A Comprehensive Bibliometric Analysis of Sustainable Leadership Research Based on Scopus

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Abstract. Sustainable leadership, focusing on balancing short-term goals with long-term environmental, societal, and economic impacts, has become a key area in management research. This study analyzes the development of sustainable leadership research from 2003 to 2024 using bibliometric methods, examining 257 documents from the Scopus database with tools like VOSviewer and Publish or Perish. Key findings show a significant rise in research contributions from scholars in the US, China, Australia, and Thailand. The cluster analysis identified four main themes: sustainable leadership concepts, green leadership practices, resilient leadership in education, and leadership for sustainable development goals. Despite progress, gaps remain in research on green innovation and strategies to promote environmental sustainability. This study offers insights for future research.

Keywords: Sustainable Leadership, Bibliometric Analysis, VOSviewer, Publish or Perish.

1 Introduction

In recent decades, the concept of sustainable leadership has become an increasingly important topic in management and organizational research. Sustainable leadership refers to leadership practices that not only focus on achieving short-term goals, but also consider long-term impacts on the environment, society, and economy. This concept emerged as a response to global challenges faced by companies and society, including climate change, socioeconomic inequality, and environmental deterioration.

The importance of sustainable leadership has been reinforced by increasing global pressure to promote environmentally friendly and sustainable business practices. International organizations such as the United Nations, through the Sustainable Development Goals (SDGs), have set guidelines for companies to contribute to global sustainability. Companies that implement sustainable leadership tend to be better able to survive and adapt to dynamic market changes, and gain support from various stakeholders. They also demonstrate better financial performance over the long term because investments in sustainable practices often result in significant operational efficiencies and innovation. Additionally, sustainable leadership can also improve a company's reputation and attract better talent, as more individuals want to work for companies that have strong social and environmental responsibilities.

Implementing sustainable leadership also plays an important role in building better relationships with local communities and society at large. Through various sustainability initiatives, companies can contribute to improving people's quality of life, such as by creating decent jobs, increasing access to education, and participating in social projects. This not only strengthens ties between companies and society, but also helps create a stable business environment and supports inclusive economic growth. Therefore, sustainable leadership not

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only benefits the company itself, but also has far-reaching positive impacts on society and the environment as a whole.

Even though research on sustainable leadership has shown significant progress, there are still several fundamental problems. One of them is the lack of consistency in the definitions and theoretical frameworks used by researchers. In addition, although there have been many studies discussing the benefits of sustainable leadership, there is still little research that explores the challenges and obstacles faced by leaders in implementing sustainability principles in real practice. However, the significant increase in the number of publications in the field of sustainable leadership in recent years drives the need for a more in-depth analysis of the research map through bibliometric analysis.

This bibliometric research is very important because it provides a comprehensive and systematic picture of the development of sustainable leadership research from a global perspective. Using bibliometric analysis, we can identify research trends, contributions of authors and countries, as well as relationships between key concepts in the field. This not only helps in understanding historical developments and existing research patterns, but also identifies gaps and opportunities for further research. Thus, this research can become the basis for developing more effective and evidence-based sustainable leadership policy strategies and practices.

Several previous bibliometric studies have been conducted to evaluate the trajectory of sustainable leadership research. For example, [1] used the analytical tools available in the Web of Science database to perform a bibliometric study on sustainable leadership. Sustainable leadership publications have evolved throughout time, and this study aims to trace their history, research fields, geographic distribution, and authors. The results demonstrate that existing articles were categorized into many clusters representing various topic areas according to the frequency of the keywords. Cluster analysis allows one to pick out patterns of thought, drawing attention to areas of sustainable leadership that have received a lot of study thus far and offering new points of view. Another bibliometric study performed by [2] considers management studies that make use of responsible leadership. This study used bibliometric analysis to investigate the intellectual structure of the responsible leadership literature. The sample consisted of 64 papers published in SSCI-indexed journals during a 10-year period (2006-2016). The most well-known journals and authors who have written extensively about responsible leadership are highlighted in the findings. There are very few empirical/case study papers; the majority of the referenced works are theoretical, utilizing Western frameworks and cultures, and center on the idea of responsible leadership. Not only that, but new areas of study are cropping up that shed light on responsible leadership's foundational principles and the gaps in our current understanding of the subject. Based on previous bibliometric studies above, there are several differences with our study. Firstly, we carried out a comprehensive bibliometric study regarding sustainable leadership research using the Scopus scientific database. Second, we proposed several further research based on network and cluster analysis. This will help scholars to understand areas or topics that have received little attention in the existing literature. This is also useful for scholars to find research gaps that can be explored further, thereby contributing to the development of new theories and knowledge. For practitioners, this can have a broad practical impact in various industries, especially for understanding how theoretical concepts can be applied in practical contexts. By knowing the patterns and relationships between various variables, practitioners can develop more effective strategies based on scientific evidence. Thus, the research questions that will be addressed in this study:

RQ1. What are publication trends and subject areas of sustainable leadership research?

RQ2. Who are the prominent authors, countries, and sources that have made the most impact and the highest number of publications on sustainable leadership research?

RQ3. What are the highly cited papers on sustainable leadership research?

RQ4. What are the main research themes in sustainable leadership research?

