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Research Article

Mapping the Landscape of Sustainability in Social Media: A Bibliometric Analysis and Research Trends

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ABSTRACT

Social media adoption has accelerated the generation and dissemination of content, allowing for the communication of important issues like sustainability and climate change. The current study seeks to explore the evolution of sustainability in social media research through network and bibliometric analysis. The bibliographic themes in the field have been studied using citation analysis, co-citation analysis, bibliographic coupling, keyword co-occurrence and content analysis using the VOSviewer software. The Scopus database has been used to survey the literature from 2001 to 2023. To ensure accuracy in the data obtained, 757 documents were finalized through numerous inclusion and exclusion criteria. Results suggest that sustainable development, marketing, perception, decision making and innovation were some of the most frequently studied topics in the area. The United States, China and the United Kingdom were the top contributing countries and Sustainability Switzerland, Journal Of Cleaner Production and Environmental Science and Pollution Research were some of the highly productive journals. Keywords such as big data, business development, economic and social effects, economic development and public attitude were less frequently studied, providing scope for future exploration. The study is one of the early attempts to research the development and evolution of sustainability in social media. It was found that the area is in its growth phase. As a result, it adds to the body of knowledge on social media and sustainability and opens new arenas for investigation.

Keywords: Social media, Sustainability, Bibliometric, Citation, VOSviewer, Scopus.

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INTRODUCTION

Following the increasing socio-environmental challenges, such as climate change, pollution and many health difficulties, sustainable development has become a universal concern across countries.[1,2] Many people think that rapid action is required to stop the tide of biodiversity loss, climatic instability, resource overuse and other concerns due to the urgency and interdependency of environmental and socioeconomic challenges.[3-5] Sustainability, according to the Bruntland Commission,[6] is defined as satisfying current needs without jeopardizing the ability of subsequent generations to meet their own needs and the World Business Council for Sustainable Development promotes the triple bottom line of sustainability-environmental quality, economic prosperity and social equity.[7] All United Nations (U.N.) member nations adopted Sustainable Development Goals (S.D.G.s) in 2015 to eradicate poverty, protect the environment and attain prosperity by 2030,[2,8] According to Pradhan *et al*., (2017),[8] the only way to address the global sustainability problem of assuring human well-being, economic prosperity and environmental protection is to successfully execute the SDG agenda. Global businesses are also getting highly aware of the sustainability agenda, which covers a wide range of topics from "green" production to social justice issues affecting the greater community.[9,10] A majority of CEOs believe that assimilating sustainability in their business models, including meeting social needs and minimizing environmental damage is extremely important, according to a large-scale global study conducted by Cooper, (2014).[11] Due to this recent change, businesses are now incorporating sustainability into many aspects of their operations, including supply chain management, staff training and new product creation.[12]

The term "social media" refers to platforms like blogs, wikis, content sharing, social networking and social bookmarking that allow communication through technology.[7] It differs from conventional media because it enables a two-way interactive experience between stakeholders and organizations rather than media outlets broadcasting information to ordinary people without any immediate reaction or response.[13] Social networking is an example of a social structure that shows the various contexts in which social actors-individuals, groups and organizations-operate and includes their social interactions and communications.[14] Scientific research and technology

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advancements are seen as the main drivers of national development in the contemporary knowledge economy.[15] The topic of culture and society has changed because of technological advancement like social media in both positive and negative ways.[16] In the end, social media and networking sites give negative as well as positive qualities to society and the impact of social media, just like any significant platform or innovation.[17] On social media, peers naturally communicate with one another, which has promoted knowledge exchange and the spread of significant information.[18] Social media as an interactive platform lowers the barriers to social interaction, making it a powerful instrument for involving many people in today's societal challenges.[19]

LITERATURE REVIEW

One of the earliest studies on the significance of using social media to spur interest in environmental measures with the ultimate goal of better conveying sustainability challenges was conducted by Kanter and Fine, (2010).[20] Their research indicates how social media sites can actively promote sustainability and environmental awareness. Social media technology may make it easier to communicate psychological, sociological, or concrete variables that can affect pro-environmental behavior, such as a sustainability production program.[21] Because of its alleged ability to tap into a variety of information sources and encourage invention among a larger network of users and partners, Social Media-Driven Open Innovation (SMOI) in the form of online channels like innovation hubs is expanding quickly.[22]

Given that this study is one of the earliest to investigate the existing literature on sustainability in social media, there are several bibliometric studies already conducted on both the topics separately. Table 1 presents a summary of the existing prominent bibliometric review based papers on social media and sustainability based on their citation frequency.

RESEARCH GAP

Top of Form

This study comprehensively evaluates the intersection of social media and sustainability, addressing the growing popularity of these domains. Social media, a key information source, plays a crucial role in promoting sustainable practices and raising awareness of related challenges. Recent advancements in research have spurred active contributions from various countries, institutions and authors. Unlike previous studies focusing on social media or sustainability separately, this research provides an integrated analysis. The study aims to fill this research gap by offering a detailed performance analysis and science mapping of key players, including journals, authors, papers and keywords in sustainability in social media research. By combining quantitative and qualitative assessments, the study provides insights for academics and researchers, guiding future research directions and highlighting emerging topics and themes in this combined field.

Here are some of the research questions aimed to be answered in this study:

RQ1: How are sustainability in social media research publications and their citations broken down statistically?

RQ2: How well do the various scientific players, such as sources, authors, countries, papers and keywords, perform in sustainability in social media research?

RQ3: How is the field of sustainability in social media changing and what are the main research themes?

RQ4: What potential research directions are there?

The paper is structured as follows: Section 2 presents the methodology adopted in this research. Analysis of the selected literature has been presented in section 3. Section 4 includes the discussion and conclusion and section 5 has the limitations and the future research agenda followed by relevant references.

