "Eco-Friendly Banking") AND PUBYEAR > 2012 AND PUBYEAR < 2024	350
3	TITLE-ABS-KEY ("Green Banking" OR "Green Portfolio" OR "Sustainable Banking" OR "Sustainability Banking Practices" OR "Eco-Friendly Banking") AND PUBYEAR > 2012 AND PUBYEAR < 2024 AND (LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "ECON") OR LIMIT-TO (SUBJAREA , "ENVI"))	310
4	TITLE-ABS-KEY ("Green Banking" OR "Green Portfolio" OR "Sustainable Banking" OR "Sustainability Banking Practices" OR "Eco-Friendly Banking") AND PUBYEAR > 2012 AND PUBYEAR < 2024 AND (LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "ECON") OR LIMIT-TO (SUBJAREA , "ENVI")) AND (LIMIT-TO (DOCTYPE , "ar"))	225

Source: *Scopus Data Base/ Exclusion & Inclusion Criteria: Author's own*

Green Banking and related themes, using Bibliometric analysis approached Scopus-indexed journals for research articles. In first search criteria, 5 keywords were used : TITLE-ABS-KEY ("Green Banking" OR "Green Portfolio" OR "Sustainable Banking" OR "Sustainability Banking Practices" OR "Eco-Friendly Banking"), that yielded 480 documents. Accordingly, the analysis covered 350 research papers published between 2013 and 2023. The domain wise search focused on social sciences, particularly Business Management, Social Science, Economics, Environmental Science, and Multi-Disciplinary subjects, that resulted in 310 documents. Study included only those publications with Green Banking and related themes of green practices. Lastly, the search included only those documents with "articles type" that fetched final 225 research papers.

3.4 Data Quantification:-

Proposed Bibliometric analysis was quantified utilizing MS Excel spreadsheet, VOS viewer and the Biblioshiny Softwares. These programs are critical for analysing the connections between commonly cited authors, investigating collaboration among diverse authors, and measuring coordination across countries, institutions, keywords, including theme related data (Hoppen & de Souza Vanz, 2016). These methods are also used for cluster analysis that requires the visualisation of spatial network maps. This is accomplished by using a matrix that contains information on a wide range of the co-authorship and the co-occurrence (N. Van Eck & Waltman, 2009; Khan, M.G., & Muktar, S.N, 2020). Additional,

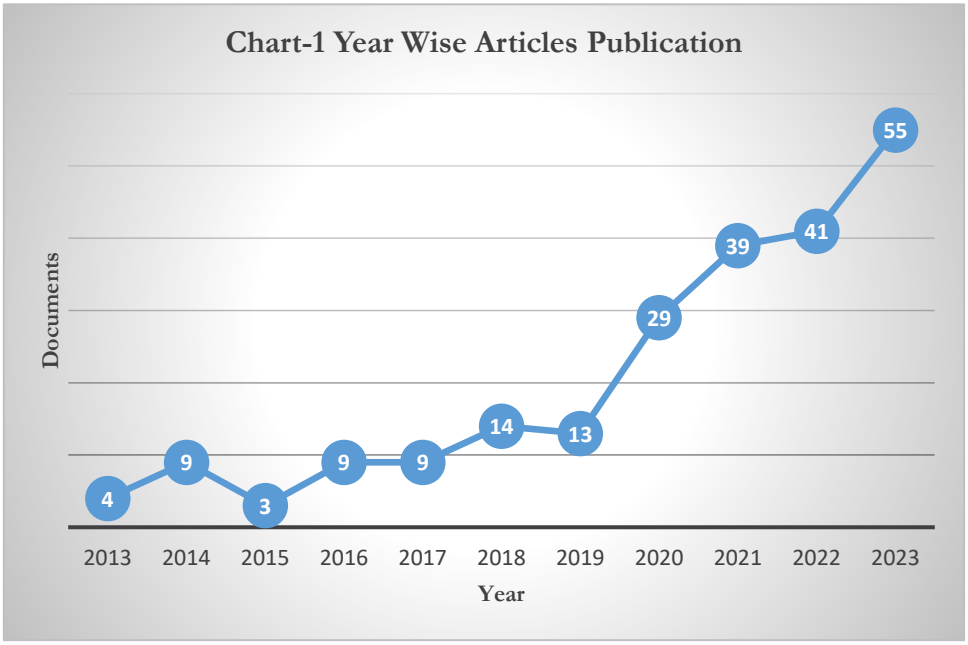
Exponential growth is used in Bibliometric analysis to identify high-growth research publication for 2024-2027 considering the trend of previous publication records. By examining the tentative growth in proposed domain, scholars may uncover field-specific accelerations that influence research program planning and international collaboration. This notion is essential for charting the changing scientific research environment across fields (Hanif, M. A., et.al 2022; Musa, S. S., et.al 2020)

4. Findings and Interpretations:

Table 1 Year Wise Articles Publication

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Articles	4	9	3	9	9	14	13	29	39	41	55