The aim of this research is to provide an in-depth bibliometric analysis of the development of sustainable leadership research using data from the Scopus database. This research aims to ascertain publication trends, main contributors, and dominant research themes in this field. Apart from that, this research also aims to identify existing research gaps and provide recommendations for further research. Thus, it is hoped that this research can make a significant contribution to the understanding and development of more effective and sustainable leadership practices in the future. The paper is structured as follows. In the following section, we shall outline the bibliometric approach employed in this study. This section provides several references to Excel, Publish or Perish, and VOSviewer bibliometric analysis references and flow diagrams. The results and discussion further serve to answer specific research questions, followed by a conclusion and further research.

2 Methods

As [3] pointed out, bibliometric analysis is an ideal tool for systematically conducting scientific mapping to evaluate particular regions comprehensively, provide visual analysis, and establish clusters of exploration from earlier studies. This method allows us to fully understand the existing literature and to identify gaps in knowledge that can guide future research directions. The search strategy used in this study aimed to encompass a wide range of relevant publications by including different languages, document types, data categories, and document years. The keywords related to "sustainable leadership" in the article's title ensured that the search results were directly related to the topic of interest.

A total of 257 documents were acquired based on the query TITLE ("sustainable leadership" OR "green leadership" OR "eco-friendly leadership" OR "long-term leadership" OR "resilient leadership" OR "responsible leadership") from sources included in Scopus. This study utilizes data sourced from Scopus, a recognized database and the largest repository of citations and abstracts. Scopus provides the most extensive overview of worldwide research throughout the STEM (science, technology, engineering, mathematics), SHA (social sciences), and ART (arts, literature, and history) fields [4]. Studies in various disciplines have used data from the Scopus research database to undertake bibliometric analyses [5].

Because no start date was provided, the search engine discovered the earliest paper in the literature and the datasets were obtained from Scopus from 2003 until 2024. There are no other inclusion or exclusion criteria we used in this study in terms of source, type of document, language, etc. By using the keywords and search techniques, the researchers aimed to gather a comprehensive range of publications that address the concept of sustainable leadership. This approach ensures that various perspectives and findings from earlier studies are considered, allowing analysis and identification of distinct clusters within the field of sustainable leadership research. After that, the data were exported into files in the research information systems (.ris) and comma-separated values (.csv) formats. Figure 1 shows the specifics of the search plan and every step involved in carrying out the bibliometric analysis.

The following tools were used to analyze the data in the bibliometric analysis: Microsoft Excel, which was used to create relevant charts and calculate the frequencies of published materials; VOSviewer software developed by [6], which was used to construct and visualize the bibliometric networks; Harzing's Publish or Perish software developed by [7], which calculated

the citation metrics, the number of cited papers and the author counts. These tools were selected based on their ability to efficiently analyze large data sets and provide comprehensive insights into the bibliometric landscape. Furthermore, there are four analyses in this study: the first analysis covered the analysis of publications and impacts by year to answer RQ1. The second analysis was conducted by presenting the contribution of authors, institutions, countries and source titles to answer RQ2. The third analysis of the top 10 highly cited documents was revealed to answer the RQ3. Finally, in order to answer RQ4, we performed network visualization map analysis and cluster analysis based on the author keywords.

Before we conducted the analysis, the data cleaning and harmonization were performed. According to [8], these stages are essential in bibliometric analysis to ensure the accuracy and reliability of the results. To achieve this objective, a VOSviewer thesaurus file can serve as an excellent tool, enabling us to effectively standardize data and enhance its correctness. Put simply, the thesaurus file is a textual document that aids in the process of data cleansing while generating a map using bibliographic data. In this study, we have consolidated various variations of keywords found in the dataset by grouping together synonyms, accounting for spelling discrepancies, and combining abbreviated phrases with their corresponding full terms. Examples of such consolidation include merging "small business", “sme “and “smes”, “sustainable” and “sustainability”, “higher education” and “university”, etc. A thesaurus file comprises two columns: a label column and a replacement column. The first line in a thesaurus file serves as a header line with column headings. All lines in a thesaurus file, excluding the first line, include a label in the label column and a corresponding alternative label in the replaced by column. This indicates that the label should be substituted with the alternative label. Once we have completed the data cleaning process, we proceed with the analysis.

