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Systematic Review

Sustainable Development Goal (SDG) 13: A Bibliometric Review and Future Research Agenda

Imran Khan[1*], Hassan Kabir Doma[2] and Ezechias Harry Azokly[3]

[1]International Business School, Teesside University, Southfield Rd, Middlesbrough TS1 3BX, United Kingdom. ORCID: 0009-0006-0457-1849. Email: imran.qhan@gmail.com
[2]International Business School, Teesside University, Southfield Rd, Middlesbrough TS1 3BX, United Kingdom. ORCID: 0009-0007-6638-6152. Email: hassankabirdoma@gmail.com
[3]International Business School, Teesside University, Southfield Rd, Middlesbrough TS1 3BX, United Kingdom. ORCID: 0009-0000-0896-8487. Email: ezechiasazokly@gmail.com
*Corresponding author: imran.qhan@gmail.com

Abstract

Sustainable Development Goals (SDGs) have been at the forefront of the strategic policies of nations both developed and developing, envisioning innovation and long-term impacts. SGD 13 calls for embracing eco-efficient emerging transformation and its durable impacts on communities and nations. Since its introduction by the UN, this area has attracted a great deal of research interest. This study quantitatively analyses the empirical literature on United Nations' Thirteen Sustainable Development Goals (SDG 13) from early 2016 to 2025, as represented by English-language articles from the international database. This study employs a bibliometric approach plus content analysis on 607 articles found in the Scopus database. We designate the field's progress and structure, including co-authorship, co-citation, thematic map, and bibliographical coupling. Amongst all the results generated, it should be emphasized the identification of emerging innovated substantial themes "Climate change SDG", "sustainable development goals" and "Industry achieve review", present a major relevance to this field. Furthermore, "energy environmental carbon" was shown as a powerful theme of evolving sustainable innovation from the perspective of SDG13 debates. This study also offers extensive suggestions the future research directions.

Keywords: SDG13; climate change; bibliometric analysis; citation structure; eco-friendly environment

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1. Introduction

The last decade has experienced emergence of sustainable innovation. These goals related to eco-efficiency were introduced in 2016 and are plugging away until 2030. There were 17 sustainable development goals (SDGs) linked with 169 interlinked targets known as Millennium Development Goals (MDGs) and measured against 232 indicators set by United Nations. These goals focus on various factors addressing global challenges and ensuring sustainable progress. Among all the goals, it is imperative to highlight climate change, and to measure, plan, and take action to demonstrate the impacts of climate change aided by renewable energy.

Climate change can be interpreted by various characterizing challenges of today's world. Climate change is appearing as a trending challenge for developing countries. The researchers have a consensus on the threats, and effects on society the scourge of climate change will have far-reaching effects on the ecologies (Hoegh-Guldberg & Bruno, 2010; Zylicz, 2015), economic growth (Ueckerdt et al., 2019) and human well-being (Patz et al., 2005; Botzen et al., 2019). Climate change is directly linked to agriculture, food system, natural disasters, carbon emission, greenhouse energy, and circular economy. The different studies conducted on SGD 13 present that almost 70% of the studies reported a decline in crop production by the 2030s, while few present 10-50% declines (Challinor et al., 2014).

Similarly, carbon emissions are also identified as a major driver of climate change and counterproductive to emerging sustainable innovation. However, carbon emissions are reported to decline in 2020 due to the COVID-19 outbreak, and to revive of economic crisis, countries are planning to switch to green technology, renewable energy sources or fossil fuels (Liu et al., 2020). Developing countries are most affected, and becoming a challenge for researchers as climate change has stalled economic growth. It is estimated that an increase in temperature will have devastating long-term impacts on the global economy, eco-friendliness and is expected to shrink by 18%. This change will also impact GDP to increase by 37% in vulnerable areas like ASEAN and Asia.

Despite the importance of sustainable climate change, there are many obstacles especially related to variations in global temperature. In 2021, the global mean temperature was between 1.11 ± 0.13 °C above pre-industrial (1850-1900s). The year 2021 has been recorded as one of the warmest years in the last seven years. The impact of climate change is also evident from melting glaciers, intense rainfall and heat, and an increase in sea levels. Asia has been experiencing abnormal rains and floods. Moreover, the global temperature is anticipated to increase beyond 1.5 °C in the next five years (Guterres, 2020). It is evident from the above discussion that SDG 13 is equally critical for developing as well as developed nations that are eagerly looking forward for innovative solutions of sustainable nature. In other words, combating climate change is directly linked to the survival and livelihood of the planet and its inhabitant. Moreover, climate change is directly linked to objectives related to economic growth, sustainable consumption and production, and industrialization, and is critical to achieving other SDGs of sustainable innovation.

The previous research on climate change covered a different range of issues. To deliver a designed indication of the most imperative ones, this study carried out a bibliometric analysis, categorize the different studies into significant research clusters, and ascertain emerging future research needs on climate change and sustainable growth along with creating an eco-friendly environment. This study has used the SCOPUS database to collect 607 papers on climate change published between 2016 and 2025, and RStudio, VOSviewer, and excel are used to examine the patterns of citation, different other connections, and keyword occurrence. As a result, following the models of Alon, Anderson, Munim, and Ho (2018), our study contributes by performing a more comprehensive evaluation of the literature to resolve the following questions:

RQ1. What are the influential aspects of top journals and authors, and the characteristics of the most studied topics?
RQ2. What are the past and emerging key research streams in start-up, performance, and sustainable growth literature?
RQ3. What are the substantial relevant future research questions to explore this trending topic?

This research yields useful results from both an academic and a business standpoint. The bibliometric analysis demonstrates the many stages of this field of study, as well as potential research avenues that might be investigated further. Overall, the findings of this investigation will add to the current body of knowledge. Indeed, our bibliometric review makes numerous exclusive contributions. First, we identify the authors whose publications might serve as standards for future researchers, the geographic coverage of climate change and environmental issues, and the most appropriate journals. Second, we assist the researchers and legislators by ascertaining different research directions and shortening the results of the most-cited papers. Finally, we identify the research avenues that deliver guidelines for further research.

The paper is organized as follows: Section 2 includes the data source and the methodology used for the study. Section 3 presents the results of this study. Section 4 includes content analysis. Lastly, Section 5, 6 and 7 give conclusion, future research directions and implications.

2. Methodology

We perform an analysis of literature in which we employ both quantitative and qualitative methodologies, such as bibliometric citation and content analysis, to conduct the current study. In the disciplines of management, business, emerging sustainable development and finance research, these methodologies are currently applied across a wide range of approaches. Bradford (1934) was the first to offer bibliometric analysis, which has progressed significantly since then. Price (1965) describes bibliometric approaches for evaluating and mapping academic publications based on citation counts (Kim and McMillan, 2008), with articles serving as the primary unit of analysis (Alon et al., 2018). Content analysis is a social science approach for methodically reviewing and confirming the validity of information in a given field of inquiry (Potter & Levine-Donnerstein, 1999).

Therefore, in this article, a bibliometric analysis has been performed of the documents published in Scopus from 2016 to 2025. As evidenced by Zupic and Čater (2015), bibliometric analysis is used in the literature to establish an overview of specific areas of knowledge. The objective of this research was exploratory and focused on identifying the core themes highlighted by these documents, instead of testing and confirming them. This is corroborated by Collis and Hussey (2013). The research sample used in this study was obtained through the selection of documents from the Scopus database that offers scientific information to the academic community.

2.1. Study Design

This study used a three-step methodological process as shown in Figure 1. The method was originally developed by Bahoo et al., (2020) which is modified for the present study. In the first step, recognized databases are searched for relevant publications for the meta-literature search. The next stage is to find the relevant literature from the selected database and the third step is to analyze the selected literature data through a bibliometric review to conclude.

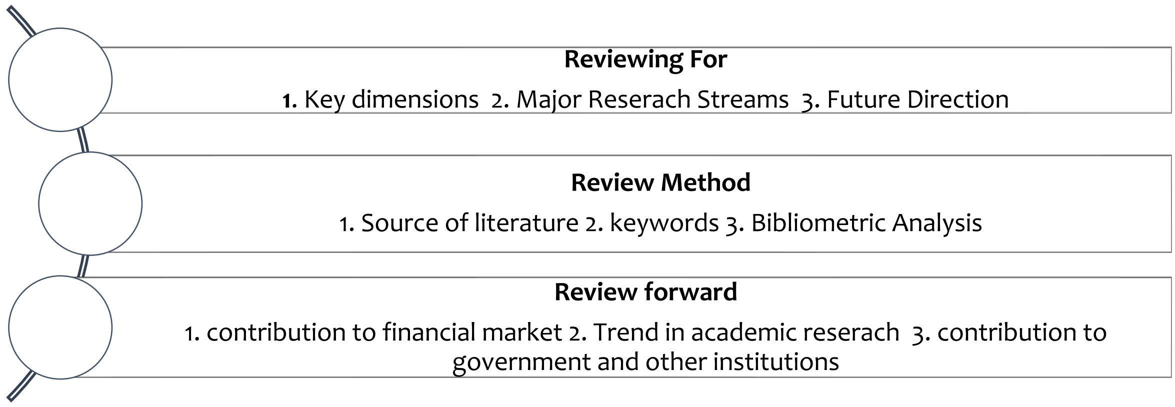

Figure 1. Research approach.

2.2. Data Selection Strategy

The data for the bibliometric review is collected from the Scopus database, a well-known database owned by Elsevier. The Scopus database has been used in several previous studies in bibliometric analysis-based papers (Goodell et al., 2021). Scopus was chosen for several reasons. First, this is the largest multidisciplinary peer-reviewed database. Second, it is the most reputable financial literature reporting database. Table 1 shows that Web of Science (WOS) has low coverage of SDG literature. Google Scholar provides more documents however it can contain many low-quality documents.

Table 1. Categorization of the literature source.

Database	Web of Science	Scopus
Articles	568	607

Researcher intervention is often needed to clear manuscripts from selection if those are not matching with the study's objectives. Scopus databases were accessed, and different keywords were used i.e., sustainable development goals 13, SDGs 13. A total of 619 documents were found including 12 documents in other languages which were removed (Table 2). Multiple keywords were used keeping in view the nature of the topic. The final data set contains articles, conference papers, review papers, and a book chapter.

Table 2. Data selection strategy.

Query Wording	Scopus search	Final only English
(TITLE-ABS-KEY ("sustainable development goals 13") OR TITLE-ABS-KEY ("SDG 13")) article, review, book chapter, and conference papers.	619	607

This study is the first to consider the entire population of the SDGs 13 literature. In the appendix, we report a list of literature for the top 15 most cited articles and the latest articles published to complement the bibliometric analysis.

2.3. Review of Literature

As mentioned above, we perform an analysis of the literature employing bibliometric analysis and content analysis to conduct the current literature state of the art. We undertake the following analyses for bibliometric citation analysis, as described by Liu et al., (2020) and Naciti et al. (2022): (1) citation analysis, (2) bibliographic coupling analysis, (3) co-citation analysis and (4) co-word analysis. In each of these maps, the size of items is determined by their "total link strength" while the thickness of each connection is based on the "link strength" (Table 3). The VOSviewer program is what we utilize. VOSviewer accepts article details as input, it visualizes items using distance-based mapping methods. VOSviewer is considered a more capable tool than Cite Space and Sci2 (Van Eck & Waltman, 2014). The software uses citation data to identify networks and clusters in various shapes and colors. These clusters are based on a link analysis, which includes the strength of linkages between the sample articles (Van Eck & Waltman, 2014).

Table 3. The terminology used by VOSviewer software.

Term	Description
Items	Objects of interest (e.g., publications, researchers, keywords, authors)
Link	Connection or relation between two items (e.g., co-occurrence of keywords)
Link strength	An attribute of each link is expressed by a positive numerical value. In the case of co-authorship links, the higher the value, the higher the number of publications the two researchers have co-authored
Network	Set of items connected by their links.
Cluster	Cluster Sets of items are included in a map. One item can belong only to one cluster.
Weight attribute: (number of links)	The number of links of an item with other items.
Weight attribute: (total link strength)	The cumulative strength of the links of an item with other items.

Source: (Van Eck and Waltman, 2018).

3. Results

Table 4 gives a broad summary of the information gathered from 607 papers published over 10 years. 565 journal articles, with an average of 10.235 citations per document, are included in this total. Approximately 41.49% of the 527 publications were co-authored. 1,013 keywords in all were reviewed.

Table 4. Descriptive statistics for bibliometric data.