Source: *Scopus Data Base Search*

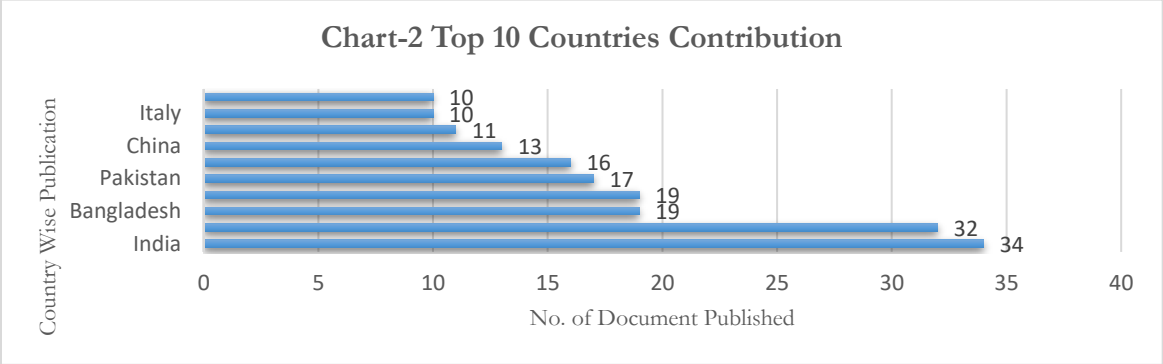


From 2013 to 2023, the table shows article publication numbers. The number of articles fluctuated in the early years, but increased steadily in subsequent years. Only 4 articles were published in 2013. In 2014, the number doubled to 9 articles. In 2015, the number of articles dropped to 3, the lowest in the time. Despite this drop, articles rose to 9 in 2016 and 2017 and stayed there. This little variation suggests that production was consistent yet variable. Since 2018, article numbers have gradually increased. That year, 14 papers were published, up significantly from prior years. From 2019 to 2020, the number of articles more than doubles from 13 to 29. From 2021 forward, 39 papers are published, accelerating increase. After 41 articles in 2022, the number climbs at 55 in 2023, the highest in the time under consideration. Article output seems to be rising, especially after 2017, when numbers rise dramatically and continuously. Recent years have seen more papers, which may indicate increasing research, interest, or distribution platforms. Over the decade, article publication has increased, with 2023 registering a large quantity of papers compared to the early years.

Table 2 Top 10 Countries Contribution

India	Malaysia	Bangladesh	UK	Pakistan	Spain	China	Germany	Italy	US
34	32	19	19	17	16	13	11	10	10

Source: *Scopus Data Base Search*

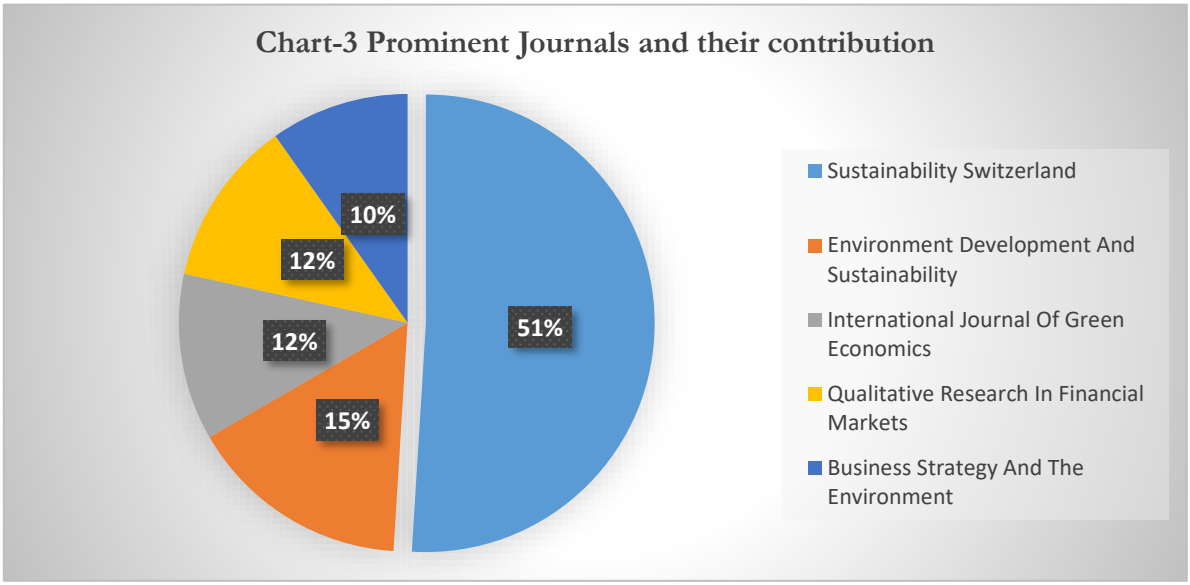


The table-4.2 shed lights on the country wise contribution towards research publication in the proposed research domain and their relevant position. India tops the list with 34 research articles, much ahead of the others. Malaysia, with 32 research publications, behind India but remains prominent. Bangladesh and the UK each have 19 paper publications, suggesting metric parity. Pakistan published 17 and Spain 16, placing them close to one other and below Bangladesh and the UK. With 13 research publications, China ranks moderately among the nations mentioned. German, Italian, and US published 11 and 10, research papers respectively, placing them towards the bottom of the list. India and Malaysia are well ahead of the others, while the other nations cluster around lower levels, indicating regional differences in the parameter being examined.

