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Mapping Global Research Trends on Sustainable Development Goals (SDGs): A Bibliometric Analysis using VOSviewer

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Abstract. *The Sustainable Development Goals (SDGs) provide a comprehensive global framework to address pressing social, economic, and environmental challenges. Despite the growing body of research, knowledge fragmentation and limited cross-disciplinary mapping hinder a holistic understanding of SDG research trends. This study aims to systematically map and analyze global SDG research developments from 2020 to 2026 using a bibliometric approach, with the 2025-2026 records treated as partial Scopus-indexed data rather than complete annual outputs. Data were retrieved from the Scopus database and processed with Publish or Perish, followed by scientific mapping in VOSviewer. The methodology included publication trend analysis, document-type distribution analysis, and keyword co-occurrence analysis to identify dominant research themes and emerging topics. A total of 186 publications were analyzed, revealing that comparable full-year research activity peaked in 2021-2022 and remained dominated by journal articles. Keyword analysis identified core clusters related to sustainable development, climate change, and food security, alongside emerging topics such as bioplastics, nanotechnology, low-carbon consumption, digital transformation, and sustainability education. These findings highlight both the evolution and diversification of SDG research, emphasizing the integration of technology, education, and practical applications. Understanding SDG research trends is essential for accelerating evidence-based environmental action, supporting climate mitigation strategies, and fostering interdisciplinary solutions to pressing ecological challenges such as biodiversity loss, pollution, and resource depletion. The study provides critical insights for researchers, educators, and policymakers to prioritize underexplored areas, foster cross-disciplinary collaborations, and guide evidence-based strategies for sustainable development.*

Keywords: *Bibliometric Analysis; Emerging Keywords; Research Trends; Sustainable Development Goals; VOSviewer*

1. Introduction

Since the United Nations launched the 2030 Agenda for Sustainable Development in 2015, the Sustainable Development Goals (SDGs) have become the primary global framework for promoting sustainable development, encompassing social, economic, and environmental dimensions (1–3). The SDGs serve not only as guidelines for development policy but also as an important focus of interdisciplinary scientific research, including education, environmental science, technology, health, and economics (4–6). The complexity of global challenges such as climate change, social inequality, environmental degradation, and the global health crisis has driven a significant increase in the number of scientific publications

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seeking to link research-based solutions to achieving SDG targets. This indicates that the SDGs have become a dominant conceptual framework in global academic discourse (4,5).

Over the past decade, scientific publications on the SDGs have surged across various fields (7). The SDGs unite diverse disciplines and methodologies (8,9). Yet, this rapid expansion creates challenges: fragmented knowledge, overlapping study foci, and difficulty tracking research directions (10,11). While studies often target specific SDG goals, the crucial relationships among topics, intellectual structures, and global scientific collaboration remain largely unmapped (7,9,10).

Several previous studies have examined the SDGs through systematic, scoping, and narrative reviews across education, the environment, public policy, and sustainable development (12–15). While these studies make important contributions to understanding key themes and findings, most still focus on specific SDG sectors or objectives and fail to capture the full landscape of SDG research (4,9,10,14,16,17). These limitations indicate a significant research gap in the need for more integrated, large-scale, data-driven scientific mapping.

The urgency of this research is further heightened given the multidimensional nature of the SDGs and the demand for cross-sector and cross-disciplinary synergy. Without a comprehensive understanding of the structure and direction of SDG research development, efforts to align research, education, and sustainable development policy agendas risk being suboptimal. Therefore, an approach is needed that provides a comprehensive overview of publication trends, key actors, dominant theme clusters, and global SDG research frontiers. A bibliometric approach using VOSviewer is relevant because it enables systematic, objective visualization and analysis of complex relationships among publications, authors, institutions, and keywords. Several previous bibliometric studies have examined sustainability and the SDGs, showing that research tends to focus on environmental issues, climate change, and economic development, with contributions from developed countries dominating (4,9,10,14). However, these studies are generally limited to a specific timeframe, focus on a subset of the SDGs, or fail to combine publication performance analysis with comprehensive knowledge structure mapping (4,9,14,17). Thus, there is still an opportunity to conduct a more comprehensive bibliometric analysis to reveal the dynamics of SDGs research development since the launch of the 2030 Agenda.

