



A Bibliometric Analysis of Green Accounting Research

Received : 4-4-2022
Revised : 18-4-2022
Accepted : 25-4-2022

Dr. Nidhi¹ ✉ Dr. Anjni Anand² ✉

Plagiarism: 13%

¹Associate Professor, Gargi College,
University of Delhi, Delhi, India.

²Associate Professor, Gargi College,
University of Delhi, Delhi, India.

Keywords: Green accounting,
Sustainability, Environmental Impact
Classification-JEL : M14, M41, M48, Q01
How to Cite: Nidhi; Anand, Anjni (2022).
A Bibliometric Analysis of Green
Accounting Research. *Journal of
Commerce and Trade* (H. Agarwal, Ed.)
17 (1), 76-84. doi:10.26703/JCT.v17i1-13

ABSTRACT

The issue of environmental protection has gained momentum in recent times. Climate change has left no one untouched, and economies across the globe are debating on ways of environmental protection. Sustainable growth has become the buzzword- including using energy-efficient sources of production and paying attention to the environment and human capital. In light of this, green or environmental accounting is significant, as this can make companies more conscious about the impact of their working on the environment, and also has the potential of motivating them to contribute towards environmental protection. The present paper attempts to find out how much research has happened in the green accounting field. Using Biblioshiny, articles published in SCOPUS from 1976 onwards were studied. The trend of publications, in terms of countries where maximum research has happened, journals publishing the maximum number of papers on green accounting, author details, impact factor, and citations were assessed. The authors concluded that a lot more work needs to be done in this area, as research in developing nations is quite low. The critical importance of green accounting needs to be reflected in the quality and quantity of research.

1. INTRODUCTION

Human beings in the race to provide themselves with a greater variety and technologically advanced range of goods and services have mostly forgotten that their development or progress cannot happen at the cost of degradation of the environment and ecological balance. We are a part of the natural environment in which we thrive and flourish. However, mindless exploitation of the environment for personal growth is a sure-shot way to devastation. This has been repeatedly proved in the form of floods, landslides, and droughts resulting from environmental exploitation. It has sent out a clear message that progress at the cost of the environment is decadence.

Therefore, sustainable growth is the buzzword today, and sustainability has to manifest in how we use all our resources- human, environmental or man-made. Progress or development should happen so that we leave

behind sufficient resources for future generations. Companies engaged in providing goods and services to the population should be held accountable for the impact of their activities on the environment. The traditional accounting system- both at the company level and national level- does not contain enough provisions for measuring and provisioning for the environmental costs of the company's operations. For this reason, Green Accounting was introduced as an essential concept around the turn of the last century.

Green accounting has been defined as the identification, tracking, analysis, and reporting of the materials and cost information associated with the environmental aspects of an organization (UN, 2000). According to The United States Environment Protection Agency, it is pertinent to bring environmental costs to the notice of those running businesses and to all other stakeholders too, so that they are aware of the impact of their operations on the

environment, can think and deliberate upon ways and means of containing this adverse impact on the environment and feel motivated to think of ways to contribute towards the betterment of the environment. This mainly concerns the environment and eco-friendly practices of manufacturing, sustainable energy generation, green supply chain management, regulations, and safety norms (Moorthy and Yacob, 2012).

Over the last decade, there has been an increased interest among researchers to analyze and understand the green accounting practices of companies, as also the green accounting norms applicable to businesses. The Companies Act 2013 also mandates a 2 per cent contribution by companies towards CSR activities out of their profits- a part of which can very well be directed towards environmental protection and putting eco-friendly production and supply practices in place. To understand the issues generated in green accounting, the current work does a bibliometric analysis of the research in this area. The study is divided into ten broad sections, including the present one, which describes the background of green accounting. Section 2 explores the studies available on the given theme. The subsequent Section 3 highlights the research methodology. The following section focuses on focuses on the summary of the data extracted. It encompasses the essential data information, annual scientific output, average annual citations, and the three-fields plot. Section 5 examines the sources section, emphasizing the most relevant sources, Bradford's Law, and the impact of the sources. The authors' analysis is explored in Section 6, followed by the word analysis in Section 7. Sections 8 and 9 examine country-wise analysis and thematic map analysis. The last section, 10, highlights the limitations and conclusions of the study.

