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Governance Mechanisms and Caron Emissions Disclosure: A Bibliometric Exploration of Trends and Gaps

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Abstract: *Governance mechanisms play a pivotal role in shaping corporate transparency, especially in the context of environmental, social, and governance (ESG) disclosures. In recent years, carbon emissions disclosure has emerged as a critical area for addressing climate change. This article is trying to overcome the gap by using Bibliometric Analysis. For the study, 196 papers published in the time span of 2003-2025 were extracted from Scopus database and analysis has been done by using R-studio. This bibliometric analysis seeks to provide a comprehensive overview of the current state of research in the specified topic and to uncover prominent patterns in publications, highly productive authors, influential research, famous journals and significant countries that contribute to this topic. The result revealed that 2024 was the most productive year and China is the most influential country. Sustainability (Switzerland) the most preferred journal. The most productive institute is the "Western Sydney University, Australia". Luo L and Tang Q is the author with the most influence. This bibliometric research does not follow the Lotka's law and Bradford's law.*

Keywords*: carbon disclosure, corporate governance, greenhouse gas emission, carbon emission.*

1. INTRODUCTION:

The growing need to address climate change has elevated carbon emissions disclosure to the highest level of corporate responsibility. As stakeholders need increased transparency on environmental effects, organisations face pressure to incorporate sustainable practices into their operations (1). Governance systems, including board composition, ownership structures, and CEO incentives, have become essential determinants of effective carbon disclosure policies (2). These mechanisms affect both, the decision to reveal and the quality and extent of the information given. Carbon emissions disclosure has transitioned from a compliance task to a strategic necessity, demonstrating a corporation's dedication to reducing environmental hazards and conforming to global sustainability objectives (3). Corporate governance is important in determining firms' reactions to environmental concerns. Diverse and independent boards are frequently associated with improved environmental supervision because they offer much wider viewpoints and emphasize long -term sustainability (4). Institutional investors and other governance stakeholders apply considerable pressure on corporations to implement transparent and thorough reporting standards (5). These governance systems enhance accountability and match business strategies with stakeholder expectations and international environmental norms (6).

Even though there is much more research on carbon emissions disclosure but there are still loop holes in our knowledge of how governance structures and disclosure practices affect each other. Disparities in disclosure quality among industries, geographies, and governance frameworks indicate that the link is complex (7). Companies in carbon-intensive sectors experience variety of demands to improve transparency, influenced by regulatory frameworks and cultural settings that define disclosure practices (8). These dynamics highlight the necessity for an in-depth examination of how governance structures affect carbon disclosure trends over time.

Bibliometric analysis offers an effective method for comprehensively delineating the intellectual framework of research in this domain. Bibliometric studies can elucidate the evolution of scholarly concentration and pinpoint significant gaps in the literature by analysing key authors (9). There isn't a lot of research on governance systems for carbon emissions disclosure (10), even though bibliometric methods are used a lot in sustainability and corporate social responsibility research. This work fills this gap by performing a bibliometric analysis of governance mechanisms and carbon emissions disclosure. This analysis, covering the years 2003 to 2025, aims to uncover dominant trends, significant studies, and neglected areas in academic contributions. This approach delineates a framework for future study

and furnishes practical insights for scholars, practitioners, and policymakers dedicated to enhancing sustainable corporate governance. The subsequent sections outline the methodological framework employed in this study, present key findings and discuss their implications for theory and practice. By shedding light on the nexus of governance mechanisms and carbon emissions disclosure, this research contributes to the broader discourse on corporate sustainability and environmental accountability. In order to achieve the study's objective, we have formulated the following research questions:

RQ1: What are the most recent developments in carbon disclosure research publications with respect to corporate governance between 2003 and 2025?
RQ2: Which performance-related metrics (authors, countries, journals, institutions and frequently used authors' keywords) have been most impactful on carbon disclosure research domain with respect to corporate governance?
RQ3: Do findings support Bradford's and Lotka's bibliometric laws?
To investigate the aforementioned research issues, the current study employs a bibliometric technique based on the Scopus database, utilizing the Bibliometrix package from R Studio application. The present work also explores performance-related measures, including trends in publications, highly productive authors, influential journals, and leading nations.

