

## A Study on Environmental Accounting: A Bibliometric Review

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### Abstract

Environmental accounting has its roots in the early 1970s, a time of rising environmental concern caused by the effects of industrial activity. There are many points to highlight the importance of environmental accounting in the recent sustainable development era. This paper aims to find out the research gaps in this field and would like to highlight the need for furthermore study in environmental accounting. For the current study of bibliometric analysis, 1266 articles, research papers, conference papers were selected by using appropriate in Scopus database from 1969 to 2023. Out of these, researchers scaled down the study to 95 articles, research papers based on the most relevant for environmental accounting.

In our analysis of environmental accounting, we highlight the multifaceted and interdisciplinary nature of this field of study. As per the thematic mapping, very little study was conducted in environmental accounting and no research can be seen in emerging themes, which highlights the importance of further detailed study with respect to environmental accounting. Even though sustainable development, environmental economics are more relevant concepts to environmental accounting, the study shows less dependency and interrelation amongst these. It is observed from the study that even though environmental accounting was a preferred topic for researchers since 1969, the concept is less studied from accounting point of view. Hence researchers find a gap for furthermore study in environmental accounting.

**Keywords:** Environmental Accounting, Sustainable Development, Bibliometric Review

### I. Introduction:

Environmental accounting has its roots in the early 1970s, a time of rising environmental concern caused by the effects of industrial activity. The release of Rachel Carson's book "Silent Spring" in 1962 (Carson, R. (2009). Silent spring. 1962) and the Santa Barbara oil spill in 1969 contributed to a greater understanding of the value of environmental conservation. Governments all over the world started introducing environmental legislation and standards in response to this growing concern, and as a result, corporations started realizing the importance of accounting for their environmental impact (Lintott, 1996).

The term "environmental accounting" was first used in the middle of the 1980s, after the first academic studies on the subject were published in the late 1970s and early 1980s.

Since then, the sector has continued to expand as new accounting standards and reporting guidelines have been developed to support environmental reporting and the relationship between environmental performance and financial performance has received increased attention (Yakhou and Dorweiler2004).

A type of accounting known as environmental accounting includes the environmental impact of a company's or organization's operations in its financial reporting (Yakhou and Dorweiler2004). It entails keeping track of, calculating, and accounting for the costs and advantages of environmental activities in a company's financial records.

Environmental accounting can help organizations to:

- Understand and manage their environmental impact
- Identify cost savings and revenue opportunities through environmentally responsible practices
- Meet regulatory requirements and reduce the risk of non-compliance
- Improve transparency and accountability with stakeholders, including investors, customers, and employees.

Tracking energy and resource use, calculating greenhouse gas emissions, determining the effects of pollution and waste, and weighing the advantages of environmental management initiatives like waste reduction and renewable energy projects are all part of environmental accounting procedures.

Bibliometric analysis is a scientific computer-assisted review process that can find key authors or pieces of research as well as their relationships. All the publications relevant to environmental accounting were used to assess the study in this field. Secondly, it was found that inductive methods to the semantic bounds of the conceptual structure of recently developed domains are appropriate applications for bibliometric. In our environmental accounting examination, we highlight the multifaceted and interdisciplinary nature of this field of study. The use of bibliometric may expand our knowledge and help scholars better understand the theoretical underpinnings of environmental accounting, just as it would in any other field of science. This paper aims to find out the research gaps in this field and would like to highlight the need for furthermore study in environmental accounting. For the study of bibliometric analysis, 1266 articles, research papers, conference papers were selected by using keywords environmental accounting or environment accounting between 1969 to 2023. Out of these researchers scaled down the study to 95 articles, research papers based on the most relevant for environmental accounting.

What is the trend of Environmental Accounting research in recent years?

Recent years have seen a steady increase in environmental accounting research, which reflects the growing significance of sustainability and environmental performance for businesses and society at large. The following are some of the major developments in environmental accounting studies in recent years:

**Integrating with other accounting disciplines:** Financial accounting, management accounting, and auditing are just a few of the accounting disciplines that are rapidly integrating with environmental accounting (Marrone et al, 2020). This demonstrates the understanding that environmental accounting must be interwoven with other facets of corporate performance and cannot be viewed in isolation.

**Corporate sustainability:** Corporate sustainability is becoming more important as businesses strive to strike a balance between their environmental, social, and economic goals. New sustainability accounting frameworks and rules, such as the Global Reporting Initiative (GRI) and the Sustainability Accounting Standards Board, have been created because of this (SASB) (Marrone et al, 2020).

**Big data and technology:** Big data and technology are increasingly being used in environmental accounting studies to monitor and assess environmental performance (Marrone et al, 2020). The use of sensors and other monitoring tools is part of this, as is the analysis of huge databases to spot patterns and trends.

**Emphasis on the circular economy:** The circular economy, which highlights the necessity of reducing waste and promoting resource efficiency, is receiving more attention (Petros et al., 2022). As a result, new methods of environmental accounting have emerged, including material flow accounting (MFA) and life cycle assessment (LCA), which monitor how resources and materials move through the economy (Lintott, 1996).

Overall, as businesses try to minimize their environmental impact and show their dedication to sustainability, environmental accounting research is becoming more and more significant.

## II. Importance of Environmental Accounting:

The identification, measurement, and reporting of environmental costs and benefits connected to an organization's operations are the focus of the accounting discipline known as environmental accounting. You can sum up the significance of environmental accounting as follows:

- **Improved decision-making:** Environmental accounting provides data that aids businesses in making more informed choices (Yakhou and Dorweiler 2004). Organizations can make wise judgements about investments in environmental preservation, resource conservation, and waste reduction by measuring the costs and benefits of environmental operations (Petros et al., 2022).
- **Regulation adherence:** Businesses are required to track and report on their environmental impact under numerous national environmental regulations (Lintott, 1996). Environmental accounting provides the information and data needed to prove compliance, which aids firms in complying with these rules.
- **Improved environmental performance:** Organizations can find chances to lessen their environmental effect and enhance their environmental performance by analyzing the environmental costs and benefits connected to their activities (Yakhou and Dorweiler 2004).
- **Enhanced financial performance:** Resource efficiency and waste minimization are two areas where environmental accounting can assist businesses in finding cost-saving options. By the creation of environmentally friendly goods and services, it can also assist businesses in identifying new revenue sources (Yakhou and Dorweiler 2004).