2. REVIEW OF LITERATURE

According to Rounaghi (2019), green accounting is a science, and the knowledge of it helps us move towards sustainable development. This is how socio-economic and technological advancements can be matched

with environmental protection. Knowledge of green accounting creates an awareness among people that economic goals and the environment are not separate issues but interlinked, as one cannot occur without having a bearing on the other. The study insists that just like other management systems that companies have to ensure a smooth flow of work, it is vital to have an environmental management system in place, which will help in a systematic assessment of environmental performance. In addition to the traditional national accounting system, green accounting provides information about the use of natural resources in the production process and changes in environmental quality due to pollution and other consequences of economic activities. Ultimately, all the concepts of green accounting, if implemented by companies, will not only result in a more conscious approach towards the environment but will also ensure sustainable growth of the company and maximization of shareholders' wealth.

According to Hernadi (2012), corporate sustainability is a function of economic performance, environmental performance and social efficiency. The company's financial performance, measured by its profitability and wealth creation, is a function of environmental performance and social efficiency. No company can achieve economic growth without paying enough attention to its environmental policies and practices aimed at socio-effectiveness. For this reason, environmental accounting or green accounting, which considers the environmental and social costs of a company's operations, has gained importance. A company is incorporated as a going concern, meaning it is expected to carry out business for perpetuity. Therefore, the sustainability aspect of a company's operations and existence cannot be overlooked. If we continue with the traditional accounting systems, where the focus is solely on profitability, the aim of sustainability takes a back seat. Only when we integrate economic, environmental and social performances can we talk about sustainability and sustainable growth. Farouk et al. (2012) conducted a literature review on the research around the area of green

/environmental accounting. He found very little empirical research in green accounting, and most of the existing research was qualitative by nature. The study found a lack of conceptual framework and a lack of an empirical model to test the environmental accounting-related performance of companies. There is a lot of talk on sustainability and what organizations should do to improve their environmental performance. Still, there is no concrete measure by which organizations can take actual budgeting decisions. There is a strong need to develop indices to measure organizational sustainability-related factors.

A similar conclusion was drawn by Raju (2018) from a review of existing literature on green accounting. There was a severe lack of quantitative research on green accounting that could measure the impact of green accounting or quantify the results of adopting green accounting practices. He then conducted a study to quantify the various environmental issues in green accounting. Environmental performance was taken as a function of environmental policy, safety of health and environment, conservation of energy, sustainability reporting, environmental targets, environmental costs and benefits, environmental reporting indications, assets and liabilities of an environment, corporate sustainability, and environmental information system. Corporate sustainability emerged as the most significant predictor of environmental performance. The respondents (who belonged to different organizations) preferred cost-benefit analysis to measure environmental accounting. The respondents believed that measuring costs and benefits in monetary terms is a difficult concept. The various initiatives taken by participating organizations to promote green operations were - resorting to the digital mode of sharing information rather than the physical way, setting up solar power plants, and making investments in various green initiative projects of the government.

To understand the relationship between green accounting and sustainable development, Dhar et al. (2021) analyzed a sample of heavy-polluting industries in Bangladesh (between

2010 and 2019). Social responsibility disclosures (regarding CSR initiatives) were taken as the moderating variable, and the study also had a set of control variables. The results of the study, obtained through correlation and regression analysis, showed a significant influence of green accounting practices on sustainable development. A significant positive correlation was found between the quality of social responsibility information disclosure and the sustainable development capabilities of heavily polluting industries. The quality of social responsibility information disclosure significantly enhances the implementation of green accounting and positively impacts the sustainable development of polluting industries. In the Colombian context, too, a study was conducted to understand the green accounting practices adopted by organizations (Gonzales and Pena-Vinces, 2022). Responses were collected from 150 companies. Information was sought on knowledge about green accounting, the application of green accounting, and communication about factors associated with green accounting. The participating companies did know green accounting, yet 54 per cent of the companies had no established strategies to implement green accounting. Only 12 per cent of companies included environmental accounting factors in their financial reports. The organizations reported a strong need for standardized green accounting models to implement the same in the current accounting system. The companies had some environmental policies in place at their level, but the same did not find their way into the company's accounting system.