2. LITREATURE REVIEW:

The relationship between governance mechanisms and carbon emissions disclosure has been increasingly studied in recent years due to the global emphasis on sustainability and transparency. This literature review synthesizes key findings from bibliometric analyses and empirical studies, examining trends and identifying gaps in the existing research. The importance of corporate governance procedures, including board composition, board independence and the existence of environmental committees has been emphasised as crucial to shaping carbon disclosure standards. Elsayih, Tang, and Lan (11) discovered a positive correlation between board independence and diversity and carbon transparency in Australian enterprises. Even after that, the existence of environmental committees did not have a much influence on the quantity of information shared. This shows that the effectiveness of governance frameworks may vary depending on the circumstances and the contextual factors.

Moreover, He et al. (12) highlighted the impact of external constraints and corporate governance on voluntary carbon disclosure in their study of Chinese firms. State-owned firms and those in heavily polluting sectors were more inclined to publish carbon-related information, especially when governance mechanisms such as larger boards and a greater number of independent directors were implemented. This suggests that internal governance frequently come into contract with external regulatory and societal influences to determine disclosure standards. Elsayih, Datt, and Tang (13) provide an alternative perspective, demonstrated that governance factors, including board meetings, gender diversity, and the establishment of environmental committees, positively influenced carbon emissions performance in Australia. These results fit with the ideas behind agency and stakeholder theories, showing that governance procedures can help companies meet both their goals and the expectations of their stakeholders. Despite these insights, several gaps remain. Most studies focus on developed economies, leaving a paucity of research in emerging markets. Additionally, while bibliometric analyses, such as those conducted by Zhang et al. (14) on carbon neutrality, provide valuable thematic and network insights, they rarely integrate findings with qualitative assessments of governance effectiveness. Furthermore, limited attention has been paid to how digital tools and AI-driven analytics might enhance carbon disclosure practices, an area ripe for exploration.

3. METHODOLOGY:

For this study, the data was extracted from Scopus Database because it is considered as one of the largest abstract and citation databases and in addition, it is indexing a vast number of high-quality journals across various databases. For extracting papers relating to our study, (carbon or greenhouse gas*) and (reporting or disclosure or emission*) and (corporate governance or boardroom) are used as keywords. These keywords search results into 279 papers which were published in the time span of 2003-2025. But this environmental disclosure gets momentum from 2013. In order to achieve the main purpose and particular goal, the search was limited to the subject areas of "Business, Management and Accounting", "Social Science", "Economics, Econometrics and Finance" and "Arts and Humanities". Additionally, the filters for document type, source type, language, and publishing stage are applied, resulting in a reduced set of 196 research papers [Figure 1].