Description	Criteria	Results
Main Information about data	Timespan	2016:2025
	Sources (journals, books, etc.)	168
	Documents	607
	Annual Growth Rate %	0
	Document Average Age	1.58
	Average citations per doc	12.235
	References	27651
Document Contents	Keywords Plus (ID)	1914
	Author's Keywords (DE)	1253
Authors	Authors	1623
	Authors of single-authored docs	41
Authors Collaboration	Single-authored docs	56
	Co-Authors per Doc	5.19
	International co-authorships %	53.25
Document Types	Article	502
	Book chapter	36
	Conference paper	34
	Review	35

The year-by-year distribution of the 607 papers published between 2016 and 2025 is shown in Figure 2. The Sustainable Development Goals 13 is an intriguing and interesting emerging field of research regarding innovative sustainable development for academics thus, given the rising trend of publication in this area. Figure 2 depicts the evolution of scientific literature. Before 2016, SDG 13 received little attention. There don't seem to be many papers in this field between 2017 and 2019. After 2020, there were more publications in this field, and more researchers from many jurisdictions began to write about it. After 2021, the number of publications started to increase, but there were also periods when it fell. Similar to that, the number of citations has been steadily increasing since 2019. The most recent year in the bibliometric analysis study period, 2022, experienced a peak in terms of publications and citations. In addition, the years 2019 and 2022 witnessed notable additions to the body of literature.

3.1. Most Influential Authors, Affiliations, and Countries

The increase of articles in this area was related to the connections, sources, and authorship of the scientific community. The authors most pertinent to this topic are displayed in Figure 3 and 4. With ten years of experience publishing articles, Sinha is the most influential researcher in Sustainable Development Goals 13, followed by Nhamo with five years of experience and Bekun with four years. The following seven writers have been submitting work for three years. Figure 4 shows the contribution of authors over time from 2016 until 2025.

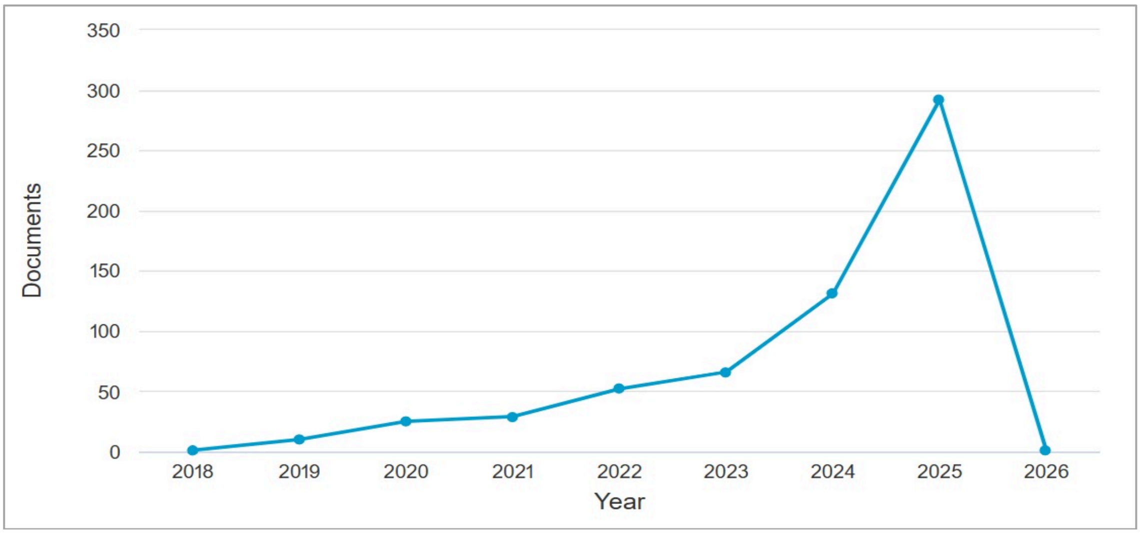

Figure 2. Number of publications per year.

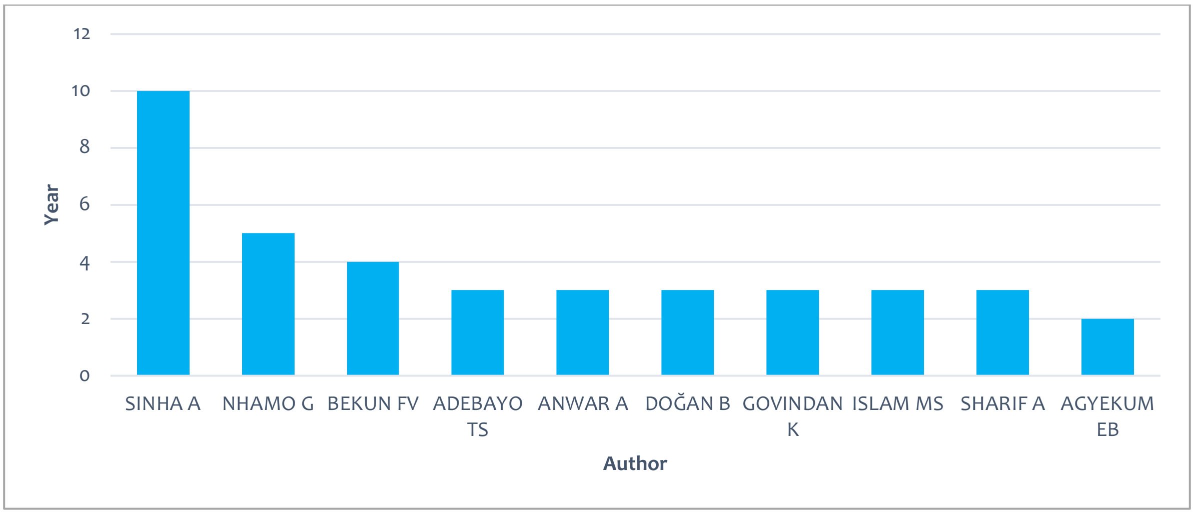

Figure 3. Most influential authors.

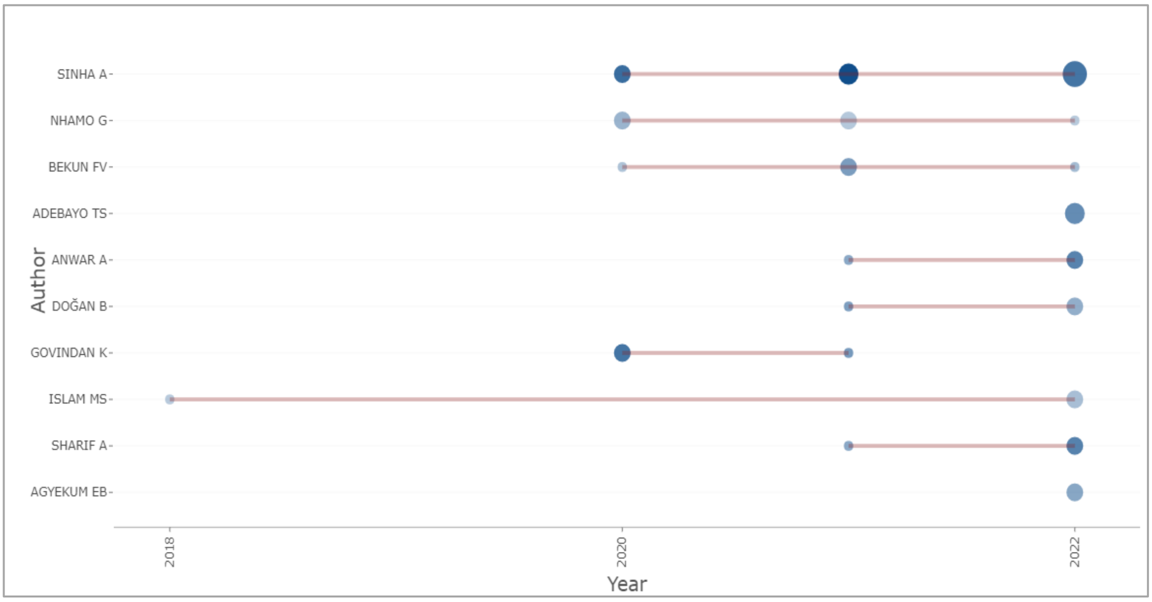

Figure 4. Most influential authors over time.

Figure 5 presents the most relative affiliations in the field of Sustainable Development Goals 13. University of Naples Federico II is the top most affiliated institution having the highest number of articles in this particular domain and the second top contributor is from Nottingham Trent University.

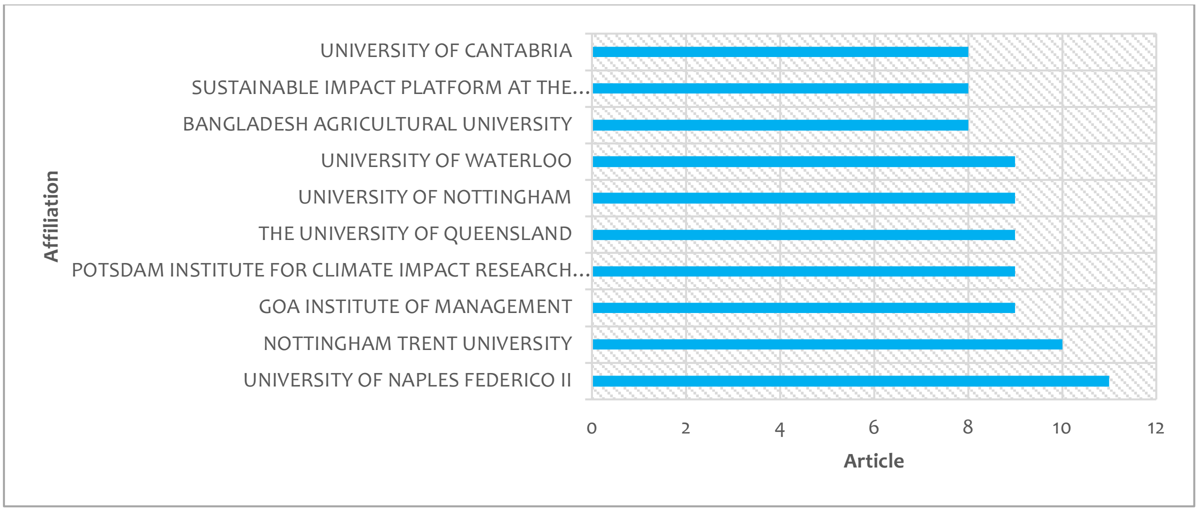

Figure 5. Most relative affiliations.

Figure 6 shows that China is the leading country with 132 publications, followed by India, United Kingdom, Malaysia, Pakistan, Turkey, Australia and so on and so forth. It shows that SDG 13 is rapidly increasing in research.

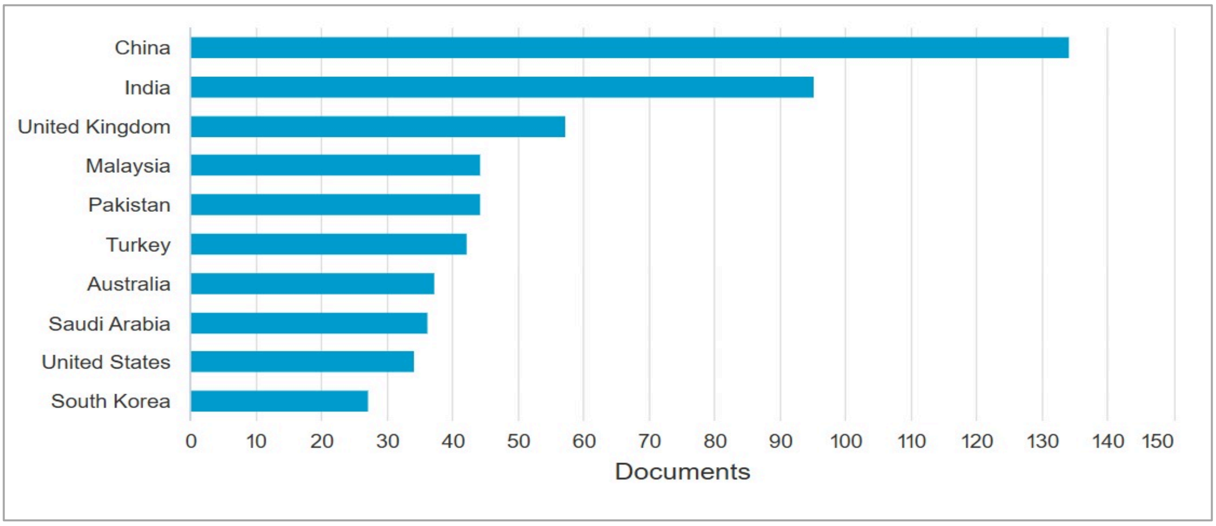

Figure 6. Corresponding author countries.

Figure 7 shows the top ten journals with the highest number of publications related to SDG 13. The result shows that Sustainability (Switzerland) has published 28 articles and ranked the highest. Journal of Cleaner production ranked the second highest number of publications with 13 articles and Environment, Development and Sustainability has the least numbers of publications in the top ten list with only 4 publications.