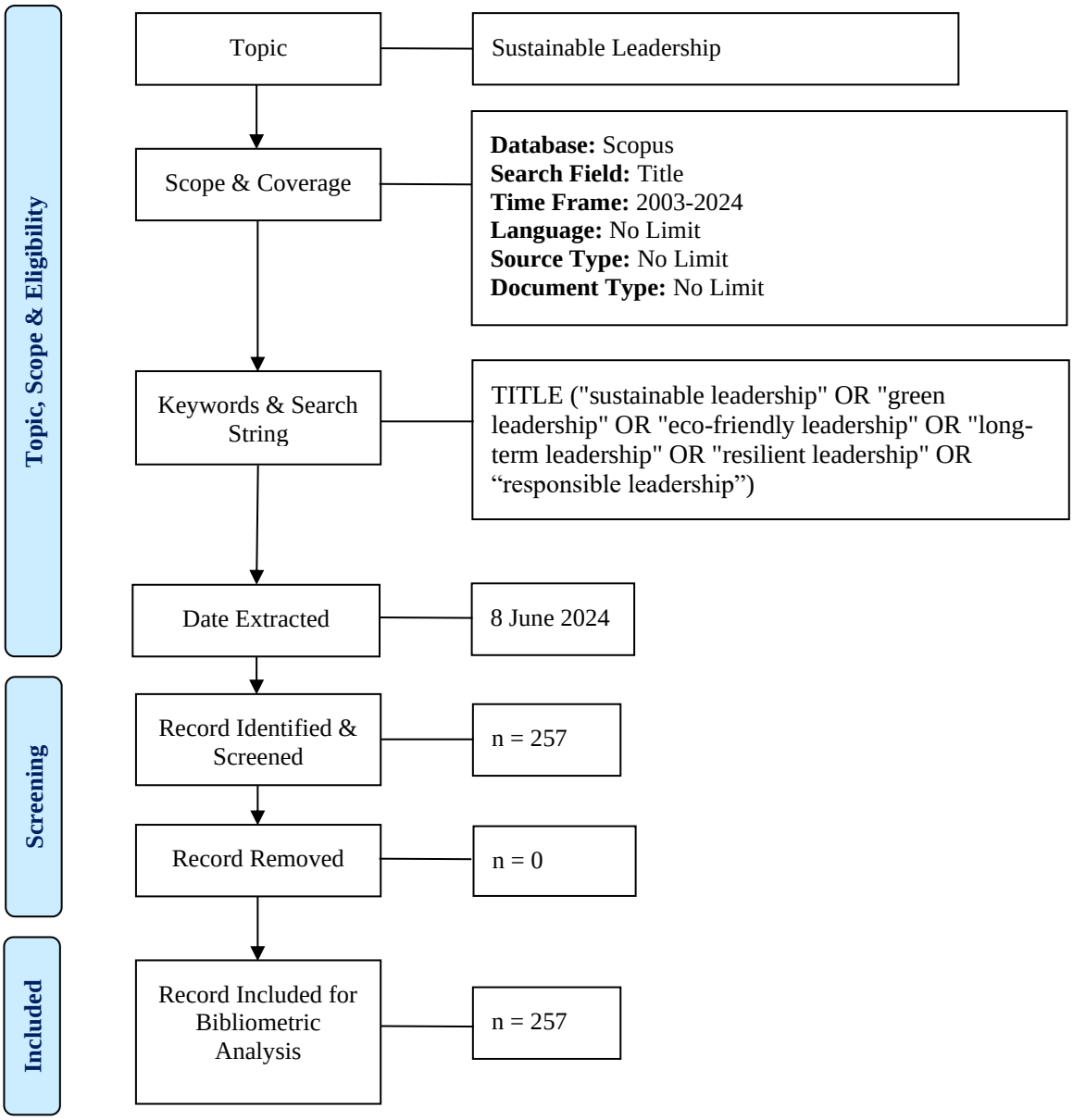

Figure 1. Flow Diagram of the Search Strategy
Source: [4]

3 Result and Discussion

This part presents the findings derived from the research questions outlined in the introduction section.

3.1 Descriptive Analysis

This section discusses the research background and profile analysis of sustainable leadership research. [9] refers to this approach as performance analysis, which evaluates the contributions of diverse research entities (including authors, institutions, nations, and publications) to a certain subject. This analysis is the hallmark of bibliometric studies. Consequently, this includes all information on the subject areas, languages, publication trends, prolific authors, countries and institutions, source titles and highly cited papers. The primary indicators are the quantity of publications and citations per year or per research component, with publication serving as a proxy for productivity, while citation serves as a metric for impact and influence. Additional metrics, such as citation per publication, h-index, and g-index, use both citations and publications to evaluate the research output of individuals or groups. The analysis, although descriptive, acknowledges the significance of several components within a research subject. For this purpose, the descriptive analysis is conducted to answer RQ1 – RQ3 in this paper.

3.2 Subject Areas

The issue of sustainable leadership attracts considerable attention from various scientific disciplines, but with a strong dominance in three main fields: Social Sciences, Business, Management and Accounting, and Environmental Science (Table 1). Social Sciences dominates with a total of 117 publications, which is 45.53% of the total. This is closely followed by Business, Management and Accounting with 115 publications or 44.75%. Environmental Science also shows significant contributions with 46 publications, accounting for 17.90% of the total.

Table 1. Subject Area

Subject Area	**Total Publications (TP)**	**Percentage (%)**
Social Sciences	117	45.53%
Business, Management and Accounting	115	44.75%
Environmental Science	46	17.90%
Economics, Econometrics and Finance	41	15.95%
Energy	37	14.40%
Computer Science	33	12.84%
Engineering	21	8.17%
Psychology	19	7.39%
Arts and Humanities	13	5.06%
Medicine	13	5.06%
Decision Sciences	11	4.28%
Physics and Astronomy	4	1.56%
Chemical Engineering	3	1.17%
Earth and Planetary Sciences	3	1.17%
Mathematics	3	1.17%
Pharmacology, Toxicology and Pharmaceutics	3	1.17%