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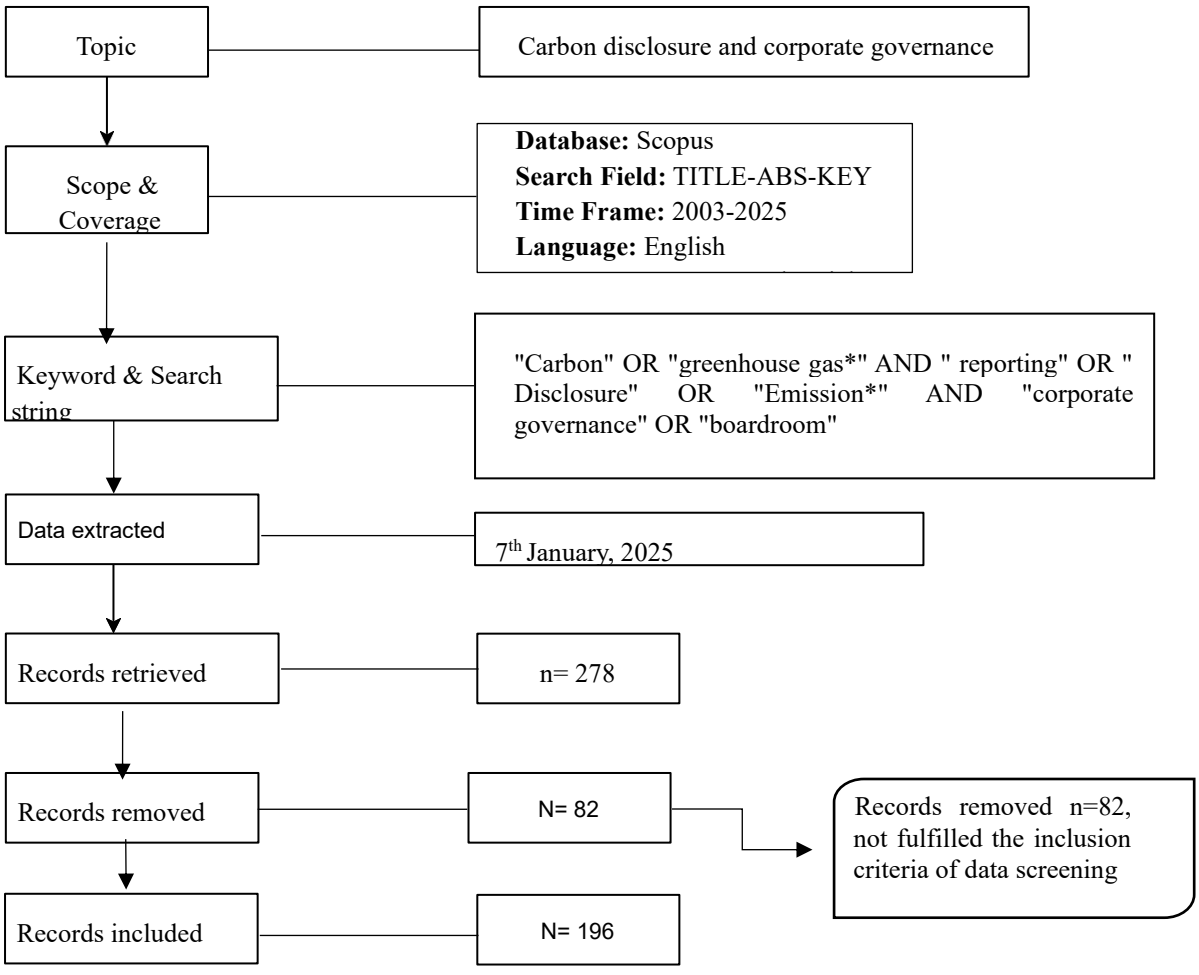
Search String: "carbon" OR "greenhouse gas*" AND " reporting" OR " Disclosure" OR "Emission*" AND "corporate governance" OR "boardroom"

After carefully reading the abstracts, purposes, results and conclusions of 278 articles, it was found that the context of some papers did not match the requirements listed above. These pieces were excluded because they did not meet either of the two requirements listed above or they only met one of them. At this point, 82 articles were removed because they did not meet any of the conditions for inclusion. Finally, a group of 196 pieces was chosen for further steps. Figure 1 is a picture that describes the study protocol. After extracting data, the analysis was performed by using R-Studio to find out the answers of various research questions like which is the most productive year, which country has contributed most in the area of research, most preferred journals, most productive authors and institutions, most cited articles and most actively used keywords for this kind of researches. After analyzing data from R-Studio, various tables were extracted. Some tables which were downloaded from the R-studio are customized according to our requirement of analysis and for better visualization, MS-Excel was used for drawing graphs.

Figure:1 The diagrammatic presentation of the data extraction is shown below:



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4. DATA ANALYSIS:

4.1 Descriptive analysis

By giving an overview of the literary work that was studied in this paper, this part makes it easier to find and understand the main features and connections in the dataset. It is shown in Table 1 articles from 101 different sources have been published between 2003 and January 7, 2025, as shown in Table 1. In the English language, 493 people wrote these articles. Out of these articles, 22 were written by a single author, while 174 were written by multiple authors. It looks like a lot of writers in this field are working together. The average number of co-author documents (2.9 per document) and the number of citations per document (39.52) both are significantly higher, which suggests that study on carbon emission disclosure evaluation is becoming more important.