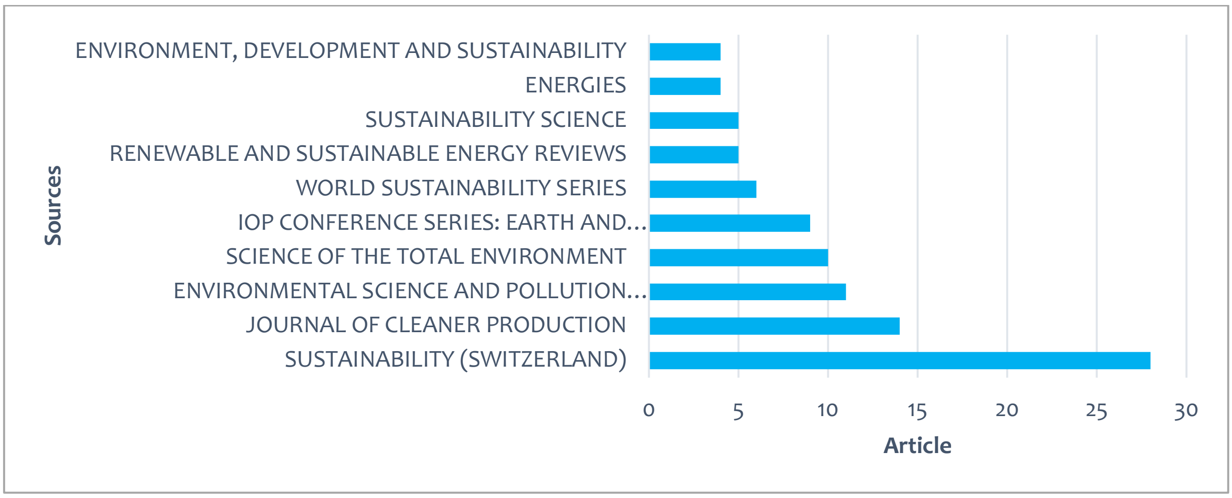

Figure 7. Top ten sources.

Figure 8 depicts a Bradford law-based journal categorization that divides journals into three categories: the core journal group, the intermediate journal group, and the broad journal group, depending on their level of output. Shaded parts and core sources with annotations identify the core journal groupings. The journals that fit into this category have produced the most research on Sustainable development objective 13 over a specific period. The figure shows that Sustainability (Switzerland) is the first by leaps from the second journal Journal of Cleaner Production, followed by Environmental Science and Pollution Research.

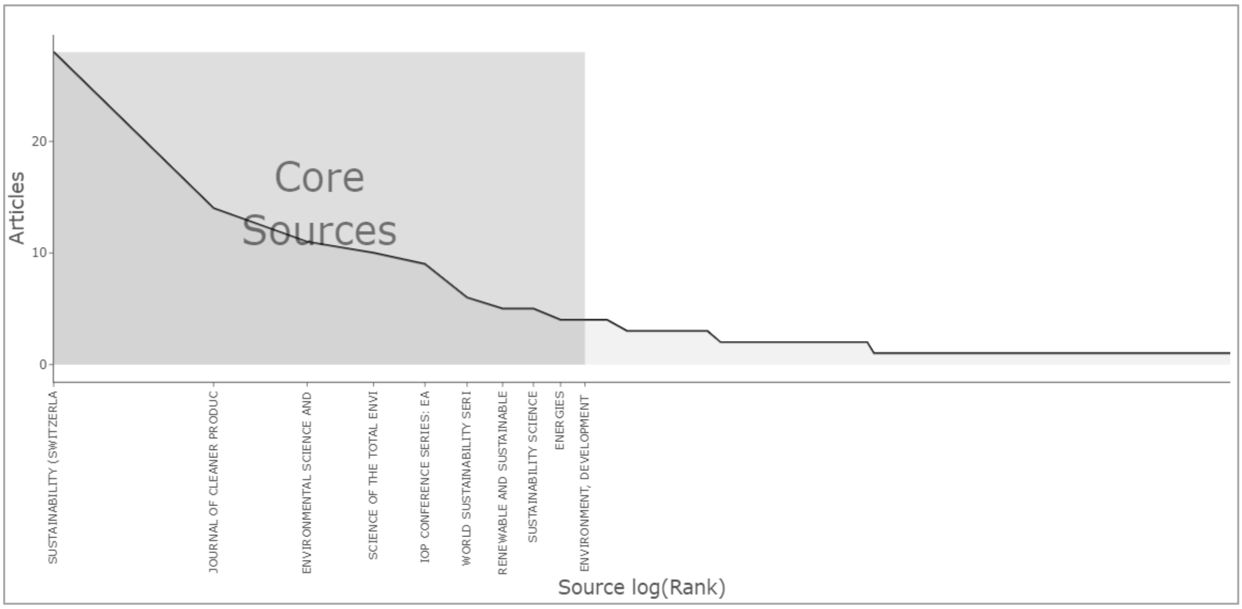

Figure 8. Bradford's law.

In terms of trends in publication, Sustainable Development Goals 13 research trend is increasing from the year 2018 and onwards and Sustainability (Switzerland) leads the trend. Figure 9 shows the yearly publication trend from the top five journals.

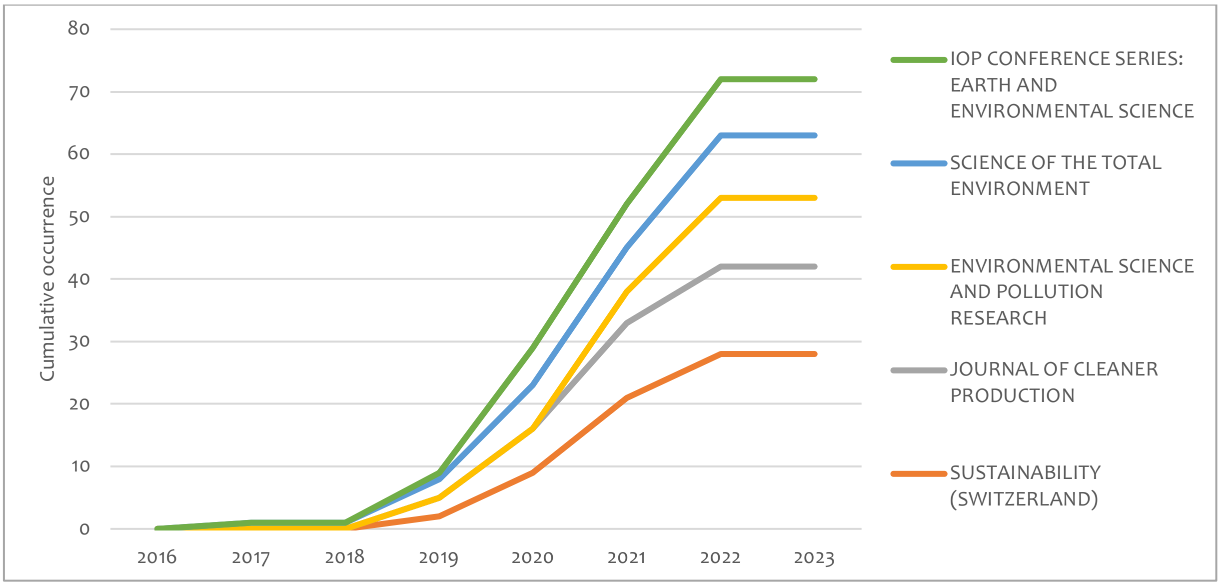

Figure 9. Yearly trend top five journals.

3.2. Keywords Analysis

Figure 10 provides insights into the research trends on Sustainable Development Goals 13. The graph shows that from 2016-2019 there is no growth in keywords. However, after 2019 it started growing there is the main boom in 2020 and onwards for the analysis of the keyword. Keywords like carbon dioxide, climate change, economics, planning, and sustainability have been growing after 2019.

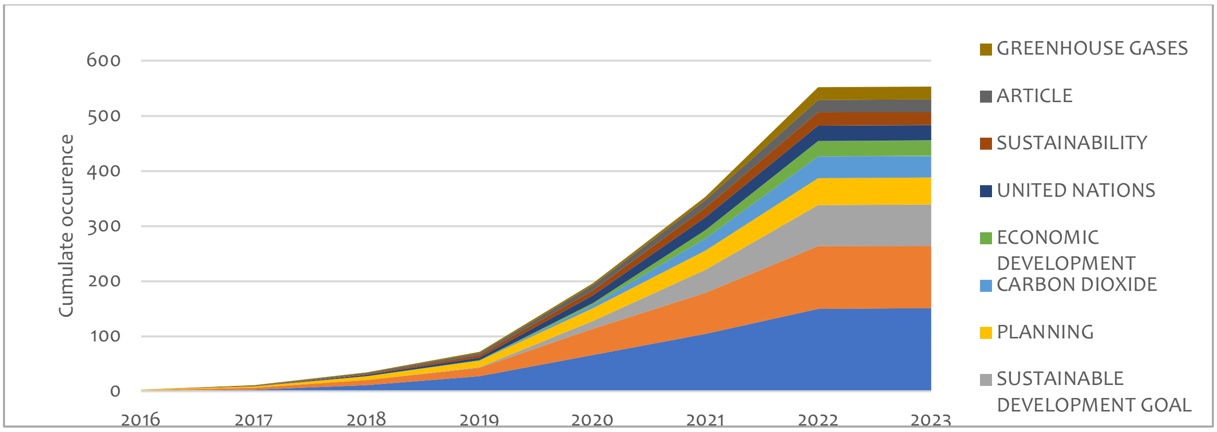

Figure 10. Keyword analysis.

Figure 11 exhibits the thematic map of global research done on Sustainable Development Goals 13 by highlighting the main keywords. These keywords are those which are given by the authors in their publications. This thematic map is an elucidation of general trends and hot spots in the field of sustainable development. Researchers focused on the areas such as climate change SDG, energy environment carbon, Mediterranean studies lagoon, and industry review. Moreover, the concept of sustainable development goals can also be found in research articles.

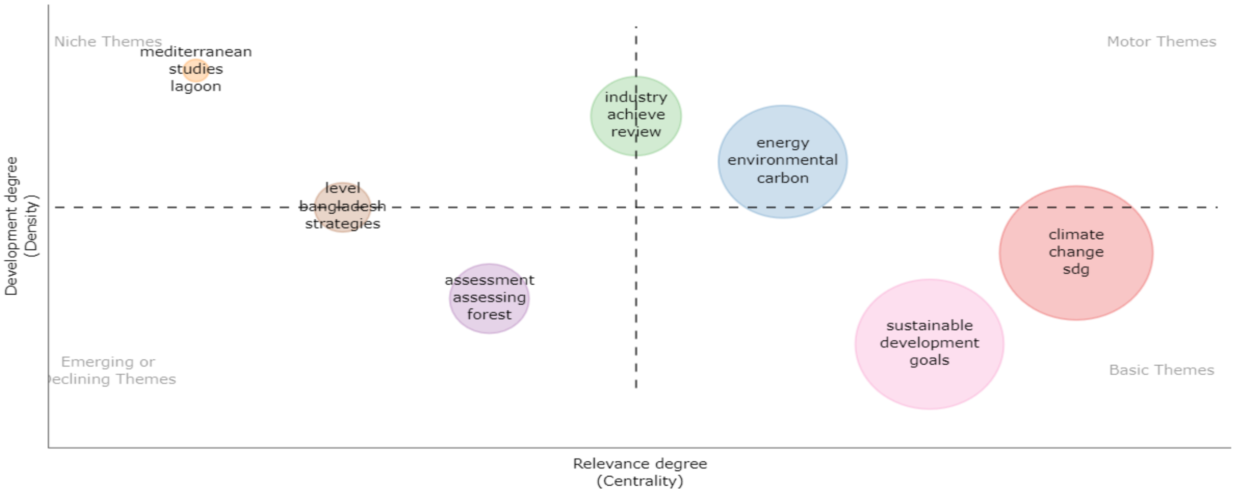

Figure 11. Thematic map.

We also created the three-field plot shown in Figure 12. In this case, the analysis was limited to 20 sources. The keywords are on the right, the authors are in the middle, and the author's countries are on the left. Based on this figure, South Africa, Pakistan, China and India dominated this field, followed by Bangladesh and Portugal. As for the Authors, Sinha dominated followed by Anwar and Sharif. Concerning keywords; carbon dioxide, climate change, economics, planning, and sustainability dominated the researcher's theme.

3.3. Citation Analysis

Figure 13 shows the top ten countries which are cited mostly. In this regard, the citation from the paper from China is very significant compared to the other countries with more than 469. India with 221 citations and Brazil, and Germany are the two following countries with almost the same number of citations, i.e.,194. The figure also shows that in the top ten lists Malaysia is new to the research in this domain. Thus, indicating the emerging trend of research in SDG 13.