Biochemistry, Genetics and Molecular Biology	2	0.78%
Multidisciplinary	2	0.78%
Chemistry	1	0.39%
Materials Science	1	0.39%
Nursing	1	0.39%

3.3 Publication Trends

According to Table 2 and Figure 2, this study indicates that Sustainable Leadership research shows dynamic research development over the years. In the early period (2003-2009), the number of publications was relatively low, but some seminal works received many citations, such as in 2004 and 2007. From 2010 to 2013, the number of publications gradually increased, with a peak in citations in 2011, indicating some key research being recognized. The period from 2014 to 2018 showed stability in the number of publications with an increasing trend in citations, indicating broader recognition. The years 2019 to 2021 recorded a surge in both publications and citations, with 2020 being the peak year. In 2022, the number of publications decreased but remained highly cited, indicating the impact of previous research. In 2023, there was an increase in publications but a decrease in citations, while 2024 saw a decline in both publications and citations. Overall, although the number of publications varied, the impact of research in terms of citations has increased, showing that "Sustainable Leadership" has become an increasingly relevant and recognized field in the last decade.

Table 2. Publication Trend

Year	**TP**	**%**	**NCP**	**TC**	**C/P**	**C/CP**	***h***	***g***
2024	34	13.23%	7	13	0.38	1.86	2	3
2023	50	19.46%	24	117	2.34	4.88	6	9
2022	24	9.34%	17	334	13.92	19.65	10	18
2021	30	11.67%	20	258	8.60	12.90	9	15
2020	17	6.61%	16	416	24.47	26.00	10	17
2019	13	5.06%	8	225	17.31	28.13	6	13
2018	8	3.11%	7	163	20.38	23.29	5	8
2017	13	5.06%	9	121	9.31	13.44	5	11
2016	8	3.11%	7	122	15.25	17.43	4	8
2015	8	3.11%	5	149	18.63	29.80	4	8
2014	8	3.11%	6	105	13.13	17.50	4	8
2013	11	4.28%	9	128	11.64	14.22	7	11
2012	7	2.72%	5	106	15.14	21.20	5	7
2011	10	3.89%	10	377	37.70	37.70	6	10
2010	2	0.78%	2	46	23.00	23.00	1	2
2009	5	1.95%	4	111	22.20	27.75	3	5
2008	2	0.78%	1	11	5.50	11.00	1	2
2007	4	1.56%	4	154	38.50	38.50	4	4
2004	2	0.78%	2	202	101.00	101.00	2	2
2003	1	0.39%	1	2	2.00	2.00	1	1
Total	**257**							

Notes: TP=total number of publications; TC=total citations; NCP=number of cited publications; C/CP=average citations per cited publication; C/P=average citations per publication; h=h-index; and g=g-index.

3.4 Top Ten Authors

In this bibliometric analysis of sustainable leadership research, several authors stand out with significant contributions as presented in Table 3. Iqbal, Q. from King Fahd University of Petroleum and Minerals in Saudi Arabia and Kantabutra, S. from College of Management Mahidol University in Thailand each have 9 publications, all of which are cited, with a total of 436 and 224 citations respectively. This indicates their research has a strong and consistent impact in the field. Additionally, Ahmad, N.H. from Universiti Sains Malaysia shows exceptional influence with 5 publications garnering a total of 343 citations, averaging 68.60 citations per publication. Other researchers like Avery, G.C. from Macquarie University in Sydney and Hargreaves, A. from the University of Ottawa in the United States also demonstrate significant contributions despite having fewer publications, with very high average citations per publication, 79.75 and 99.33 respectively. These researchers highlight that despite varying numbers of publications, their research impact remains highly substantial and relevant in sustainable leadership research.

Table 3. Top Ten Authors

Author's Name	**Affiliation**	**Country**	**TP**	**NCP**	**TC**	**C/P**	**C/CP**	***h***	***g***
Iqbal, Q.	King Fahd University of Petroleum and Minerals, Dhahran	Saudi Arabia	9	9	436	48.44	48.44	8	9
Kantabutra, S.	College of Management Mahidol University, Bangkok	Thailand	9	9	224	24.89	24.89	8	9
Suriyankietkaew, S.	College of Management, Bangkok	Thailand	7	7	321	45.86	45.86	7	7
Ahmad, N.H.	Universiti Sains Malaysia, Minden	Malaysia	5	5	343	68.60	68.60	5	5
Avery, G.C.	Macquarie University, Sydney	Australia	4	4	319	79.75	7975	4	4
Piwowar-Sulej, K.	Uniwersytet Ekonomiczny we Wrocławiu, Wroclaw	Poland	4	4	93	23.25	23.25	4	4

Bulmer, E.	Universidad Antonio de Nebrija, Hoyo de Manzanares	Spain	3	1	11	3.67	11.00	1	3
Hargreaves, A.	University of Ottawa, Ottawa	United States	3	3	298	99.33	99.33	3	3
Kostoulas-Makrakis, N.	University of Crete, Rethymnon	Greece	3	0	0	0.00	-	0	0
Yuenyong, C.	Khon Kaen University, Khon Kaen	Thailand	3	1	7	2.33	7.00	1	2

Notes: TP=total number of publications; TC=total citations; NCP=number of cited publications; C/CP=average citations per cited publication; C/P=average citations per publication; h=h-index; and g=g-index