Table 1: Statistical analysis of data characteristics

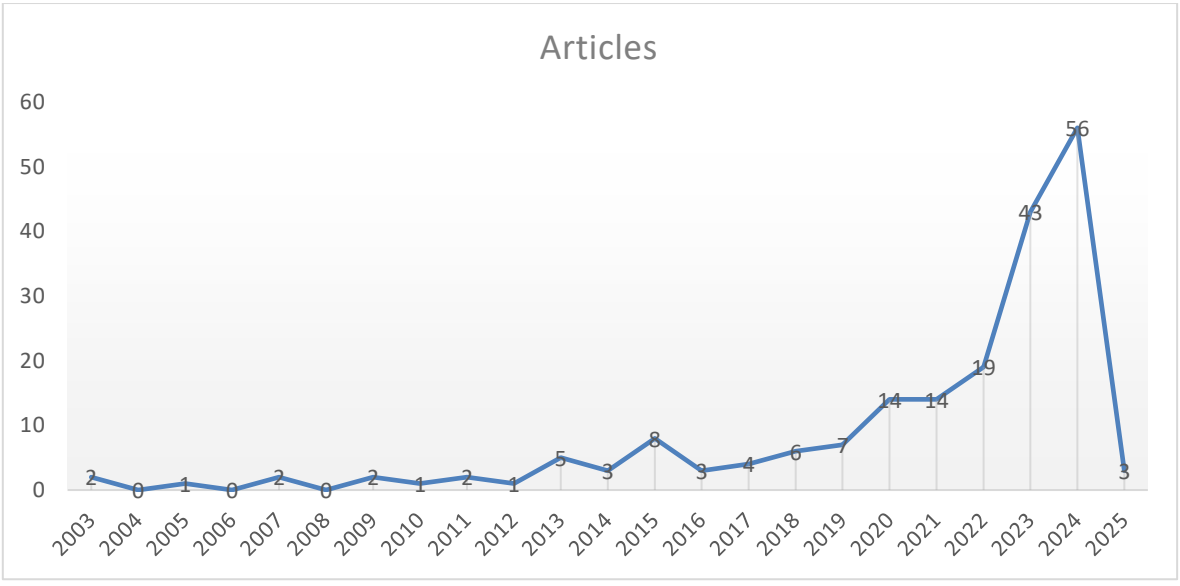
Description	Results
Timespan	2003:2025
Sources (Journals, Books, etc.)	101
Documents	196
Annual Growth Rate %	1.86%
Average citations per doc	39.52
References	13311
Author's Keywords (DE)	578
Authors	493

Source: Authors' own computation using biblioshiny software

4.2 Annual Scientific Publications

Figure2. shows the trend of number of articles published each year in area of herbal cosmetics. The data is retrieved from bibliometric analysis and chart is drawn by using excel. This trend analysis shows amplification in researches related to carbon disclosure with respect to corporate governance. Starting with 2003, only 2 articles were published and not much growth was shown till 2013. However, the number of published articles in the year 2013 counts 5 which shows an upward trend, regardless of carrying this growth forward, as per the trend the number of published articles fell down in 2014 i.e. N=3. But this area of research again gained momentum in last four years that is from 2021-2024 and the data depicts that at least 5 articles were adding each year. 2024 proved the most productive year by having 56 published articles which depicts that this research field has prospect for further researches.

Figure 2: Annual Scientific production



Source: Authors own analysis using R-based Bibliometrix

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4.3 Most impactful countries (publication based)

This section presents the rank of countries with the reference to the number of papers that have been published in the relevant topic (Table 2). There were 135 papers published in China, making it the most productive country on the list. Australia and Indonesia came in second and third, respectively, with 66 and 46 publications.

Table 2: Country-wise total publications

Rank	Name of Country	Manuscript Published
1	China	135
2	Australia	66
3	Indonesia	46
4	UK	33
5	USA	31
6	Malaysia	30
7	Canada	19
8	Italy	15
9	Turkey	15
10	Germany	13

Source: *Author's own computation*

1.4 M*ost preferred journals:*

Figure 3 shows the most preferred journals which are publishing articles regarding carbon emission disclosure and corporate governance. This graph revealed the top 10 journals.According to data extracted from Scopus database, "Sustainability (Switzerland)" is the top most journal which is publishing 21 articles. The "Business Strategy and the Environment" follows this list with a total of 16 articles. "Journal of Cleaner Production" is on third position with total of 8 publications.

Figure 3: leading journals

Source: *Authors" own analysis using R-based Bibliometrix*

4.5 *Most Productive Institutions*

Figure 4 shows the most productive institutions. The bar graph shows the 15 most productive institutions which are publishing articles related to the carbon disclosure and corporate governance. The most productive institute is the "Western Sydney University, Australia" which had published 11 research papers "Universiti Malaysia Terengganu" is on second number on the list of most productive institutions with 10 articles published during the time frame of 2003-2025 and "Shanghai University" is on number three with 9 publications. 1 Indian institute gain positions in these top 15 institutes which is "University of the Punjab" holds 11th position.

