Sustainability and Finance in Developing Nations: Current State and Future Directions

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Abstract

Using the bibliometric analysis on a corpus of 492 Scopus-indexed documents, this study comprehensively analyses the literature on sustainable finance, revealing significant growth from one article in 1991 to 53 in 2024, with 2023 being the peak publication year. The highest citations occurred in 2020, totaling 1,531. Saini, N. and Singhania, M. are among the most productive authors, while Rehman, M.A. leads in citations. Garcia A.S. ranks first among the most cited authors. The Journal of Cleaner Production is the most productive and cited journal. Universitas Indonesia and Kwame Nkrumah University Malaysia are the top productive institutions. Keyword analysis highlights "Sustainable Development" as a central theme, with emerging markets prominently featured. Gracia A.S. leads collaborative research activities, indicating strong interdisciplinary cooperation in sustainable finance.

Keywords: *Sustainability; Bibliometric analysis; Finance; Developing nations; Literature review*

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1. Introduction

The synergy between finance and sustainability has gained significant attention in recent years, highlighting the necessity of addressing these interconnected fields simultaneously (Carolina Rezende De Carvalho Ferrei et al., 2016). This evolving discourse presents numerous opportunities to explore their interconnections. Key areas of focus include the institutional foundations within capital markets (Gray, 2011), the increasing importance of environmental, social, and corporate governance (ESG) criteria (Nikolakis et al., 2012), the influence of investments (Hebb, 2013), and issues related to climate change and human rights (Alm & Sievänen, 2013). Additionally, socially responsible investment (SRI) has become a pivotal theme (Vandekerckhove & Leys, 2012). Chow (2011) underscores the ethos of sustainable investment, rooted in a commitment to community and environmental well-being, transcending cultural boundaries and advocating for responsible resource allocation.

The nexus between finance and sustainability holds particular significance within capital markets, where investors increasingly prioritize moral values and SRI in their portfolios (Gray, 2011). Investments manifest in diverse forms, reflecting the heterogeneous nature of investors within societies—from capital providers to consumers and community stakeholders (Bloxham, 2011a). Acknowledging this diversity is paramount for a comprehensive understanding of sustainable finance, necessitating a standardized definition of investors (Bloxham, 2011b).

No published article has comprehensively reviewed the intersection of sustainability and finance in developing countries. By synthesizing existing literature, our review aims to elucidate prevailing research, identify gaps and inconsistencies, and offer insights into the nuanced relationship between sustainability and finance. Grounded in stakeholder theory (Freeman, 1984), which advocates value creation for all stakeholders, and the triple bottom line

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concept (Elkington, 1994), which expands financial metrics to encompass social and environmental dimensions, our review also draws upon modern portfolio theory adapted to incorporate ESG factors (Markowitz, 1952). Moreover, the efficient market hypothesis posits that markets, if efficient, should integrate ESG information into asset prices, reflecting their impact on financial performance (Fama, 1970).

The burgeoning literature on sustainability and finance in developing nations reflects a diverse landscape of research, policy analyses, and practical interventions to foster sustainable development trajectories. This body of work examines the efficacy of various mechanisms in mobilizing capital towards environmentally friendly projects and social enterprises in developing contexts (Littlewood & Holt, 2018; Corson, 2010; Di Domenico *et al.*, 2010; Bhatt & Altinay, 2013). Studies on green bonds, microfinance initiatives, and impact investing underscore their catalytic role in driving innovation and inclusive growth, mainly where traditional financing avenues are limited (Cicchiello *et al.*, 2022; Zhang & Umair, 2023; Bhutta *et al.*, 2022; Kedia & Joshipura, 2023). Regulatory frameworks and governance structures emerge as pivotal determinants in shaping the interface between sustainability and finance (Wang *et al.*, 2024; Onyeka Chrisanctus Ofodile *et al.*, 2024; Yinka James Ololade, 2024), with policy interventions such as carbon pricing mechanisms and sustainable banking regulations influencing investment practices and mitigating environmental risks (Khurshid *et al.*, 2023; Rastegar *et al.*, 2024; Santos, 2022).

Given this context, a comprehensive analysis of the existing literature is essential to proceed with theoretical understanding and inform policy and practice in the field. This review will address the diverse perspectives on the relationship between sustainability and finance by thoroughly evaluating the existing literature. To achieve this, we employ a scientific bibliometric analysis to uncover the key bibliometric attributes and research themes related to this subject area (Basu *et al.*, 2023; Bhaskar et al., 2022, 2023; Cumming *et al.*, 2023; Donthu *et al.*, 2021; Kumar *et al.*, 2023; Lal et al., 2023; Mukherjee *et al.*, 2022; Pandey et al., 2023, 2024). Through this bibliometric review, we aim to illustrate the trends and directions of prior research on sustainability and finance in developing countries and to provide future research directions. This extensive review is a significant effort to explore the association between sustainability and finance from a bibliometric perspective, highlighting current themes and future research prospects in developing countries. Accordingly, we specifically investigate several research questions (RQs):

RQ1. *What are the year-by-year publication and citation trends in the literature on sustainability and finance?*

RQ2. *Which articles, journals, authors, and institutions are the most influential in sustainability and finance in developing countries?*

RQ3. *How do authors, journals, affiliated nations, and documents on sustainability and finance in developing countries engage in bibliographic coupling?*

RQ4. *What do the keywords co-occurrence analysis and co-authorship network reveal about sustainability and finance in developing countries?*

RQ5. *Where should future research focus to enhance understanding of the relationship between sustainability and finance in developing countries?*

The analysis reveals five major significant themes in sustainability and finance in developing countries. "Navigating Sustainability Research Across Industries and Geographies", "Exploring interconnections: FDI, Sustainability, and Economic Growth in Emerging Markets", "Examining the association between Financial Characteristics and Environmental, Social, and Governance (ESG) Performance: Insights from Global Studies",

"Exploring the Dynamics between Corporate Social Responsibility (CSR) and Firm Performance: Insights from Diverse Studies", "Exploring Intersections: Sustainability Performance and Firm Dynamics across various Contexts".

The next sections of the paper are organized as follows: Section 2 explains the research methodology. Section 3 shows the results of the bibliometric analysis. Section 4 provides the conclusions and discusses the findings. Finally, Section 5 outlines the future research directions from this study.