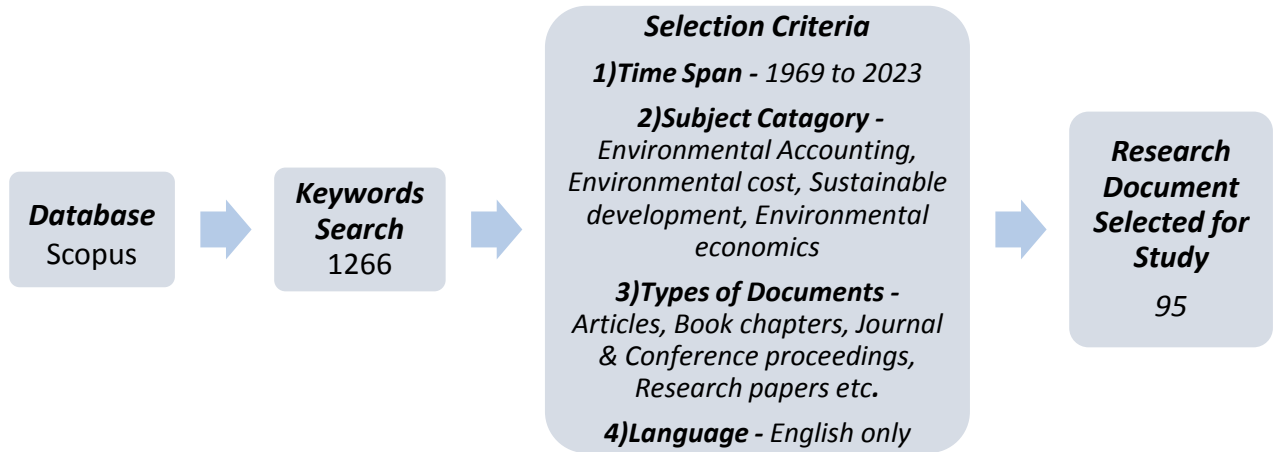
- **Improved reputation:** Environmental accounting can help businesses establish a reputation for being environmentally conscious by highlighting their dedication to sustainability and environmental preservation (Petros et al., 2022).

In general, environmental accounting is crucial for businesses to ensure that they are complying with legal obligations, making wise decisions, enhancing their environmental performance, and assisting in the long-term sustainability of our world.

As the topic under consideration is relatively new and growing in importance, Indian researchers' contribution seems less in this field. For the past few years, one of the world's main economies with the quickest growth rates has been India. India's real gross domestic product (GDP) growth averaged over 7% per year in the ten years before to the COVID-19 epidemic, which is regarded as a rapid rate of economic expansion (Subramanian, A. (2019). India's GDP mis-estimation: Likelihood, magnitudes, mechanisms, and implications. *CID Working Paper Series*). Hence India would be most preferred country for many industries. But environment accounting awareness in India yet to gather pace. Moreover, there are few studies done on environmental accounting considering the importance of the topic. Marrone et al, (2020) studied environmental accounting research within and outside of accounting subject domain. Rounaghi (2019) focused on how environmental accounting can be used to protect the environmental degradation. Eugénio et al, (2010) conducted a review on environmental accounting during 2000 to 2006. With this background, the current study aims to understand various trends in environmental accounting literature and to explore environmental accounting research with the other areas of research to understand the future scope of research.

### III. Methodology:

The information required for this investigation was located after selecting the right database. The data set was constructed using inclusion and exclusion criteria following a proper search and the use of an appropriate combination of keywords. After which, R software tools were used to examine the data. The first step comprises descriptively assessing the data by author, source, country, and document while the next stage was to create a network map that described how the data was conceptualized. The information required for this investigation was located after selecting the right database. There are a few databases accessible for bibliometric study. Some of them are Scopus, Scimago, EBSCO, Google Scholar, ResearchGate. Out of all, Scopus is the biggest data set for conceptual and references as it contains a wide range of studies directed all over the world in Science, Technology, Medical, Social Sciences and Arts and Humanities. Hence Scopus Database has been utilized for this review.



**Research questions:**

- RQ1. What are the recent trends in environmental accounting publication from 1969 to 2021?
- RQ2. Which journals are preferred by the researchers for publication on environmental accounting?
- RQ3. Which are the countries, organizations and authors that have been most productive in environmental accounting?
- RQ4. What are some of the most commonly used keywords in environmental accounting?

**IV. Result and Discussion:**

*Figure 1: Data base selection*

Description	Results
<b>MAIN INFORMATION ABOUT DATA</b>	
Timespan	1969:2023
Sources (Journals, Books, etc.)	553
Documents	1266
Annual Growth Rate %	3.37
Document Average Age	10.8
Average citations per doc	30.64
References	1
<b>DOCUMENT CONTENTS</b>	
Keywords Plus (ID)	4545
Author's Keywords (DE)	2772
<b>AUTHORS</b>	
Authors	2793
Authors of single-authored docs	251
<b>AUTHORS COLLABORATION</b>	
Single-authored docs	305

Co-Authors per Doc	2.85
International co-authorships %	18.96
<b>DOCUMENT TYPES</b>	
article	1112
conference paper	154