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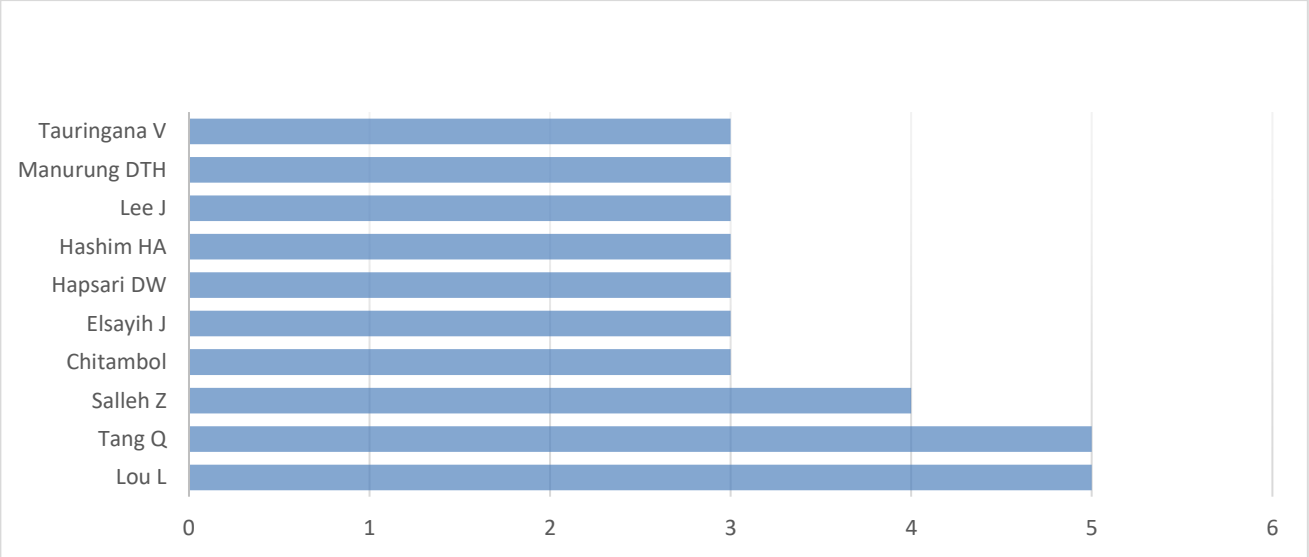
Figure 4: Most productive institutions

Source: Authors‟ own analysis using R-based Bibliometrix

4.6 Authorship

The author's productivity is demonstrated by the number of research articles they have published and the total number of citations they have received.

Figure 5: Author's Production per year



Source: *Authors" own analysis using R-based Bibliometrix*

4.7 *Keywords Analysis*

Figure 6 depicts the various keywords which are used in the articles related carbon disclosure and corporate governance. This word cloud shows different keywords together with their frequency of occurrence and the percentage of occurrence. According to this tree map, "governance approach" is the most frequently used keyword and contributing 7.69 % in total with a frequency of 32. Whereas, "Carbon Emission" contribute 7.45% in total keywords used. Climate Change, Corporate Strategy and China are the next frequently occurred words which are contributing 5% followed by words like emission control, environmental economics, sustainability. Least used words are environmental impact, environmental protection and institutional framework.

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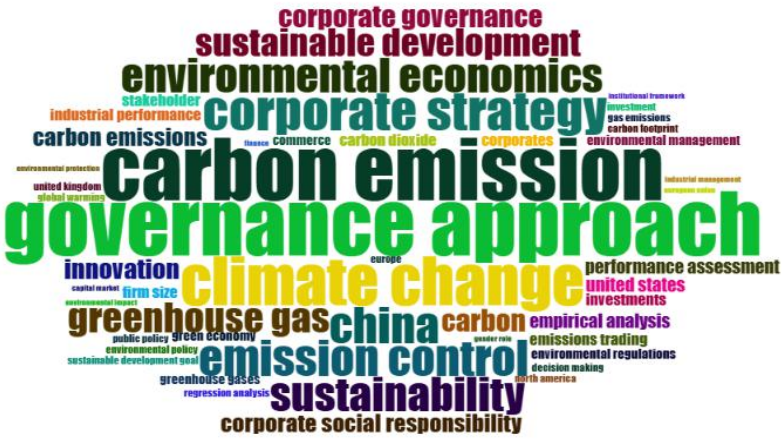
Figure 6: Word cloud