METHODOLOGY

Data collection

Data were extracted using the keywords “sustainability” or “sustainable” and “social media” or “social networks” or “social networking” present in the article title or keywords. 1056 papers made up the initial data set, which was further constrained in four steps by the inclusion and exclusion of certain criteria. The data was first restricted to only “English" language yielding 1043 documents. Only “Articles” and “Book chapters” published in “Journals” or as “Books” were kept which produced 783 documents. Finally, documents in their final stage of publication were considered as the main dataset which consisted of 757 papers. These papers were reviewed to map the performance of various contributors, including authors, journals, countries and institutions that have made advancements in the field, as well as to identify the most crucial themes in sustainability in social media literature. The data for this study was extracted on 20th July, 2023.

Search string

TITLE (“sustainability” OR “sustainable”) AND TITLE (“social media” OR “social network” OR “social networking”) OR KEY (“sustainability” OR “sustainable”) AND KEY (“social media” OR “social network” OR “social networking”) AND (LIMIT-TO (LANGUAGE, “eng”) AND (LIMIT-TO (DOCTYPE, “ar”) OR ((LIMIT-TO (DOCTYPE, “bookch”) AND (LIMIT-TO (SOURCETYPE, “jr”) OR (LIMIT-TO (SOURCETYPE, “book”) AND (LIMIT-TO (PUBSTAGE, “fin”).

Data analysis strategies

Alan Pritchard first proposed the idea of bibliometrics or bibliometric analysis in 1969. But the study of bibliographies in a specific topic only emerged in the 19th century.[38] Since the

Table 1: Focus of previous bibliometric analysis papers.

Sl. No.	Document	Time Period	Focus of the Study	No. of papers referred	Database
1	(X. Chen *et al.*, 2018)[23]	2009-2017	To investigate the current state of research and the future growth trends in the area of event detection in social media.	565	Web of Science
2	(Rita and Ramos, 2022)[24]	2001-2022	To examine the intellectual, conceptual and social knowledge of sustainability and consumer behavior in e-commerce research.	104	Scopus
3	(Gangurde *et al.*, 2022)[25]	2013-2021	Bibliometric Analysis of Deep Learning and Machine learning articles in Hostile, Hate and Abusive speech on social media.	321	Scopus
4	(Hossain *et al.*, 2022)[26]	2019-2021	This paper examined growth and country collaboration on Social Media (SM) research during the COVID-19 pandemic through a systematic review and citation and network analyses.	519	Web of Science
5	(Gardazi *et al.*, 2023)[27]	1975-2021	Examined the emergence and evolution of research in the subject of corporate sustainability performance.	1,518	Scopus
6	(Hoang *et al.*, 2023)[28]	2008-2022	Examined the knowledge structure of research on social media usage in supply chain management.	354	Web of Science
7	(Effah *et al.*, 2023)[29]	2004-2021	Investigated the topic of sustainability reporting by identifying contributing authors, institutions, locations and current hotspots in the field using keyword co-occurrence analysis.	1,624	Web of Science
8	(Bhatt *et al.*, 2022)[30]	2019-2021	To comprehend and map the scientific literature and evolutionary subtleties in the COVID-19 and tourism sustainability research fields.	440	Scopus
9	(Dima *et al.*, 2022)[31]	1976-2021	Investigated the topic of frugal innovation (FI) and how it contributes to business sustainability.	2072	Web of Science
10	(Li *et al.*, 2023)[32]	2004-2021	To investigate the conceptual framework and influential components of the family firm sustainability literature.	131	Scopus
11	(Zyoud *et al.*, 2018)[33]	2004-2014	To explore the trend of the literature in the field of psychology connected to the most popular social networks all over the world (i.e., LinkedIn, Facebook, Snapchat, Twitter and Instagram).	959	Web of Science
12	(Noor *et al.*, 2020)[34]	2009-2019	To investigate the most significant journals, institutions and countries in knowledge management-related social media literature.	234	Web of Science
13	(Pasko *et al.*, 2021)[35]	1981-2020	To comprehend the intellectual environment of worldwide research on sustainable reporting.	Scopus-928, Wos- 374	Web of Science, Scopus
14	(Zhang *et al.*, 2023)[36]	1995-2022	To give a thorough knowledge mapping and in-depth analysis of plastic and sustainability research in order to better understand emerging global trends and directions in this sector.	1933	Web of Science
15	(Jia *et al.*, 2019)[37]	1990-2019	To investigate current sustainability research published over the last three decades.	37,322	Web of Science

introduction of the Internet, which improved contact among researchers worldwide and allowed for quick access to the findings in a given area, the field has dilated enormously.[39]

According to current trends in bibliometric research,[40,41] several complementary bibliometric analyses were used[42] based on a database search that adhered to the systematic review protocol to provide a thorough map of the knowledge structure of the connection[43] between social media and sustainability.

The data for this investigation were found using the SCOPUS database. SCOPUS contains almost 36,377 titles from roughly 11,678 publishers (22,794 active titles and 13,583 inactive titles), of which 34,346 are peer-reviewed journals in the top-tier subject areas of life sciences, social sciences, physical sciences and health sciences.[44] It is also evolving into a platform that connects associations, research concepts and researchers.[25]

The VOSviewer software from the Centre for Science and Technology Studies at Leiden University in Leiden, the Netherlands, has been used for the bibliometric examination of the research area.[45] VOSviewer is frequently used in bibliometric analysis, particularly in theme, graphical and cluster analysis.

Bibliometrics makes it possible to draw insightful conclusions from academic analysis of citations, co-citations, geographic distribution and keyword frequency in the literature in a particular field of study which aids researchers and decision-makers in understanding the themes and patterns of the development

Table 2: Overview of documents on sustainability in social media.

Items	Findings	Document Type	Share	% of Share
Total documents	757	Article	744	98.8%
Total journals	327	Book chapter	9	1.2%
Total authors	2268			
Average authors	1.009			
Cited documents	652			
Total citations	13274			
Average citations	17.6			

Table 3: Top 30 highly cited documents.