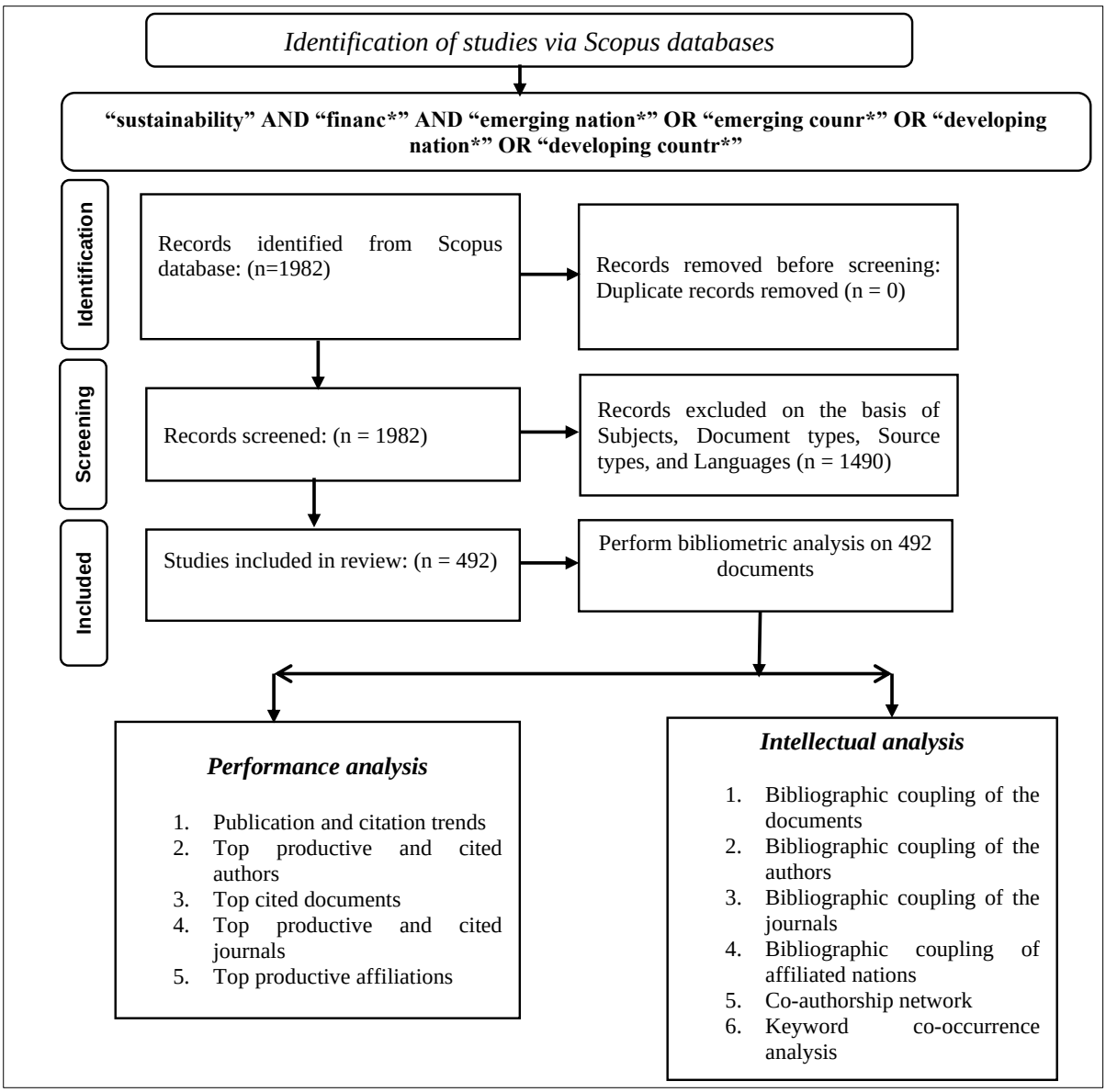

Figure 1. PRISMA Framework 2020

2. Research methodology

This paper delves into the literature on Sustainability and Finance in developing nations, using bibliometric analysis techniques to evaluate research papers quantitatively and qualitatively, and suggests future research directions based on its findings (Donthu et al., 2021; Yu et al., 2020). To facilitate this analysis, the study utilizes both Biblioshiny and Gephi software (Viswalekshmi et al., 2023; Majiwala & Kant, 2023). Gephi aids in visualizing networks and analyzing various aspects such as citation patterns, co-authorship networks, keyword co-occurrence, and bibliographic coupling (Kocak et al., 2019). On the other hand,

Biblioshiny facilitates data collection and analysis across multiple dimensions, including document analysis, thematic mapping, and conceptual structuring (Mougenot & Doussoulin, 2023). Figure 1 showcases the PRISMA framework, detailing the search query utilized to retrieve all relevant papers for inclusion in the analysis.

2.1. Defining search query

The study reviewed papers from Elsevier's Scopus database because it has a vast collection of indexed journals (Mahato et al., 2023) and is widely acknowledged as a solid alternative to the Web of Science (Harzing & Alakangas, 2016). Global literature on sustainability and finance in developing nations from 1991 to May 11, 2024, was examined using a comprehensive search string comprising key terms to retrieve all relevant papers. The search query, which includes *"sustainability" AND "financ*" AND "emerging nation*" OR "emerging countr*" OR "developing nation*" OR "developing countr*,"* was conducted across titles, abstracts, and keywords to ensure relevance to the study's theme. The search string was validated by ensuring it could successfully identify known primary studies.

2.2. Refinement of search results

For this study, documents were obtained from the Scopus database on May 11, 2024, using the specified search criteria, yielding 1982 search results (see Figure 1). The retrieved documents encompass various types, including research and review papers, which undergo an extensive peer-reviewed process (Lim et al., 2022). Furthermore, the selected source type is limited to journals, which contribute significantly to the body of knowledge across various subjects, such as business and economics, directly relevant to commerce (Lim et al., 2022). Ultimately, 492 English-language documents were chosen for the bibliometric analysis.

3. Results of bibliometric analysis

In the existing literature, four main approaches to conducting systematic literature reviews are identified: domain-based, theory-based, method-based, and meta-analytical reviews (Paul & Criado, 2020). Bibliometric analysis falls under the domain-based systematic literature review category, which focuses on collecting and utilizing quantitative information to describe, evaluate, and monitor published literature on a given topic (Donthu et al., 2021). This methodology enables the analysis of topical interests, related documents, social networks, significant publishers, and influential articles. By examining a large volume of scientific data within a specific field, this study employs bibliometric analysis to uncover explored and emerging research areas. Such bibliometric studies assist researchers in determining future research directions within relevant fields and identifying suitable publication outlets, relevant publications, and esteemed authors based on citation counts and research trends to guide their studies (Agbo et al., 2021).

3.1. Completeness of bibliographic metadata

Figure 2 illustrates the completeness of bibliography metadata regarding sustainability and finance in developing countries, offering insights into the reliability of data extracted from the Scopus database. This figure, generated using the Biblioshiny software, assesses various metadata descriptors, including abstract, author, document type, journal, language, publication year, title, total citation, affiliation, cited references, and keywords. Each descriptor is assigned a status indicating its quality: excellent, good, acceptable, critical, or completely missing. For our analysis, we have exclusively included descriptors with an excellent or good status to ensure the reliability and robustness of our data.

Metadata	Description	Missing Counts	Missing %	Status
AB	Abstract	0	0.00	Excellent
AU	Author	0	0.00	Excellent
DT	Document Type	0	0.00	Excellent
SO	Journal	0	0.00	Excellent
LA	Language	0	0.00	Excellent
PY	Publication Year	0	0.00	Excellent
TI	Title	0	0.00	Excellent
TC	Total Citation	0	0.00	Excellent
C1	Affiliation	3	0.61	Good
CR	Cited References	7	1.42	Good
DE	Keywords	26	5.28	Good
DI	DOI	32	6.50	Good
RP	Corresponding Author	81	16.46	Acceptable
ID	Keywords Plus	329	66.87	Critical
WC	Science Categories	492	100.00	Completely missing

Figure 2. Completeness of bibliographic metadata

3.2. Main information

Table I provides an extensive overview of a dataset from 1991 to 2024, comprising 492 documents sourced from 270 journals, books, and other publications. Notably, the dataset demonstrates a robust annual growth rate of 12.78%, indicative of a vibrant and continually evolving field of study. With an average document age of 5.38 years, the dataset prioritizes recent research, underscoring its relevance and timeliness. Moreover, each document garners an impressive average of 24.34 citations, highlighting its significance and impact within the scholarly community. Collaboration is also evident, with 72 single-authored documents and an average of 3.04 co-authors per document, further emphasizing the cooperative nature of academic research. Additionally, the dataset reflects international engagement, with 33.13% of documents featuring co-authorships across borders, fostering a diverse and global perspective within the field.

3.3. Trend in publications and citations:

Table 2 presents the trend of publications and citations concerning sustainability and finance literature, and Figure 3 visualizes the same. With only one article in 1991, the total number of publications totaling 53 in 2024. However, significant growth has been evident in recent years. The most publications are found in 2023, with 91 articles, followed by 60 articles in 2022. Moreover, in 2020, the publications garnered the highest total citations (1531), followed by 1093 citations in 2021.

Further, it is evident from the table that no articles are cited in 2007 and 2008. However, 2023 garnered the highest number of cited publications, with 67 articles, followed by 52 in 2022. 2005 and 2004 received the highest average citations, amounting to 135.40 and 100, with five and three total cited articles, respectively. Additionally, 2024 shows a decline in total publications (53) and total cited publications (23), with 55 total and 1.04 average citations.

Table 1. Main information

Description	**Results**
MAIN INFORMATION ABOUT DATA	
Timespan	1991:2024
Sources (Journals, Books, etc)	270
Documents	492
Annual Growth Rate %	12.78
Document Average Age	5.38
Average citations per doc	24.34
References	30093
DOCUMENT CONTENTS	
Keywords Plus (ID)	1395
Author's Keywords (DE)	1671
AUTHORS	
Authors	1413
Authors of single-authored docs	69
AUTHORS COLLABORATION	
Single-authored docs	72
Co-Authors per Doc	3.04
International co-authorships %	33.13
DOCUMENT TYPES	
Article	471
Review	21

Table 2. Publications and citations trend

Year	**TP**	**TC**	**TCP**	**AC**
1991	1	22	1	22.00
1993	1	5	1	5.00
1995	1	19	1	19.00
1996	2	83	2	41.50
1998	1	28	1	28.00
2000	2	104	2	52.00
2002	2	21	1	10.50
2003	2	54	2	27.00
2004	4	402	3	100.50
2005	5	677	5	135.40
2006	4	89	4	22.25
2007	10	417	0	41.70
2008	5	451	0	90.20
2009	4	51	4	12.75
2010	6	320	6	53.33
2011	10	742	9	74.20
2012	14	449	13	32.07
2013	14	552	9	39.43
2014	11	137	9	12.45
2015	8	198	8	24.75
2016	14	247	11	17.64
2017	14	756	14	54.00
2018	25	968	25	38.72
2019	29	976	27	33.66
2020	52	1531	50	29.44
2021	47	1093	46	23.26
2022	60	877	52	14.62
2023	91	635	67	6.98
2024	53	55	23	1.04

Notes: TP- total publications, TC- total citations, TCP- total cited publications, and AC- average citations.