Table 3 Prominent Journals and their contribution

Sources	Articles	% of Contribution
Sustainability Switzerland	26	51%
Environment Development And Sustainability	8	15%
International Journal Of Green Economics	6	12%
Qualitative Research In Financial Markets	6	12%
Business Strategy And The Environment	5	10%

Source: *Scopus Data Base Search*



The table-4.3 illustrates the contribution of diverse academic sources to a study domain, emphasising their distinct contribution. Sustainability Switzerland is the foremost contributor, with 51% of the total articles with 26 contributions. This dominance highlights its significance in sustainability talks, indicating its broad impact and comprehensive coverage of the topic. The magazine serves as a crucial forum for communicating research on sustainability, environmental challenges, and green practices, garnering significant academic attention. Subsequently, Environment Development and Sustainability significantly contributes 8 papers, accounting for 15% of the total. Despite its lesser volume relative to Sustainability Switzerland, this publication remains important in the domain, concentrating on subjects that connect environmental development with sustainable practices. Its contribution is substantial, offering an ancillary viewpoint to the prevailing subjects examined in the premier publication. Two sources, the International Journal of Green Economics and Qualitative Research in Financial Markets, each provide 6 articles, accounting for 12% of the total. Their participation underscores the convergence of green economics and financial markets, indicating the increasing significance of economic and financial factors within the wider sustainability dialogue. These publications probably examine novel financial models, sustainable investment methods, and qualitative assessments of market trends, enhancing the academic discourse with insights that connect sustainability to economic activities. Finally, Business Strategy and the Environment provides 5 articles, or 10% of the whole amount. This publication highlights the significance of corporate tactics in advancing environmental sustainability. The emphasis presumably centres on how enterprises might integrate sustainable practices into their operations, so enriching the discourse on the actual application of sustainability in corporate settings.

Table 4 Significant Authors and their contribution

Authors	Articles	Articles Fractionalized
Bukhari, S.A.A.	6	1.41
Hashim, F.	6	1.29
Amran, A.	5	0.89
Bose, S.	4	1.39
Forcadell, F.J.	4	0.89
Julia, T.	4	1.41
Kassim, S.	4	0.89
Khan, H.Z.	4	5.89
Nisha, N.	4	0.78
Úbeda, F.	4	1.41