*Figure 2: Number of Publications*

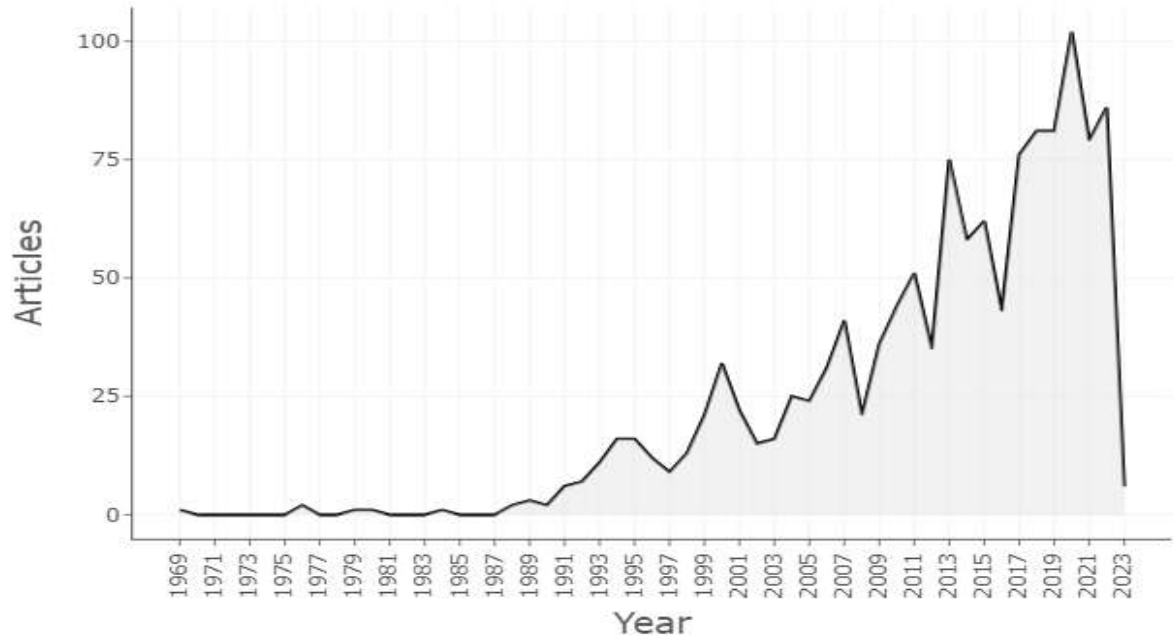


Figure 1 indicates that there is an upward trend in research for Environmental Accounting during the time span of last 54 years from 1969 to 2023. Importance was felt in the third industrial revolution (1969) and its pace increased in the fourth industrial revolution (20<sup>th</sup> century). From there onwards more research was done in this area, especially in 2019, more than 100 articles were published. This was mainly because of sustainable development; environmental awareness became the buss word in industry.

*Figure 3: Average Citation Per Year*

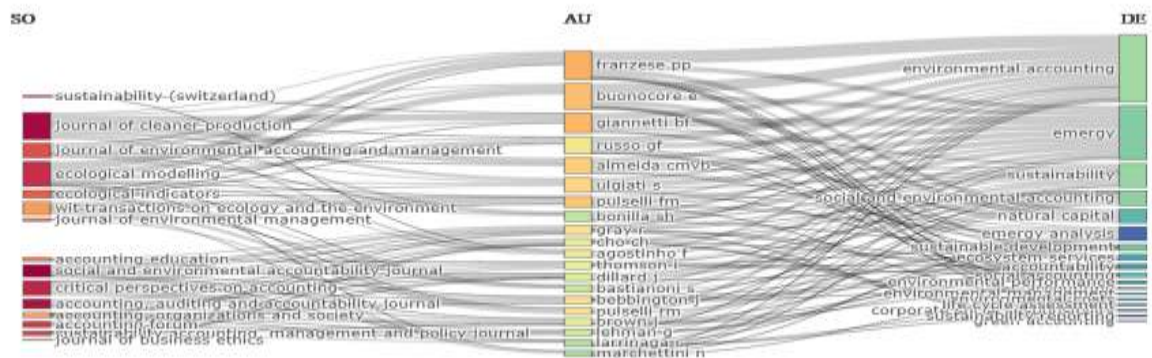
Year	N	MeanTCperArt	MeanTCperYear	CitableYears
1969	1	22.00	0.41	54
1970	0	0.00	0.00	0
1971	0	0.00	0.00	0
1972	0	0.00	0.00	0
1973	0	0.00	0.00	0
1974	0	0.00	0.00	0
1975	0	0.00	0.00	0

1976	2	21.50	0.46	47
1977	0	0.00	0.00	0
1978	0	0.00	0.00	0
1979	1	1.00	0.02	44
1980	1	13.00	0.30	43
1981	0	0.00	0.00	0
1982	0	0.00	0.00	0
1983	0	0.00	0.00	0
1984	1	0.00	0.00	39
1985	0	0.00	0.00	0
1986	0	0.00	0.00	0
1987	0	0.00	0.00	0
1988	2	80.00	2.29	35
1989	3	29.00	0.85	34
1990	2	5.50	0.17	33
1991	6	25.17	0.79	32
1992	7	15.00	0.48	31
1993	11	6.45	0.22	30
1994	16	27.63	0.95	29
1995	16	24.31	0.87	28
1996	12	28.75	1.06	27
1997	9	25.00	0.96	26
1998	13	30.77	1.23	25
1999	21	35.24	1.47	24
2000	32	28.97	1.26	23
2001	22	36.18	1.64	22
2002	15	86.53	4.12	21
2003	16	49.13	2.46	20
2004	25	62.80	3.31	19
2005	24	83.04	4.61	18
2006	31	57.13	3.36	17
2007	41	115.07	7.19	16
2008	21	55.57	3.70	15
2009	36	48.72	3.48	14
2010	44	72.16	5.55	13
2011	51	24.61	2.05	12
2012	35	34.89	3.17	11
2013	75	32.91	3.29	10
2014	58	31.41	3.49	9
2015	62	23.73	2.97	8
2016	43	25.72	3.67	7

2017	76	25.05	4.18	6
2018	81	23.42	4.68	5
2019	81	12.20	3.05	4
2020	102	9.93	3.31	3
2021	79	4.54	2.27	2
2022	86	1.45	1.45	1
2023	6	0.00		0

The year 2000 had 32 articles published in environmental accounting with 28.97 citations per article, and the average number of citations per year was 1.26. From the year 2011 onwards even though the number of articles had increased, the citations per articles are decreasing year by year which indicates that more research was done based on primary data than secondary data. In the year 2020 the highest number of articles 102 were published but still average number of citations per year decreased to 9.93. This underlines that more research is required on the said topic to check the authenticity of the results.