Ranking	Author and year	Title	TC	TCpY
1	(Butler, 2001)[46]	Membership Size, Communication Activity and Sustainability: A Resource-Based Model of Online Social Structures.	632	28.7
2	(Chabowski *et al.*, 2011)[47]	The structure of sustainability research in marketing, 1958-2008: A basis for future research opportunities.	329	27.4
3	(Dubey *et al.*, 2016)[48]	The impact of big data on world-class sustainable manufacturing.	246	35.14
4	(Casper, 2007)[50]	How do technology clusters emerge and become sustainable? Social network formation and inter-firm mobility within the San Diego biotechnology cluster.	214	13.37
5	(Abbas, *et al.*, 2019)[16]	The impact of social media on learning behavior for sustainable education: Evidence of students from selected universities in Pakistan.	195	48.75
6	(La *et al.*, 2020)[49]	Policy response, social media and science journalism for the sustainability of the public health system amid the COVID-19 outbreak: The Vietnam lessons.	186	62
7	(Hicks *et al.*, 2016)[51]	Engage key social concepts for sustainability.	173	24.7
8	(Geissinger *et al.*, 2019)[52]	How sustainable is the sharing economy? On the sustainability connotations of sharing economy platforms.	151	37.75
9	(Neumeyer and Santos, 2017)[53]	Sustainable business models, venture typologies and entrepreneurial ecosystems: A social network perspective.	146	20.85
10	(Manetti and Bellucci, 2016)[54]	The use of social media for engaging stakeholders in sustainability reporting.	138	19.7

Table 4: Top 10 authors based on total publications and citations.

Based on total publications						VS	Based on total citations					
Ranking	Country/ Institution	Authors	No. of Papers	TC	TC/ paper		Ranking	Country/ Institutions	Authors	TC	No. of papers	TC/ paper
1	Canada	Ann Dale	5	147	29.4		1	United States	Brian S. Butler	632	1	632
2	Germany	Nina Kolleck	5	92	18.4		2	Saudi Arabia	Mohammad Nurunnabi	332	4	83
3	Taiwan	Ming Lang Tseng	5	122	24.4		3	United Kingdom	Theodoros Papadopoulos	246	1	246
4	Czech Republic	John Amoah	4	19	4.75		4	France	Samuel Fosso Wamba	246	1	246
5	South Korea	Sunghae Jun	4	76	19		5	Vietnam	Quon Hoang Vuong	197	2	98.5
6	South Korea	Sungmin Kang	4	12	3		6	France	Thu Trang Vuong	197	2	98.5
7	Saudi Arabia	Mohammad Nurunnabi	4	332	83		7	Sweden	Christian G. Sandrom	190	2	95
8	South Korea	Sangsung Park	4	88	22		8	Japan	Hong Kong To Nguyen	186	1	186
9	Iran	Sajjad Shokouhyar	4	46	11.5		9	Vietnam	Khanh- Linh P. Nguyen	186	1	186
10	Singapore	Jacob G. Wood	4	72	18		10	Vietnam	Minh Hoang Nguyen	186	1	186

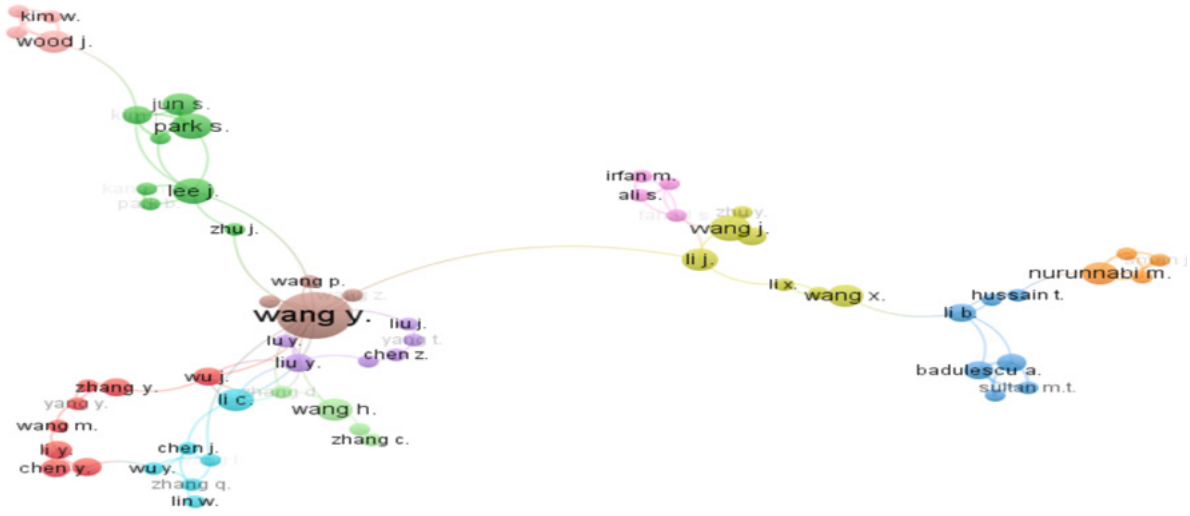

Figure 1: Network map of author collaborations.

of research in a certain area and helps them comprehend the limitations and gaps of earlier studies.

Overview of dataset

The first research on "Sustainability in social media" on SCOPUS appeared in 2001, but it began to gain steam in 2009. The analysis used a total of 757 papers from 2268 different authors that were published in 327 journals. Of these, 652 (86%) have at least one citation in the Scopus database, giving a total of 13274 citations. The average number of citations per document for these publications was 17.5 and the average number of authors per document was 3. It appears that the three subject

areas that contributed the most were "social sciences" (23.8%), "environmental science" (21.2%) and "Energy" (16.1%). Table 2 provides a summary of the documents used in this study.

Analysis

This section includes an investigation of the important trends in the sustainability in social media research as per different parameters such as the number of yearly publications, the performance of authors, institutions, journals and territories based on productivity and citation count; and an analysis of the most and least popular keywords to identify scope for future research in the area. To properly understand the evolutionary processes that have constituted the area, citation analysis, co-citation analysis, bibliographic coupling and keyword co-occurrence analysis have been applied.

Research growth

Apart from a slight decline in 2015, the area had been expanding at a decent clip, with a significant jump between 2019 and 2021 indicating a growing interest and importance. 2021 saw the peak and a sharp decline in the number of publications was observed afterwards. The increase between 2019 and 2021 could be due to growing digital usage as a result of COVID-19.