Source: *Scopus Data Base Search*

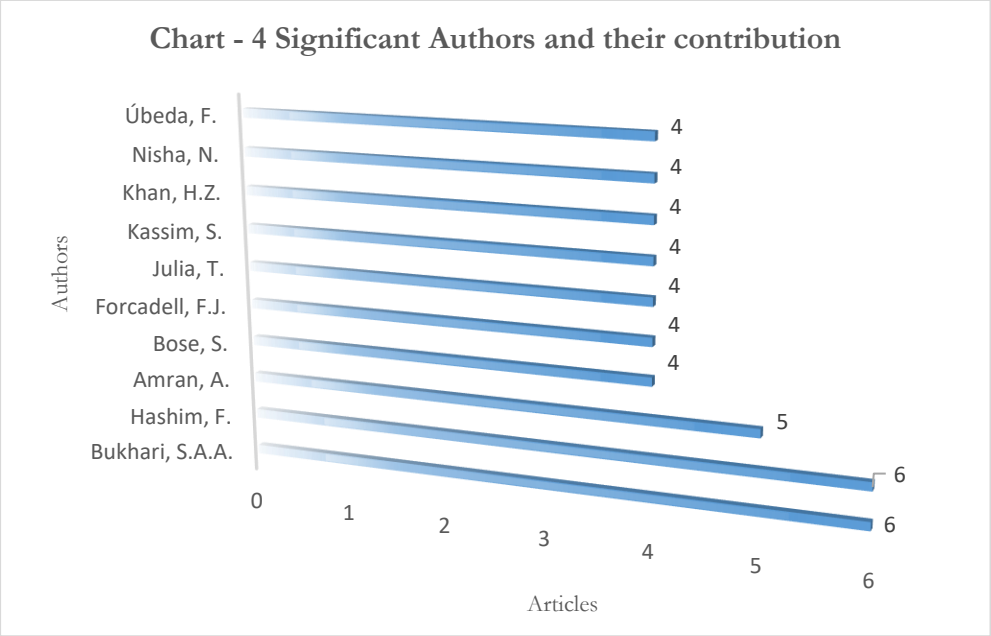


Table 4.4 demonstrates how fractionalised statistics and author articles build topics. The overall number of publications authored by each individual is substantial, indicating their involvement and impact within the academic community. A total of 6 research papers by S.A.A. Bukhari and F. Hashim. A has fractionalised score of 1.41 implies that Bukhari's work is highly acclaimed in literature for its quality and effect. Hashim's fractionalised score of 1.29 is great, but Bukhari's is better. Both authors publish often and well, suggesting productive researchers. Amran, A. has 5 publications and a fractionalised score of 0.89, less than the top and second rank authors. We found that Amran's many publications may not be well-known or cited. Rest authors viz., Bose, S.Forcadell, F.J., Julia, T., Kassim, S., Khan, H.Z., Nisha, N., Úbeda, F. works were influential with each of 4 publication. Bose's fractionalised score of 1.39 reflects their importance and appreciation. Khan, H.Z. had 5.89 fractionalised score. With high score implies they are often argued in research, making them essential to our study. Khan's fractionalised score did not match that of other authors with the same number of publications, highlighting the necessity of judging academic contributions based on quantity and quality. Nisha and Kassim's 0.78 and 0.89 grades indicate low performance against others in terms of their individual contribution towards research paper. The table presents a comprehensive perspective on authorship and influence in a research environment, prompting additional investigation into the fundamental reasons that account for variations in comprehending and citation trends. Thus, this study reflects on how the publication production correlates with the academics in operation, in order to form the basis of understanding these author endeavours.

Table 5 Top 10 Most Citied Authors

Authors	Citations	Year
Bose,S	126	2018
Rubel, M.R.B	115	2020
Sun, H	107	2020
Jan, A.A	101	2021
Raut, R	97	2017

Khan, H.Z	87	2021
Sharma, M	85	2022
Rehman, A	77	2021
Kumar,K	76	2019
Aracil, E	75	2021

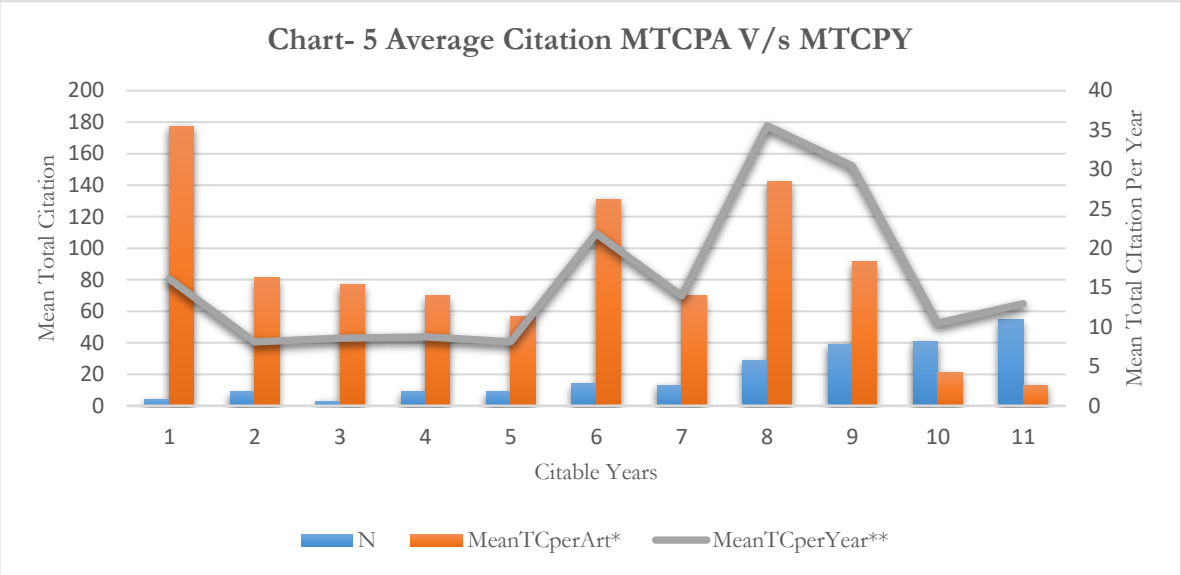
Source: *Scopus Data Base Search*

The table 4.5 shows a variety of research outputs from various years by author and their citation received, that provides an interesting perspective. Bose, S. takes the top spot with 126 citations in the year 2018, demonstrating his academic influence. The most referenced research is Bose's, indicating its fundamental or important status. Following closely, Rubel, M.R.B., with 115 citations in 2020, and Sun, H., with 107 citations for the year 2020, show that their very recent articles have had a considerable impact, perhaps in fast developing domains. Jan, A.A., Khan, H.Z., and Rehman, A., all from 2021, have 101, 87, and 77 citations, respectively, indicating that research from this year are highly regarded. This shows that numerous authors made substantial contributions to their disciplines in 2021. Raut, R., in 2017, has 97 citations, indicating consistent involvement with their work. Raut's study remains relevant despite its earlier publication date. Kumar, K.'s 2019 work, with 76 citations, shows their research's academic importance. Sharma, M., the most recent addition in the table, has 85 citations in 2022, suggesting that their work is already having an influence. Finally, Aracil, E., with 75 citations in 2021, concludes a remarkable year for high-citation research. The table shows that many research contributions have affected the academic community, with strong citation clusters in 2020 and 2021 suggesting active intellectual work.