A secondary data-based study was conducted in the Indian context on a sample of manufacturing companies listed on the Nifty 50 index (Gola et al., 2022). Manufacturing industries were chosen with a specific aim as they can be considered to have a greater impact on the environment due to their operations. The purpose of the study was to understand the disclosures on sustainability made by these Indian companies. A list of keywords as prescribed under GRI were chosen, and the presence of these words in the annual reports of

the 29 short-listed companies was done (some examples of these keywords are: sustainable, carbon footprint, environment-friendly, pollutants, and energy conservation among the 25 selected keywords). Sustainable, community and renewable were three keywords found in the annual reports of all companies. The energy sector emerged with the highest word count of all keywords. The word count was meagre for some crucial concepts, such as carbon footprints and environmental effects. Although organizations talk about their environmental concerns in the annual reports, concern without action serves little purpose. Unless there are concrete norms for environmental disclosures in the accounting framework, very less can be achieved on the environmental protection front.

A review of the literature of research in the area of Green Accounting brought forth the significance of this concept in the present times, but at the same time, raised doubts about the procedures for green accounting adopted by the companies. The research results are crucial instruments for bringing about the desired improvements in any area that may impact many people's lives. Research findings can trigger a series of more concrete and constructive steps in the desired direction. So, to understand the quality and quantity of research in the area of green accounting, the concentration and dispersion of the same across various countries, the time frame where it gained momentum, the number and proportion of articles on green accounting published in multiple journals, a bibliometric analysis were undertaken by the authors. As a concept, bibliometric analysis was introduced by Pritchard (1969) to provide a scientific basis for evaluating publications, the impact factor and citations. Although bibliometric analyses are becoming increasingly popular, the idea of Green Accounting has yet to be the subject of any study.

As a result, our study aims to bridge this gap and address these issues by quantitatively unravelling this subject through bibliometric analysis. There are many advanced tools available today which can help in carrying out detailed and in-depth bibliometric analysis. One

of the earliest and basic open-source tools available is biblioshiny which does not require any coding knowledge. The current paper aims to study the following utilizing bibliometric analysis:

- a) Citing notable authorship, references, and author affiliations and countries,
- b) Learning about the main research themes and streams
- c) Using Network Visualization to gauge the degree of collaboration

3. RESEARCH METHODOLOGY

The present study relies on the Scopus database to extract data. Scopus (Elsevier) indexed research is the most extensive peer-reviewed database for procuring research data related to any area. The database for the present study was searched by typing the keywords (Green Accounting OR Environmental Accounting). The search was conducted in March, 2022, and yielded a total of 1654 documents as a result of the keywords entered. This result was further narrowed by specifying "articles" as the document type, "business, management, and accounting" as the subject, and "English" as the language. The outcome was 533 articles related to Green Accounting or Environmental Accounting. The search results were interpreted using the Biblioshiny software.

4. DESCRIPTIVE BIBLIOMETRIC ANALYSIS

4.1 Basic Information

The primary statistics on Green Accounting are shown in Table 1. It shows that from 1976 to 2022, 533 manuscripts were published in 136 journals by 969 writers, of whom 119 were single authors.

4.2 Annual Scientific Production

Figure 1 shows the annual number of publications on green accounting in the Scopus database. According to the data, there was just one paper published in 1976, no articles were published from 1977 to 1990, and after that, a marginal increase in articles was visible till 2003. Following that, a rising trend is seen (except for 2008), with 44 articles (8 per cent) published in 2013. Once more, research on the topic slowed down, picking up later and peaking in 2020 with

56 papers (10.5 per cent). The average growth rate of publications over the past ten years has been merely 7 per cent, indicating that there hasn't been much study on this subject.