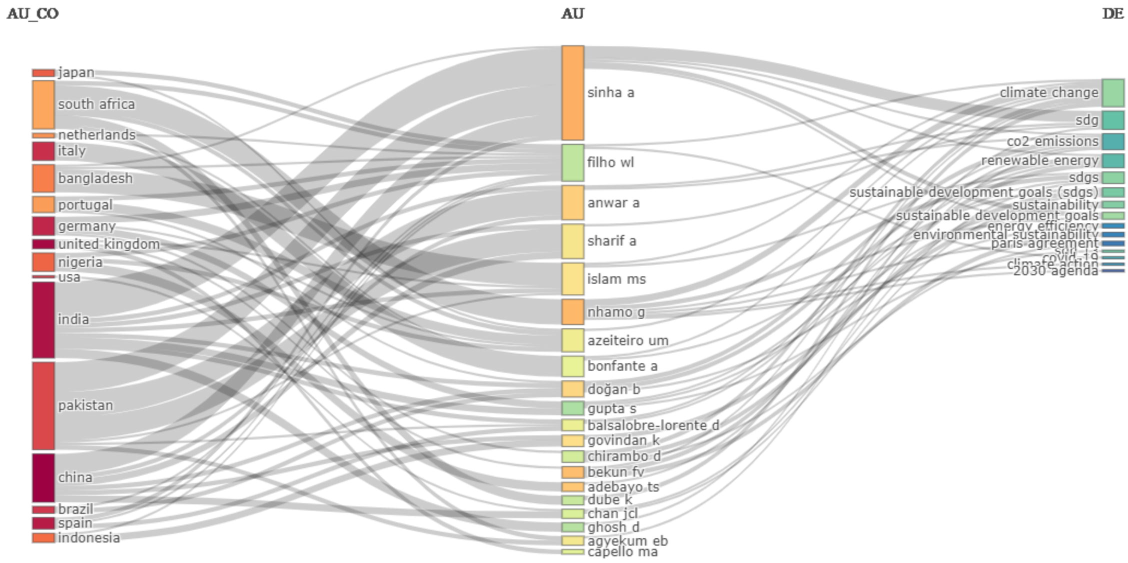

Figure 12. Three-field plot.

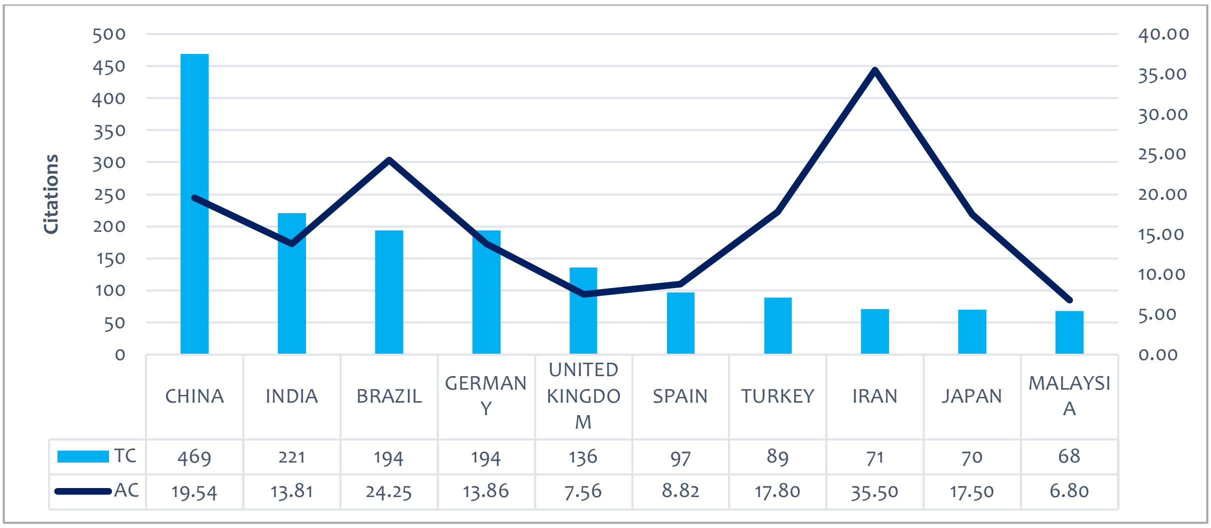

Figure 13. Most cited countries.

The number of citations is widely used to track the scientific impact and relevance of previous research. As a result, a high citation index for a research paper usually means it has had or will have a significant impact in the field. Furthermore, the influence of research on researchers may be shown in citation patterns in publications (Naciti et al, 2022). The relationship between the two documents is shown by citation analysis. This analysis has drawn criticism for, among other things, misrepresenting the quality assessment of a publication as a result of negative citations (citation of wrong results), self-citations, and disregarding the period specified for citations. This section includes citation analysis of the documents, references, and sources together with the impact of sources and writers to demonstrate that, despite these objections, citation analysis is still a valuable measure of influence. Journal of Cleaner Production received the highest number of citations of a paper, followed by Sustainable Production and Consumption and Energy Policy. Table 5 below addresses the most cited papers in the field of SDG 13.

Table 5. Top ten global cited document.

No	Author and Year	Journal name	Citation
1	Sinha a, (2020)	Journal of Cleaner Production	136
2	Fatimah ya, (2020)	Journal of Cleaner Production	118
3	Dantas tet, (2021)	Sustainable Production and Consumption	97
4	Shahbaz m, (2021)	Energy Policy	79
5	Zhang x, (2019)	Science of Total Environment	79
6	Bruce m c, (2018)	Current Opinion in Environmental Sustainability	78
7	Humpenöder f, (2018)	Environmental Research Letter	66
8	Jouzdani j, (2021)	Journal of Cleaner Production	64
9	Monteiro nbr, (2019)	Journal of Cleaner Production	62
10	Omer mab, (2020)	Sustainable Cities and Society	60

The impact of authors and sources are discussed in Table 6 and 7, respectively. With a H index of 7, Sinha A has the most influence, followed by Bekun Fatima with a score of 4. According to Table 6, additional individuals in the top ten rankings have a H index of between 3 and 2. The most pertinent journals on this subject, according to our analysis of the source impact, are the Journal of Clean Production, Sustainability (Switzerland), Science of the Total Environment, and Environmental Science and Pollution Research.

Table 6. Author local impact.

Author	H Index	G index	M index	TC	NP	Year
Sinha a	7	8	2.33	414	8	2020
Bekun fv	4	4	1.33	84	4	2020
Adebayo ts	3	3	3	38	3	2022
Govindan k	3	3	1	236	3	2020
Agyekum eb	2	2	2	21	2	2022
Anwar a	2	2	1	93	2	2021
Balsalobre-lorente d	2	2	1	57	2	2021
Bonfante a	2	2	0.33	34	2	2017
Chan jcl	2	2	0.5	39	2	2019
Doğan b	2	3	1	71	3	2021

Table 7. Source impact.

Journal	H Index	G index	M index	TC	NP	Year
Journal of cleaner production	11	14	2.75	638	14	2019
Sustainability (Switzerland)	8	13	2	193	22	2019
Science of the total environment	7	8	1.167	175	8	2017
Environmental science and pollution research	5	8	2.5	71	8	2021
International journal of environmental research and public health	3	4	0.6	42	4	2018
Renewable and sustainable energy reviews	3	3	1	112	3	2020
Sustainability science	3	4	0.75	20	4	2019
Current opinion on environmental sustainability	2	2	0.4	124	2	2018
Energy and environment	2	2	2	20	2	2022
Environment, development and sustainability	2	3	1	73	3	2021

3.4. Network Analysis

3.4.1. Co-authorship

Co-authorship refers to the authorship of two or more authors working together on the same topic. Our results show 10 papers, 3 clusters with a strong link of 18 when the minimum benchmark is set for the 3 papers. This shows moderate link strength as a higher score indicates a stronger link (Van Eck & Waltman, 2014). Sinha n leads the blue cluster with three co-authors. Anwar a leads the green cluster whereas Dogan b leads the red cluster. This shows that the authors from different jurisdictions collaborated and conduct studies on sustainable development goals 13. Figure 14 below shows the detailed network of co-authorship maps.

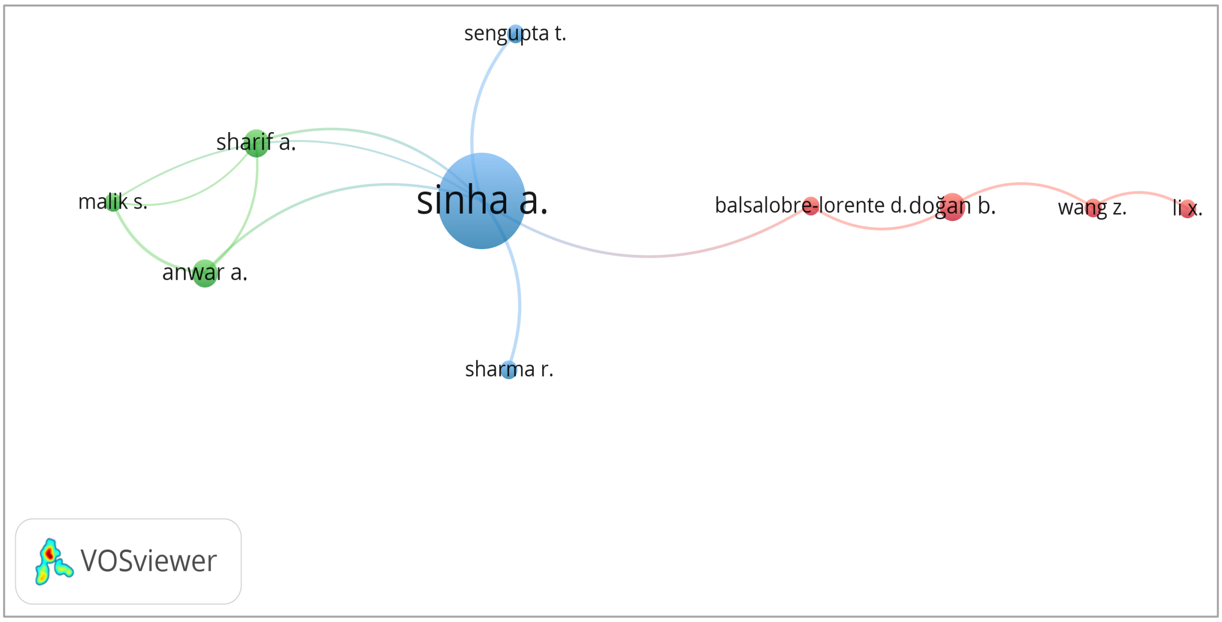

Figure 14. Co-authorship.

3.4.2. Co-authorship Countries

With regards to the co-authorship countries, we found that a total number of 34 papers are reported in 5 clusters. Figure 15 shows that there was a concentration of research in the United Kingdom and China and India. However new jurisdictions were added in 2020-2021 which can be seen in green, purple, and yellow colors with the emergence of research in countries like Germany, Turkey, Spain, and The United States. This shows that authors from many parts of the world are gradually conducting studies on sustainable development goals 13. Figure 16, on the other hand, shows the collaboration of authors across the globe. It was found that China and the United Kingdom have major collaboration followed by collaborations among authors from Bangladesh, India, Australia, Denmark, and The United States. The third most collaborative is between Pakistan, Saudi Arabia, Malaysia, and Turkey while the collaborations between authors from Nigeria and South Africa ranked the fourth.

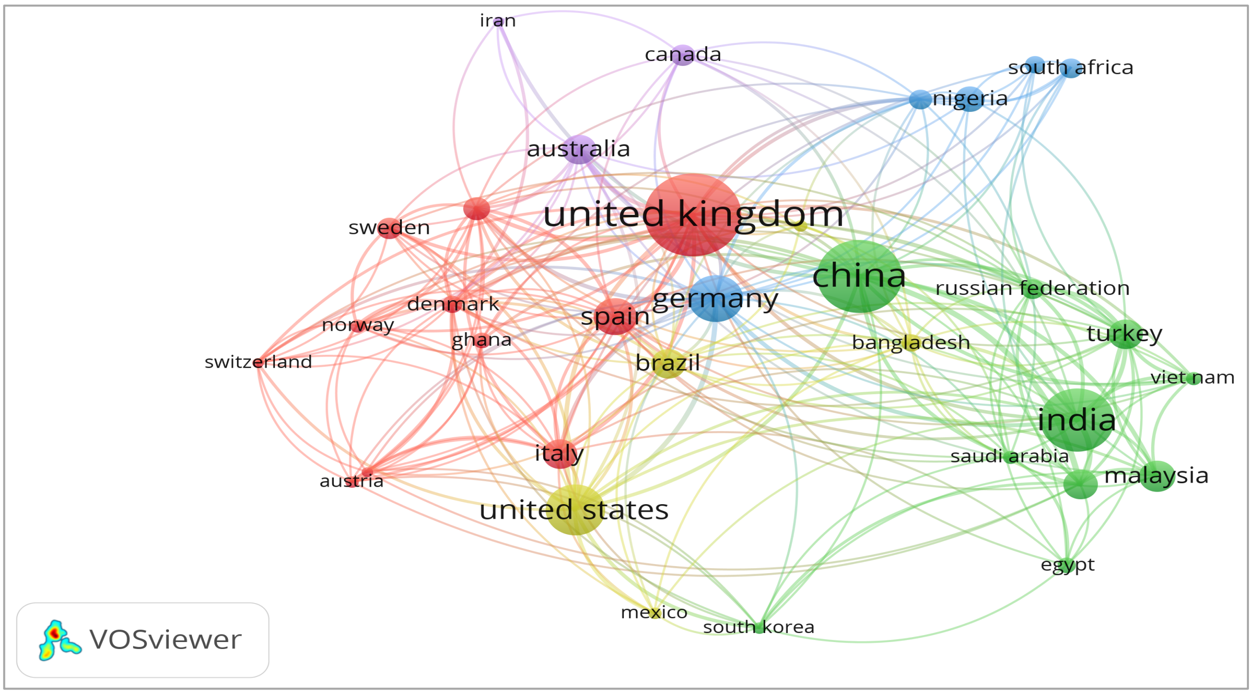

Figure 15. Co-authorship countries.