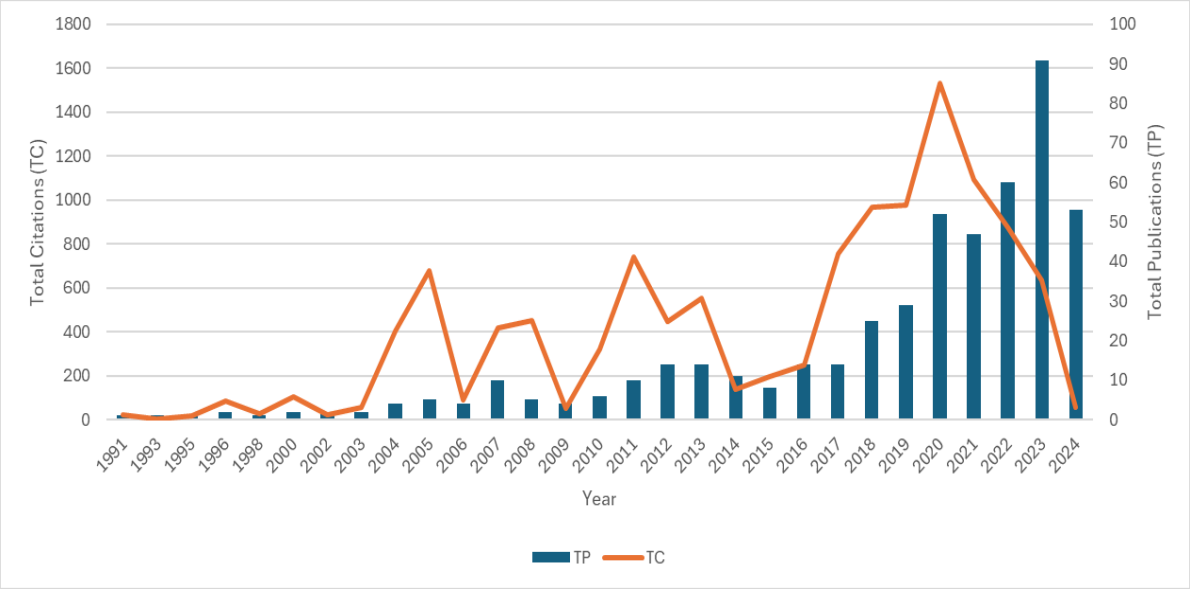

Figure 3. Trend in publications and citations

3.4. Most productive authors and most cited authors

Table 3a provides details of the top seven most productive authors in the field of sustainability and finance with the total link strength (TLS), total publications, total citations, and average citations. Saini, N. and Singhania, M. lead with 498 TLS across four publications with 205 total citations and 51.25 average citations. This is followed by Rahman, H.U. and Zahid, M., having 381 TLS across three publications. In terms of total and average citations Rehman, M.A. ranks first with 83 total citations and 27.67 average citations, followed by Murshed, M. with 81 total citations and 27 average citations. The top seven listed authors have a minimum of three and a maximum of four publications.

Table 3a. Top productive authors

Authors	TLS	TP	TC	AC	PGRK
Saini, Neha	498	4	205	51.25	0.037202
Singhania, Monica	498	4	205	51.25	0.051546
Murshed, Muntasir	117	3	81	27.00	0.018284
Rahman, Haseeb Ur	381	3	66	22.00	0.021642
Rehman, Mubeen Abdur	176	3	83	27.67	0.033589
Zahid, Muhammad	381	3	66	22.00	0.084559
Owusu-Manu, De-Graft	1	3	31	10.33	0.013091

Notes: TLS= Total link strength, PGRK = Page rank

Table 3b. Top cited authors

Authors	TLS	TP	TC	AC	PGRK
Garcia, Alexandre Sanches	76	2	447	223.50	0.016909
Saini, Neha	498	4	205	51.25	0.037202
Singhania, Monica	498	4	205	51.25	0.051546
Buallay, Amina	640	2	143	71.50	0.015999
Fadel, Sayed M.	640	2	143	71.50	0.018099
Saudagaran, Shahrokh	640	2	143	71.50	0.045523
Raut, Rakesh D.	2	2	84	42.00	0.016027
Rehman, Mubeen Abdur	176	3	83	27.67	0.033589
Murshed, Muntasir	117	3	81	27.00	0.018284

Notes: TLS= Total link strength, PGRK = Page rank

Table 3b offers insights into this field's top nine most cited authors. It is evident from the table that Buallay, A., Fadel, S.M. and Saudagaran, S. are the top cited authors with 640 TLS across two publications. In terms of total and average citations, Garcia, A.S. holds the

position first with 447 total citations and 223.5 average citations per publication. All the nine top-cited authors have a minimum of two and a maximum of four publications.

Table 4. Top cited documents

Authors	Title	Source title	TC	AC
Garcia et al. (2017)	Sensitive industries produce better ESG performance: Evidence from emerging markets	Journal of Cleaner Production	362	51.71
Powlson et al. (2011)	Soil management in relation to sustainable agriculture and ecosystem services	Food Policy	361	27.77
Braa et al. (2004)	Networks of action: Sustainable health information systems across developing countries	MIS Quarterly: Management Information Systems	342	17.10
Chan et al. (2018)	Critical barriers to green building technologies adoption in developing countries: The case of Ghana	Journal of Cleaner Production	307	51.17
Zbinden and Lee (2005)	Paying for Environmental Services: An analysis of participation in Costa Rica's PSA program	World Development	306	16.11
Hartarska and Nadolnyak (2007)	Do regulated microfinance institutions achieve better sustainability and outreach? Cross-country evidence	Applied Economics	294	17.29
Li et al. (2008)	Tourism development of World Heritage Sites in China: A geographic perspective	Tourism Management	279	17.44
Pizzi et al. (2020)	Management research and the UN sustainable development goals (SDGs): A bibliometric investigation and systematic review	Journal of Cleaner Production	274	68.50
Goyal et al. (2013)	Corporate sustainability performance and firm performance research: Literature review and future research agenda	Management Decision	269	24.45

3.5. Most cited documents

Table 4 displays the list of the nine most cited articles, including publication year, authors, source title, total citations, and average citations. In terms of total citations, "Sensitive industries produce better ESG performance: Evidence from emerging markets" ranks first with 362 total citations. "Soil management in relation to sustainable agriculture and ecosystem services" ranked second with 361 total citations, followed by "Networks of action: Sustainable health information systems across developing countries" with 342 total citations. In terms of average citations, "Management research and the UN sustainable development goals (SDGs): A bibliometric investigation and systematic review" leads with 68.5 citations, followed by "Sensitive industries produce better ESG performance: Evidence from emerging markets" and "Critical barriers to green building technologies adoption in developing countries: The case of Ghana" both having 51.71 citations.

3.6. Most productive journals and most cited journals

Table 5a highlights 14 top productive journals, with details such as "TLS," "total publications," "total citations," and "average citations." The "Journal of Cleaner Production" stands out with 443 TLS and 32 publications. "Journal of Cleaner Production" maintained its position with 2351 total citations, while "Resources, Conservation and Recycling" leads with 81.67 average citations, followed by "World Development" with 78.6 average citations. Table 5b illustrates 14 top-cited journals. "Journal of Cleaner Production" leads with 2351total citations across 32 publications, followed by "World Development", "Management Decision", and "Resources, Conversation and Recycling" with 786, 498 and 490 total citations across 10, 3 and 6 publications, respectively. Meanwhile, "Management Decision" and "Applied Economics" lead with average citations of 166 and 150, respectively.