Table 3 presents the top 10 documents as per the number of citations they have received. Butler. (2001),[46] Chabowski *et al.* (2011),[47] Dubey *et al.* (2016)[48] were the top 3 documents with the highest citation count. Total Citation per year (TCpY) was also calculated for the top 10 documents to identify those that did well on an annual average. This forms a more accurate basis for analyzing their performance as the articles were published in different time periods. With yearly average citations of 62, 48.75 and 38.67 respectively, La *et al.*, (2020).[49] Abbas, *et al.*, (2019) [16] and Dubey *et al.*, (2016)[48] were the top three documents with the highest average citations.

Most productive authors

In recent years, sustainability in social media has garnered substantial research interest. Since 2001, top authors Ann Dale, Nina Kolleck and Ming Lang Tseng have each published 5 documents (2% of total). Table 4 lists the top 10 authors by document count and citations. Brian S. Butler, Mohammad Nurunnabi and Theodoros Papadopoulos lead in citations per paper. Brian S. Butler holds the highest average citation, receiving 632 on a single paper, followed by Theodoros Papadopoulos and Samuel Fosso Wamba, co-authoring a paper cited 246 times.

Only Mohammad Nurunnabi, among the top authors with the most publications, ranked among the top 10 cited authors with 332 citations from 4 articles. Various factors like accessibility, journal quality and overall researcher profile can impact citation counts. Further investigation is needed to understand the factors influencing the citation count of an article.

Author collaborations

VOSviewer generated a network map (Figure 1) to illustrate author collaborations, considering authors with at least two publications. Out of 195 such authors, 62 had collaboration history. Lines connecting circles represent collaborations, with circle size indicating frequency. Yu Wang leads with collaborations with 15 authors, followed by Joonhyuck Lee (6 collaborators). Sangsung Park, Jacob G Wood, Jing Wang, Benqian Li and Mohammad Nurunnabi each collaborated with at least 4 authors. With a few notable instances, the collaborative efforts between authors do not seem particularly outstanding.

The map also reveals distinct author clusters in different colors (red, green, yellow, blue and purple). Each cluster represents authors who collaborate more frequently than average. In the brown cluster, Wang Y has the largest circle, signifying high collaboration frequency. Notably, Wang Y collaborates extensively with authors like Wang P., Zhigang Wang and Dalia Streimikiene

Table 5: Top 10 institutions based on total publications and citations.

Sl. No.	Institution	Country	Total Documents	TC	TC/ paper
1	Chung-Ang University	South Korea	10	70	7
2	Hong Kong Polytechnic University	Hong Kong	9	184	20.44
3	Kyung Hee University	South Korea	8	78	9.75
4	Chongqing University	China	7	194	27.7
5	Wageningen University and Research	Netherlands	7	154	22
6	Dalian University of Technology	China	7	159	22.7
7	University of Electronic Science and Technology of China	China	7	65	9.28
8	Prince Sultan University	Saudi Arabia	7	341	48.57
9	University of Bern	Switzerland	7	141	20.14
10	University of Oxford	United Kingdom	7	344	49.14

Table 6: Top productive journals VS Top cited journals.

Based on total publications						vs	Based on total citations					
Sl. No.	Journal	ISSN No.	No. of Papers	TC	TC/ paper		Sl. No.	Journal	ISSN No.	TC	No. of Papers	TC/ paper
1	Sustainability Switzerland	20711050	257	2180	10.04		1	Sustainability (Switzerland)	20711050	3574	257	13.9
2	Journal of Cleaner Production	0959-6526	19	246	8.4		2	Journal of cleaner production	0959-6526	700	19	36.84
3	Environmental Science and Pollution Research	0944-1344	9	528	33		3	Information systems research	10477047	632	1	632
4	International Journal of Environmental Research and Public Health	1660-4601	9	81	6.2		4	Journal of the academy of marketing science	15527824	329	1	329
5	Sustainable Development	09680802	9	7	0.5		5	Technological forecasting and social change	0040-1625	309	7	44.14
6	British Food Journal	0007070X	7	4	0.44		6	Journal of sustainable tourism	0966-9582	279	7	42.42
7	Journal of Sustainable Tourism	0966-9582	7	125	13.8		7	International journal of advanced manufacturing technology	14333015	246	1	246
8	Technological Forecasting and Social Change	0040-1625	7	101	14.4		8	Research policy	00487333	232	3	77.33
9	Business Strategy and The Environment	09644733	6	186	26.5		9	Business strategy and the environment	09644733	215	6	35.33
10	Frontiers In Psychology	16641078	6	25	4.1		10	Sustainable development	09680802	201	9	22.33

within the same cluster, surpassing collaborations with members from other clusters.

Institution-wise analysis

Articles on sustainability in social media involve 1873 institutions worldwide. The Top 3 universities contributing the most publications are Chung-Ang University (South Korea), Hong Kong Polytechnic University (Hong Kong) and Kyung Hee University (South Korea).

Table 5 outlines the top 10 universities, detailing their total publications, total citations and average citations per document. The University of Oxford and Prince Sultan University lead in total citations (344 and 341, respectively) and average citations per document (49.14 and 48.57). Noteworthy citation ratios are also seen in Chongqing University and Dalian University of Technology from China, with average citations of 27.7 and 22.7. The top institutes predominantly hail from South Korea, China and European countries, while notable institutions from South

Table 7: Top productive countries VS Top cited countries.