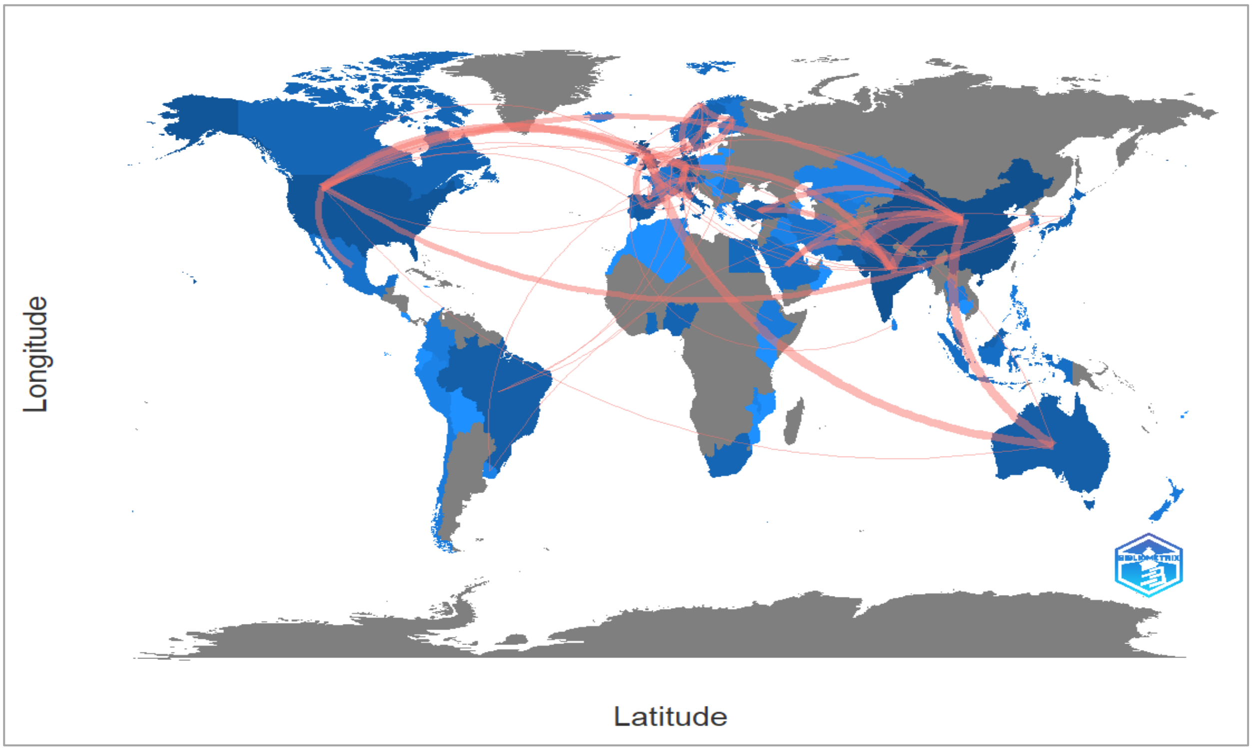

Figure 16. World collaboration map.

3.4.3. Bibliographical Coupling

In bibliographic coupling analysis, the number of references shared by two objects defines their relatedness (Figure 17). As a result, two publications are said to be bibliographically connected (coupled) if they both cite the third publication. The goal of examining bibliographic coupling is to determine what is presently being researched in a field. Bibliographic coupling allows us to discover important elements in our data set. This is a widely used method for identifying frequently cited documents in the bibliography. Figure 17 shows the commonly cited documents with Sustainable development goals 13 literature. The threshold for minimum citation was set to be 5. Seven clusters are identified with cluster have 41 documents. The results show that the most cited articles are written by Bruce mc (2018), Urgent action to combat climate change and its impacts (SDG 13): transforming agriculture and food systems, Fatima ya (2020) Industry 4.0 based sustainable circular economy approach for a smart waste management system to achieve sustainable development goals: A case study of Indonesia, Sinha n (2020) Interplay between technological innovation and environmental quality: Formulating the SDG policies for next 11 economies and Dantas t.e.t (2021) How the combination of Circular Economy and Industry 4.0 can contribute towards achieving the Sustainable Development Goals.

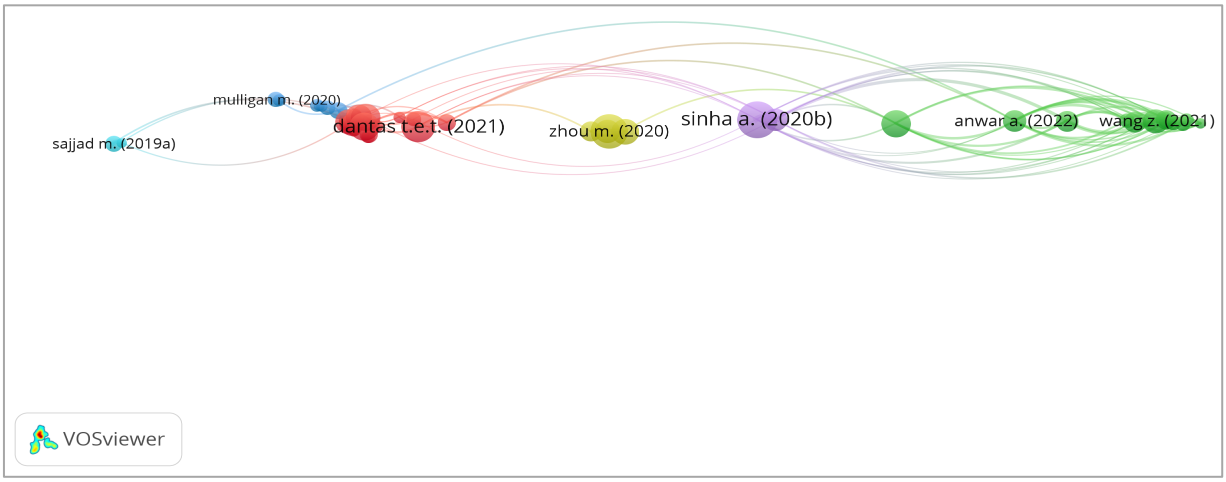

Figure 17. Bibliographic coupling of the documents.

3.4.4. Coupling by Sources

Figure 18 shows the coupling by document by source. We limit the cited reference to five to find meaningful clusters from the data. Two clusters representing shows of different colors red and green were identified. Sustainability leads in the red cluster and journal of cleaner production in blue whereas environmental science and pollution research leads the green cluster.

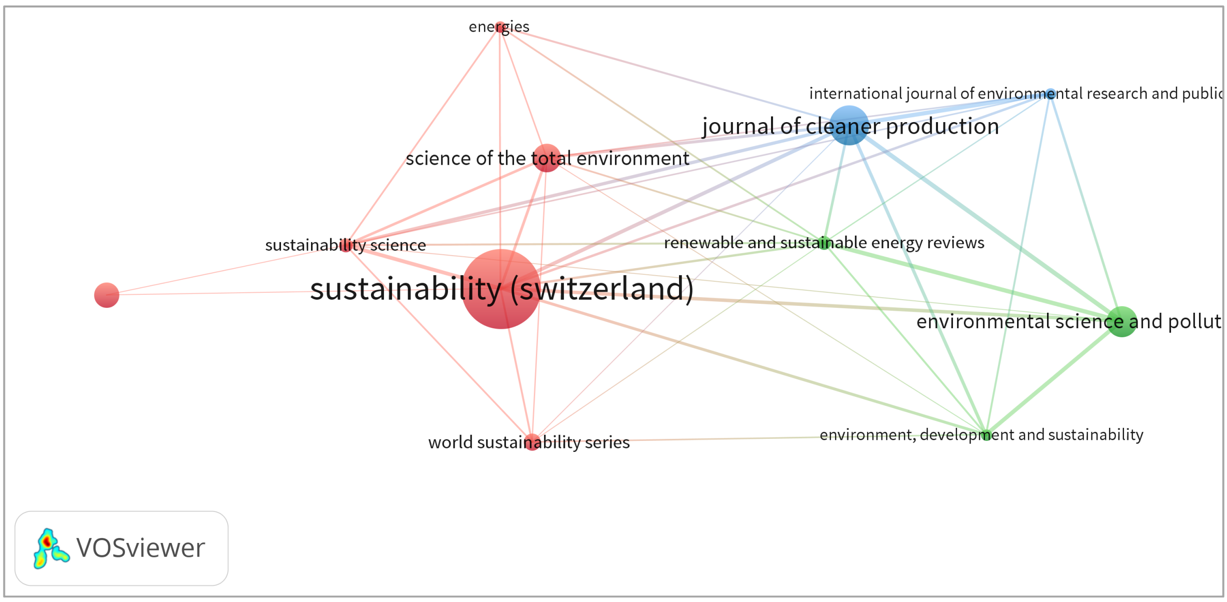

Figure 18. Coupling by source.

3.4.5. Cartography Analysis

A keyword analysis is a technique that examines the actual content of the publication. Similar to co-citation analysis, the co-word analysis assumes that words that frequently appear together have a thematic relationship with each other. Because themes formed through commonalities in publications tend to be relatively general, co-word analysis can be used as a supplement to enrich the understanding of thematic clusters derived from co-citation analysis or bibliographic coupling. Furthermore, when relevant "words" with future publishing implications and research objectives are incorporated into the study, this form of analysis may be used to anticipate future research on the topic. The relevance of this study is that it assisted the researcher in revealing the evolution and structure of the research field. It aided in the conceptual mapping of scientific literature. The keywords are derived from the title, abstract, and author keywords of the article. The picture depicts a grid focused on reproducing keywords from the literature on general financial performance characteristics for start-ups.

The cartographic analysis shows the occurrence of the keyword relevant to SDG 13. VOSviewer uses the data provided and displays the occurrence of the key works. The distance between the keywords shows how closely keywords are related to each other (Laudano et al., 2018). The minimum threshold was set to at least 5 keywords to get meaningful output. The data shows six clusters colored in red (1), green (2), blue (3), yellow (4) light blue (5), and purple (6). These clusters are dominated by the main theme like carbon dioxide (red), sustainable development (green), urban development (blue), sustainable development goal (yellow), greenhouse gases (light blue), and environmental protection (purple). Overall, we find themes like sustainable development, climate change, connected with environment protection and carbon omissions environmental impact, climate action, food security, energy efficiency, and global warming.