Table 5a. Top productive journals

Journals	TLS	TP	TC	AC
Journal of Cleaner Production	443	32	2351	73.47
Resources Policy	227	18	295	16.39
Environment, Development and Sustainability	203	16	120	7.50
World Development	61	10	786	78.60
International Journal of Energy Economics and Policy	14	8	32	4.00
Corporate Governance (Bingley)	108	7	101	14.43
Cogent Business and Management	213	7	34	4.86
Business Strategy and The Environment	194	6	173	28.83
Social Responsibility Journal	174	6	226	37.67
International Journal of Productivity and Performance Management	171	6	291	48.50
Business Strategy and Development	133	6	35	5.83
Economies	32	6	19	3.17
Journal of Sustainable Finance and Investment	86	6	216	36.00
Resources, Conservation and Recycling	40	6	490	81.67

Notes: TLS- total link strength, TP- total publications, TC- total citations, AC- average citations

Table 5b. Top cited journals

Journals	TLS	TP	TC	AC
Journal of Cleaner Production	443	32	2351	73.47
World Development	61	10	786	78.60
Management Decision	115	3	498	166.00
Resources, Conservation and Recycling	40	6	490	81.67
Applied Economics	11	2	300	150.00
Resources Policy	227	18	295	16.39
International Journal of Productivity and Performance Management	171	6	291	48.50
Technology in Society	50	4	284	71.00
Social Responsibility Journal	174	6	226	37.67
Technological Forecasting and Social Change	95	4	218	54.50
Journal of Sustainable Finance and Investment	86	6	216	36.00
Meditari Accountancy Research	105	4	175	43.75
Business Strategy and The Environment	194	6	173	28.83
Environment, Development and Sustainability	203	16	120	7.50

Notes: TLS- total link strength, TP- total publications, TC- total citations, AC- average citations

3.7. Most productive institutions

Table 6 highlights 10 top productive institutions affiliated with sustainability and finance. "Universitas Indonesia" ranked first with 17 articles. "Universiti Sains Malaysia" secured second position with 13 articles, followed by "Kwame Nkrumah University of Science and Technology" and "Makerere University Business School," with 12 and 9 articles, respectively.

Table 6. Top productive Institutions

Affiliation	Articles
UNIVERSITAS INDONESIA	17
UNIVERSITI SAINS MALAYSIA	13
KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY	12
MAKERERE UNIVERSITY BUSINESS SCHOOL	9
UNIVERSITY OF WATERLOO	9
YORK UNIVERSITY	9
NATIONAL INSTITUTE OF INDUSTRIAL ENGINEERING	8
UNIVERSITAS AIRLANGGA	8
UNIVERSITY OF DELHI	8
UNIVERSITY OF DHAKA	8

3.8. Co-occurrence analysis of author's keywords

Figure 4 displays a keyword co-occurrence analysis of authors' keywords. Initially, there were 1,671 total author keywords, but after setting a threshold of at least five occurrences, 59 keywords met the criterion between 1991 and 2024. The keyword co-occurrence analysis

presents a visually captivating depiction centred on the theme of "Sustainable Development," intricately weaving together various interconnected concepts and geographical regions. At its core lies the pivotal node of "Sustainable Development," serving as the nexus from which several key areas emanate, including "Sustainability," "Corporate Social Responsibility," "Financial Development," and "Renewable Energy." Each of these branches extends further, delving into more specialized topics or specific regions, thereby illuminating sustainable development's global and multifaceted dimensions. For instance, the node "Renewable Energy" forms links with "Economic Development" and "Natural Resources," elucidating the intricate relationship between environmental stewardship and economic progress. Moreover, the inclusion of geographical tags such as "India," "China," "Ghana," and "Nigeria" underscores a deliberate focus on emerging markets and developing nations, shedding light on their distinctive roles and challenges within the broader discourse on sustainability.

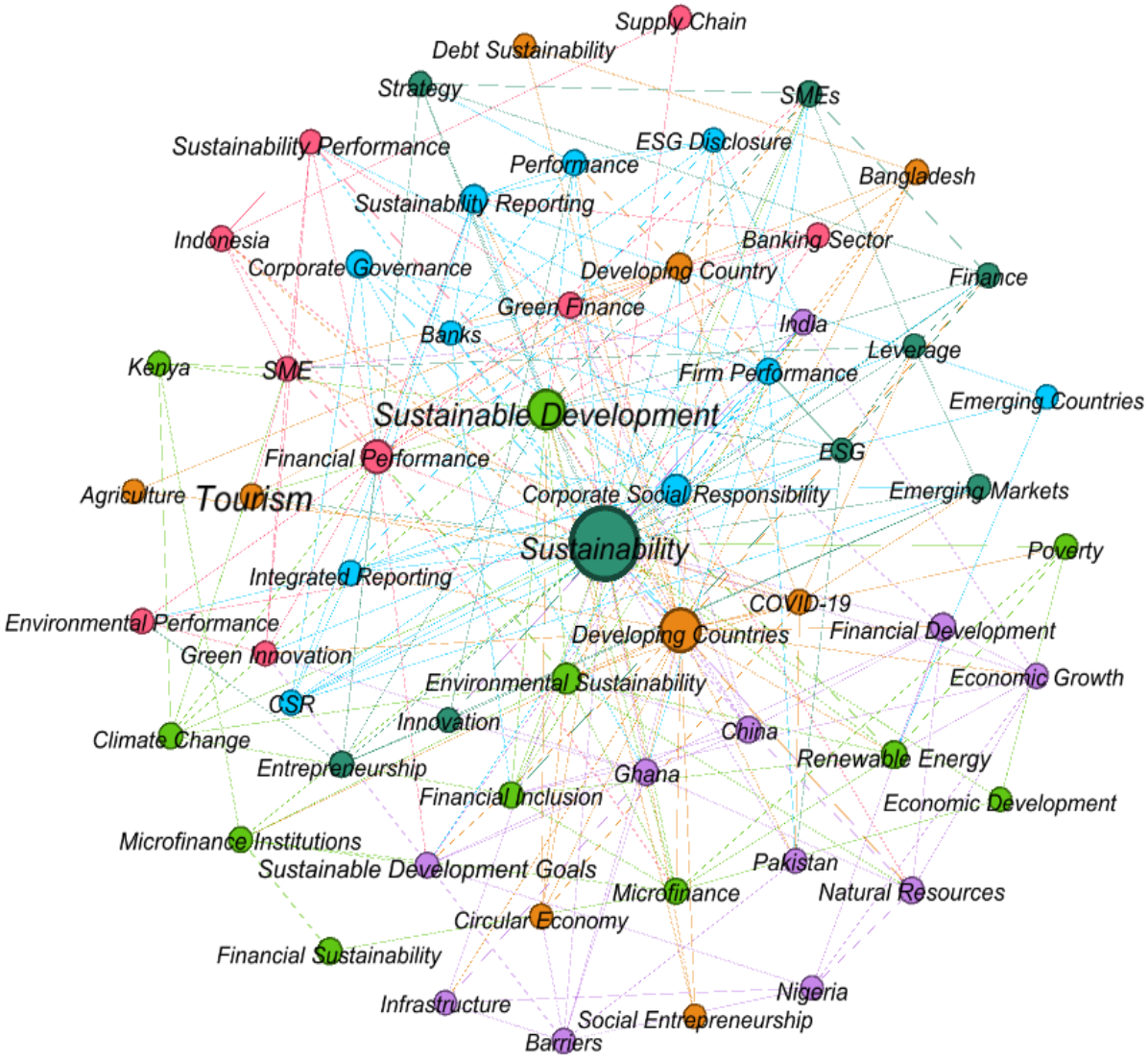

Figure 4. Keyword co-occurrence network - Total keywords 1671, 59 met threshold of 5 occurrences.

3.9. Co-authorship network analysis of authors

Figure 5 displays the authors' co-authorship network. Initially, there are 1,444 authors, but after setting a threshold of at least two documents and five citations, only 35 major co-authorship networks meet the criteria. Alexandre Sanches Gracia has the largest node, followed

by Shahrokh Saudagaran, Muhammad Zahid, Monica Singhania, and Sayed M. Fadek. These authors are actively engaged in collaborative research activities in sustainability and finance.

3.10. Bibliographic coupling

Bibliographic coupling is an analytical method in intellectual exploration predicated on the notion that publications with shared references likely cover similar topics (Kessler, 1963; Weinberg, 1974). Its primary aim is to classify publications into thematic clusters based on their shared references, with optimal effectiveness observed when conducted within a defined timeframe (Zupic & Cater, 2015). As a result, this approach can provide insight into the present state of research within a given field (Donthu et al., 2021).

3.10.1. Bibliographic coupling of documents

Figure 6 depicts the bibliographic coupling of documents. Initially, there were 492 documents. However, after applying a minimum threshold of 50 citations, 57 documents meet the criteria, and all are connected. For this analysis, we have created five bibliographic clusters, each named according to the thematic similarities observed among the documents within each cluster.