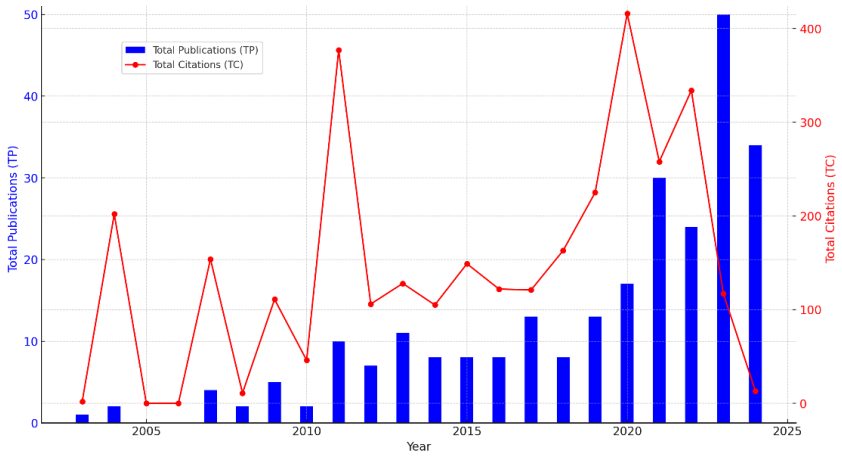

Figure 2. Number of publications and citations each year

3.5 Prolific Countries

In this bibliometric analysis, the United States and China stand out as major contributors with significant numbers of publications and citations, as illustrated in Table 4. The United States leads in North America with 36 publications and a total of 685 citations, resulting in an average citation per publication (C/P) of 19.03 and an average citation per cited publication (C/CP) of 27.40, indicating a substantial impact of their research. In Asia, China shows strong contributions with 28 publications and 453 citations, having a C/P of 16.18 and a C/CP of 23.84. Australia from Oceania also provides significant contributions with 23 publications and 591 citations, and the second-highest C/CP of 28.14, highlighting the considerable influence of research from this region. Contributions from other Asian countries like Thailand, Malaysia, India, Indonesia, and Pakistan show varying impacts of their research. Thailand, with 23 publications and a total of 635 citations, has the highest C/CP of 33.42, underscoring the importance of contributions from Asia. Malaysia and the United Kingdom from Europe each

make notable contributions with 20 publications (403 citations) and 17 publications (254 citations), respectively. Although contributions from these countries are significant, their impact is still below that of the top countries like the United States, China, Australia, and Thailand. Overall, Asia shows a crucial role in "Sustainable Leadership" research, albeit with varying levels of impact across different countries.

Table 4. Most Prolific Countries

Country	TP	NCP	TC	C/P	C/CP	h	g	Continent
United States	36	25	685	19.03	27.40	11	26	North America
China	28	19	453	16.18	23.84	10	21	Asia
Australia	23	21	591	25.70	28.14	10	23	Oceania
Thailand	23	19	635	27.61	33.42	14	23	Asia
Malaysia	20	15	403	20.15	26.87	7	20	Asia
United Kingdom	17	12	254	14.94	21.17	7	15	Europe
India	14	8	44	3.14	5.50	4	6	Asia
Indonesia	13	10	122	9.38	12.20	6	11	Asia
Pakistan	13	8	54	4.15	6.75	4	7	Asia
Bahrain	10	6	42	4.20	7.00	4	6	Asia

Notes: TP=total number of publications; TC=total citations; NCP=number of cited publications; C/CP=average citations per cited publication; C/P=average citations per publication; h=h-index; and g=g-index.

3.6 Prominent Source

Table 5 displays the primary sources that have published articles on sustainable leadership research, based on the total number of articles published and the total number of citations.

Table 5. Top Ten Source Titles

Source Title	TP	NCP	TC	C/P	C/CP	h	g	Quartile
Sustainability Switzerland	24	20	420	17.50	21.00	11	20	Q1
Frontiers in Psychology	8	6	41	5.13	6.83	4	6	Q1
2021 Sustainable Leadership and Academic Excellence International Conference	6	3	14	2.33	4.67	2	3	Q4
Technical and Vocational Education and Training	5	0	0	0.00	-	0	0	Q4
Journal of Global Responsibility	4	3	107	26.75	35.67	3	4	Q2
Verbum et Ecclesia	4	1	1	0.25	1.00	1	1	Q1
Sage Open	3	1	56	18.67	56.00	1	3	Q1
Springer Proceedings in Business and Economics	3	0	0	0.00	-	0	0	Q4
Advances in Developing Human Resources	2	2	50	25.00	25.00	2	2	Q1

Source Title	TP	NCP	TC	C/P	C/CP	h	g	Quartile
AIP Conference Proceedings	2	1	7	3.50	7.00	1	2	Q4

Notes: TP=total number of publications; TC=total citations; NCP=number of cited publications; C/CP=average citations per cited publication; C/P=average citations per publication; h=h-index; and g=g-index; Quartile=journal rank based on percentile.