Based on total publications					vs	Based on total citations			
Ranking	Countries	No. of Papers	TC	TC/ paper		Countries	TC	No. of papers	TC/ paper
1	China	134	2054	15.32		United States	3656	130	28.12
2	United States	130	3656	28.12		United Kingdom	2168	75	28.9
3	United Kingdon	75	2168	28.9		China	2054	134	15.32
4	South Korea	55	717	13.03		Italy	798	44	18.13
5	Canada	45	762	16.93		Canada	762	45	16.93
6	Italy	44	798	18.13		South Korea	717	55	13.03
7	Germany	40	672	16.8		Australia	682	37	18.43
8	Spain	40	481	12.02		Germany	672	40	16.8
9	Australia	37	682	18.43		Saudi Arabia	646	23	28.08
10	Netherlands	29	632	21.79		Netherlands	632	29	21.79

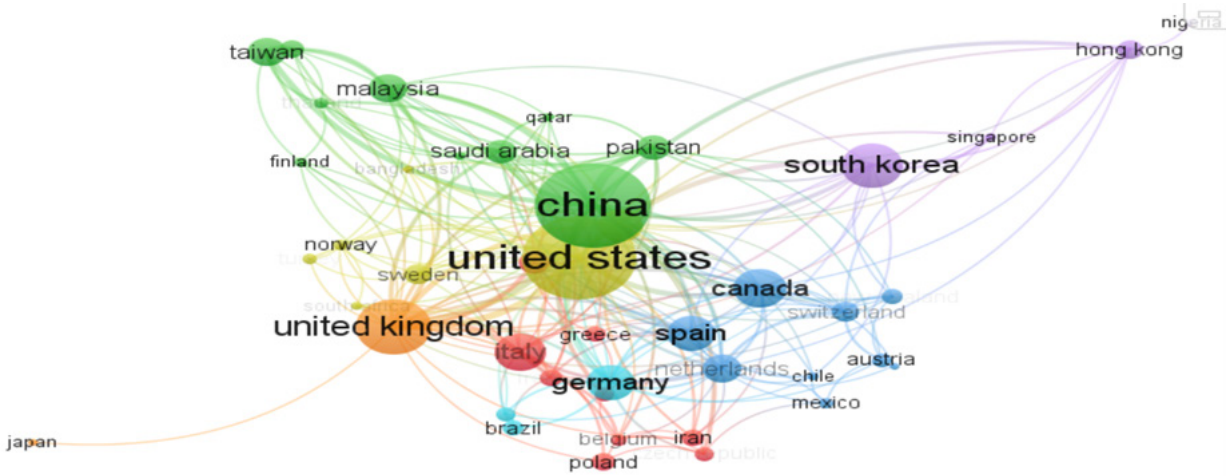

Figure 2: Network map showing collaborative relations between various countries.

Asian, American and African countries are absent from the list. Top of Form

Top source journals

This section provides an overview of key journals contributing to the field. The dataset comprises articles from 404 journals, averaging 20.9 citations and 2.47 papers per journal. Table 6 provide an overview of the top journals. Sustainability (Switzerland) leads with 217 publications (21.8% of total) and 2180 citations (25.8%). Other top journals include Global Sustainability, Journal of Cleaner Production and Journal of Sustainable Tourism. The International Journal of Retail and Distribution Management has the highest average citations (112 per document), followed by the Journal of Product Innovation Management (111) and MIS Quarterly: Management Information Systems (66). Notably, Sustainability (Switzerland) has the most citations overall, but only averages 10 citations per article, suggesting its high overall citation may be due to a large number of publications.

Country-wise analysis

Table 7 outlines the top 10 most productive and highly cited countries in sustainability in social media research. Among 83 countries publishing on the subject, 65 have produced at least two research works. The leading countries, each with at least 29 papers, are China, the United States, the United Kingdom and South Korea. Spain, Italy, Canada, Australia and Germany also make notable contributions to sustainability in social media research.

Saudi Arabia, despite having the least number of documents among the top countries, ranks third in average citations (28.08), following the United States (28.12) and the United Kingdom (28.9). Notably, no South Asian country, such as India, Bangladesh, Pakistan, Sri Lanka, etc., emerged as a top contributor in sustainability in social media research.

Continent- wise analysis

A continent-wise analysis was also carried out where the top three contributors were Asia (435 papers), Europe (414 papers) and

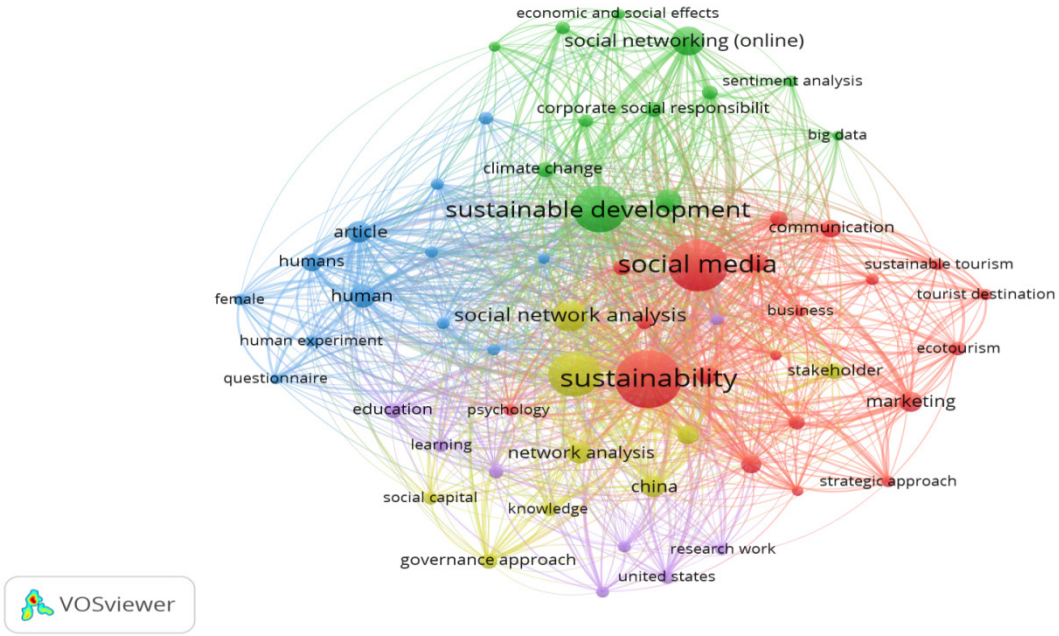

Figure 3: Network map of keyword co-occurrences.

Table 8: Keyword clusters with the number of keyword occurrences.