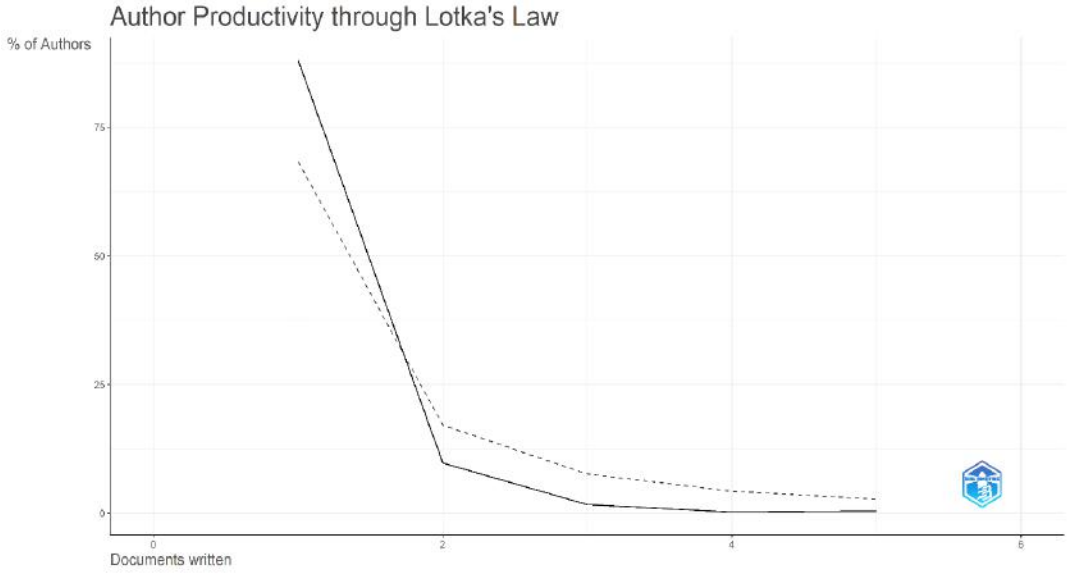


Source: *Authors" own analysis using R-based Bibliometrix*

4.8 Lotka's law

Lotka'slaw (15) is a bibliometric law that describes the frequency distribution of scientific productivity among researchers. The data indicates that the number of authors contributing n times is approximately $1/n^2$ of those contributing once. Furthermore, it suggests that around 60 percent of all contributors make only a single contribution. This indicates that within a specific academic discipline, 60 percent of authors will possess a single publication, while 15 percent will have two publications, and 6.6 percent will have three publications, among others. Figure7 displays Lotka's distribution of author productivity. The results of the distribution reveal that 88% of authors have produced a single document, 9.7% have contributed two works, and 1.6% have published three articles, among other distributions. A substantial proportion of authors possess only a single publication, which notably exceeds the threshold of 60% as stipulated by Lotka's law. Similar to this observation, authors typically have two or three published articles, falling short of the expectations set by Lotka's law. The results align with those of (16), suggesting that this dataset loosely follows Lotka's law.

Figure 7: Authors' productivity distribution using Lotka's law



Source: *Authors' own computation using biblioshiny software*

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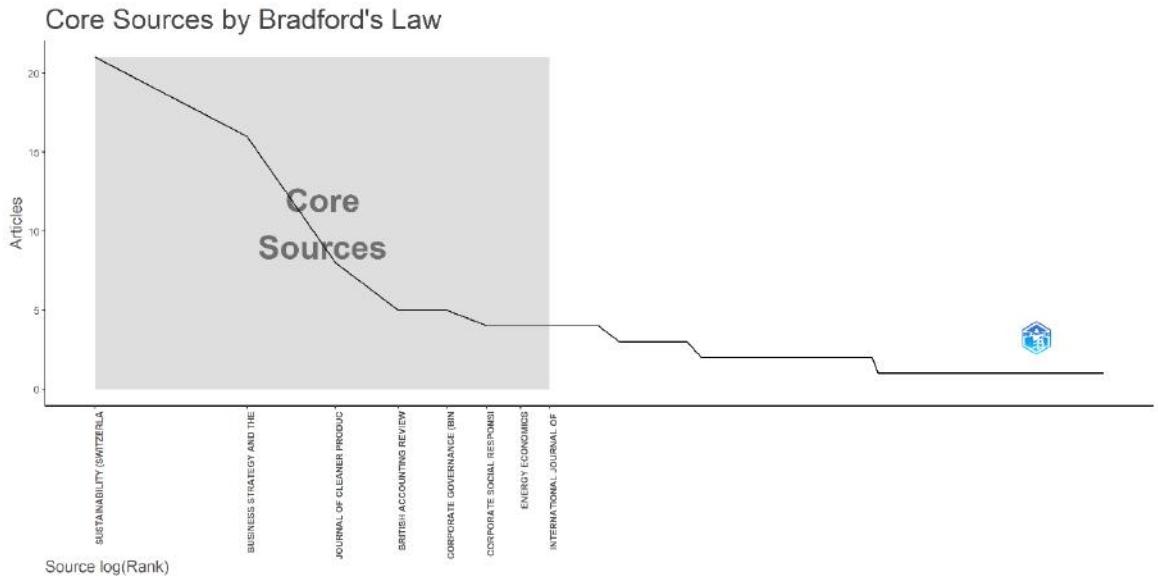
4.9 Bradford's law