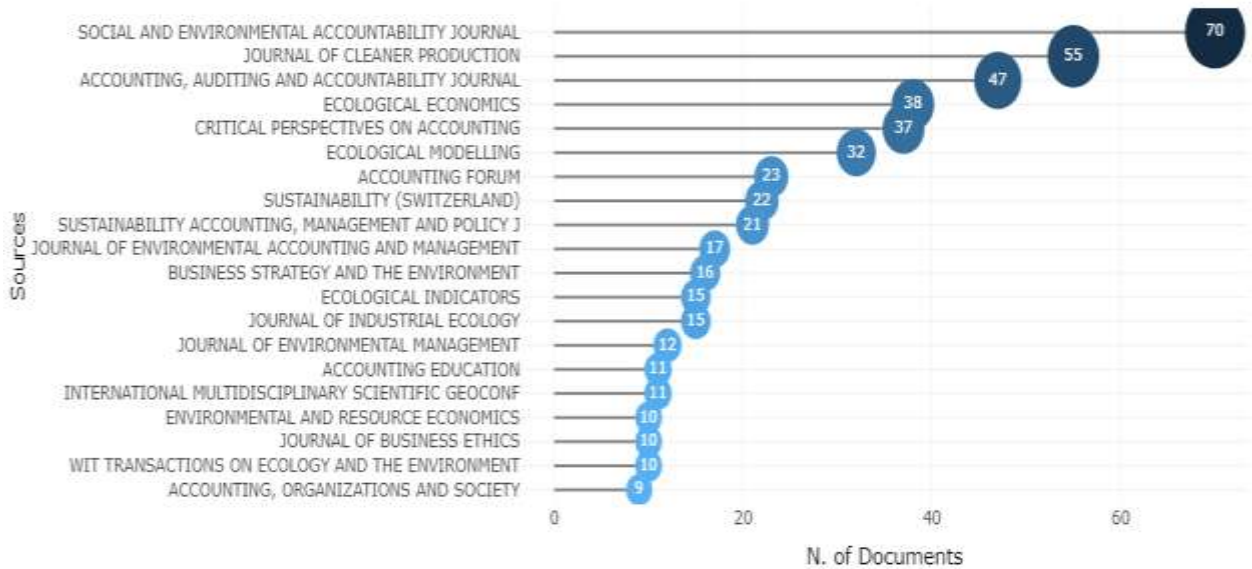
*Figure 4: Three-Field Plot*



In this figure, SO represents source of journal while Au represents author and DE indicates keywords. Journal publications such as Journal of cleaner production, Journal of environmental accounting and management and Ecological modelling have more publications in the field of environmental accounting. Franzese PP, Buonocore E and Glannetti BF authors have contributed more in terms of publications related to environmental accounting. Environmental accounting, energy and sustainability are the keywords showing more frequency. But Green accounting, environmental cost, these terms are not in this category, which indicates a research gap, and hence more research is required in this area.



Figure 5: Most Relevant Sources



Social and environmental Accountability Journal has published a maximum of 70 articles while Accounting, Organizations and Society had the least publications, 9. Other publications were Journal of cleaner production 55, Accounting, Auditing and Accountability journal 47, Accounting forum 23 and accounting education 11. As this concept is very much close to sustainability, articles were published in Sustainability (Switzerland) 22, Sustainability Accounting, Management and Policy 21.

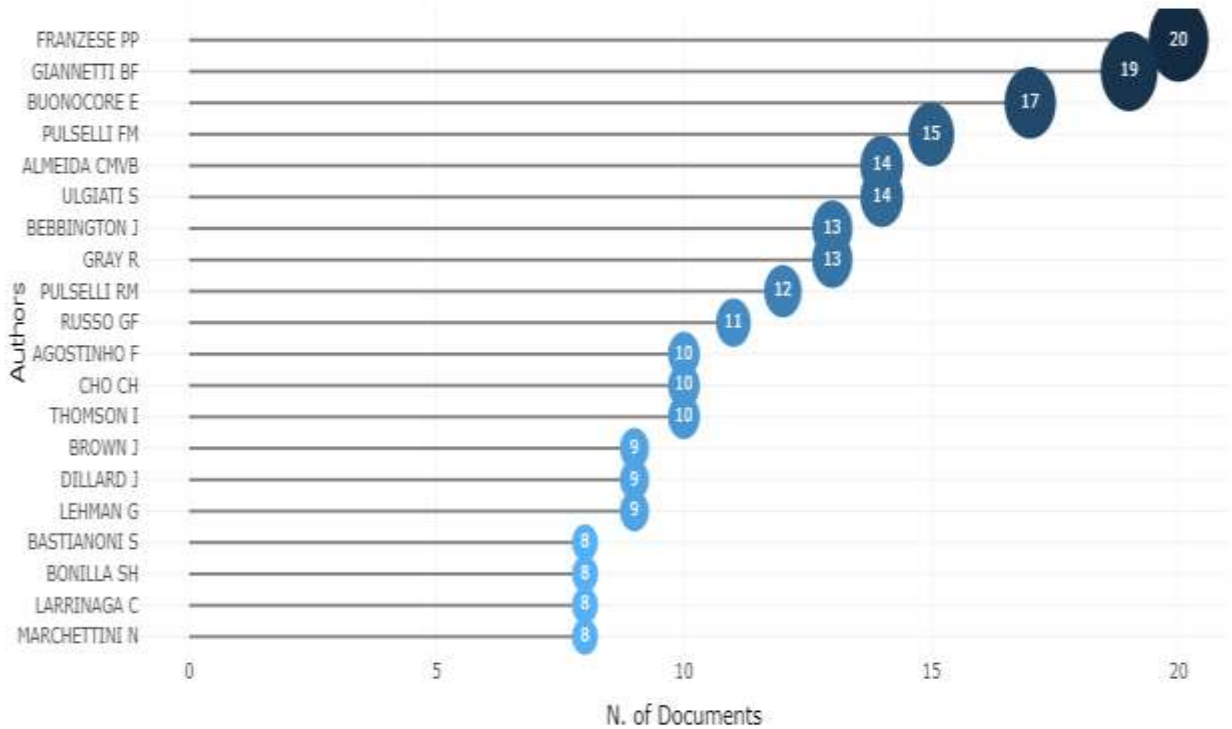
Figure 6: Source Local Impact



The h-index of a publication is the largest number h such that at least h articles in that publication were cited at least h times each. The study analyzes the h-index of environmental accounting to measure citation impact of sources of publications. Journal of cleaner production was the most productive with 30 h-index followed by Critical perspectives on accounting with 27-h index each, as shown in Figure 6. The publications by Journal of Industrial ecology, Social & environmental accounting journal, Business