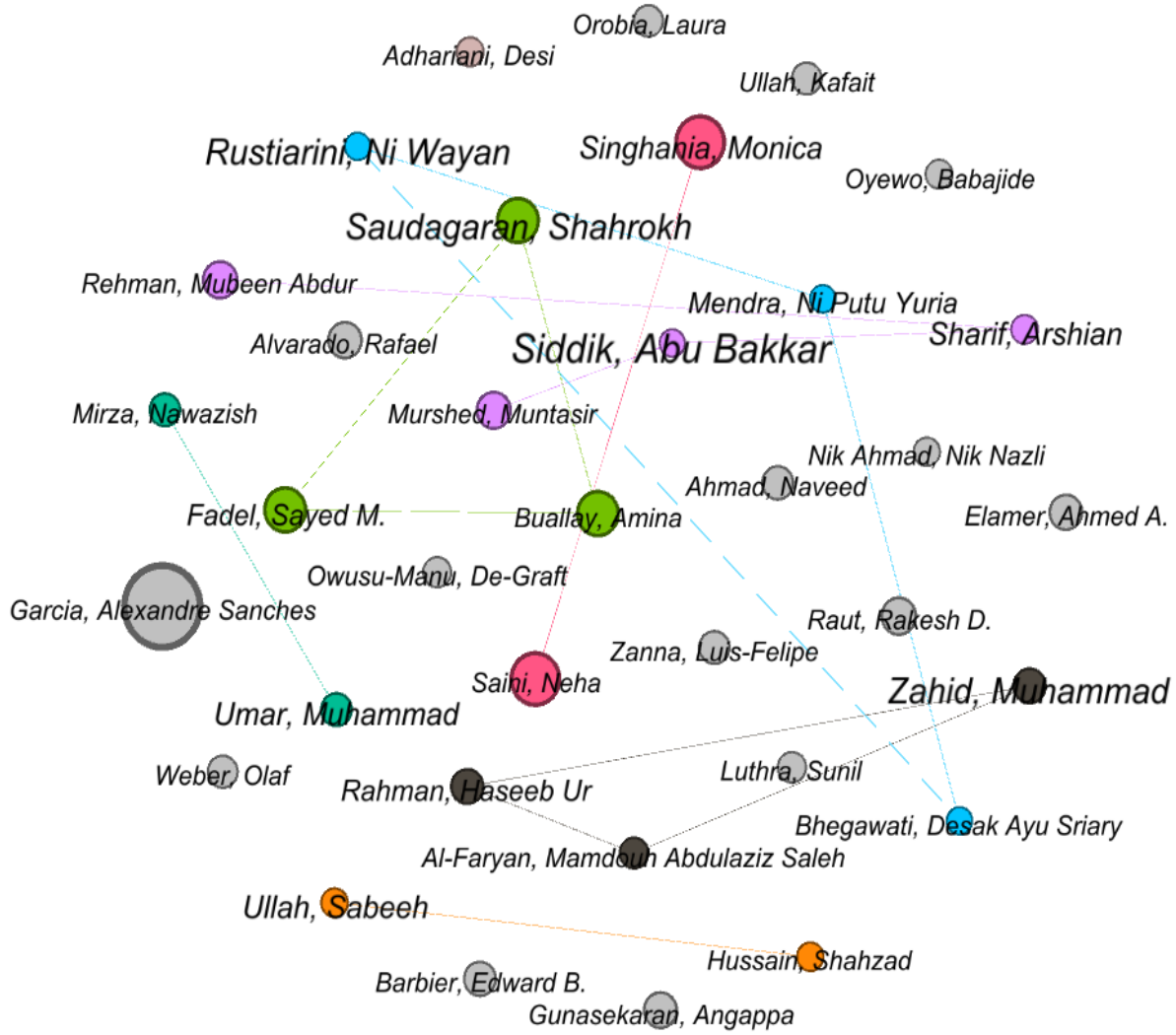

Figure 5. Co-authorship network - Total authors 1444, 35 met threshold of 2 doc and 5 citations.

Cluster 1: Navigating Sustainability Research across Industries and Geographies:

Chan et al. (2018) authored the most cited document in this cluster, garnering 307 citations. Their study delves into the primary barriers hindering the adoption of Green Building

Technologies (GBTs) in the Ghanaian construction market. They identified 20 critical barriers, with government-related hurdles emerging as particularly significant, highlighting the pivotal role of governmental involvement in promoting GBTs adoption in Ghana. Following closely is Pizzi et al. (2020), with 274 citations, conducting a systematic inquiry utilizing bibliometric and systematic literature review methodologies to investigate the relationship between scientific knowledge on Sustainable Development Goals (SDGs) and the business sector. Their study identified four main research themes: technological innovation, firms' contributions in developing countries, non-financial reporting, and education for SDGs. Agyemang et al. (2019) rank third in citations with 229, examining the key drivers and obstacles to implementing Circular Economy (CE) principles in Pakistan's automobile manufacturing industry. Their findings reveal that profitability, market share, and environmental concerns are primary drivers, while lack of awareness, financial constraints, and scarcity of expertise are major barriers to CE implementation in Pakistan's automotive sector. Rosca et al. (2017) explored the intersection of frugal and reverse innovation with sustainability, highlighting how enterprises adeptly integrate business model elements to create economic, social, and environmental value. Lastly, Borsatto and Amui (2019) investigated the impact of environmental regulation severity and international competitiveness on Green Innovation (GI) efforts in industrial sectors across Developed Countries (MEDC) and developing countries (LEDC). Their study illustrates that this relationship can vary in correlation, influenced by factors such as company size and internationalization levels.

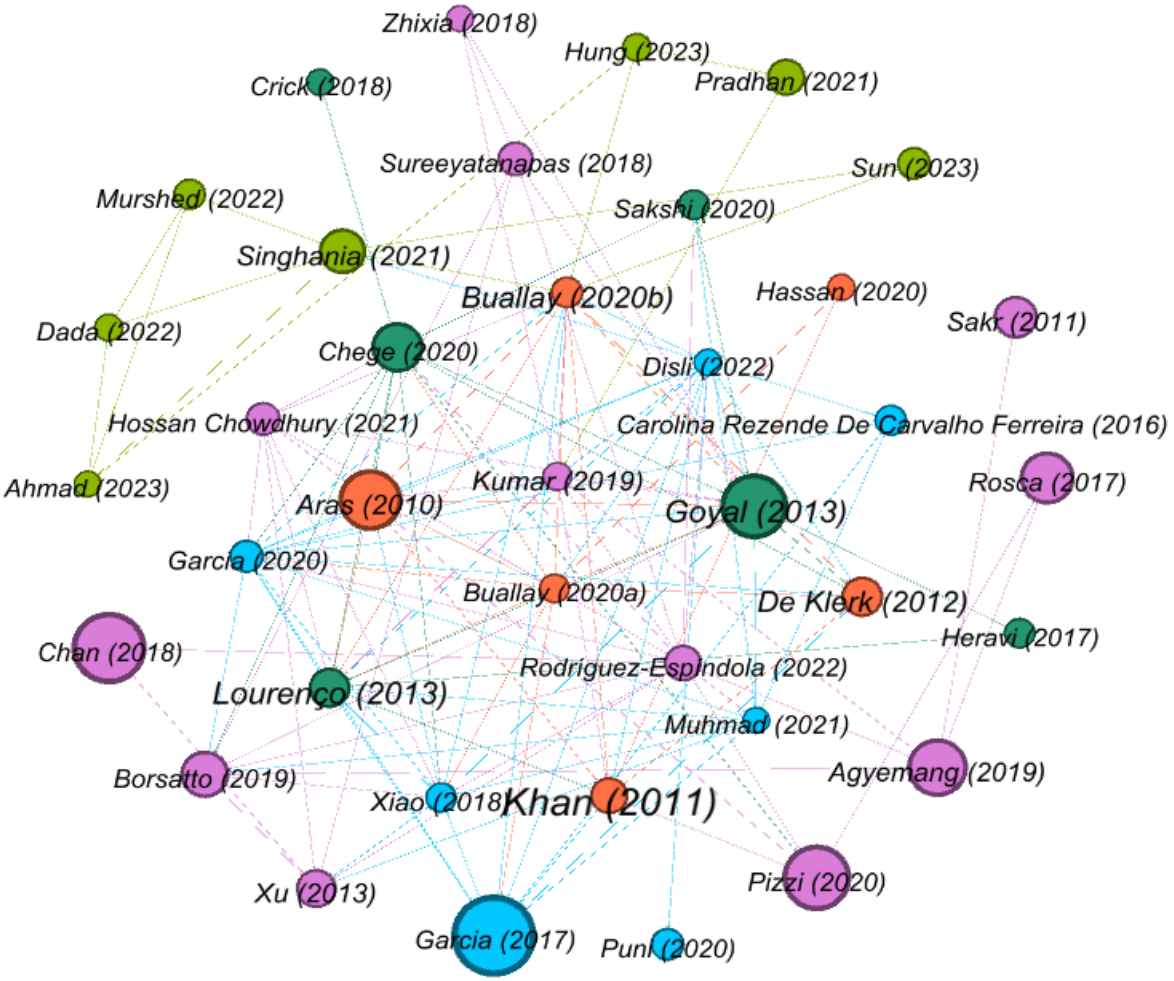

Figure 6. Bibliographic coupling of documents - Total documents 492, 57 met threshold of 50 citations – all connected