Based on this background, this study aims to map and analyze research trends in sustainable development using a bibliometric approach. Through comprehensive scientific mapping, this research is expected to provide theoretical contributions to understanding the dynamics of SDGs knowledge and practical contributions for researchers, educators, and policymakers in formulating evidence-based research and policy agendas for sustainable development. Understanding SDG research trends is essential for accelerating evidence-based environmental action, supporting climate mitigation strategies, and fostering interdisciplinary solutions to pressing ecological challenges such as biodiversity loss, pollution, and resource depletion.

2. Methods

This study uses a bibliometric approach to map the development and structure of global research related to the Sustainable Development Goals (SDGs). Bibliometric analysis was chosen because it can systematically process scientific publication data to identify publication patterns and clusters of emerging research themes over a specific period. The initial stage of the research involved searching the Scopus database for scientific publications,

widely recognized as one of the largest and most reputable citation databases for international academic publications. The search and download of publication metadata were carried out using Publish or Perish software. The publication timeframe was limited to the period 2020-2026 to capture relatively recent SDGs research, while the 2025-2026 records were treated as partial Scopus-indexed data and were not interpreted as complete annual publication trends. Search keywords were specifically defined using the title word "SDGs," so that only documents that explicitly place the SDGs as the main focus of the research were identified. The stages of this research are shown in Figure 1.

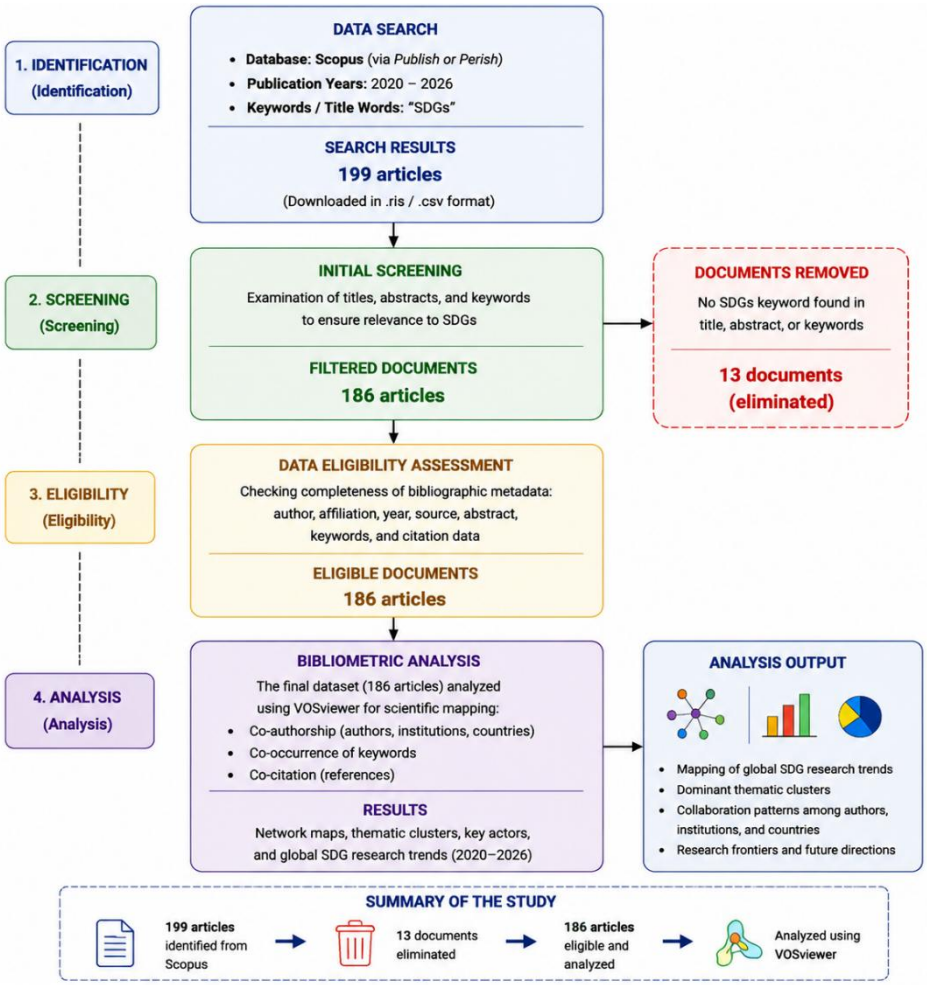

Figure 1. Research stages

Based on the initial search results, 199 documents were indexed in the Scopus database. Next, a data cleaning process was conducted to ensure data quality and relevance. At this stage, 13 documents were removed because they did not meet the eligibility criteria, namely the absence of author keywords in the publication's primary metadata. Thus, a total of 186 documents were declared valid and used in the further analysis phase.