4.3 Average Citations Per Year

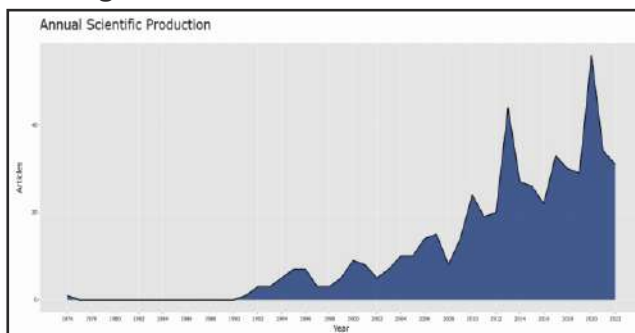
The average number of citations per year is computed by dividing the total number of citations by the number of years the Author or publication has been publishing papers. This indicator can be quite helpful in determining the annual effect of a journal or Author.

Table 1: Main Information Relating to the Data

Description	Results
Documents	533
Sources (Journals, Books etc.)	136
Keywords Plus (ID)	643
Authors' Keywords (DE)	1173
Period	1976-2022
Average Citations per documents	37.78
Authors	969
Author Appearances	1308
Authors of Single Author documents	119
Authors of Multi-Author documents	850
Single authored documents	145
Documents per Author	0.55
Authors per document	1.82
Co-authors per documents	2.45
Collaboration Index	2.19
Document Type - Article	533

Source: Elaborated by authors using biblioshiny

Figure 1: Annual Scientific Production

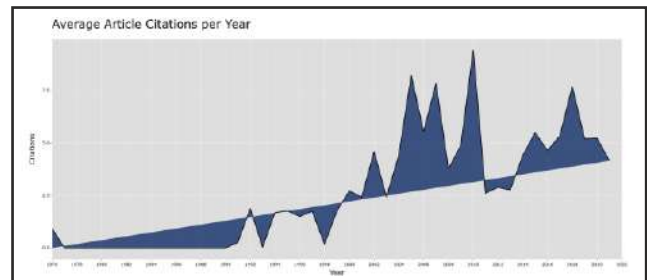


Source: Elaborated by authors using biblioshiny

Figure 2 shows the annual average number of citations for articles on green accounting. All years from 1976 through 1990 had zero average citations, except for 1976, which had a mean citation of 0.93. However, the

average number of citations rose, peaking at 9.41 in 2010. Following that, it continued to range between 2.5 and 7.

Figure 2: Average Citations Per Year

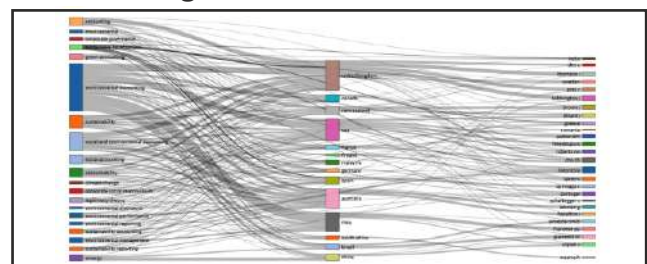


Source: Elaborated by authors using biblioshiny

4.4 Three Fields Plot

The three-field plot shows the key items of any three selected fields (e.g. authors, keywords, countries) and their relationships with each other. The relevant elements are represented with varied colours in rectangle shapes. The rectangle's height shows the association between many elements (including countries, sources, well-known authors, author keywords, etc.). The greater the height of the rectangle more is the relationship between the elements.