Cluster 2: Exploring Interconnections: FDI, Sustainability, and Economic Growth in Emerging Markets:

Singhania and Saini (2021) authored the most cited document in this cluster, accumulating 156 citations, where they delve into the complex interconnections among Foreign Direct Investment (FDI), institutional factors, financial development, and sustainability by re-evaluating the pollution haven (or halo) hypotheses. Their findings suggest a notable positive impact of FDI on environmental degradation. Following closely, Pradhan et al. (2021) scrutinize the short-term and long-term dynamics between economic growth, financial inclusion, and Information and Communication Technology (ICT) infrastructure development across 20 Indian states from 1991 to 2018, uncovering compelling evidence of robust temporal causality between these variables in both the short and long run. With 84 citations, Sun et al. (2023) rank as the third most cited document in this cluster, assessing the relationship between green innovation, resource efficiency, and sustainable economic growth within the E7 countries (China, Indonesia, Mexico, Russian Federation, Turkey, Brazil, and India) utilizing the Generalized Method of Moments (GMM) technique spanning from 2010 to 2021. Their results affirm that green innovation and resource efficiency positively and substantially impact green economic growth in the examined nations. Murshed et al. (2022) endeavor to assess the effects of FDI inflows on augmenting the utilization of renewable energy and achieving environmental sustainability in Bangladesh from 1972 to 2015, with their findings indicating that FDI inflows contribute to an increase in the proportion of renewable electricity output relative to the total electricity output levels of the country. Hung (2023) analyzes avenues for promoting economic sustainability in Vietnam through leveraging opportunities presented by green investment, digitalization, and financial development, with empirical evidence from their study underscoring the significant roles that digitalization, green investment, and financial development can play in enhancing the sustainability of Vietnam's ongoing robust economic growth trajectories.

Cluster 3: Examining the association between Financial Characteristics and Environmental, Social, and Governance (ESG) Performance: Insights from Global Studies:

Garcia et al. (2017) authored the most cited document in this cluster, accumulating 362 citations, wherein they investigated the potential link between firms' financial status and their environmental, social, and governance (ESG) performance, focusing on entities in Brazil, Russia, India, China, and South Africa. Their findings suggest that companies operating in industries highly sensitive to environmental concerns exhibit superior environmental performance, even after adjusting for firm size and national context. Following closely, Garcia and Orsato (2020) explored the relationship between environmental, social, and governance (ESG) performance and financial performance across companies in both emerging and developed economies, emphasizing the influence of the institutional environment on firms' financial and ESG performances. Puni and Anlesinya (2020), ranking as the third most cited document with 84 citations, examined the impact of corporate governance mechanisms recommended by the Securities and Exchange Commission (SEC) of Ghana on firm performance, revealing that a balanced mix of insiders and outsiders on corporate boards positively influenced financial performance. Additionally, factors such as board size, frequency of board meetings, and shareholder ownership structure were found to have favorable effects on financial performance. Carolina Rezende de Carvalho Ferreira et al. (2016) synthesized findings from a systematic review of literature concerning the relationship between finance and sustainability, while Xiao et al. (2018) empirically tested a hypothesis suggesting that firms operating in countries with higher sustainability performance face greater challenges in leveraging corporate sustainability performance for financial gain compared to counterparts in nations with lower sustainability performance levels.

Cluster 4: Exploring the Dynamics between Corporate Social Responsibility (CSR) and Firm Performance: Insights from Diverse Studies:
Aras et al. (2010) lead the cluster as the most cited document with 246 citations, examining the complex relationship between CSR and firm financial performance, noting a correlation between firm size and CSR activities but finding no significant link between CSR initiatives and financial performance or profitability. Following closely, De Klerk and De Villiers (2012) explore the association between Corporate Responsibility Reporting (CRR) and its impact on shareholder assessment of a company's equity value, revealing that higher levels of CRR correlate with higher share prices, indicating potential value-relevance of CSR activities for investors. Khan et al. (2011) scrutinize sustainability reporting practices of major commercial banks in Bangladesh, revealing a focus on societal aspects in sustainability reports. Buallay et al. (2020) assess the impact of sustainability reporting on bank performance post-financial crisis, suggesting a potential weakening of bank performance by Environmental, Social, and Governance (ESG) factors while also finding a significant positive impact of ESG considerations on bank performance in emerging countries within the Middle East and North Africa region.

Cluster 5: Exploring Intersections: Sustainability Performance and Firm Dynamics Across Various Contexts:
Goyal et al. (2013) lead the cluster as the most cited document with 269 citations, aiming to construct a comprehensive taxonomy of existing literature on the relationship between sustainability performance and firm performance, highlighting gaps in understanding within emerging economies. Following closely, Chege and Wang (2020) assess the interplay between technological innovation, environmental sustainability, and small business performance, finding that technological advancements positively influence environmentally conscious practices and subsequently enhance company performance. Lourenço and Branco (2013) investigate the determinants driving high levels of corporate sustainability performance in an emerging market context, specifically Brazil, revealing the heightened significance of financial characteristics in shaping sustainability performance compared to developed counterparts. Sakshi et al. (2020) explore the impact of environmental policy and training initiatives on hotel sustainability practices, noting a growing trend towards integrating sustainability into operational strategies and its positive effects on environmental and financial outcomes. Lastly, Heravi et al. (2017) focus on the social, economic, and environmental dimensions of Sustainable Development (SD) within industrial buildings, aiming to evaluate sustainable indicators and develop a multi-criteria decision-making framework for optimal selection of sustainable options.

3.10.2. Bibliographic coupling of authors

Figure 7 effectively illustrates the bibliographic coupling of authors. Initially, there were 1,444 authors included in the analysis. After applying a threshold of at least two documents and five citations, 35 authors meet the criteria, forming a network where 33 are interconnected. Notably, Gracia, A.S. emerges with the largest node, indicating that this author's references are the most frequently cited. Following closely are Singhania M., Umer M., Saini N., and Buallay A., who also contribute significantly to the shared citations.

3.10.3. Bibliographic coupling of journals

Figure 8 presents the Bibliographic coupling of journals. Initially, the analysis included 270 journals. However, after applying a minimum threshold of 2 documents and 51 citations, 51 journals meet the criteria, with 48 fully interconnected. Notably, the Journal of Cleaner Production emerges with the largest node, indicating that articles published in this journal are extensively cited in similar journals. The following are Resource Policy, Resource,

Conservation and Recycling, World Development, Journal of Development Economics, and Applied Economics. These findings suggest thematic solid connections and influence within the network of journals analyzed.