Table 6 Average Citations per Year

Year	N	MeanTCperArt*	MeanTCperYear**	CitableYears
2013	4	177.30	16.11	11
2014	9	81.10	8.11	10
2015	3	77.26	8.58	9
2016	9	69.89	8.73	8
2017	9	56.92	8.13	7
2018	14	131.21	21.86	6
2019	13	69.80	13.96	5
2020	29	142.18	35.54	4
2021	39	91.29	30.43	3
2022	41	20.96	10.48	2
2023	55	12.98	12.98	1

Source: *Scopus Data Base Search (Biblioshiny)/ * denotes Mean total Citation /Articles **Mean total Citation/year. Note- MTCPA denotes Mean total Citation/Articles & MTCPY denotes Mean total Citation/year*



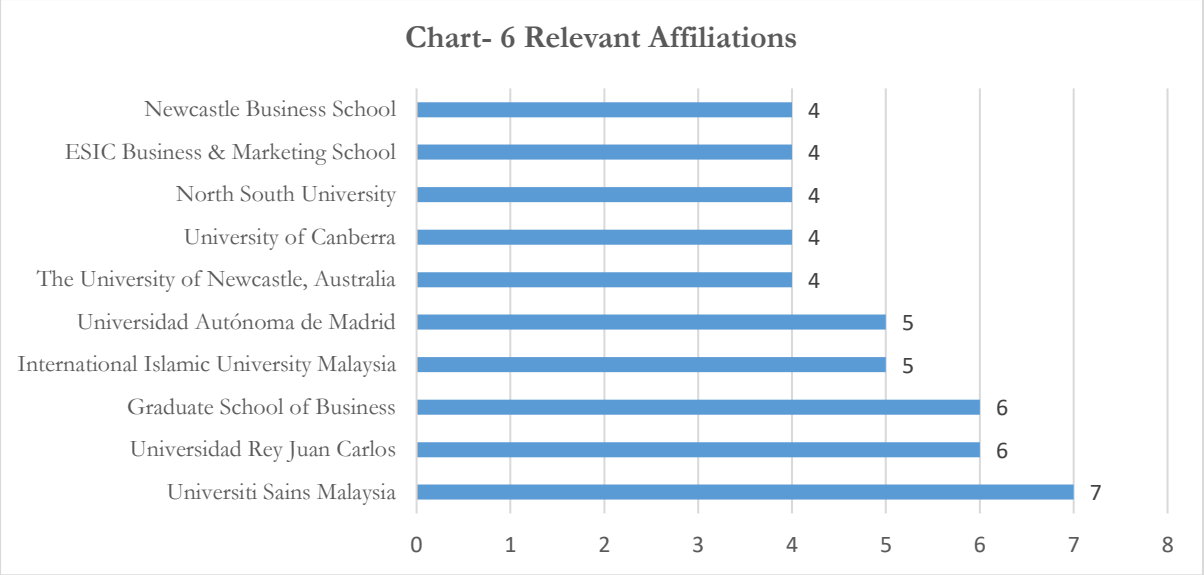
From 2013 to 2023, the table 4.6 offers annual analyses of research article metrics to reveal trends. Metrics include the number of articles (N), mean total citations per article (MeanTCperArt*), mean total citations per year (MeanTCperYear**), and citable years. Starting in 2013, we see that notwithstanding a small number of publications (N=4), the mean total citations per article is 177.30, whereas the mean citations per year is 16.11. MeanTCperArt steadily decreased from 177.30 in 2013 to 81.10 in 2014, suggesting that when more articles are produced, each article's citation effect decreases. Notably, the number of publications rises rapidly from 9 in 2017 to 14 in 2018, then steadily to 55 in 2023. As seen by the drop in MeanTCperArt from 142.18 in 2020 to 12.98 in 2023, more articles do not mean more citations. The steady reduction in MeanTCperArt may indicate a dilution of citation effect due to more publications or a change in research citation practices. The annual article citation rate, MeanTCperYear, shows intriguing tendencies. It peaks at 35.54 in 2020, suggesting that recent work was relevant or of wide interest as it received more citations in the early years after publication. This ratio drops to 12.98 by 2023, supporting the assumption that newer articles are gathering fewer citations each year, which may indicate changes in research interest or citation behaviour, which is assumed on how long an article is important or relevant in terms of citations declines from 11 years in 2013 to 1 year in 2023. This trend suggests that fresher publications have a more immediate but short-lived citation effect, potentially owing to fast-changing research topics or higher publishing rates that make older works outdated faster. Overall, the number of research papers has grown, but the average citation impact per article has declined, indicating a trade-off between quantity and impact.

Table 7 Relevant Affiliations

Affiliation	Articles
Universiti Sains Malaysia	7
Universidad Rey Juan Carlos	6
Graduate School of Business	6
International Islamic University Malaysia	5
Universidad Autónoma de Madrid	5

The University of Newcastle, Australia	4
University of Canberra	4
North South University	4
ESIC Business & Marketing School	4
Newcastle Business School	4