Cluster 1- Business, Marketing and Tourism	Cluster 2 - Climate change and Sustainable development goals	Cluster 3 - Education	Cluster 4- Innovation and Governance	Cluster 5 - Demographics and General research terms
Keyword with Occurrences	Keyword with Occurrences	Keyword with Occurrences	Keyword with Occurrences	Keyword with Occurrences
Business (15) Business development (15) Communication (39) Consumption behavior (25) COVID-19 (30) Decision making (46) Ecotourism (27) Marketing (54) Numerical model (26) Perception (47) Psychology (19) Public attitude (15) Strategic approach (19) Sustainable tourism (17) Tourism (17) Tourist destination (19)	Big data (15) Climate change (28) Corporate social responsibility (28) Economic and social effects (15) Planning (22) Sentiment analysis (17) Sustainable development (269) Sustainable development goal/s (36) Twitter (25)	Education (29) Higher education (17) Information and communication technology (17) Learning (23) Research work (16) Student (20) University sector (16)	Governance approach (28) Innovation (44) Knowledge (22) Network analysis (61) Social capital (23) Stakeholder (33)	Conceptual framework (17) Female (16) Human experiment (16) Questionnaire (15)

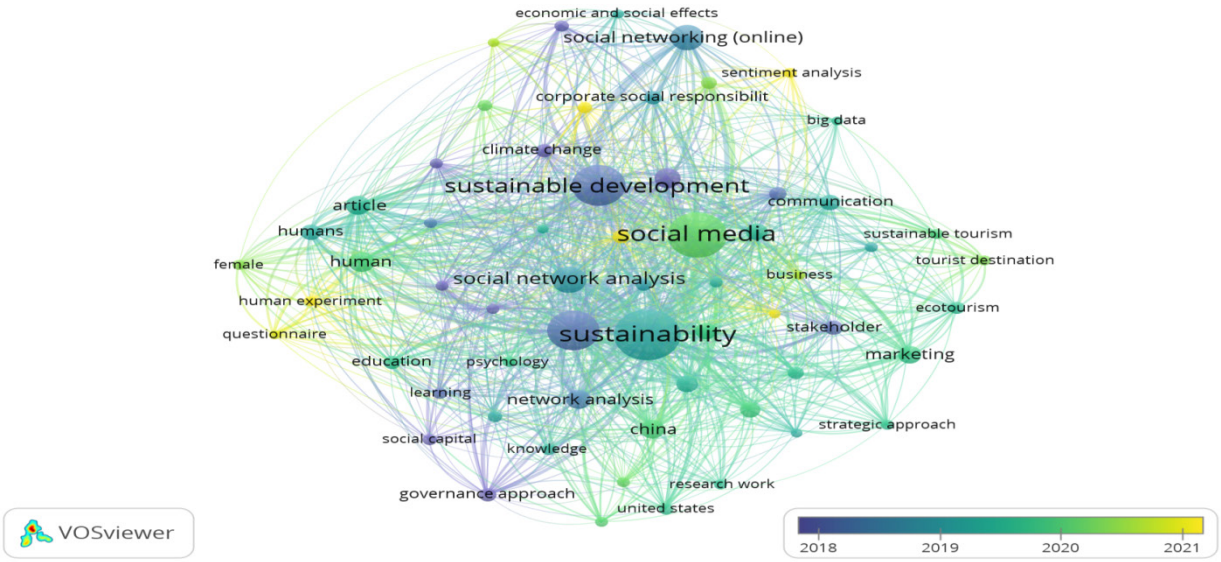

Figure 4: Timeline of Keyword occurrences.

Figure 5: Top keyword trends in different years.

North America (183 papers), with respective shares of 38.12%, 36.28% and 16.03% of the total publications. On the other hand, Africa, Oceania and South America together had less than 15% contribution in the total literature on the topic.

Country collaboration

A network map of the nations that have a high frequency of collaboration with other nations on research about sustainability in social media is depicted in Figure 2. For the map, only countries with a minimum of 5 documents and 30 citations were selected. It is evident by the size of their circles on the map that China, US, UK, South Korea, Canada, Germany, Spain, etc. seem to be the countries with high collaborative performance. Countries such as Japan, Chile, Qatar, Nigeria need to improve their collaborations with other countries.

Research Keyword Analysis

The study of the co-occurrence of keywords in the articles' content is based on the theory that a research specialization can be recognized by the specific correlations generated between its keywords.[55] 61 keywords with a minimum of 15 occurrences were taken into consideration for analysis in this section. Sustainable development (269), Marketing (54), Perception (47), Decision

making (46), Innovation (44) were some of the keywords with the highest occurrences.

To further simplify the analysis of the co-occurrence of keywords, a network map has been created to show the connectivity and the density of keywords (Figure 3). In the map, the subject appears to be dominated by five interconnected clusters of topics: Red cluster (Business, Marketing and Tourism), Green cluster (Climate change and Sustainable development goals), Purple cluster (Education), Yellow cluster (Innovation and Governance) and Blue cluster (Demographics and General research terms), (Table 8). Each cluster represents keywords which have been studied together more often compared to those from other clusters.

Timeline analysis of keywords

To establish the timeline of the popular keyword occurrences in recent years, Figure 4 displays an overlay visualization of the keywords occurring between 2018-2023. The diagram's presentation of the keywords in different colors indicates the years in which they were most popular. In studies conducted at the start of 2018, terms such as social capital, governance approach, network analysis and learning were often used. Information and communication, ecotourism, big data and innovation were popular in 2019 and 2020. In 2021, additional concepts such as "sentiment analysis," "COVID 19," "pandemic" and "advertising" received increased attention. Numerous research on the pandemic was conducted between 2020-2022, as COVID-19 spread was at its peak during this period.

To further elaborate the timeline analysis, data was procured for different sets of periods to find out the most popular keywords in those years. Figure 5 categorizes the top keywords with the highest occurrence for each duration into different clusters.

DISCUSSION

The prominent keyword clusters such as Business, Marketing and Tourism; Climate Change and Sustainable Development Goals; Education, Innovation and Governance; and Demographics and General Research Terms have been discussed below.