The results reveal a diverse range of contributions across various journals and conference proceedings. "Sustainability Switzerland" stands out as the most prolific source with 24 total publications (TP) and a high total citation count (TC) of 420, resulting in an impressive average of 17.50 citations per publication (C/P) and 21.00 citations per cited publication (C/CP). This journal's strong performance is further underscored by its h-index of 11 and g-index of 20, placing it in the Q1 quartile. Other notable contributors include "Frontiers in Psychology," with 8 publications and a more modest citation impact, and "Journal of Global Responsibility," which, despite having only 4 publications, boasts a high average citation rate of 26.75 per publication and 35.67 per cited publication, indicative of its impactful contributions. In contrast, some sources such as "Technical and Vocational Education and Training" and "Springer Proceedings in Business and Economics" show minimal citation impact with zero citations, despite their contributions. This suggests a lower influence or newer entries in the field of sustainable leadership. Meanwhile, "Sage Open" and "Advances in Developing Human Resources" also display strong citation performance, with "Sage Open" having an average of 18.67 citations per publication and a remarkably high 56.00 citations per cited publication. These variations highlight the different levels of influence and reach among sources, with Q1 journals generally showing higher citation metrics and impact compared to Q4 sources, which tend to have fewer citations and lower indices. Overall, the data illustrate that while some journals dominate in terms of citation impact and publication volume, there is a broad spectrum of contributions across different quartiles and disciplines.

3.7 Highly Cited Documents

The analysis of highly cited papers on sustainable leadership research reveals a significant focus on the multifaceted aspects of sustainable practices within leadership, emphasizing resilience, performance, and empowerment (Table 6). [10] work, "Sustainable leadership practices for enhancing business resilience and performance," stands out with a substantial citation count, highlighting its influence in the field and underscoring the significance of sustainability practices in improving the performance and resilience of businesses. Similarly, the research conducted by [11] on the seven principles of sustainable leadership exemplifies a fundamental methodology that remains highly esteemed, illustrating the enduring relevance of core sustainable leadership principles. Furthermore, more recent studies such as those by [12]; [13] show a burgeoning interest in the intersection of sustainable leadership with psychological empowerment and sustainable performance, particularly in learning organizations. These works demonstrate a high citation rate per year, indicating their contemporary relevance and the increasing recognition of psychological and educational dimensions in sustainable leadership discourse. Other significant contributions include empirical studies on the application of sustainable leadership practices in various organizational settings, such as Thai SMEs and higher education institutions, reflecting a growing acknowledgment of the practical implications of sustainable leadership across diverse industries and geographical contexts. Overall, the citation patterns suggest a dynamic and evolving field,

with foundational theories being built upon by innovative, empirical research that addresses current challenges and applications in sustainable leadership.

Table 6. Highly Cited Papers

Author(s)	Title	TC	C/Y
[10]	Sustainable leadership practices for enhancing business resilience and performance	213	1638
[11]	The Seven Principles of Sustainable Leadership	196	980
[13]	A moderated-mediation analysis of psychological empowerment: Sustainable leadership and sustainable performance	129	3225
[14]	Science Mapping of the Knowledge Base on Sustainable Leadership, 1990-2018	112	1867
[15]	The relationships among transformational leadership, sustainable leadership, lean manufacturing and sustainability performance in Thai SMEs manufacturing industry	98	1960
[16]	Sustainable Leadership and Development in Education: Creating the future, conserving the past	96	565
[17]	Sustainable development: The colors of sustainable leadership in learning organization	91	3033
[18]	Sustainable leadership: Management control systems and organizational culture in Novo Nordisk A/S	82	547
[19]	Sustainable leadership practices driving financial performance: Empirical evidence from Thai SMEs	73	913
[20]	Resilient leadership: a transformational-transactional leadership mix	72	800
[21]	Achieving green product and process innovation through green leadership and creative engagement in manufacturing	71	3550
[22]	Resilient Leadership as Paradox Work: Notes from COVID-19	58	1450
[12]	How Does Sustainable Leadership Influence Sustainable Performance? Empirical Evidence From Selected ASEAN Countries	56	1400
[23]	Conceptualising sustainable leadership	52	743
[24]	Sustainable Leadership Practices and Competencies of SMEs for Sustainability and Resilience: A Community-Based Social Enterprise Study	51	2550
[25]	Sustainable leadership in higher education institutions: social innovation as a mechanism	50	2500
[26]	The Good Manager: An Archetypical Quest for Morally Sustainable Leadership	45	375
[27]	Servant and sustainable leadership: An analysis in the manufacturing environment	45	321

[28]	The Perceptions of Ethical and Sustainable Leadership	43	430
[29]	Organizational resilience and organizational performance: Examining the mediating roles of resilient leadership and organizational culture	42	840

Notes: TC = total citations; C/Y = total citations per year

3.8 Network Analysis

Network analysis is one of the most frequently employed instruments in bibliometric analysis. [30] referred to this analysis as scientific mapping, which investigates the connections among research components. Intellectual interactions and organizational ties among research participants are the primary foci of the examination. [31] stated that VOSviewer is widely used for network exploration. The next section examines the co-occurrence and cluster analysis of sustainable leadership research.