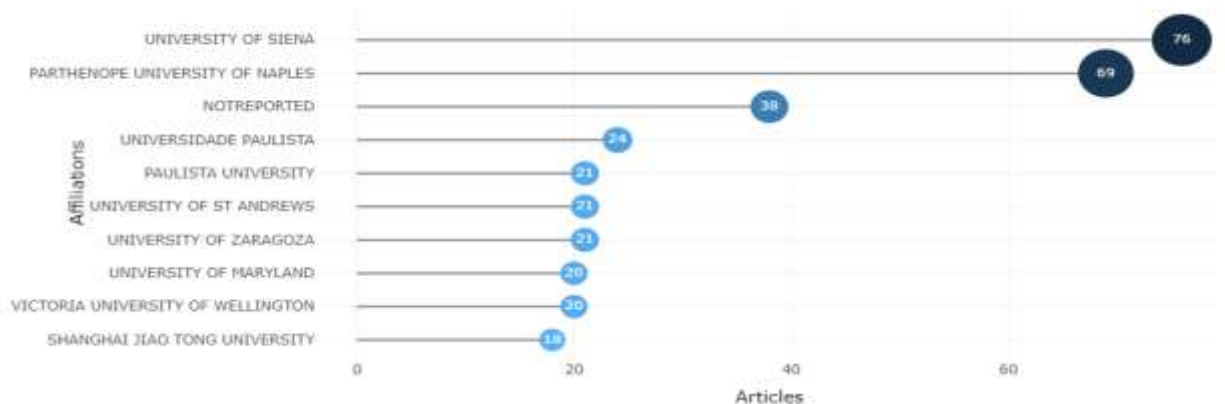
strategy and the environment, Ecological indicators and Sustainability Accounting, Management and Policy journal are most consistent with each document cited at least 11 to 12 times. The rest of the publications with 5 to 9-h index indicate that 5-9 documents were cited at least 5-9 times in environmental accounting.

*Figure 7: Most Relevant Authors*



The next section of the study identifies the most prominent authors in this field as shown in Table 7. Based on the number of articles published and their h-index. Franzese PP and Giannetti BF tops the list with 19 and 20 articles respectively. The other authors such as Buonocore E, Pulselli FM, Almedia CMVB also have notable contributions. Even the lowest on the list, such as Marchettini N, Larrinaga C, have 8 publications which underline the importance of the concept.

*Figure 8: Most Relevant Affiliations*



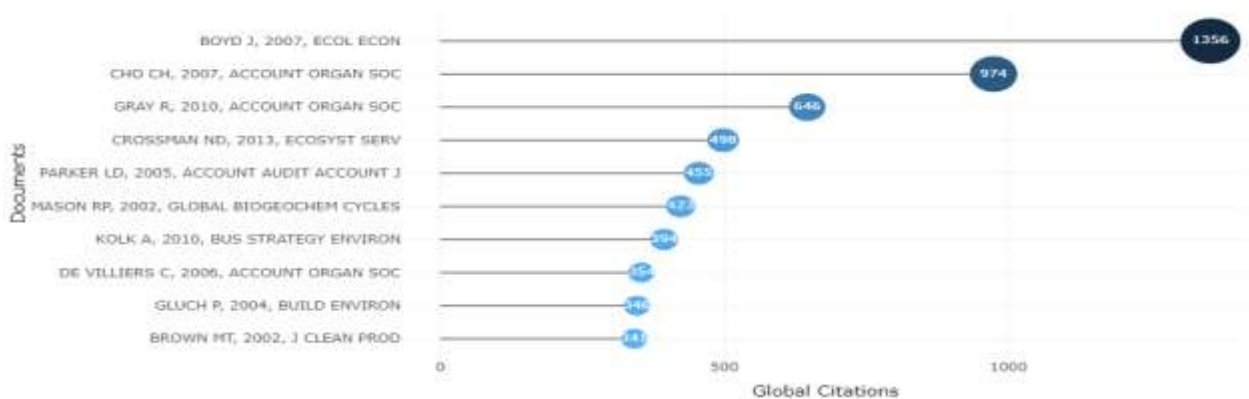
Universities have always been the backbone to promote and support research. In terms of affiliations, University of Siena was found to be the most productive in terms of the total number of articles published as 76 followed by the Parthenope University of Naples 69 and Notreported with the total number of articles published as 38. One of the most notable authors, Franzese PP, belongs to the University of Naples. It is important to note that most of the research work is done in European countries in the field of environmental accounting.