Figure 3: Three Fields Plot



Source: Elaborated by authors using biblioshiny

Figure 3 displays a three-field plot diagram for research data on Green Accounting that demonstrates the relationship between the Author's name (right), countries (centre), and keywords (left). The grey line connecting the three components demonstrates how they are related to one another (Rusydiana, 2021). The width of the grey thread between the elements reflects the total number of items. The countries in the middle column are related to the keywords on the left and the authors' names on the right, showing the incoming and outgoing item numbers (Shi et al., 2020). The primary keywords used in the current research are environmental accounting (243 items), social

and environmental accounting (93 items) and sustainability (64 items), showing their connection with multiple countries.

The United Kingdom, the United States, and Australia are the leading research nations in the field, with Bebbington, Thomson, and Gray among the top UK authors.

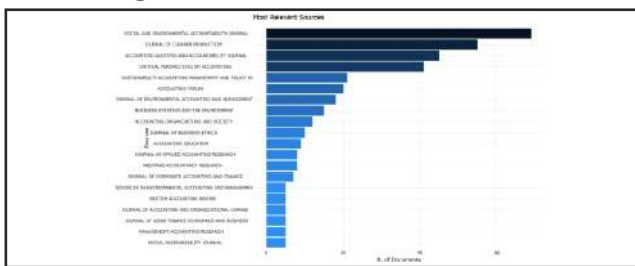
5. SOURCES

A source is a journal, book, conference proceedings, etc., that publishes one or more articles in the bibliographic collection.

5.1. Most Relevant Sources

As per the data extracted, 533 research papers on Green Accounting were published in 136 journals from 1976 to 2022. Figure 4 displays the 20 relevant sources of the period, as mentioned earlier. The chart shows that the majority of the 69 publications (13 per cent) on green accounting are published in the journal of Social and Environmental Accounting, followed by 55 articles (10 per cent) in the Journal of Cleaner Production, and 45 articles (8 per cent) in the Accounting Auditing and Accountability Journal.

Figure 4: Most Relevant Sources



Source: Elaborated by authors using biblioshiny

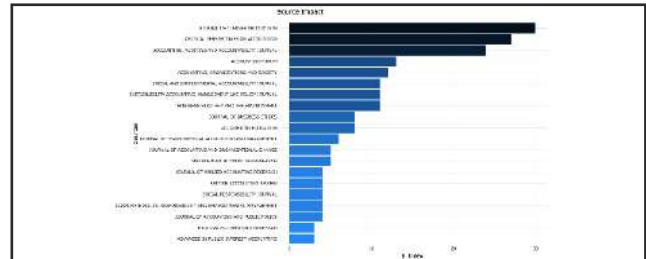
5.2. Source Impact

The journal's H-Index provides quantifiable indicators of the journal's impact factor. The Hirsch index (H-index) is an author's (or journal's) number of published articles (h), each of which has been cited in other papers at least h time. The study also calculated the journal's h-index, represented in the bar chart (Figure 5), to examine the influence of each journal that published articles on green accounting. The influence of each journal is shown in this picture along with a numerical h-index value, with darker blues denoting journals with a more significant impact.

The Journal of Cleaner Production,

Critical Perspectives of Accounting, and Accounting, Auditing and Accountability Journal are the three publications with the most considerable influence, with an H-Index of 30, 27 and 24, respectively.

Figure 5: Source Impact of Top Twenty Sources

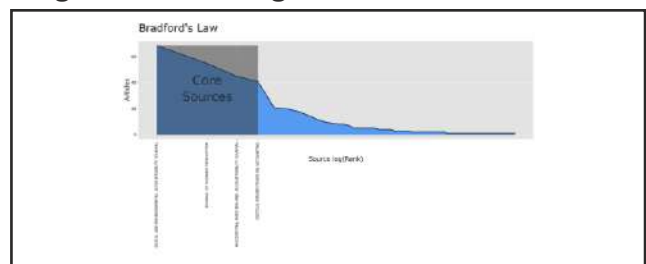


Source: Elaborated by authors using biblioshiny

5.3. Bradfords Law

Bradford's Law states that if the journals are arranged in descending order of the number of articles they carried on the subject, then successive zones of periodicals containing the same number of articles on the subject form the simple geometric series 1 : n: n2: n3 (Bradford, 1934). Bradford called the first zone the nucleus of journals devoted to the subject (Figure 7). In this Figure, the core is composed of four journals out of 136, and these four journals published about a third of the documents of the entire collection. Bradford's Law can identify the core journal in a discipline and eventually focus the analysis on the core zone documents. (Figures 6 and 8)