Cluster 1: Business, marketing and tourism

Researchers in cluster 1 focussed on the business, marketing and management aspect of sustainability in social media. Many studies in this cluster also had a prominent focus on tourism. He, (2022)[56] explored the role of online media on sustainable business development and decision making. Almaghlouth, (2022)[57] studied online discourses on sustainability and investigated how environmental sustainability has been developed within the Saudi arabia internet discourse. The study indicated that the Saudi discourse on environmental sustainability has had an important impact in raising the public's awareness of environmental problems and encouraging participation in debates on topics such as deforestation. Ali *et al*., (2022)[58] assessed the purchase intention and green consumption behavior of millennials towards a sustainable environment. They investigated the role of social media in shaping consumption behaviors among millennials, taking into account eco-branding, eco-labeling, social norms and purchase intentions in order to encourage green consumption and reduce carbon emissions. Ali *et al*., (2022)[58] concluded that social media has a profoundly positive impact on shaping and influencing youths' behaviors towards green consumption, resulting in increased intention towards a sustainable environment and decreased carbon emissions. Conte *et al*., (2018)[59] analyzed how leading healthcare organizations use Facebook to promote their sustainability, with a focus on distinct components of the 3Ps (people, profit and planet) and interactive communication tactics used on social media. Their findings suggest that the social component of sustainability triumphs over environmental and economic concerns, while it does not appear to improve consumer engagement. Pucci *et al*., (2021)[60] investigated how customers' attitudes towards adopting a sustainable diet may be influenced by their social media usage. They discovered that there is a lot of diversity across countries and that there is no "one variable fits all" solution, thus each country should use various marketing tactics to urge people to have sustainable diets.

Cluster 2: Climate change and Sustainable development

The primary emphasis of researchers in the cluster was on topics such as sustainable development, sustainable development goals, climate change and corporate social responsibility. The whole sustainability research in a way contributes to these terms and these topics are the basis for expanding the sustainability debate further. Can and Alatas, (2017)[61] studied the harmful social and environmental implications caused by unsustainable business practices and elaborated the impact of social media and big data towards 2030 sustainable development objectives. Furthermore, they conclude that the adoption of measures created for resolving various social network analysis issues with the aim to attain sustainable development goals and manage big data will contribute in some manner to each sustainable development objective. Oppong-Tawiah and Webster, (2023)[62] examine deceptive communication on twitter in the disguise of corporate social responsibility, usually referred to as greenwashing. According to Oppong-Tawiah and Webster, (2023)[62] there is mounting evidence that time is running out for satisfying internationally agreed-upon environmental sustainability goals and preventing large-scale, potentially fateful changes in our natural environment. Under these conditions, if greenwashing goes unchecked, especially by extremely polluting companies, it can be highly detrimental by attracting stakeholders into passivity.[62] Carella and Monachesi, (2018)[63] conducted a behavioral analysis of data from social media to assess the elderly people's attitude towards environmental issues and they argue that may exert a significant influence on involving the elderly in

care practices of other humans and especially of nature, thereby actively contributing to sustainable development. A study by Akoh and Lekhanya, (2022)[64] aiming to better understand the impact of networking challenges on social entrepreneurs and their contribution to long-term development concluded that networking issues continue to be a barrier to the value generation of social entrepreneurs. Alexander, (2018)[65] studied the difficulties encountered by a group of interns and students working for a non-profit sister firm of a private US-based property development company planning to establish a "sustainable city" in the Panamanian jungle. They explored the difficulties of the rural Panamanian people with contaminated drinking water and illnesses caused by it.

Cluster 3: Education

Research papers in cluster 3 revolve around terms relating to education and related keywords. Istenic Starcic *et al*., (2018)[66] studied how much students' perceptions of personal, academic and digital aspects affect their sustainable development (SD) awareness, SD behavioral intention and SD lifestyle. Personal characteristics were identified as the most important determinants of SD behavioral intention, while academic predictors were identified as the most important predictors of SD awareness.[66] Kolleck *et al*., (2017)[67] compared how climate change education is negotiated and implemented within and through the UN Framework Convention on Climate Change (UNFCCC) global conferences with how the UN Decade of education for sustainable development is implemented through networks. They proposed that social networks play a particularly important role in policy domains such as climate change education and education for sustainable development, which are best described as multi-level and multi-actor governance. Dür and Keller, (2019)[68] investigated the impact of the research-education collaboration 'AustrIndia-4QOL' (Teenagers from Austria and India Perform Quality of Life Research) on teenagers' awareness of the importance of environmental aspects in terms of quality of life, as well as their willingness to act towards more sustainable lifestyles. The findings suggest that conducting education for sustainable development necessitates long-term educational engagement and that unforeseen consequences cannot be ruled out.[68]

Cluster 4: Innovation and Governance

The papers in cluster 4 revolve around innovation, governance and stakeholders. Manetti and Bellucci, (2016)[54] studied whether online interaction via social media, including Facebook, Twitter and YouTube, is an effective stakeholder engagement strategy for defining the contents of Social, Environmental, or Sustainability Reporting (SESR). Only a small percentage of organizations engage stakeholders using social media to define the contents of SESR and the level of interaction is often modest.[54] Du *et al*., (2016)[69] investigates the roles of sustainability and Social Media driven inbound Open Innovation (SMOI) for a firm's New Product Development (NPD) performance in. Stevens *et al*., (2016)[70] presented social media as a medium where multiple players and games converge and, via their interactions, form emergent dynamics with implications for agro-food sustainable governance. They conclude that, while a large amount of self-communication on social media creates an emergent force that undermines agrofood governance, it also creates data that powerful parties can use to reclaim control.

Cluster 5: Demographics and General research terms

Cluster 5 consisted of most frequently occurring research terms such as conceptual framework, female, human experiment and questionnaire. It could be assumed that studies with a female demographic were in majority in comparison to other genders. Park *et al*., (2015) developed a social network analysis and measurement-based strategy for selecting sustainable technology. The network analysis model was created using graph theory and statistics. Serna *et al*., (2021)[71] offered a method for processing user-generated information in order to obtain a high accuracy and resilient sentiment analysis model about transportation modes at the review level. They also give a transport classification score based on the sustainability of the transport types observed in the use case dataset. Using the Importance-Performance Analysis (IPA) technique, Chen *et al*., (2021)[72] built an evaluation framework for Sustainable Forest Management (SFM) development based on local perspectives in a rural area of Taiwan. Mukherjee and Wood, (2021)[73] studied to determine whether the digitalization of Unorganized Retail (UR) businesses in emerging markets has a positive socioeconomic impact on the lives of subsistence consumer-merchants who serve as both consumers and managers of micro-UR businesses. They create a framework for long-term business model innovation at the bottom of the pyramid by conducting content analysis on 65 newspaper articles (interviews with senior executives and founders of digital app-based platforms, expert analysis), as well as social media and YouTube testimonials from UR business users in Vietnam, Indonesia, Malaysia and the Philippines.