*Figure 9: Country Scientific Production*

<i>region</i>	<i>Freq</i>
USA	455
ITALY	430
CHINA	391
UK	332
AUSTRALIA	266
SPAIN	144
BRAZIL	138
CANADA	98
GERMANY	88
FRANCE	64
INDIA	64
INDONESIA	60
JAPAN	60
NETHERLANDS	57
NEW ZEALAND	55
ROMANIA	45
FINLAND	44
GREECE	43
NORWAY	41

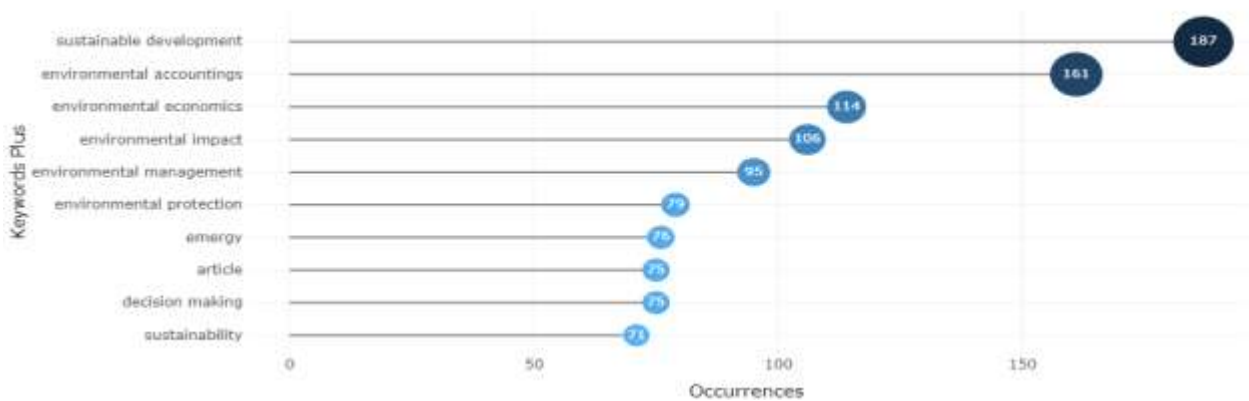
The results of Biblioshiny indicate that the USA was the most cited country with 455 citations in the environmental accounting research, as shown in Figure 9. This figure represents the country's scientific contribution. Based on the environmental accounting research countries having the most extensive collaboration networks are USA (455), Italy (430), China (391) and UK (332) which are at the forefront of extremely high output in terms of the number of publications in the relevant area. India is 11<sup>th</sup> in the rank with notable contribution (64). Countries on the lower side also have remarkable contributions such as Finland (44), Greece (43) and Norway (41)

**Figure 10: Most Global Cited Documents**



The top 10 articles are highlighted in Table 10. The author’s name, as well as the title of their paper and the year it was published, are all included on the table. The most globally cited document is Nonmarket benefits of nature: What should be counted in green GDP? by Boud J (J., 2007). Followed by the role of environmental disclosures as tools of legitimacy: A research notes by Cho C.H. (H., 2007). This pattern indicates that the topic is receiving more attention, as indicated by the increasing number of citations per article each year.

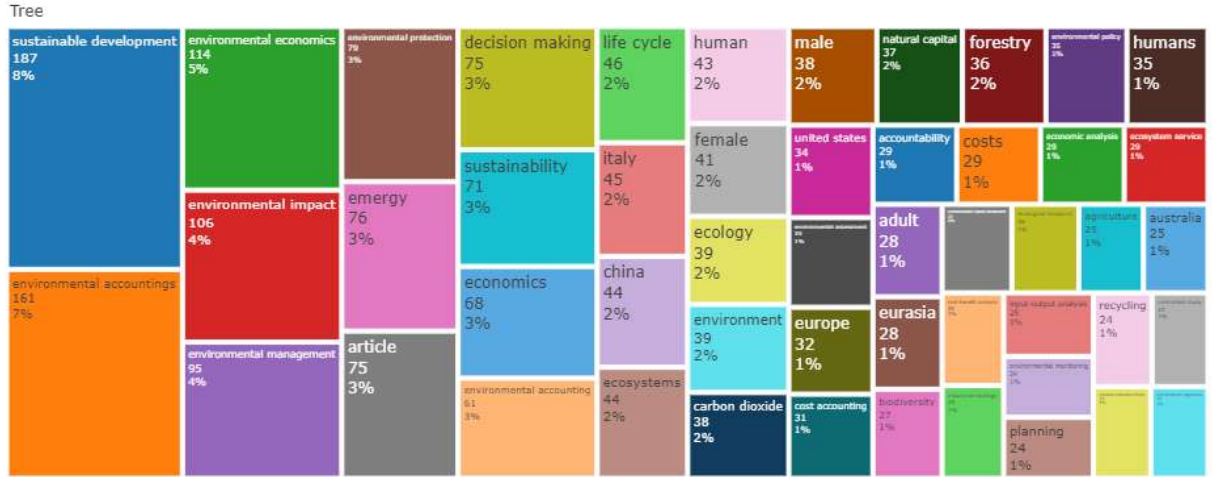
**Figure 11: Most Frequent Words**



The results of the analysis indicate that sustainable development was the frequently used keyword with 187 occurrences, followed by environmental accounting and environmental economics with 161 and 114 occurrences, respectively, as shown in Figure 11. The study used frequency as the word occurrence measure to identify the frequently used keywords in environmental accounting. The keywords, including environmental impact, environmental management and environmental protection have been used 106, 95 and 79 times. The other keywords of importance include energy, articles, decision making and sustainability with more than 70 occurrences in the period. The period between 1969 to 2023 is a crucial phase in the current research area as many trending topics evolved with high frequency such as sustainable development,

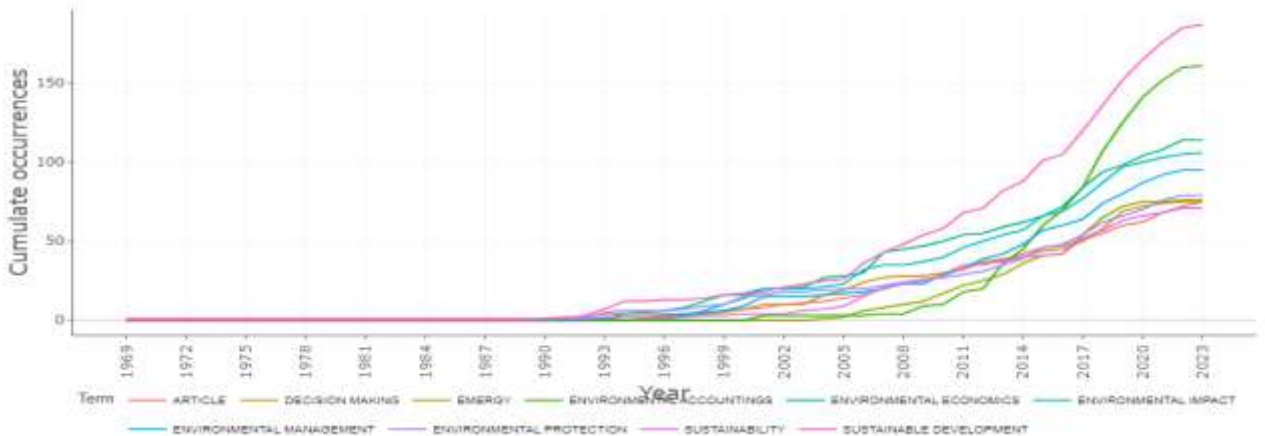
environmental accounting, environmental protection etc. These keywords may help the authors and academicians to understand how the literature on environmental accounting has relied significantly on these concepts throughout the many years.