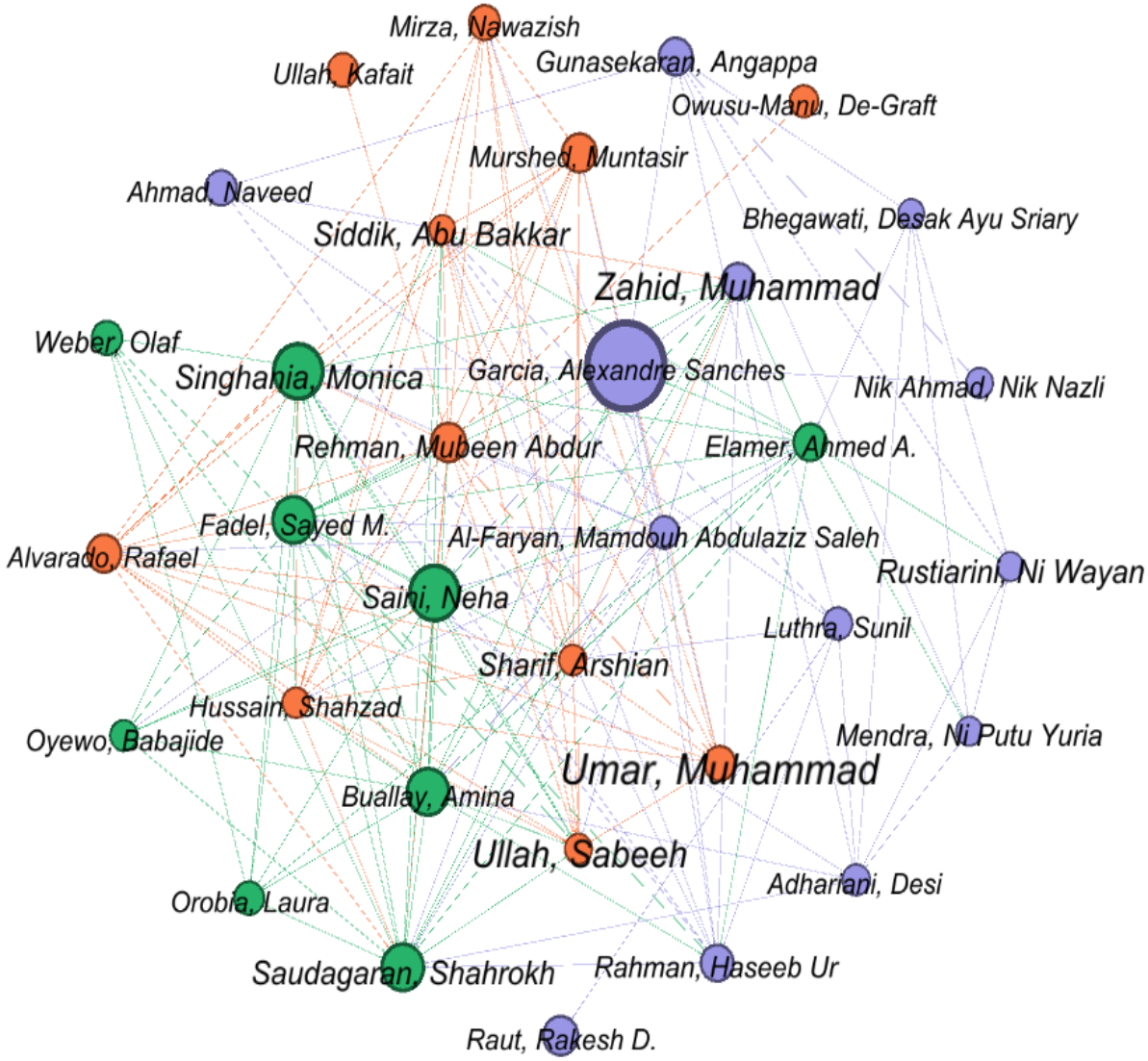

Figure 7. Bibliographic coupling of authors - Total authors 1444, 35 met threshold of 2 doc and 5 citations– 33 connected

3.10.4. Bibliographic coupling of affiliated nations

Figure 9 illustrates the bibliographic coupling of affiliated nations. Initially, the analysis includes 94 countries. However, after applying a minimum threshold of 2 documents and 15 citations, 59 nations meet the criteria, forming a fully interconnected network. The United Kingdom emerges with the largest node, indicating that publications from this country share significant common references with those of other nations. The United States, China, India, Germany, Vietnam, and Turkey follow closely, suggesting robust collaboration and thematic similarity across diverse countries.

4. Conclusion and discussion

The intersection of sustainability and finance in developing nations presents a complex landscape ripe with opportunities and challenges. Our analysis has revealed the evolving discourse surrounding the relationship between sustainability and finance, emphasizing key

themes such as environmental, social, and corporate governance criteria, the impact of investments, and considerations regarding climate change and human rights.

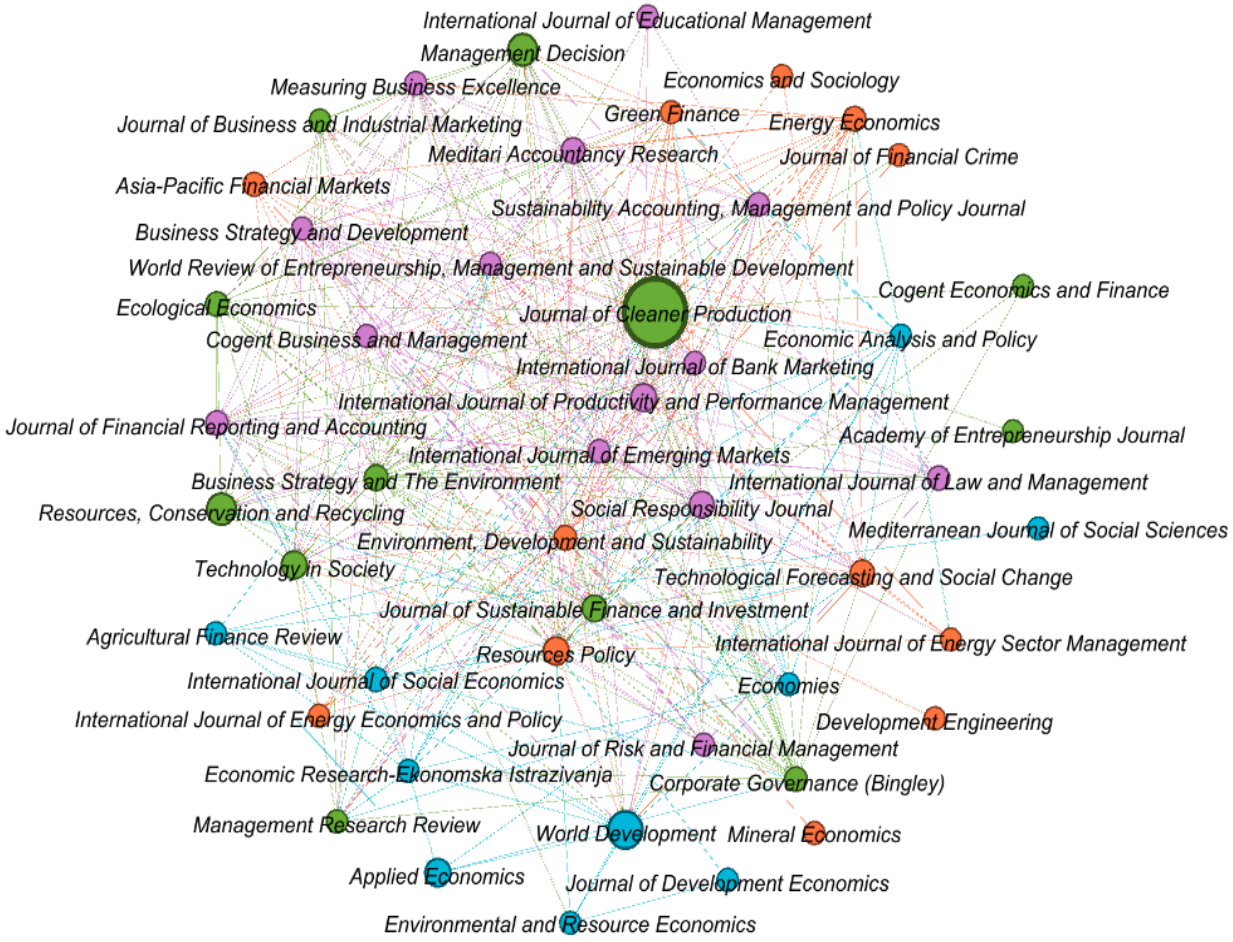

Figure 8. Bibliographic coupling of journals - Total journals 270, 51 met threshold of 2 doc and 15 citations – 48 connected

Through a comprehensive bibliometric review, we have identified significant trends, influential articles, authors, and institutions, shedding light on the research trajectory in this domain. Moving forward, policymakers, practitioners, and researchers must continue exploring and addressing the interconnectedness of sustainability and finance in developing nations, leveraging insights from this analysis to drive informed decision-making and foster sustainable development pathways. We listed down the key takeaways of this review:

First, the descriptive analysis shows that with only one article in 1991, the literature on sustainable finance grew to 53 in 2024, during the last 34 years. With 91 articles, 2023 holds the highest number of publications within this domain. The publications garnered the highest number of citations in 2020, with 1,531 total citations, while 2005 led with 135.4 average citations.

Second, Singhania, M. leads with four publications, each among the top seven most productive authors in this field, Saini, N. and Singhania, M. In terms of total and average citations, Rehman, M.A. is the most productive author, with 83 and 27.67 total and average citations, respectively. Further, in the list of most cited authors, Buallay, A., Fadel, S.M. and Saudagaran, S. are the most cited authors with two publications. However, in terms of citations, Garcia A.S. secured rank first among most cited authors with 447 and 223.5 total and average citations, respectively.