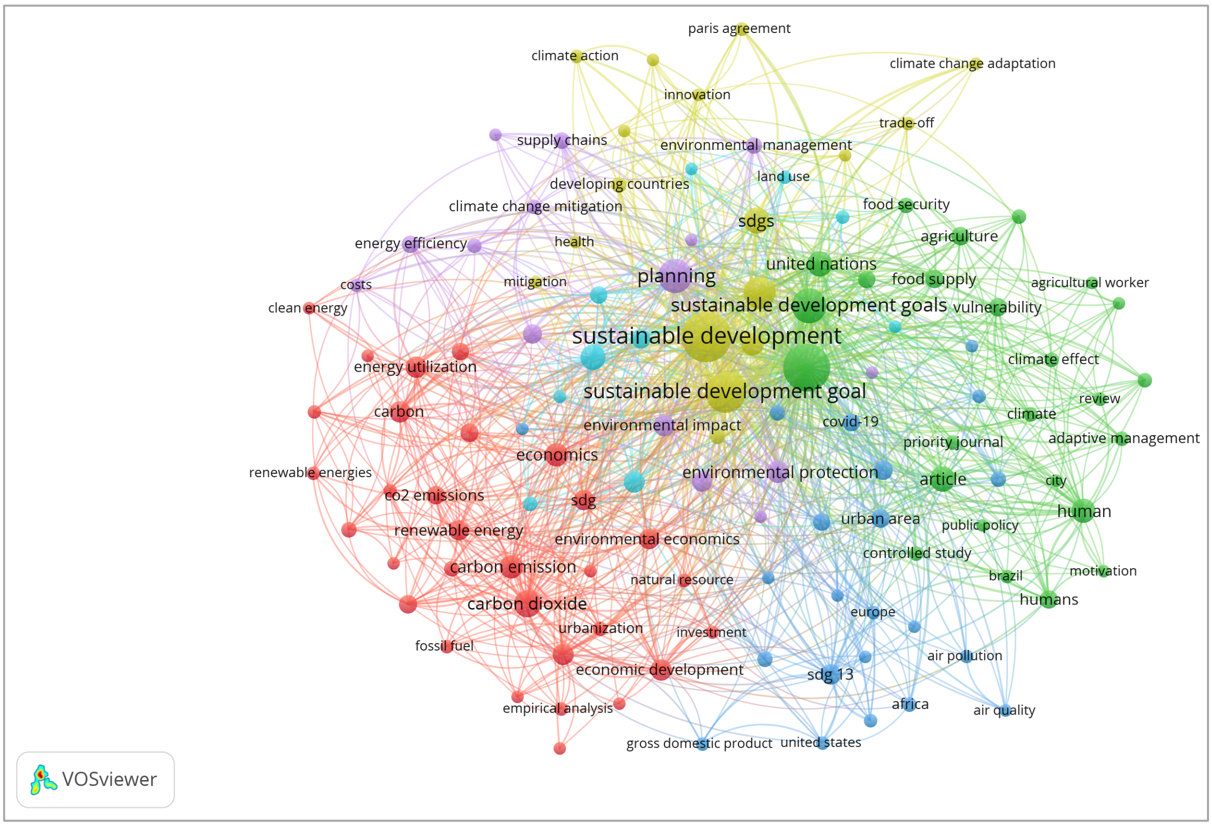

Figure 19. Keyword co-occurrences network.

4. Content Analysis

Sustainable Development Goal (SDG) 13 pertains to Climate Action, stands as one of the central columns of the United Nations 2030 Sustainable Development Agenda. Adopted in 2015, SDG 13 underlines the urgency of taking "imperative action to combat climate transformation and its influences," as climate change has been accelerating in intensity and scope across the globe. As a critical issue, climate change influences and is influenced by a wide range of environmental, economic, and social factors. Especially, mitigation measures aim to curtail global warming by reducing greenhouse gas (GHG) emissions derived largely from the combustion of fossil fuel. Transition toward reduced reliance on coal, oil, and gas is therefore essential. Wind energy, a prominent renewable source, has become increasingly competitive in cost relative to conventional fossil fuels. On the other hand, large-scale utilization requires complementary advancements in storage systems and grid-level infrastructure to manage variability and enhance stability (Olivier et al., 2017; Ram et al., 2019).

Accompanying these efforts, reducing methane emissions; especially from agriculture, industrial operations, and waste management, is critical. Methane exerts powerful near-term warming effects; therefore, optimizing dairy and meat consumption patterns while improving waste practices, and implementing modern agricultural technologies are vital mitigative strategies (IPPC, 2014). Beyond GHG reductions, emerging climate engineering and carbon capture technologies promise long-term solutions by removing CO_2 from the atmosphere, mitigating warming, and enabling ecosystems to recover (Carreon, 2015). The UN Framework Convention on Climate Change (UNFCCC) remains the key global mechanism guiding climate governance. Its objective is to stabilize GHG concentrations at levels that prevent dangerous anthropogenic interference with the climate system. The Paris Agreement reaffirmed the commitment to keep warming below 2 °C compared with pre-industrial temperatures (Nhamo & Muchuru, 2019), reinforcing SDG 13 as an anchor target for global policy.

SDG 13 contains five specific targets, focusing on resilience enhancement, institutional integration, and capacity building. Three targets involve "output actions," such as strengthening adaptive capabilities and embedding climate considerations into national policies. The remaining two promote international cooperation and capacity-building mechanisms. Progress toward these targets is evaluated through complementary indicators that assess adaptation integration, policy coherence, and implementation effectiveness (Kokotovic et al., 2019). Climate change (SDG 13) is one of the utmost emerging challenging matters continuing in developed and developing economies, and as a result, divergent policy directions have appeared adequately (Bisbis et al., 2018). Recent records highlight urgency: Le Quéré et al. (2018) project escalating carbon emissions, while the World Meteorological Organization notes that 2013–2017 recorded the highest five-year global temperature average in recent history.

4.1. Alignment of SDG 13 with Other SDGs

SDG 13 is intricately connected with various other SDGs, underscoring the integrated nature of sustainable development. A fundamental connection exists with SDG 7; Affordable and Clean Energy. Transformation from fossil fuels to clean energy systems shows one of the most significant diversions for reducing emissions. While based on the 2018 Sustainability Statement, renewable energy is projected to reach only 21% of global energy consumption by 2030. The shortfall heralds that implementation depends heavily on socio-economic dynamics, infrastructure investment, R&D commitments, and policy frameworks. Economies, therefore, must advance investment in green technologies and eco-friendly industrial processes to unlock the potential of clean energy. The sustainable development goals and 2030 Agenda are to escalate the policy consistency and decrease trade-offs between the sectoral strategies (Le Blanc, 2015).

SDG 13 also interacts strongly with SDG 8; Decent Work and Economic Growth. The green transition generates new economic opportunities. In particular within the renewable energy sector, green construction, clean technology manufacturing, eco-tourism, and climate-oriented scientific domains. This transformation drives demand for new skill sets, supporting job creation and establishing labour markets. Therefore, SDG 13 supports SDG 8 by stimulating green economic growth and facilitating long-term productivity gains through low-carbon industrial models. As climate-aligned job markets expand, economies strengthen resilience against climate-related shocks while promoting inclusive development. Climate doings are a vibrant driver of the sustainability of food structures and the conditions affecting them: land, hazard, and water Oceans (Campbell et al., 2017).

Expanding the lens further, SDG 13 interlinks with SDG 2 (Zero Hunger), SDG 6 (Clean Water & Sanitation), SDG 12 (Responsible Consumption & Production), SDG 5 (Gender Equality), SDG 15 (Life on Land), and SDG 1 (No Poverty). Food systems, for instance, shape and are shaped by climatic variations. Agricultural productivity relies on stable climate conditions; contrarily, unsustainable agricultural expansion contributes to deforestation and emissions. Prioritizing efficiency across food supply chains could reduce emissions by 15–30% (Kawano & Kanehira, 2020). SDG 15 comes under pressure when forest conservation policies confine agricultural expansion, especially in Brazil and Congo. Decoupling deforestation from agricultural activities is thus very critical.

4.2. Corporate Reporting, Accountability, and Climate Governance

Literature on environmental accounting and corporate social responsibility (CSR) demonstrates that several theoretical frameworks explain the dynamics driving environmental disclosure. Stakeholder theory emphasizes firms' obligations to meet the information needs of diverse, sometimes competing stakeholder groups (Clarkson et al., 2008). Stakeholders increasingly demand transparency regarding climate-related performance (Depoers et al., 2016), while urging firms to disclose emissions reduction measures, resource stewardship strategies, and climate-related risks.

Legitimacy theory highlights the importance of aligning corporate behaviour with societal expectations (Deegan, 2010). Firms with weaker environmental performance may increase disclosures to maintain legitimacy. Cho and Patten (2007) find that poorly performing companies disclose more environmental information, seemingly compensating for weaker outcomes. This dynamic suggests a strategic dimension to disclosure patterns. In the same vein, Pellegrino and Lodhia (2012) show that industry bodies and firms often frame climate disclosure as an avenue to legitimize emission practices. Meanwhile, voluntary disclosure theory argues that environmentally strong firms voluntarily disclose more to signal superior performance and compete advantageously in markets (Clarkson et al., 2008). Altogether, these theories illuminate how firms conceptualize, measure, and communicate actions related to SDG 13.

4.3. Bibliometric Patterns and Innovation Conduits

Bibliometric analyses have developed significantly since global digitization improved access to technical databases. These analyses help recognize evolving academic themes, research trajectories, and knowledge gaps. In this domain, "energy environmental carbon" is an emerging cluster related to SDG 13, which shows the importance of integrating sustainable innovation within energy-oriented climate strategies. "Climate change SDG," "Mediterranean studies lagoon and industry review," and "sustainable development" also emerge as topical themes, reflecting growing scientific attention to SDG 13. Technological innovation plays a major role in accelerating climate action. AI-assisted energy forecasting, smart grids, predictive climate modelling, and sophisticated energy storage systems optimize energy supply chains and support climate adaptation. Carbon capture technologies, now more pervasive in energy-intensive industries, illustrate the acceleration of mitigation strategies. These breakthroughs enhance operational efficiency while aligning national strategies with SDG 13.

Sustainable innovation further interacts with SDG 7 by advancing more affordable renewable energy solutions. At the same time, it supports SDG 8 by generating climate-oriented job markets requiring varied competencies ranging from engineering to environmental policy. Integrating sustainable innovation into circular economy systems reduces material waste, promotes resource regeneration, and supports responsible consumption (SDG 12). A unified view recognizes technology as both a vehicle and outcome of SDG-aligned development. Strategic collaboration among policy, business, and community actors is fundamental to developing responsible innovation.

In short, sustainable innovation builds a foundation for proactive environmental governance, institutional integration, and structural transformation. Policy measures that support R&D, promote clean energy funding, and embed sustainability into educational systems deepen national capacities to meet SDG 13. The alignment of sustainable innovation with production and consumption cycles enhances social equity while generating economic and environmental value, ultimately accelerating a resilient, climate-secure future.

5. Conclusion

SDG 13 (Climate Action) rests at the heart of global sustainability transitions, which reflects the urgency of mitigating climate change against rising emissions, intensifying climate emergencies, and systemic ecological instability. Collective action through mitigation, adaptation, and innovation is therefore indispensable for meeting the Paris Agreement targets and safeguarding global development prospects. At the intersection of climate and development, SDG 13 aligns closely with SDG 7 (Affordable and Clean Energy) and SDG 8 (Decent Work and Economic Growth). Shifting to renewable energy remains a cornerstone of global mitigation. Similarly, current projections highlight that clean energy will represent only 21% of energy consumption by 2030 signals the need for accelerated green infrastructure investment and supportive sustainable industrial policies. Clean energy expansion and decarbonization also stimulate labour markets, while generating employment across climate-aligned sectors. Climate policy therefore reinforces economic growth by creating new industries and enhancing competitiveness. The growing body of climate-related research reflects evolving priorities, including energy-environmental carbon systems, bibliometric trends, and sustainable development. These focal areas capture increasing scientific attention toward climate responses, particularly concerning industrial growth, circular economy applications, and socio-environmental risk management. Emerging innovation including carbon capture, AI-driven energy analytics, and smart infrastructure, offers effective pathways to meet SDG 13 targets. Theoretical frameworks from stakeholder theory, legitimacy theory, and voluntary disclosure theory identify corporate environmental reporting as central to sustainability governance. Theories highlight how firms respond to stakeholder demands, legitimize environmental performance, and signal competitive advantage. Transparent environmental reporting fosters accountability and positions climate action at the core of corporate management. SDG 13 also intersects with SDG 2, SDG 6, SDG 12, SDG 15, SDG 5, and SDG 1. Trade-offs involving forest conservation (SDG 15) and agricultural expansion require multi-stakeholder collaboration and policy coherence to preserve ecosystems. Ultimately, aligning SDG 13 across industrial policy, innovation ecosystems, and multilevel governance is vital to the 2030 Agenda. Cross-sector innovation and sustainable investment frameworks enhance climate resilience and mitigate systemic risk. When combined with inclusive development strategies, climate action delivers simultaneous gains in equity, prosperity, and environmental stewardship. Thus, SDG 13 provides a transformative lens for planning sustainable futures in addition to anchoring global action toward a prosperous, low-carbon, climate-secure world.

6. Future Research Avenues

Climate change is upsetting every economy in every region. It is disturbing nationwide economies and upsetting lives. The patterns of weather are fluctuating, sea levels are intensifying, and weather events are fetching more extreme. Though greenhouse gas emissions were anticipated to drop about 6 percent in 2020 due to travel prohibitions and economic slowdowns resulting from the COVID-19 pandemic, this development proved only short-term. Climate change is not on suspension. Besides showing the relevance of Sustainable Development Goal13 as a core theme in numerous studies in the literature, this current study presented those matters most addressed and also the emerging ones. The outcomes presented here might be used in future research avenues as a source of material to base other articles and by policymakers to establish support influences concerning the establishment of energy environmental carbon systems and suggestions of corporations for it. Particularly when the strategic map is explained, a clear point of view is delivered to researchers and strategic policymakers about how each theme is characterized concerning their significance and concentration, giving the appropriate theoretical support.

Table 8. Future research questions.