Source: *Scopus Data Base Search*

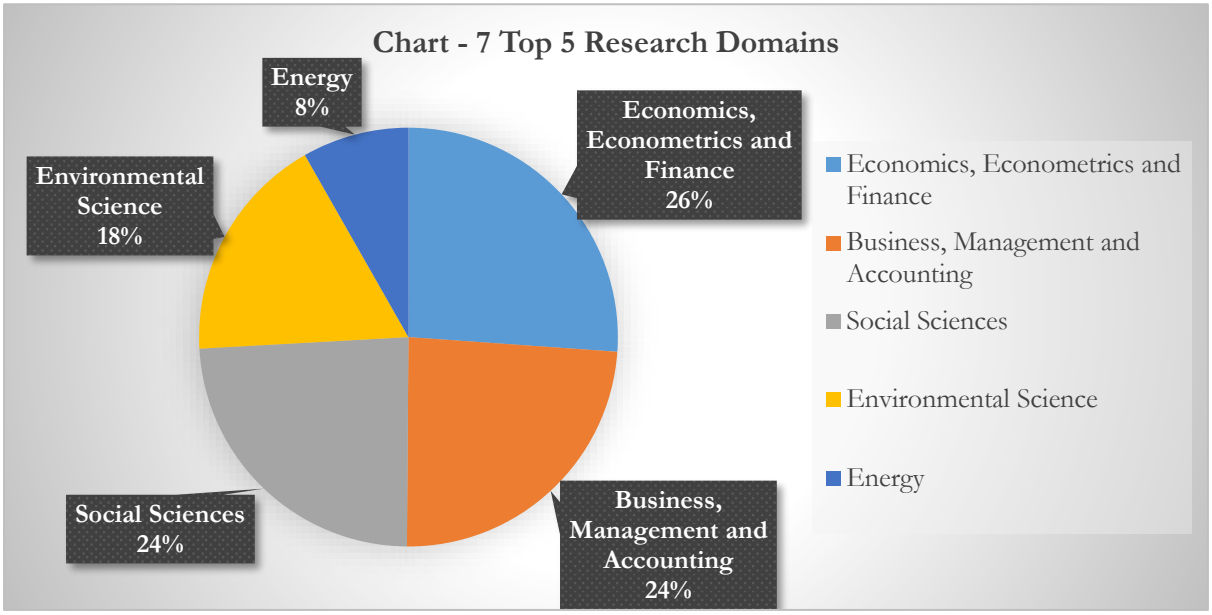


The table 4.7 shows academic institution publication distribution, showing intellectual contributions by affiliations. Universiti Sains Malaysia leads with 7 articles, showing it is active in academic research. This prominence may indicate the university's strong research efforts or a concentration on relevant topics of study. Both Universidad Rey Juan Carlos and the Graduate School of Business contain 6 articles; closely following. Both institutions are heavily intellectual, contributing to knowledge. Their comparable publication counts suggest similar research and demonstrate their contributions to academic discourse in their fields. 5 papers show that the International Islamic University Malaysia and Universidad Autónoma de Madrid are academically active. Their study spans several regions and shows global collaboration. Newcastle University, Canberra University, North South University, ESIC Business & Marketing School, and Newcastle Business School submitted 4 papers. This shows a measured but strong interest in academic writing. Universities from Australia, Bangladesh, Spain, and other countries contribute to this global intellectual network. The table shows a diverse range of university research connections and a noteworthy distribution of contributions from several continents. Regional research importance and academic collaboration are reflected in paper dissemination, with universities globally actively engaging in the global research framework.

Table 8 Top 5 Research Domains

Domains	Percentage of Contribution
Economics, Econometrics and Finance	22.3%
Business, Management and Accounting	20.5%
Social Sciences	20.5%
Environmental Science	15.10%
Energy	7%

Source: *Scopus Data Base Search*



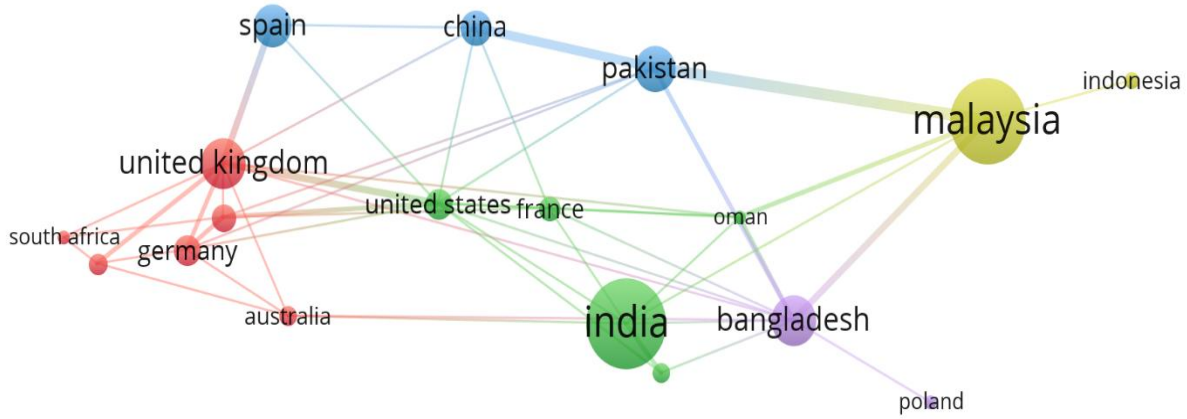
A table 4.8 displays about top five research disciplines that contribute to academic productivity. At 22.3%, Economics, Econometrics, and Finance dominate. Financial systems, economic strategies, and quantitative models are examined for global economic stability and decision-making. This domain's popularity illustrates how essential these studies are for financial concerns and national and international politics. Accounting, Management, and Business equalled Social Sciences for second with 20.5%. This balances corporate and social issues. The competitive global market requires organisations to assess strategy, leadership, and financial accountability for growth, as Business, Management, and Accounting has shown. The equal contribution of societal Sciences highlights the significance of understanding human behaviour, societal dynamics, and trends. This study affects social growth, inequality, and governance via political, cultural, and psychological factors. Environmental Science accounts 15.1%. Global objectives include sustainability, climate change, and environmental preservation. Environmental research is crucial to ecological crises, conservation, and green technologies, as shown by the high percentage. Finally, energy research accounts for 7%. Though smaller than other disciplines, its value is undeniable. In the face of global energy security, renewable energy, and sustainable energy system issues, this area is essential for supporting technologies that offer a sustainable and efficient energy future. The distribution of research contributions reflects a dynamic and integrative approach to current issues. Economic, economic, and social sciences dominate, although environmental and energy studies highlight sustainability and resource management for development.