CONCLUSION

This study evaluates global research trends in sustainability in social media, encompassing 757 publications by 2268 authors, accumulating 13274 citations. The peak in publications occurred in 2021, with the most substantial growth observed between 2019 and 2021, followed by a decline. Ann Dale, Nina Kolleck and Ming Lang Tseng were prolific authors, while Brian S. Butler had the highest average citations per document. Wang Y. led in author collaborations. Chung-Ang University (South Korea) emerged as the top university and the University of Oxford (United Kingdom) led in citations and average citations per document. Top journals included Sustainability Switzerland, Journal of Cleaner Production and Environmental Science and Pollution Research. Leading countries in research production were China,

the United States, the United Kingdom, South Korea, Canada and Italy. Europe and Asia dominated research output by continent, followed by North America. Keyword clusters such as Business, Marketing and Tourism; Climate Change and Sustainable Development Goals; Education, Innovation and Governance; and Demographics and General Research Terms were prominent in the analyzed articles.

FUTURE RESEARCH AGENDA AND LIMITATIONS

The frequency of keyword co-occurrence, as well as the bustiness of terms and clusters obtained, may aid in determining the key research directions in a field.[29] Although keywords consisting of "sustainable development," "corporate social responsibility," "climate change," and "ecotourism" have received a lot of attention because they are fundamental to the field, other keywords like "marketing," "perception," "decision making," "innovation," "communication," "stakeholder" and “Governance Approach” have also gotten equal attention all giving a business perspective to the domain. In addition to these keywords, which have maintained their popularity over the course of the study, a number of other keywords have grown in popularity in recent years. Studies relating to collective action, public health, environmental economics and Conservation Of Natural Resources have started to gain popularity in the years between 2021- 2023. Several studies targeting developing countries and their policies have also started to gain attention in these years only. Apart from these, some rare or infrequent keywords can also be useful to study further such as sustainable water management, virtual reality, waste disposal, water pollution, etc. Artificial intelligence, machine learning, big data and natural language processing are examples of advanced approaches that can automate analysis and produce detailed insights.[74] Newer advancements and tools from these domains such as chat gpt would add up to the effectiveness of analysis for future studies. Most of the studies in the domain of sustainability in social media were related to the business sector, specifically the tourism sector. Some studies also paid attention to the education, energy and agriculture sector. Whereas, a very small amount of research was dedicated to governance and its policies. Other industries important for the sustainability agenda such as the fashion industry, construction, transportation and technology also have huge scope for future study. There aren't many studies that are specifically focused on a certain generation or age bracket, such as millennials, boomers, or Gen Z. Future studies might focus on a particular generation or age group. Even while Asia has produced a large amount of research work on sustainability in social media, the graph of different Asian countries is uneven. Where China had the highest publications and South Korea was in the top 10, authors from other countries such as India, Indonesia, Thailand, Nepal, Malaysia, etc. need to contribute more. Africa, Oceania and South America together contributed less than 15% to the total literature. This symbolizes an opportunity for authors from these regions to produce more research work. Cross-author collaborations may also result in innovative ideas that would improve the sustainability in social media research and progressively uncover novel findings. Additionally, it appeared that after 2021, when there was a real need for deeper studies in the field, there was a steep fall in research on sustainability in social media. As a result, academics from all regions of the world must continue to work diligently on the subject and more collaboration between authors from various institutions and locations would aid in the discovery of the field's deeper subfields.

Even while this study seeks to thoroughly evaluate the bibliographic elements of research in the domain of sustainability in social media, it is not free of certain limitations. Only papers listed in Scopus were included in the search. While Scopus is one of the largest databases in the world, not all articles on sustainability in the social media field have been included there. Other international databases, such as PubMed or Web of Science, could be used for future studies. The dataset taken for the study comprised 757 papers limited to only articles and book chapters produced in English language, which may not have included all of the research papers relevant to our area of interest. As opposed to this investigation, which analyzed sustainability in social media across disciplines to present a larger perspective of the trends, studies focusing on individual academic fields in connection to sustainability in social media can show even more exciting arenas and may open newer worlds of research. As they have lesser occurrence in the earlier studies, areas like behavioral research, social marketing, supply chain management, business development, cultural heritage, food waste, governance approach, management practice, tourism development, urban area, artificial intelligence, detection method, information and communication technology, social sustainability and social media marketing could be investigated for additional research. While the current study is a comprehensive analysis of different scientific players of the sustainability in social media research, a comparative analysis of other fields related to the sustainability in social media could help policymakers and researchers to understand the level of attention and focus on the topic. This paper uses the number of publications and citations to measure the impact of the existing literature, future studies may use any other indicator such as media coverage or policy influence. The study majorly uses quantitative methods, a qualitative analysis of successful practical applications and interviews with different players such as authors and journals could provide deeper insights into the field.

Bibliometric analysis of sustainability in social media research will be advantageous to both academics and professionals in several ways. The first advantage of this study is that it will enlighten them about the history, development and current trends of sustainability in social media. Academics will be able to identify areas that still require more research.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

SD: Sustainable development; **SDG:** Sustainable Development Goals; **U.N.:** United Nations; **SMOI:** Social Media-Driven Open Innovation; **SM:** Social Media; **FI:** Frugal innovation; **3Ps:** people, profit and planet; **UNFCCC:** UN Framework Convention on Climate Change; **SESR:** Social, Environmental, or Sustainability Reporting; **NPD:** New Product Development; **IPA:** Importance-Performance Analysis; **SFM:** Sustainable Forest Management; **UR:** Unorganized Retail.

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