Future Research Questions	Reference
How the spillover and dynamic effects of economic growth and energy transition on CO_2 emissions for the Belt and Road Initiative?	Abban & Hongxing (2021)
How do circular economy and Industry 4.0 effects SDG's?	Patyal et al., (2022)
How physical and chemical properties of methane (CH_4) policy instruments related to climate, ecosystems, and health?	Mar et al., (2022)
What interdependent and mutually reinforcing relationships are at play, and how can they be fully understood?	Boyd et al., (2021)
How viability of Weather index insurance (WII) can be used as an effective tool for climate risk mitigation?	Singh (2024)

The research was developed with all methodical rigor to deliver reliability to the material identified. However, some limitations can be mentioned. As suggestions for future studies, we endorse the conduction of research focused on the link between renewable energy, green energy, and environmental carbon, particularly in developing economies. As for seeing the relevance of this stage in the search for sustainable development and goals, further studies scrutinizing behaviors to ensure an eco-friendly environment for everyone are imperative. Therefore, this study proposes the following research questions for further research in two folds. Table 8 shows the first-fold research question for future research with the reference to well-written and reputed articles. The energy economics empirical literature argued that economic growth and energy consumptions are substantial key drivers of climate change and CO_2 emissions. Therefore, the BRI economies and emerging economies should be focused on low-carbon technologies. The main role of natural resources is very essential for achieving different sustainable development goals. Therefore, future research should be focused on how natural resources help to condense greenhouse gases for sustainable growth. The rapid technological developments will affect future arrays of efficiency, attractiveness, and engagement. Therefore, Industry 4.0 has the potential to achieve sustainable development goals. The wealth index insurance and physical & chemical properties of methane (CH_4) policy are comparatively effective parameters that might be used to help the mitigation of climate risk factors. So, the future researcher will focus on this important tool. The second-fold research question for future research is the followings: (1) how is the quantitative simulation of multimedia pollution in the carbon environment? (2) How your economy is responding to the simulation under climate change? (3) From the perspective of authorities, how developing countries can work on the optimization framework for different environmental regulations, which ultimately positive effect on the eco-friendly environment? (4) How to increase Greenfield investment projects on a global scale? (5) How the industry focused on green products and helps to minimize carbon emission? (6) How the climate change and carbon emissions influence the other sustainable development goals? Given the continued interest in the issue, as well as the importance of sustainable development for economic growth, our comprehensive review should pique academics and practitioners' curiosity.

7. Implications

7.1. Theoretical Implications

This bibliometric review contributes significantly to the theoretical discourse on sustainable development and climate action by strengthening the intellectual connections across SDG 13 along with the broader sustainable development agenda. The review establishes the relevance among stakeholder theory, legitimacy theory, and voluntary disclosure theory within the sphere of environmental accounting and climate governance. The focus of research themes on environmental performance and disclosure advocates that firms' climate-related communication remains shaped not only by regulatory demands but also by stakeholder expectations and legitimacy-seeking behaviour. This highlights how theoretical models can be employed to analyse why and how organizations manage the complexities of climate response within sustainability reporting environments.

Furthermore, the bibliometric mapping highlights the increasing prominence of concepts such as "energy environmental carbon" and "sustainable innovation," by indicating a shift toward more integrated theoretical frameworks. This suggests that researchers are increasingly examining climate action through multi-theoretic perspectives, and at the same time bridging innovation management, sustainable energy transitions, and climate resilience. The theoretical implications therefore support the development of hybrid models that explain how technological innovation, environmental governance, and corporate strategy interact to accelerate SDG 13 progress. Similarly, this review identifies a visible transformation in interdisciplinary collaboration among climate studies, environmental policy, energy systems analysis, and global development. These emerging associations show that climate action scholarship is no more confined to environmental sciences but is expanding into economic development, industrial policy, and institutional governance. This convergence depicts the availability of an opportunity for researchers to refine contemporary theories to incorporate cross-sector paradigms, including how SDG 7 (Affordable and Clean Energy) and SDG 8 (Decent Work and Economic Growth) mediate climate mitigation and adaptation dynamics. All a whole, these insights provide a strong basis for future theoretical advancement and better illustrates the interconnected architecture of sustainable development.

7.2. Practical Implications

The findings of the review carry several implications for practitioners, industry actors, and organizations driving climate-related initiatives. First of all, the rise of research clusters focused on energy, environmental carbon, and sustainable innovation indicates that low-carbon strategies and cleaner production models must be prioritized. Emerging sustainable technologies, such as carbon capture systems, AI-driven forecasting tools, and smart infrastructure, offer viable pathways to reduce emissions while improving operational efficiencies. Organizations that proactively adopt these technologies will be in a better position to manage climate-related risks and capitalize on green market opportunities. Secondly, the review emphasizes the value of transparent environmental disclosure. Stakeholder and legitimacy theory underscore that companies with weak environmental performance tend to disclose more by representing that firms increasingly use sustainability reporting to build and maintain trust. Practitioners, therefore, must develop robust environmental accounting and reporting systems that accurately reflect climate-related actions and results. Such systems can strengthen organizational credibility, enhance investor confidence, and improve access to green finance. Thirdly, the review's findings clearly depict that green innovation provides competitive advantages. Companies investing in R&D, circular economy initiatives, and renewable energy development are likely to benefit from new revenue streams, cost reductions, and enhanced brand value. Practical commitments to eco-friendly supply chains, resource optimization, and sustainable consumption patterns can further support climate resilience and meet evolving consumer expectations at the same time. As talent markets shift toward green sectors, organizations prioritizing climate-aligned skill development will benefit from a more capable workforce able to support sustainable transformation.

7.3. Policy Implications

This review strengthens the critical role of effective policy frameworks in advancing SDG 13 and its related goals. The findings suggest that governments must intensify policies that support renewable energy expansion. The projected 21% share of renewables in global energy consumption by 2030 remains insufficient, indicating a need for policy tools such as fiscal incentives, public–private partnerships, and streamlined permitting to accelerate clean-energy deployment. These interventions will also support SDG 7, ensuring universal access to affordable and clean energy. Policy actors should explore strategies that incorporate climate action with economic development. The connection between SDG 13 and SDG 8 implies that climate-focused investments can generate green jobs and stimulate industrial diversification. Therefore, policymakers are required to take initiatives for labour-market reforms, skill upgrading, and innovation policies that enable economies to transition toward low-carbon industries without sacrificing social inclusion or job security. At the same time, the themes emerging from this review highlight the need for policy coherence across food systems, land-use planning, and biodiversity protection. Trade-offs between SDG 13 and SDG 15 (Life on Land) require balanced policy approaches that minimize deforestation while supporting agricultural productivity. Policies that incentivize sustainable land use, promote agricultural innovation, and encourage shorter supply chains can reduce emissions by up to 15–30%, aligning with climate and food security objectives. Also, this review underlines the value of enhanced climate-related disclosure requirements. Policymakers can strengthen corporate accountability by implementing mandatory environmental reporting standards aligned with global frameworks. These kinds of mandates would improve transparency and encourage to adopt climate-positive practices. In addition, increased funding for R&D and climate innovation ecosystems, through grants, subsidies, and innovation hubs, will be essential to accelerate sustainable technological diffusion. Lastly, the cross-SDG interactions reenforced in this review exhibit that policy actions on SDG 13 generate ripple effects across other goals. Integrated policymaking frameworks are, therefore, necessary to harmonize priorities across climate, energy, labour, food, water, and ecosystem governance. Coherent policy as envisioned under the 2030 Agenda will enable countries to strengthen institutional capacity, enhance resilience, and position climate action as a catalyst for national development.

Author Contributions:

Conceptualization: Imran Khan, Hassan Kabir Doma
Data curation: Imran Khan, Ezechias Harry Azokly
Formal analysis: Hassan Kabir Doma, Ezechias Harry Azokly
Funding acquisition: Imran KhanEzechias Harry Azokly
Investigation: Imran Khan, Hassan Kabir Doma
Methodology: Imran Khan, Hassan Kabir Doma
Project administration: Imran Khan, Ezechias Harry Azokly
Resources: Hassan Kabir Doma, Ezechias Harry Azokly
Software: Hassan Kabir Doma, Ezechias Harry Azokly
Validation: Hassan Kabir Doma, Ezechias Harry Azokly
Visualization: Imran Khan, Hassan Kabir Doma
Writing –original draft: Imran Khan, Hassan Kabir Doma
Writing –review & editing: Imran Khan, Ezechias Harry Azokly
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Annex 1. Top 15 articles.

Author	Title	Year	Journals	Citation
Sinha A., Sengupta T., Alvarado R.	Interplay between technological innovation and environmental quality: Formulating the SDG policies for next 11 economies	2020	Journal of Cleaner Production	138
Fatimah Y.A., Govindan K., Murniningsih R., Setiawan A.	Industry 4.0 based sustainable circular economy approach for smart waste management system to achieve sustainable development goals: A case study of Indonesia	2020	Journal of Cleaner Production	120
Dantas T.E.T., de-Souza E.D., Destro I.R., Hammes G., Rodriguez C.M.T., Soares S.R.	How the combination of Circular Economy and Industry 4.0 can contribute towards achieving the Sustainable Development Goals	2021	Sustainable Production and Consumption	97
Zhang X., Chen N., Sheng H., Ip C., Yang L., Chen Y., Sang Z., Tadesse T., Lim T.P.Y., Rajabifard A., Bueti C., Zeng L., Wardlow B., Wang S., Tang S., Xiong Z., Li D., Niyogi D.	Urban drought challenge to 2030 sustainable development goals	2019	Science of the Total Environment	80
Shahbaz M., Sharma R., Sinha A., Jiao Z.	Analyzing nonlinear impact of economic growth drivers on CO2 emissions: Designing an SDG framework for India	2021	Energy Policy	79
Bruce M C., James H., Janie R., Clare M S., Stephen T., Eva L.W.	Urgent action to combat climate change and its impacts (SDG 13): transforming agriculture and food systems	2018	Current Opinion in Environmental Sustainability	79
Humpenöder F., Popp A., Bodirsky B.L., Weindl I., Biewald A., Lotze-Campen H., Dietrich J.P., Klein D., Kreidenweis U., Müller C., Rolinski S., Stevanovic M.	Large-scale bioenergy production: How to resolve sustainability trade-offs?	2018	Environmental Research Letters	66
Jouzdani J., Govindan K.	On the sustainable perishable food supply chain network design: A dairy products case to achieve sustainable development goals	2021	Journal of Cleaner Production	65
Monteiro N.B.R., da Silva E.A., Moita Neto J.M.	Sustainable development goals in mining	2019	Journal of Cleaner Production	63
Omer M.A.B., Noguchi T.	A conceptual framework for understanding the contribution of building materials in the achievement of Sustainable Development Goals (SDGs)	2020	Sustainable Cities and Society	60
Wang Z., Ben Jebli M., Madaleno M., Doğan B., Shahzad U.	Does export product quality and renewable energy induce carbon dioxide emissions: Evidence from leading complex and renewable energy economies	2021	Renewable Energy	58

Author	Title	Year	Journals	Citation
Zhou M., Govindan K., Xie X.	How fairness perceptions, embeddedness, and knowledge sharing drive green innovation in sustainable supply chains: An equity theory and network perspective to achieve sustainable development goals	2020	Journal of Cleaner Production	54
Sinha A., Sengupta T., Saha T.	Technology policy and environmental quality at crossroads: Designing SDG policies for select Asia Pacific countries	2020	Technological Forecasting and Social Change	53
Swain R.B., Karimu A.	Renewable electricity and sustainable development goals in the EU	2020	World Development	49
Anwar A., Sinha A., Sharif A., Siddique M., Irshad S., Anwar W., Malik S.	The nexus between urbanization, renewable energy consumption, financial development, and CO2 emissions: evidence from selected Asian countries	2022	Environment, Development and Sustainability	48

Annex 2. Top 25 latest articles.