The fundamental concept of keyword analysis is that the selected keywords by the author effectively encapsulate the article's substance [32]. The co-occurrence of two terms in the article signifies a connection between the two themes. In order to investigate the last research question (RQ4), we employ co-occurrence and cluster analysis within the VOSviewer program. We employed VOSviewer, a software application for constructing and visualizing bibliometric networks, to analyze the provided keywords and generate a mapping of these keywords to each article. Figure 3 illustrates a network representation of authors' keywords generated using VOSviewer. The visualization showcases the strength of the connections between keywords through the use of color, the size of the circles, and the font and thickness of the connecting lines. Related keywords are often grouped together based on their color. The significance of an item or keyword increases proportionally with its frequency, resulting in a larger circle.

The frequency of recurrence directly influences the dimensions of the items. Unsurprisingly, sustainable leadership research was one of the most frequently researched topics, given its high occurrence rate. The analysis has resulted in the development of four clusters in sustainable leadership research, based on the author keywords (Table 7). The total unique author keywords found in this study are 602 words. Table 7 shows most frequently used keywords that occur at least two times.

There are four clusters that indicate main research topic in this field—cluster 1 has total 36 items. Sustainable leadership, leadership, sustainability, and sustainable development are the most common terms in this cluster. The label of this cluster is Core Concepts of Sustainable Leadership. This cluster primarily revolves around the concept of sustainable leadership, which integrates the principles of leadership with the overarching goals of sustainability and sustainable development. Sustainable leadership involves guiding organizations in ways that are not only effective and ethical but also ensure long-term ecological and social well-being. It emphasizes balancing economic success with environmental stewardship and social responsibility. This cluster reflects a focus on how leaders can foster practices that contribute to enduring positive impacts on society and the planet.

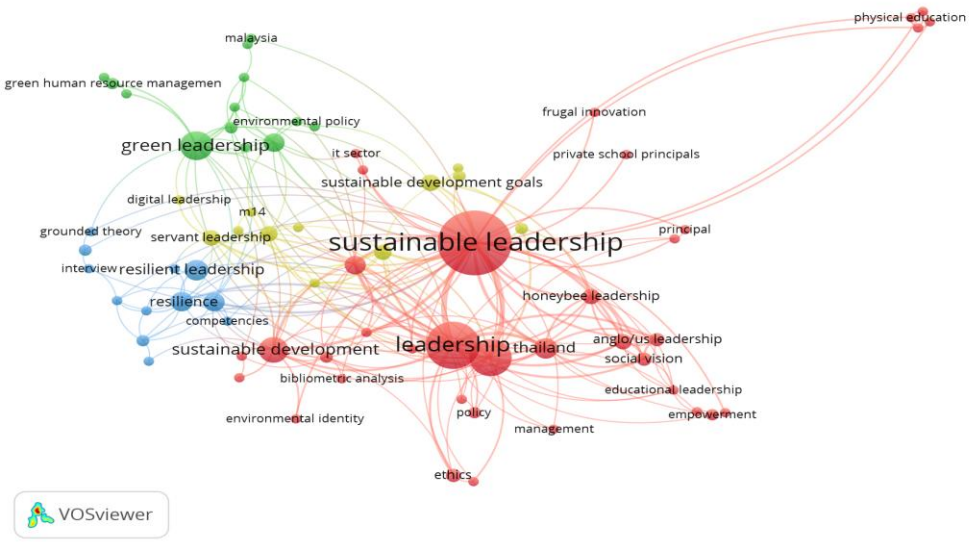

Figure 3. VOSViewer' Network Visualisation

Table 7. Cluster Analysis

Cluster	Most Frequent Keywords	Occurrences	Less Frequent Keywords	Occurrences
1	Sustainable leadership	86	Innovation	3
1	Leadership	66	Policy	3
1	Sustainability	8	Environment	2
1	Sustainable Development	7	Developing Country	2
2	Green Leadership	17	Green Innovation	3
2	Sustainable Corporate Performance	7	Environmental Responsibility	2
2	Green Human Resource Management	5	Environmental Policy	2
2	Green Behavior	5	Sustainable Innovation	2
3	Resilient Leadership	9	Adversity	2
3	Resilience	8	Competencies	2
3	Higher Education	7	Authentic Leadership	2
3	Leadership Development	3	Grounded Theory	2

Cluster	Most Frequent Keywords	Occurrences	Less Frequent Keywords	Occurrences
4	Sustainable Development Goals	6	Environmental Sustainability	3
4	Transformational Leadership	5	Social Sustainability	2
4	Servant Leadership	5	Digital Leadership	2
4	Corporate Sustainability	5	Transactional Leadership	2