Figure 6: Clustering Based On Bradford's Law



Source: Elaborated by authors using biblioshiny

Figure 7: Bradford Law

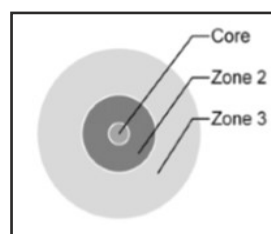
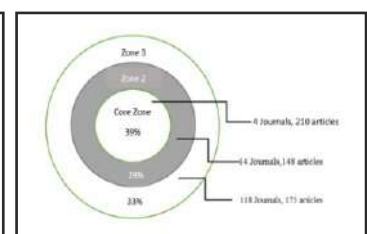


Figure 8: Clustering of Zones



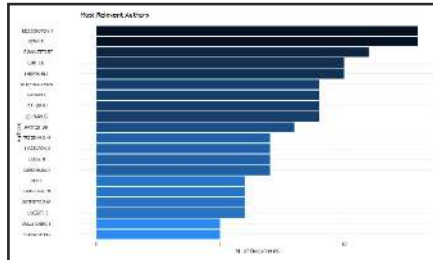
Source: Elaborated by authors using biblioshiny

6. AUTHORS

6.1 Most Relevant Authors and Author's Productivity

There are 969 authors who have contributed to the research on green accounting with a varying number of publications. The data relating to the number of publications of each Author is presented in Figure 9.

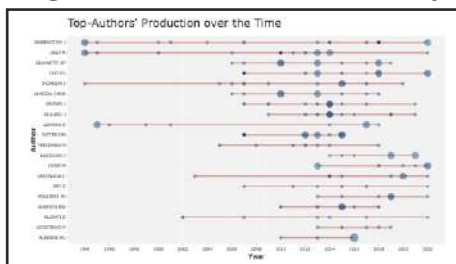
Figure 9: Most Relevant Authors



Source: Elaborated by authors using biblioshiny

According to the statistics, Bebbington and Gray published the highest number of 13 documents each. They also are the most productive writers in this area, as displayed in Figure 10. The line shows the timeline of the Author in the graphic. The timeline indicates that Bebbington and Gray have been active from 1994 until 2022. The presence of a bubble at a certain year indicates that at least one document was published that year. The bubble size varies according to the number of documents released that year. For example, Bebbington authored two articles in 1994 and two in 2022, while Alewine published three in 2016. Additionally, the colour intensity relates to the number of citations a document receives each year, as in Gray, who had 47.23 citations in 2010.

Figure 10: Author's Productivity



Source: Elaborated by authors using biblioshiny

6.2. Lotka's Law

Lotka's Law of scientific productivity provides a platform for studying inequality in authors' productivity patterns in a given field

and over a specified period (Lotka, 1926).

Table 2 shows the Author's productivity as per Lotka's Law. According to the data, 820 authors have only produced one article on green

Table 2 : Author's Productivity

Documents written	Number of Authors	Proportion of Authors
1	820	0.846
2	83	0.086
3	31	0.032
4	9	0.009
5	8	0.008
6	4	0.004
7	4	0.004
8	1	0.001
9	4	0.004
10	2	0.002
11	1	0.001
13	2	0.002

Source: Elaborated by authors using biblioshiny
accounting. In comparison, eight authors out of 969 produced five documents each on green accounting.