Authors	Title	Year	Findings
Anwar A., Sinha A., Sharif A., Siddique M., Irshad S., Anwar W., Malik S.	The nexus between urbanization, renewable energy consumption, financial development, and CO2 emissions: evidence from selected Asian countries	2022	• The empirical evidence demonstrates that urbanization, financial development, and economic growth increase CO2 emissions • renewable energy consumption reduces CO2 emissions.
Olabi A.G., Obaideen K., Elsaid K., Wilberforce T., Sayed E.T., Maghrabie H.M., Abdelkareem M.A.	Assessment of the pre-combustion carbon capture contribution into sustainable development goals SDGs using novel indicators	2022	• The proposed indicators have nine main benefits, i.e., assist in the achievement of the SDGs, providing information for the decision-makers, enhance and benchmark sustainability performance, improve risk management, enhance data management and reporting practices, improve resource allocation and reduce the expenses, improve environmental performance, reduce social impact, and improve communications with stakeholder. Moreover, the different barriers facing the CCT were presented.
Adebayo T.S., Agyekum E.B., Kamel S., Zawbaa H.M., Altuntaş M.	Drivers of environmental degradation in Turkey: Designing an SDG framework through advanced quantile approaches	2022	• The outcomes from the QQR show that in all quantiles, financial development, economic growth, urbanization, and agriculture impact CO2 emissions positively, while in the middle quantiles, the influence of renewable energy use on CO2 is negative. Furthermore, the outcomes from the non-parametric Granger causality test disclosed that in mean and variance, all the variables could predict CO2 emissions at different quantiles. A complete SDG-oriented policy framework has been proposed based on the research's findings so that Turkey may move toward reaching its SDG 13 and SDG 7 targets.
Doğan B., Chu L.K., Ghosh S., Diep Truong H.H., Balsalobre-Lorente D.	How environmental taxes and carbon emissions are related in the G7 economies?	2022	• The results suggest that environmental taxes effectively reduce emissions for the G7 countries. • and confirm that the marginal effects of the environmental tax on traditional energy consumption, natural resources rent and renewable energy consumption rise with the level of taxation in a statistically significant way. • The findings indicate that strict environmental tax laws will allow businesses to shift production towards cleaner methods.
Akadiri S.S., Adebayo T.S., Asuzu O.C., Onuogu I.C., Oji-Okoro I.	Testing the role of economic complexity on the ecological footprint in China: a nonparametric causality-in-quantiles approach	2022	• that renewable energy, non-renewable energy use, economic growth and economic complexity affects ecological footprint positively. • the nonparametric causality outcomes revealed that renewable energy, non-renewable energy use, economic growth and economic complexity can significantly predict variations in ecological footprint at different quantiles.
Gyamfi B.A., Adebayo T.S., Bekun F.V., Agboola M.O.	Sterling insights into natural resources intensification, ageing population and globalization on environmental status in Mediterranean countries	2022	• results shows that both income and natural resources rent have an inverted U-Shaped connection with CO2 emission, which affirms the Environmental Kuznets Curve (EKC) hypothesis. • Subsequently, globalization and energy use show a positive relationship with emissions • while AP is negatively correlated with emissions.
Musah M., Owusu-Akomeah M., Nyeadi J.D.,	Financial development and environmental sustainability in West Africa: evidence from	2022	• the countries should integrate environmental welfare objectives into their financial development policies.

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Alfred M., Mensah I.A.	heterogeneous and cross-sectionally correlated models		
Hossain M.E., Islam M.S., Bandyopadhyay A., Awan A., Hossain M.R., Rej S.	Mexico at the crossroads of natural resource dependence and COP26 pledge: Does technological innovation help?	2022	• the result of the novel dynamic ARDL simulation does not validate the Environmental Kuznets curve (EKC) hypothesis. • Thus, implying that Mexico's economy remains at the scale stage, with a scope of economic expansion relative to environmental quality. • However, the Pollution Haven Hypothesis (PHH) is validated.
Mehmood Mirza F., Sinha A., Rehman Khan J., Kalugina O.A., Wasif Zafar M.	Impact of energy efficiency on CO_2 Emissions: Empirical evidence from developing countries	2022	• that energy efficiency is major contributor of CO_2 emissions reduction. • While structural shifts in developing countries tend to increase CO_2 emissions • However, the income is one of the major contributors of CO_2 emissions. • While renewable energy consumption has negative and industrialization has positive impact on CO_2 emissions in developing countries.
Qyyum M.A., Ismail S., Ni S.-Q., Ihsanullah I., Ahmad R., Khan A., Tawfik A., Nizami A.-S., Lee M.	Harvesting biohydrogen from industrial wastewater: Production potential, pilot-scale bioreactors, commercialization status, techno-economics, and policy analysis	2022	• The current implementation and commercialization challenges during hydrogen production were also highlighted in this review. Furthermore, a literature survey revealed research gaps associated with optimum conditions for maximized biohydrogen yield. • Numerous review studies in literature focus on biohydrogen potential from solid biowaste; nevertheless, a comprehensive review on biohydrogen from wastewater is still needed.
Yin C., Zhao W., Pereira P.	Soil conservation service underpins sustainable development goals	2022	• The results showed that i) SCS ensures the SDG achievement by mitigating soil erosion; ii) SCS showed a significant and positive relationship (coef. = 0.41, $p < 0.01$) with SDG 15 (Life on land) in China. • Moreover, SCS supports multiple SDGs by regulating ecological processes, producing food and products, and providing social and cultural values. • More than 50% of respondents recognised that SCS benefits SDG 15, SDG 13 (Climate Action), and SDG 6 (Clean water and sanitation).
Bandari R., Moallemi E.A., Lester R.E., Downie D., Bryan B.A.	Prioritising Sustainable Development Goals, characterising interactions, and identifying solutions for local sustainability	2022	• We identified the five highest priority SDGs for the region as clean water and sanitation (SDG 6), agricultural activities (SDG 2), economic growth (SDG 8), climate action (SDG 13), and life on land (SDG 15). • Across these five priority SDGs and their 45 targets, we found 307 potential interactions, of which 126 (41%) were synergistic, 19 (6%) were trade-offs, and 162 (53%) were benign.
Gholami V., Khaleghi M.R., Pirasteh S., Booij M.J.	Comparison of Self-Organizing Map, Artificial Neural Network, and Co-Active Neuro-Fuzzy Inference System Methods in Simulating Groundwater Quality: Geospatial Artificial Intelligence	2022	• The results demonstrate the high performance of the three methods in groundwater quality simulation. However, in the test stage, CANFIS (R-sqr = 0.89) had a higher performance than the SOM (R-sqr = 0.8) and ANN (R-sqr = 0.73) methods. • The tested CANFIS model was used to estimate GWQI values on the area of the plain. • Finally, the groundwater quality was mapped in a GIS environment associated with CANFIS simulation. The results can be used to manage groundwater quality as well as support and contribute to the sustainable development goal (SDG)-6, SDG-11, and SDG-13.
Patyal V.S., Sarma P.R.S., Modgil S., Nag T., Dennehy D.	Mapping the links between Industry 4.0, circular economy and sustainability: a systematic literature review	2022	• the study also depicts the CE practices leading to the select SDGs ("SDG 6: Clean Water and Sanitation," "SDG 7: Affordable and Clean Energy," "SDG 9: Industry, Innovation and Infrastructure," "SDG 12: Responsible Consumption and Production" and "SDG 13: Climate Action").
Coenen J., Glass L.-M., Sanderink L.	Two degrees and the SDGs: a network analysis of the interlinkages between transnational climate actions and the Sustainable Development Goals	2022	• We find that actions of 71 initiatives contribute to achieving 16 SDGs, • thus generating valuable co-benefits. Besides SDG 13 on climate action and SDG 17 on partnerships for the goals, transnational climate actions frequently address SDGs 9 on industry, innovation and

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			infrastructure, SDG 7 on affordable and clean energy, and SDG 12 on responsible consumption and production. • While SDG 3 on good health and well-being and SDG 4 on quality education are barely addressed, SDG 5 on gender equality is not at all covered by transnational climate actions. Additionally, • the network reveals that SDG 9 is highly synergistic with many other frequently addressed SDGs and functions as an important connector between them. • Finally, our results indicate that transnational initiatives fill a governance gap left by states with regards to SDG 12.
Okere K.I., Onuoha F.C., Muoneke O.B., Nwaeze N.C.	Sustainability challenges in Peru: embossing the role of economic integration and financial development—application of novel dynamic ARDL simulation	2022	• This research output confirms the inverted-U-shaped hypothesis between economic growth and carbon emissions. • In contrast, the kernel-based regularized least squares confirms the scale effect and fossil curse hypothesis in the relationship between financial development and carbon emission, and heterogeneous effects in economic integration and carbon emission. • We further document that financial development, fossil fuel consumption, urban population, affluence (economic growth), and government final consumption expenditure spur environmental pollution while economic integration reduces it.
Wang Q., Liu C., Hou Y., Xin F., Mao Z., Xue X.	Study of the spatio-temporal variation of environmental sustainability at national and provincial levels in China	2022	• Our results show that the scores of SDG 6, SDG 11, SDG 12, SDG 13, and SDG 15 experienced an increasing trend, • while SDG 14 experienced a decline.
Zhao L., Saydaliev H.B., Iqbal S.	ENERGY FINANCING, COVID-19 REPERCUSSIONS AND CLIMATE CHANGE: IMPLICATIONS FOR EMERGING ECONOMIES	2022	• Study finding resulted that higher energy consumption and rise in environmental pollution has brought a great change in the ASEAN and Asian economies' climate, for which, modern and renewable energy sources are suggested to use for the climate change mitigation. • A sufficient amount of funds and the supply of energy finance to mitigate the climate change are eminently needed for the post-covid-recovery.
Xu D., Sheraz M., Hassan A., Sinha A., Ullah S.	Financial development, renewable energy and CO2 emission in G7 countries: New evidence from non-linear and asymmetric analysis	2022	• An SDG-oriented policy framework has been recommended based on these study outcomes. While this policy framework is aimed at addressing the objectives of SDG 13 and 7, the framework is generalizable to other nations. • The contribution of the present study is an emphasis on the environmental policy issues of the G7 countries, and the accompanying recommendation of this SDG-oriented policy framework.
Mehmood U., Agyekum E.B., Uhunamure S.E., Shale K., Mariam A.	Evaluating the Influences of Natural Resources and Ageing People on CO2 Emissions in G-11 Nations: Application of CS-ARDL Approach	2022	• The Westerlund co-integration test that assesses co-integration confirms the firm association among the parameters, and the values of coefficient of the cross-sectional autoregressive distributed lag (CS-ARDL) approach show that a 1% increase in the ageing population will lower the emissions of CO2 by 13.41% among G-11 countries. • Moreover, the findings show that there exists an environmental Kuznets curve (EKC) among natural resources, globalization, economic growth, ageing people, and the emission of CO2. Based on the findings, this work presents some important policy implications for achieving sustainable growth in the G-11 countries. These countries need to lower the amount of energy obtained from fossil fuels to improve air quality.
De Boeck K., Decouttere C., Jónasson J.O., Vandaele N.	Vaccine supply chains in resource-limited settings: Mitigating the impact of rainy season disruptions	2022	• Our baseline simulation predicts the national vaccination coverage with good accuracy and suggests that 67% of regions with low reported immunization coverage are affected by rainy season disruptions or operational inefficiencies,

Authors	Title	Year	Findings
			causing significant geographical inequalities in vaccine access.
Filho W.L., Hickmann T., Nagy G.J., Pinho P., Sharifi A., Minhas A., Islam M.R., Djalanti R., García Vinuesa A., Abubakar I.R.	The Influence of the Corona Virus Pandemic on Sustainable Development Goal 13 and United Nations Framework Convention on Climate Change Processes	2022	• Results of the bibliometric analysis show that the most common terms associated with this theme are COVID-19, climate change, CO2, energy, "pandemic-related," and "adaptation-related." • In addition, the survey revealed some difficulties associated with online participation in the processes from many developing countries. • The study concluded that there is negative impact of COVID-19 pandemic on the UNFCCC process, more minor government priorities regarding climate action, loss of traction of the process.
Romero-Perdomo F., Carvajalino-Umaña J.D., Moreno-Gallego J.L., Ardila N., González-Curbelo M.Á.	Research Trends on Climate Change and Circular Economy from a Knowledge Mapping Perspective	2022	• found that research on climate change and CE is continually growing and interdisciplinary in nature. Europe notably leads scientific production. Keyword evolution shows that CE has been influenced by more lines of research than climate change. • We also found that waste management is the CE approach most associated with climate change, mitigation is the climate action most impacted by CE, and food is the most reported greenhouse gas (GHG)-emitting material. solutions are promising themes.
Balogun A.-L., Tella A.	Modelling and investigating the impacts of climatic variables on ozone concentration in Malaysia using correlation analysis with random forest, decision tree regression, linear regression, and support vector regression	2022	• The results show a very strong correlation between temperature and ozone. • Wind speed also exhibits a moderate to strong correlation with ozone, while relative humidity is negatively correlated. • The highest correlation values were obtained at Bukit Rambai, Nilai, Jaya II Perai, Ipoh, Klang and Petaling Jaya.
Mir K.A., Purohit P., Cail S., Kim S.	Co-benefits of air pollution control and climate change mitigation strategies in Pakistan	2022	• Our results reveal that Pakistan's current air pollution control measures are insufficient to meet the country's air quality standards under the baseline scenario. • Implementing sustainable development strategies will reduce nationwide PM2.5-related mortalities by 24% in 2050 compared to the baseline. • While advanced control measures have the potential to improve air quality and human health in Pakistan, when combined with national sustainable development strategies, they have the potential to halve greenhouse gas emissions (implementing SDG 13 indicator on climate action) and save on emission control costs approximately by a quarter (0.32% of GDP) by 2050.