Figure 12: Tree Map



The results of the tree map suggest that sustainable development consists of 8% (187) of total key words while environmental accounting constitutes 7% (161) of the total keywords, followed by environmental economics 5% (114), environmental impact 4% (106), environmental management 4% (95), environmental protection 3% (79) as shown in Figure 12.

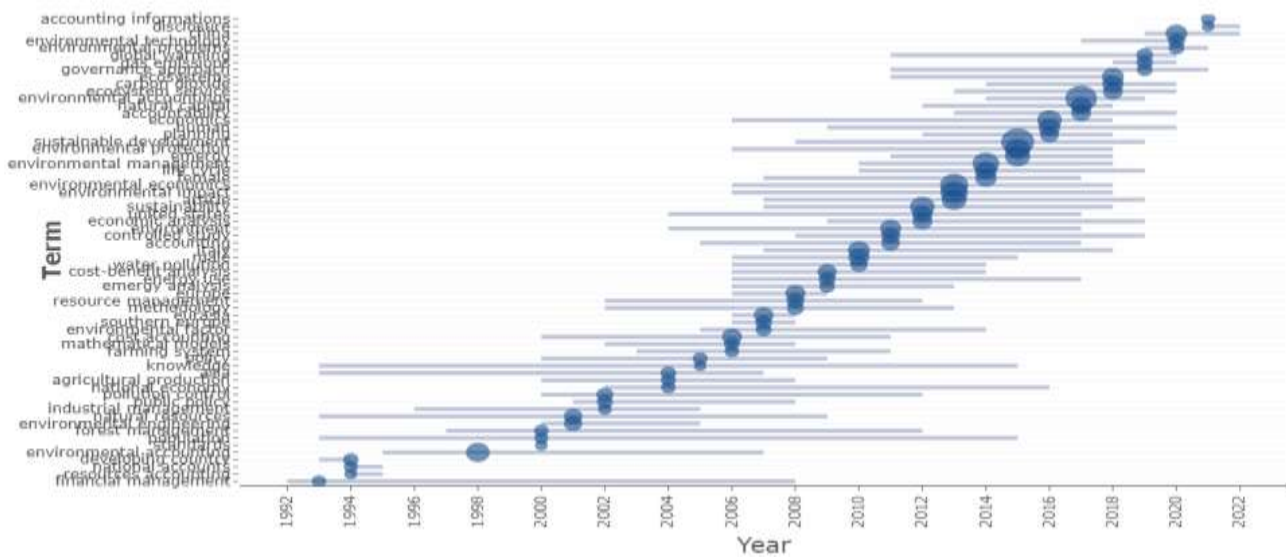
Figure 13: Word Dynamics



This figure indicates the concurrence of more relevant words over the time span of 1969 to 2023. In earlier years as the concept was new, up to 1990, sustainability, terms like sustainable development and environmental protection were used more often. But the environment Protection Act was passed in 1986. Prof. Peter Wood (Professor of

Economics) first brought environmental accounting terms into common usage. By late 1980s United Nations & other international organizations started recognizing the importance of environmental accounting hence many terms like environmental economics, environmental impact, environmental management, environmental protection, sustainability emerged post 1990.

*Figure 14: Trend Topics*



The study further analyzes the trended topics in environmental accounting, and the results indicate that sustainable development was the most discussed theme from 2008 to 2019, as shown in Figure 14. The period 2014–2019 was dominated by environmental accounting as one of the commonly used themes followed by environmental economics from 2006 to 2018. The other trended topics include environmental impact (2006–2018) and environmental management (2010–2018) in the environmental accounting.