7. WORDS ANALYSIS

7.1 Words Cloud

The word cloud, made from keyword plus, displays the words in varying sizes based on how frequently they have appeared in all publications. Although the word placement is fairly haphazard, the dominant words are positioned in the centre so that they are visible, given their colossal size. The words that appeared most frequently in the publications on Green Accounting are seen in Figure 11. The

Figure 11: Word Cloud

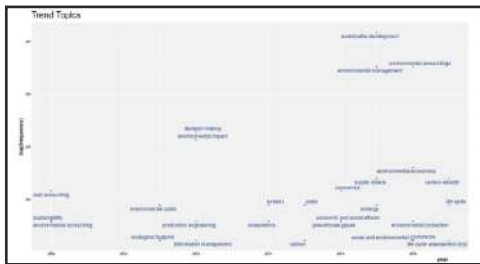


Source: Elaborated by authors using biblioshiny
most often occurring word was decision making, followed by environmental impact then environmental economics and so on.

7.2 Trend Topics

Topic trends are a part of this research as well, and Figure 12 shows how various themes have developed year by year so that one knows which topics have recently surfaced and which have been popular for a while. The topic's emergence is also adjusted to the frequency with which the word appears in studies on the current theme. The term is used more frequently when it is higher in the graph and more recently when it is further to the right. According to the graph above, topics in 2008 included cost accounting, environmental accounting, and sustainability. Additionally, environmental effects and decision-making were prominent study subjects in 2012. Sustainable development topped the list of popular themes

Figure 12 : Trend Topics



Source: Elaborated by authors using biblioshiny in green accounting in 2017, followed by environmental management and environmental accounting in 2017 and 2018, respectively.

8. COUNTRY WISE ANALYSIS

The study further analyzed the references in terms of the contribution of different countries. Extant literature on green accounting comprises articles from fifty-eight countries. Figure 13 shows the primary contributing countries and regions in the knowledge domain. The colour intensity is proportional to the number of publications and

Figure 13: Country Scientific Production

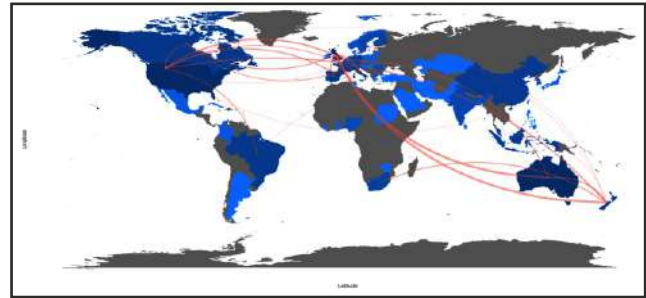


Source: Elaborated by authors using biblioshiny

signifies the number of articles per country. The number of documents per country is depicted in Figure 13, with the UK having the highest number of 174.

Figure 14 depicts the country collaboration network, with wider lines denoting a significant collaborative connection between the two nations. The United Kingdom and

Figure 14: Country Collaboration Map



Source: Elaborated by authors using biblioshiny

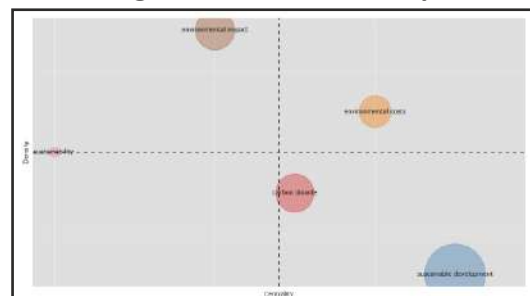
Australia, the United Kingdom and New Zealand, and Italy and the United Kingdom collaborate the most for research on green accounting out of a total of 99 collaboration partnerships.

9. THEMATIC MAP

This study also conducted a thematic map analysis based on density and centrality, which were separated into four topic quadrants. These results were obtained from a semi-automatic algorithm by reviewing the titles of all references to the research object and adding relevant keywords other than the Author's keywords so that the results can capture deeper variations.