Table 9 Top Countries and Co-Authorship

Country	Documents	Citations
India	34	704
Malaysia	32	609
Pakistan	17	608
China	13	595
Bangladesh	19	494
Australia	7	352
UK	19	336

Spain	16	296
US	11	251
France	9	236
Germany	11	215
Italy	8	164
Turkey	7	164
Vietnam	6	95
Oman	5	84
Indonesia	4	65
South Africa	4	40
Poland	3	38

Source: *Scopus Data Base Search*



Source*: VOSviewer*

The table analyses co-authorship networks between nations and their research output, showing how authors collaborate to publish research. To ensure relevance and intellectual influence, the data requires 5 research publications and 3 citations per publication. India tops the ranking with 34 documents and 704 citations, suggesting strong research production and impact. India's scholarly impact and cooperation span many fields. Malaysia follows closely with 32 papers and 609 citations, demonstrating its strong scientific community and worldwide reputation. Pakistan contributed 17 works but has 608 citations, demonstrating its scholarly significance. China, with 13 documents and 595 citations, has comparable patterns of important research production despite less contributions. Bangladesh has 494 citations versus the UK's 336 for its 19 papers. Bangladeshi research may have a greater per-document effect than UK research. Australia has just 7 documents but 352 citations, demonstrating its high-quality and relevant research. Spain, France, Germany, and Italy also contributed, giving 16 (296 citations), 9 (236), 11 (215), and 8 (164). These data show European research activity with variable citation impact. The US produces 11 papers with 251 citations, whereas Turkey, Vietnam, Oman, and Indonesia contribute less but remain in the research network. Turkey's 7 papers earn 164 citations while Vietnam's 6 receive 95, indicating modest academic activity. With 5 and 4 documents, Oman and Indonesia have modest research outputs but high citation counts. With the fewest papers (4 and 3 respectively), South Africa and Poland represent new research with low citation effects. While, South Africa's 40 citations and Poland's 38 indicate that their scholarly achievements are being recognised. The table shows a dynamic global research environment where nations make substantial contributions with different publication and citation impacts.

5 Exponential Growth Model:-

The exponential growth model helps Bibliometric predict future research trends, citations, and cooperation networks. Many fields utilise this constant-growth model to study and forecast growth. Growth models, particularly exponential models, are vital for assessing research output across disciplines and predicting scientific publication patterns, (Bansal and Tiwari 2023). Bibliometric' Exponential growth model measures research output acceleration, particularly in new disciplines. Global concerns encourage rapid research in renewable energy and environmental sciences, therefore this model must represent quick development. (Hanif et al. 2022) related the exponential rise in renewable energy research articles to global sustainability efforts. For instance, in health research, the exponential model forecasts disease spread and academic output. (Musa et al. 2020) approximated COVID-19 reproduction using the exponential growth model, demonstrating how it may reflect scientific research growth during health catastrophes. Additional (Singh 2021) emphasised exponential models in anticipating the pandemic's spread in India, matching the rapid surge in COVID-19 research. Hence, considering following methodology of linear regression model, we are predicting the research publication for the year 2024-2027:

a) **Linear Regression Model:** A linear regression model was applied to the data, which estimates the relationship between the year and the number of articles.

b) **Equation of a Straight Line:** The model fits the data into the form of a straight line using the equation: **y = mx + b**

Where:

- y is the predicted number of articles,
- m is the slope of the line (the rate of change of articles per year),
- x is the year, and
- b is the y-intercept (the starting value when x = 0).

c) **Model Parameters:** After fitting the model to the data from 2013 to 2023, the model calculated the slope and intercept:

- Slope (m): Approximately 4.8636
- Intercept (b): Approximately -9720.5

d) **Projections for 2024–2027:** Using the equation y = mx + b, predictions for future years were made by plugging in the respective year (x) values.