Cluster 2 has a total of 13 keywords, with the main keywords being green leadership, sustainable corporate performance, green human resource management, and green behavior. The label of this cluster is Green Leadership and Organizational Practices. This research theme highlights how leaders can influence and encourage green behaviors among employees, the implementation of green HRM practices such as eco-friendly recruitment and training, and the overall impact of these practices on corporate performance. Research might also explore case studies of organizations that have successfully integrated green practices, analyzing the leadership styles and strategies that facilitated these changes. Additionally, this cluster examines the broader implications of green leadership on corporate sustainability, competitive advantage, and compliance with environmental regulations. Cluster 3 consists of 12 items. Resilient leadership, resilience, higher education and leadership development constitute the predominant keywords within this cluster. The label of this cluster is Resilient Leadership in Education and Development. This research theme addresses how leaders in educational institutions can foster resilience among staff and students, ensuring continuity and growth despite disruptions. It may also cover leadership development programs aimed at enhancing resilience, examining the methods and outcomes of such initiatives. Additionally, this cluster explores the role of resilience in leadership effectiveness, investigating how resilient leaders navigate complex situations, maintain organizational stability, and drive innovation. The insights gained from these studies can inform the design of training programs and policies that support resilient leadership in various contexts. Cluster 4 also has a total of 12 keywords, with sustainable development goals, transformational leadership, servant leadership and corporate sustainability being the most prevalent terms in this cluster. The theme of this cluster is Leadership Approaches for Sustainable Development Goals. This research theme examines how transformational and servant leaders contribute to achieving sustainable development goals (SDGs) within organizations. Studies may explore the specific behaviors and strategies these leaders use to embed sustainability into corporate culture and practices, such as fostering innovation, ethical decision-making, and stakeholder engagement. Additionally, this cluster delves into the outcomes of such leadership styles on organizational performance, employee well-being, and societal impact. By highlighting the alignment between leadership approaches and sustainability objectives, insights gained from this study can greatly aid efforts to cultivate ethical and productive leadership inside corporations.

4 Further Research

Based on the network cluster analysis that has been conducted as presented in Figure 3 and Table 4, we propose several research directions in the future for each cluster obtained in this bibliometric study. The further research is suggested based on the less frequent keywords that appear as follows: Cluster 1: Further research in this cluster could delve into the

development of innovation based on sustainable leadership. How innovative approaches are integrated into leadership practices to drive sustainability needs more investigation. Exploring how leaders in developing countries navigate environmental challenges and leverage innovation could provide valuable insights into scalable and context-specific strategies for sustainable development. Additionally, investigating the role of policies in creating an enabling environment for sustainable innovation can contribute to the broader understanding of how regulatory frameworks can support long-term sustainability goals. Cluster 2: Further research in this area could explore the specific strategies that leaders use to promote green innovation and environmental responsibility within their organizations. Green innovation is critical for sustainable leadership, yet it is underrepresented in the literature. Future research could explore the mechanisms through which leaders foster green innovation within their organizations, including the role of organizational green culture, incentives, and external partnerships. Moreover, studies could examine the outcomes of green innovation initiatives, such as their impact on environmental performance and organizational sustainability. Cluster 3: While adversity is a common theme in leadership studies, its specific implications for sustainable leadership are less explored. Future research could investigate how leaders overcome adversity in the context of sustainability, identifying the strategies and behaviors that enable them to turn challenges into opportunities for sustainable development. Additionally, examining the impact of adversity on leaders' commitment to sustainability can provide insights into the resilience and perseverance required for sustainable leadership. Cluster 4: While environmental sustainability is a critical aspect of sustainable leadership, more research is needed to understand how leaders can effectively promote it. Future studies could examine the specific practices and strategies that leaders use to achieve environmental sustainability, including the role of innovation, collaboration, and stakeholder engagement. Additionally, exploring the challenges and barriers to environmental sustainability can provide insights into how leaders can overcome them.

5 Conclusion

This study offers a thorough examination of the evolution of sustainable leadership research by conducting a bibliometric analysis using data from the Scopus database. Several key findings emerge from this study, including publication trends, contributions of authors and countries, and main research themes in the field of sustainable leadership. First, publication trends indicate a significant increase in the number of studies on sustainable leadership over the past few decades, with a peak in publications and citations occurring in 2020. This demonstrates that the topic is becoming increasingly relevant and widely recognized among academics and practitioners.

Second, the analysis of contributions reveals that researchers from various countries, particularly the United States, China, Australia, and Thailand, have made significant contributions to this research area. Scholars such as Iqbal Q., Kantabutra S., and Ahmad N.H. stand out with a high number of publications and citations, highlighting the strong impact of their research in this field. Third, the main research themes identified through cluster analysis include core concepts of sustainable leadership, green leadership and organizational practices, resilient leadership in education and development, and leadership approaches for sustainable development goals. Each cluster represents a distinct but interconnected focus of research, enriching the understanding of how sustainable leadership can be applied in various contexts. This study also identifies several research gaps that need further exploration. For instance, the integration of innovation into sustainable leadership, strategies to promote green innovation, and the challenges and barriers to achieving environmental sustainability are areas that have not

received sufficient attention. Therefore, further research is needed to delve into these areas and provide deeper insights into best practices in sustainable leadership.

Despite providing valuable insights into the field of sustainable leadership, this study has several limitations that should be acknowledged. One primary limitation is the reliance solely on data from the Scopus database. Although Scopus is a comprehensive and widely recognized source, it may not encompass all relevant publications on sustainable leadership. Other databases, such as Web of Science or Google Scholar might include additional pertinent studies that were not captured in this analysis. This reliance on a single database may have resulted in an incomplete picture of the research landscape, potentially omitting significant contributions from other sources. Another notable limitation is the exclusion of qualitative data. This study focuses on quantitative bibliometric analysis and does not incorporate qualitative insights from the reviewed publications. A rigorous literature study might yield a more profound comprehension of the intricacies and complexities of sustainable leadership practices that are not captured by citation metrics and keyword frequencies.

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