The top right quadrant is a driving theme characterized by high density and centrality; hence, it needs to be developed and further researched. "Environmental costs" relate to this region (Figure 15). Furthermore, the upper left quadrant shows a specific and rare theme but

Figure 15: Thematic map



Source: Elaborated by authors using biblioshiny

has high development, indicated by high density but low centrality. The theme of environmental impact falls in this region. The lower right quadrant is a basic theme characterized by high centrality but low density. These themes are important to be included in the research as they are general topics that are commonly used. Carbon dioxide and sustainable development are topics that fall under this category.

10. LIMITATIONS AND SUGGESTIONS

However, a few limitations of the current study must be addressed. First, only a few bibliometric techniques were used to examine the content of publications that had been published. Alternative data analysis techniques may have been used. Similarly, data searches need to be widened by using multiple search engines and different search terms to find more articles. Another issue with the study is using titles and abstracts rather than full texts to choose publications. However, while it's vital to acknowledge some research limitations, it's also crucial to remember that these studies' shortcomings are common to the genre of bibliometric analysis as a whole.

To summarize the study, the results obtained from the bibliometric analysis show

that research in the area of green accounting has been sluggish for a long time and only picked pace after 2003, showing a random pattern and peaking in 2020 only. The UK, USA and Australia lead in research on green accounting, with Bebbington, Thomson, and Gray among the top UK authors. Only four journals, namely, Social and Environmental Accounting Journal, Journal of Cleaner Production, Accounting, Auditing and Accountability Journal and Critical Perspectives of Accounting, have the highest concentration of articles on green accounting. The latter three journals have the highest H-index in terms of citations. Overall, there has been a dearth of research in the area of green accounting, which, given the importance of climate change and environmental awareness, is not in line with environmental protection's political and economic agenda. Environment costs emerged as a theme that requires more investigation, given its high density and centrality. Developing nations of the world, which also act as manufacturing hubs for most products, must ensure more standardized environmental accounting norms, making it easier to quantify the companies' environmental costs and protection policies. ●

REFERENCES

1. Bradford, S.C. (1934), *Sources of Information on Specific Subjects, Engineering: An Illustrated Weekly Journal (London)*, 137, (January 26), pp. 85–86.
2. Dhar, B. K., Sarkar, S. M. and Ayithey, F. K. (2020), *Impact of Social Responsibility Disclosures Between The Implementation of Green Accounting And Sustainable Development: A Study of Heavy Polluting Industries In Bangladesh, Corporate Social Responsibility and Environment Management*, 29, 71-78.
3. Farouk, S., Cherian, J. and Jacob, J. (2012), *Green Accounting and Management for Sustainable Manufacturing in Developing Countries, International Journal of Business and Management*, 7 (20), 36-43.
4. Gola, K. R. Dharwal, M. and Gupta, G. (2022), *Green Accounting And Its Application: A Study on Reporting Practices of Environmental Accounting In India, World Review of Entrepreneurship Management and Sustainable Development*, 18(1), 23-39.
5. Gonzales, C. C. and Pena-Vinces, J. (2022). *A Framework For A Green Accounting System-Exploratory Study In A Developing Country Context, Colombia. Environment, Development and Sustainability*.
6. Hernadi, B. H. (2012), *Green Accounting for Corporate Sustainability. Club of Economics in Miskolc*, 8 (2), 23-30.
7. Lotka, A. J. (1926), *The frequency distribution of scientific productivity". Journal of the Washington Academy of Sciences*, 16 (12), 317–324.
8. Moorthy, K. and Yacob, P. (2013), *Green Accounting: Cost Measures. Open Journal of Accounting*, 2, 4-7.
9. Raju, K. K. (2018), *Green Accounting Practices. Indian Journal of Accounting*, 50 (1), 59-68.
10. Rounaghi, M. M. (2019), *Economic Analysis Of Using Green Accounting And Environmental Accounting To Identify Environmental Costs And Sustainability Indicators, International Journal of Ethics and Systems*, 35 (4), 504-512.
11. Pritchard, A. (1969), *Statistical Bibliography or Bibliometrics, Journal of Documentation*, 25, 348-349.