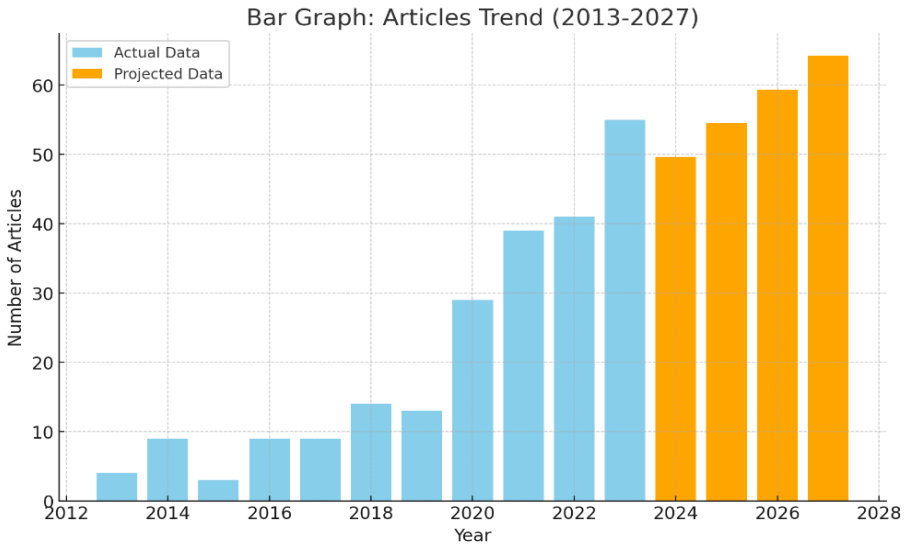
- For 2024:- y = (4.8636 × 2024) + (-9720.5) ≈ 49.64
- For 2025:- y = (4.8636 × 2025) + (-9720.5) ≈ 54.50
- For 2026:- y = (4.8636 × 2026) + (-9720.5) ≈ 59.36
- For 2027:- y = (4.8636 × 2027) + (-9720.5) ≈ 64.23

Based on the Exponential Growth model, we forecast the number of publications for the next 4 years:

Table 10 Exponential Growth Model

Year	Forecasted Articles
2024	~50
2025	~55
2026	~59
2027	~64

Source: *Biblioshiny and author's calculation*



Analysis in the Table 4.10 shows linear regression model with substantial link between year and quantity of articles published from 2013 to 2023. The linear regression model estimates this link to help explain research output changes and anticipate them. The equation used in this study is a straight line: $y = m\,x + b$ y=mx+b. The equation uses yy to forecast the number of articles, and mm to indicate the annual change in article numbers. Identify the year (x) and the y-intercept (b) as the initial value for the number of articles when x = 0.After fitting the model to the data, crucial parameters were determined, resulting in a slope of 4.8636 and an intercept of -9720.5. The slope suggests that research output is growing as the number of papers published each year rises. The intercept, although negative, is a mathematical artefact that shows the model's adjustment to real data over time, not a practical meaning for year zero, which is usually irrelevant. By putting year values into the linear regression equation, 2024–2027 projections were made. The prognosis for 2024 was 49.64 articles, while the following years showed an increase: 54.50, 59.36, and 64.23, the estimates for 2024, 2025, 2026, and respectively. This uniformity across both models reinforces the forecasts and shows the analytical approach's durability. This data shows a clear growth trend in research publications and helps academics, research policy, and funding organisations prepare for future research output.

CONCLUSION

This Scopus-indexed journal Bibliometric study of Green Banking and related themes from 2013 to 2023 shows key increasing trends and insights into this domain's research environment. After retrieving 480 papers, 350 relevant articles were found, demonstrating scholarly interest in sustainable banking methods. India led with 34 articles, followed by Malaysia and other countries, indicating regional concentration and cooperation. Bibliometric analysis analysed big datasets and discover research topics and trends, according to the study. Recent publishing output, especially in 2023, suggests a growing interest in green banking, probably motivated by environmental concerns and the necessity for sustainable financial processes. But the diminishing average citation effect per article shows a trade-off between quantity and quality in research production, since younger studies may not have the same impact as foundational ones. This investigation also used complex Bibliometric analysis also visualised author affiliations and cooperation patterns, offering a complete picture of Green Banking research and contributions of affiliations, co-author collaboration among countries which has enhanced the research productivity related to proposed domain. This technique helps comprehend the literature and predict future research paths using exponential growth models. The results add to the existing literature on Green Banking

investment and provide a foundation for future investigations of its consequences on sustainable development and environmental conservation.

Limitations:

In this Bibliometric analysis of Green Banking and related themes has few limitations. Research is limited only up to Scopus database, for wide scope of study other database would have in sighted more on the deeper understanding of the domain. However, prominent publication indexed in Web of Science may have been missed, restricting the analysis's comprehensiveness (Albort-Morant et al., 2017). Further, utilizing only five keywords to get documents may bias the search criteria, excluding relevant work that uses alternative connotation or addresses banking sustainability concerns or themes. This term constraint may bias green banking study results, interference and interpretations. Focusing only on the publication within 2013 to 2023 not completely represent the field's advancement or new trends that might substantially influence research outputs beyond this era. The rising pace of publications in recent years may indicate greater interest but would also dilute the citation effect, indicating a trade-off between quality and quantity that deserves additional examination. Lastly, VOSviewer, Microsoft Excel and Biblioshiny are good at visualising links and trends, but they may not account for contextual differences in research or the multidisciplinary character of Green Banking. Thus, quantitative data insights must be evaluated with care since Bibliometric analysis alone cannot adequately represent the intricacies and ramifications of research in this expanding subject.

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