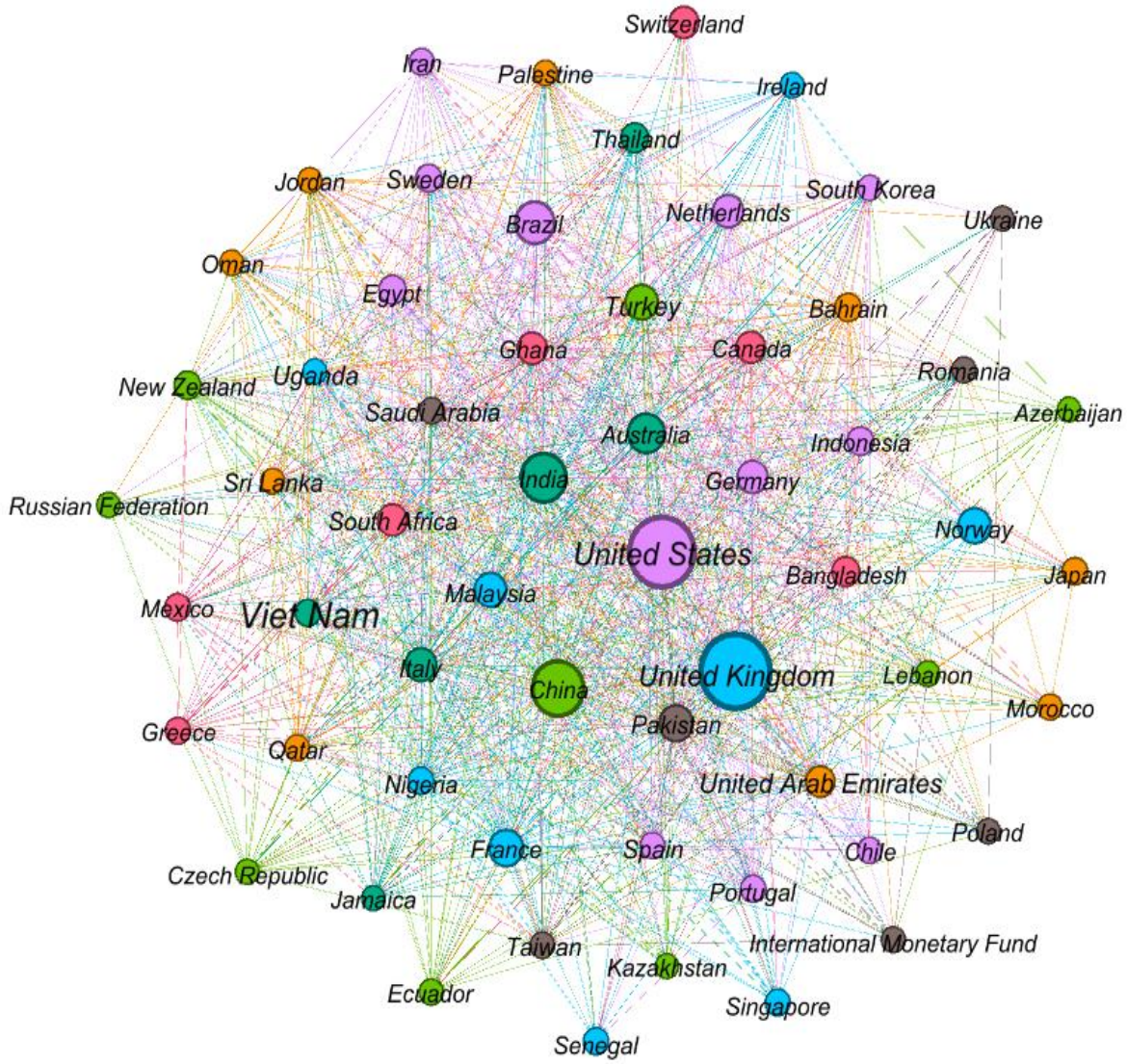

Figure 9. Bibliographic coupling of affiliated nations- Total countries 94, 59 met threshold of 2 doc and 15 citations – all connected

Third, the analysis of the most cited documents shows that "Sensitive industries produce better ESG performance: Evidence from emerging markets" leads with 362 total citations, while "Management research and the UN sustainable development goals (SDGs): A bibliometric investigation and systematic review" secured rank first in terms of average citations, accounting for 68.5 citations per publication.

Fourth, in the list of most productive journals, we found that the Journal of Cleaner Production is the top productive and most cited journal, with 32 publications and 2351 total citations. In terms of average citations, Resources, Conservation and Recycling is the most productive journal, with 78.6 citations per publication, while Management Decision is the most cited journal with 166 citations per publication.

Fifth, among the top 10 productive institutions linked with sustainable finance, Universitas Indonesia is the first top productive institution with 17 publications. With 13 articles, Kwame Nkrumah University Malaysia is the second most productive institution.

Sixth, keyword co-occurrence analysis of author's keywords shows that "Sustainable Development" serves as the central node, connecting key areas like "Sustainability,"

"Corporate Social Responsibility," "Financial Development," and "Renewable Energy." Moreover, geographical tags such as "India," "China," "Ghana," and "Nigeria" emphasize a focus on emerging markets and developing nations, showcasing their unique roles and challenges in sustainability discourse.

Seventh, Gracia A.S. emerges with the largest node in the network, indicating significant collaborative activity. Notable authors like Shahrokh Saudagaran, Muhammad Zahid, Monica Singhania, and Sayed M. Fadek are also prominent in the network. These authors are actively engaged in collaborative research activities within sustainability and finance, suggesting a strong focus on interdisciplinary cooperation in these areas.

While this study offers valuable insights into the relationship between sustainability and finance in developing nations, it is essential to acknowledge its limitations. Firstly, our analysis was confined to the Scopus database. Thus, future studies could benefit from incorporating additional databases such as Web of Science and Dimension. Secondly, the search string used in this study may not have captured all relevant articles, potentially limiting the comprehensiveness of our findings. Lastly, our focus on subject areas within Business and Economics may have overlooked valuable contributions from other disciplines, suggesting that future studies could broaden their scope to encompass a wider range of subject areas for a more holistic understanding.

5. Future research agenda

The literature across various clusters highlights several vital gaps that warrant further exploration. Firstly, there is a notable deficiency in understanding the role of governmental policies and incentives in promoting the adoption of Green Building Technologies (GBTs) in developing countries. While barriers have been identified, strategies for effective governmental intervention remain underexplored. Additionally, the role of education in bridging the knowledge gap regarding Sustainable Development Goals (SDGs) in the business sector is not thoroughly examined, suggesting a need for research into educational strategies that could enhance business engagement with SDGs. Hence, the following Future Research Questions (FRQs) are suggested:

FRQ1. *How can governments in developing countries design and implement policies to effectively incentivize the adoption of Green Building Technologies (GBTs)?*

FRQ2. *What are the most effective educational strategies to enhance business sector engagement with Sustainable Development Goals (SDGs)?*

FRQ3. *What industry-specific strategies can facilitate the successful integration of circular economy principles in the manufacturing sectors of developing countries?*

In corporate governance and sustainability, the influence of national institutional environments on firms' Environmental, Social, and Governance (ESG) performance requires deeper investigation. Understanding how different regulatory and cultural contexts impact ESG outcomes could provide valuable insights for multinational corporations and policymakers. Furthermore, the impact of Foreign Direct Investment (FDI) on renewable energy adoption in various economic contexts is under-researched. While the relationship between FDI and environmental outcomes has been studied, specific mechanisms through which FDI can promote renewable energy in developing and developed countries need more attention. Hence, the following FRQs are suggested:

FRQ4. *How do different national institutional environments influence firms' Environmental, Social, and Governance (ESG) performance in emerging versus developed markets?*

FRQ5. *How does Foreign Direct Investment (FDI) contribute to adopting and expanding renewable energy technologies in countries with different levels of economic development?*

FRQ6. *What are the synergistic effects of digitalization and green investments on promoting economic sustainability in emerging economies?*
FRQ7. *How do various corporate governance mechanisms affect firms' ESG performance and financial outcomes in different regulatory environments?*

Another significant gap exists in understanding how digitalization and green investments can synergistically promote economic sustainability, particularly in emerging economies. Additionally, there is a lack of comprehensive research on the mediating factors influencing the relationship between CSR activities and firm financial performance. This gap highlights the need for studies that examine the underlying dynamics and context-specific factors that shape this relationship. Lastly, the determinants of effective sustainability reporting practices in the banking sector of developing countries and their impact on financial performance remain insufficiently explored. Hence, the following FRQs are suggested:
FRQ8. *What mediating factors influence the relationship between CSR activities and firm financial performance across different industries?*
FRQ9. *How can small businesses leverage technological innovations to improve their environmental sustainability and competitive performance?*
FRQ10. *What are the key determinants of effective sustainability reporting practices in the banking sector of developing countries, and how do these practices impact financial performance?*

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