*Figure 15: Thematic Map*

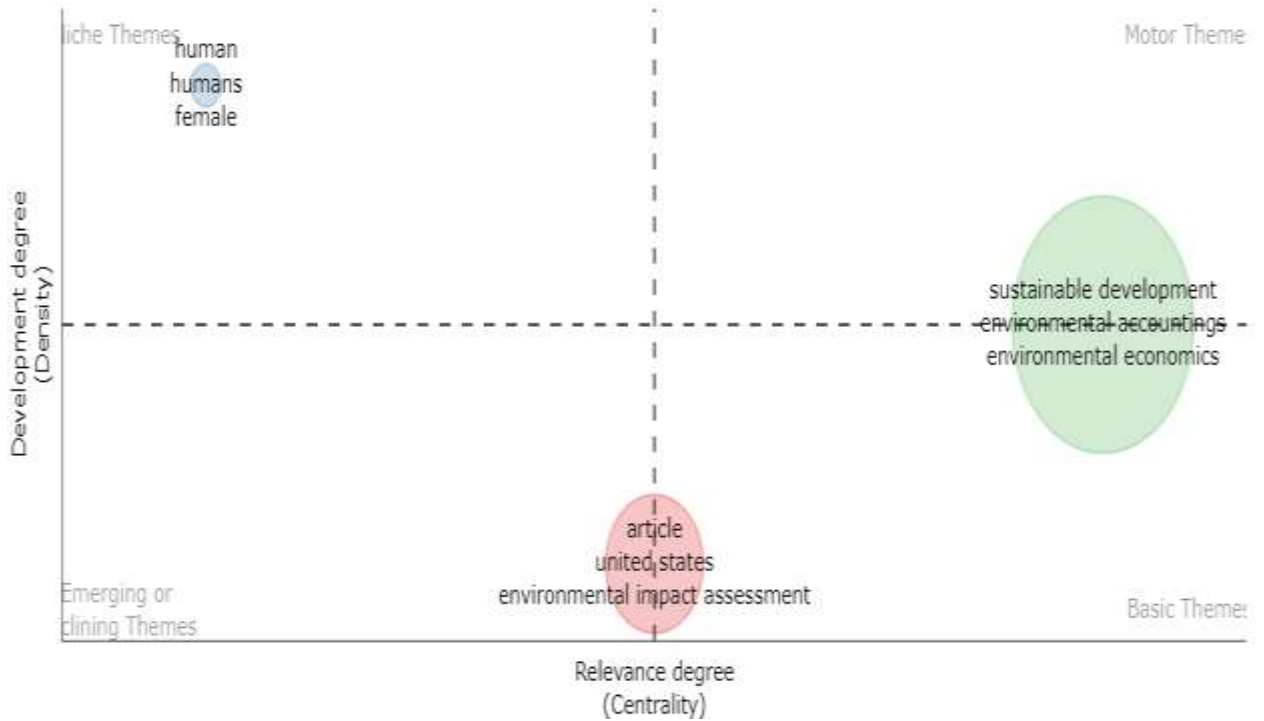
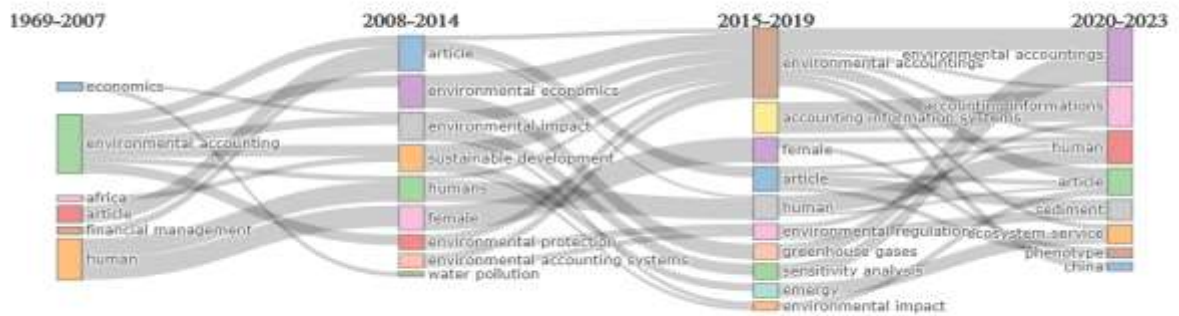


Figure 15 shows the thematic clustering of the author’s keywords, which are provided by them during the publication process. These keywords are clustered into different themes based on the clustering algorithm. The four clusters in the figure are interpreted across the two variables i.e. centrality and density. Centrality indicates the level of involvement of a network with other networks while on the other side, density reflects the internal strength of the network (Cobo et al., 2018). The significance of the topic in the research area is denoted by its centrality and density may be defined as the measurement of a subject’s growth in the relevant literature. The upper-right quadrant, which is defined by both high centrality and density represents the well-developed significant theme. Sustainable development falls under this quadrant, which means that sustainable development is a concept relevant to environmental accounting. The upper left quadrant exhibits high-density themes but insignificant external connections, and therefore, is of little relevance for the research area (low centrality) (Della Corte et al., 2019). human, humans and female falls under this quadrant representing a well-developed theme in the literature but of little relevance from the environmental accounting perspective. The lower left quadrant represents the low density and low centrality themes. These themes are declining or evolving in nature and there is no concept under this category representing the great scope for research in environmental accounting and other areas of the fields. The last lower right quadrant represents the basic and recurring themes. The theme of environmental economics is shifting from the upper left quadrant to the lower left quadrant representing the evolving and recurring concept in environmental accounting.

*Figure 16: Thematic Evolution*



From 1969-2007, environmental accounting was the only concept which later evolved into other terms such as environmental economics, environmental impact, environmental protection and environmental accounting systems in 2008-2014 but environmental accounting was not studied during this period. But again in 2015-19 and 2020-23 environmental accounting gained importance and more research was done in this area. The other topics such as environmental economics, environmental impact, sustainable development lost track in 2015-19 and 2020-23.

## V. Conclusion and Future Research Agenda:

The study on environmental accounting started by keeping in mind a few research questions. The researcher's observation is that research in environmental accounting gained pace after 2000 onwards, but still contribution of Indian researchers' is very negligible.

Most preferred journals by researchers for publication on environmental accounting are Social and environmental Accountability journal which has published maximum articles 70 while Accounting, Organizations and Society had least publications. Other publications were Journal of cleaner production, Accounting, Auditing and Accountability journal, accounting forum and accounting education. It can be observed that Indian publications' contribution is less.

Countries such as USA, Italy, China, UK, Australia and Spain are the countries who have been most productive in environmental accounting. But here also India is lagging which again emphasizes need for more research in environmental accounting.

The most used keywords in environmental accounting can be found are sustainable development, followed by environmental economics, environmental impact, environmental management and environmental protection. It can be observed that environmental accounting as a keyword was not used frequently. This concludes that environmental accounting topics are not studied from an accounting perspective.



As per the thematic mapping, very little study was conducted in environmental accounting and no research can be seen in emerging themes, which highlights the importance of further detailed study with respect to environmental accounting. Even though sustainable development, environmental economics are more relevant concepts to environmental accounting, the study shows less dependency and interrelation amongst these. It is observed from the study that even though environmental accounting was a preferred topic for researchers since 1969, the concept is less studied from accounting point of view. Hence researchers find a gap for furthermore study in environmental accounting.

## VI. Limitations of the Study:

Many review methods have integral restrictions. The current study has tried to unbiased review the research on environmental accounting but has few limitations. The current study has taken only Scopus database for the review of research on environmental accounting. One needs to review many databases to increase the scope of the current topic in future research.

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