Bradford's Law of bibliometrics describes how articles on a specific topic are distributed across journals, indicating that a few core journals will publish the majority of articles, while many other journals publish fewer on that topic. This law delineates a classification system for journals into three distinct zones: the core zone, zone 1, and zone 2. Each zone contains one-third of the total number of documents [17]. Furthermore, switching from the core zone to zone 2 reveals an increase in the number of sources. This suggests that within a particular domain, certain journals serve as influential drivers, which we refer to as "core zone journals." (16) states that "Bradford's law indicates about the niche sources of any particular domain." Figure 8 shows the distribution of journals according to the Bradford law. The results state that only a few journals are the core journals, which publish one-third of the total articles. It states that Sustainability (Switzerland), Business Strategy and the Environment, Journal of Cleaner Production, are core source journals for the publication on carbon emission disclosure. The study's results indicate that the first group of 8 journals produced 67 papers, the second group of 29 journals published 65 articles, and the third group of 34 journals generated 64 articles. In alignment with (16), the findings indicated that investigations into CED do not follow Bradford's law. The observed distribution of journals exhibits a minor deviation from the results predicted by Bradford's law.

Figure 8: Journal productivity distribution using Bradford's law



Source: *Authors' own computation using biblioshiny software*

5. DISCUSSION:

This bibliometric analysis reveals the current trends of publications on the carbon emission disclosure with respect to corporate governance. The result shows the rising interest of the academicians and authors, towards the disclosure of carbon emission because of which number of publications on the subject is increasing annually and among many nations. The results of this review depict that despite the pragmatic growth of this industry there is a smaller number of researches conducted carbon emission disclosure with respect to corporate governance. The result shows that only 196 articles have been published from 2003 to 2025 and the most productive year was 2024 in which 56 articles were published and China is most influential country which had published 135 articles till 2025 and contributing 68.87% in total. Australia besides being the second most productive country with 66 manuscript publishes and gets highest citations with a count of 1966 total citation. "Sustainability (Switzerland)" is the top most journal which is publishing 21 articles. The "Business Strategy and the Environment" follows this list with a total of 16 articles. "Journal of Cleaner Production" is on third position with total of 8 publications. The most productive institute is the "Western Sydney University, Australia" which had published 11 research papers "Universiti Malaysia Terengganu" is on second number on the list of most productive institutions with 10 articles published during the time frame of 2003-2025 and "Shanghai University" is on number three with 9 publications. Luo L and Tang Q is the author with the most influence. They have achieved the highest count in the number of articles produced with published a total of 5 articles. The data of this bibliometric research does not follow the Lotka's law and Bradford's law

This study shows that carbon disclosure is growing very rapidly but this area of research is less explored by the researchers in India. Further studies can be done on impact of firm's performance. The limitation of the present study is that it only considered the articles published specifically on carbon disclosure with relation to corporate governance. Further studies can also be done on considering all researches on carbon disclosure.

Implication of the Study

This study adds to the corpus of knowledge on carbon emission disclosure and corporate governance. By analyzing the pattern of the published articles and highlights the key findings on theme Carbon disclosure and corporate governance. This study will be beneficial for researchers as the study reveals various insights which will help researchers to find out research gap and conduct study to fulfil this gap. The results of most relevant Journals will help researchers to target the most cited Journal for publication of their articles as well as the findings of top institutions and top authors will help the researchers to make collaborations with the Institutes and the authors who are doing wonderful work in this domain.

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