After the screening process, data attributes were checked for completeness, including author information, institutional affiliation, publication year, journal source, abstract, author keywords, and citation data. Only documents with complete metadata relevant to publication-trend and keyword analyses were included in the bibliometric analysis to ensure the accuracy of the scientific mapping. The verified data were then exported in a compatible format for analysis using VOSviewer software.

Bibliometric analysis was conducted using publication performance analysis and keyword co-occurrence mapping. Publication performance analysis was used to describe annual publication distribution and document types, while keyword co-occurrence analysis was used to identify research theme clusters and emerging topics. Network and overlay visualizations generated by VOSviewer were used to interpret relationships among keywords and to provide an overview of trends, main focuses, and directions of SDG research development during the 2020-2026 period. Because co-authorship and co-citation networks were not included in the final analysis, collaboration patterns and intellectual-structure mapping were not interpreted in the Results and Discussion section.

3. Results and Discussion

The following are the results and discussion of the results of processing Scopus database data:

3.1. Bibliometric Analysis Results

Based on the collected data, a total of 186 documents were analyzed. The annual distribution shows that the number of publications increased from 43 in 2020 to 48 in 2022, then decreased to 23 in 2023 and increased slightly to 25 in 2024. As shown in Figure 2, the comparable full-year data therefore indicate a peak in the 2021-2022 period, followed by lower output in 2023 and a modest recovery in 2024. The 2025 and 2026 values each contain only one indexed record and should be interpreted cautiously because Scopus indexing for these years is partial and not comparable to complete annual data. Therefore, the low values in 2025-2026 are not used as evidence of a genuine decline or a definitive shift in SDG research focus.

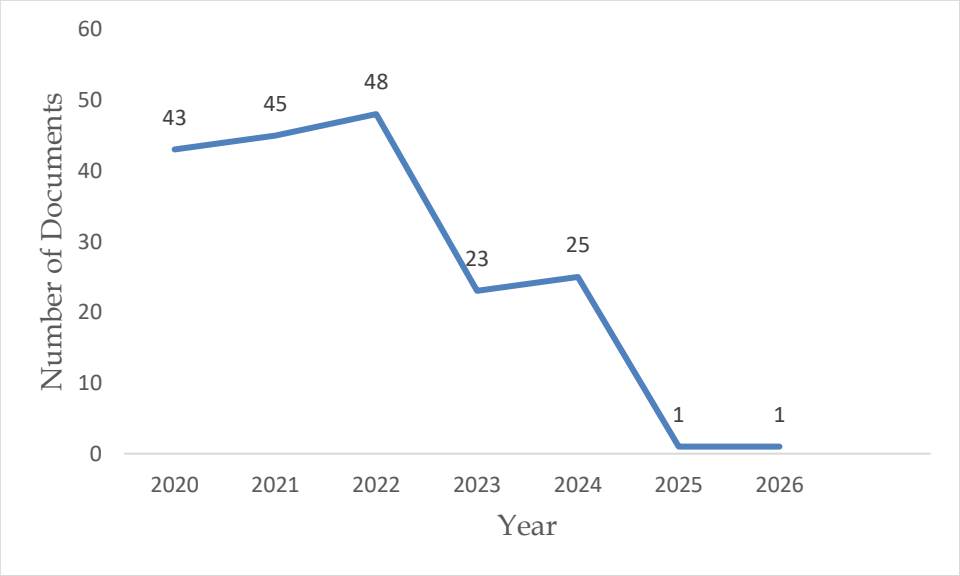

Figure 2. Annual distribution of SDG-related publications (2020-2026; 2025-2026 data are partial Scopus-indexed records)

Table 1 shows the distribution of document types. The majority of publications are articles (160 documents), followed by reviews (22 documents), conference papers (2 documents), and notes (2 documents). No books, book chapters, or editorials were included in the final dataset. This distribution indicates that peer-reviewed journal articles remain the dominant channel for disseminating SDG-related research in the analyzed Scopus dataset.

Table 1. Distribution of document types

Document Type	Number of Documents
Article	160
Book	0
Book Chapter	0
Conference Paper	2
Editorial	0
Note	2
Review	22

3.2. Keyword Co-occurrence Analysis and Research Networks

The overlay visualization (Figure 3) in VOSviewer displays 629 items divided into 59 clusters, with 2,458 links and a total link strength of 2,571. The most prominent keywords are "sustainable development goals," "sustainable development," "SDGs," "sustainability," and "climate change." The high total link strength indicates that these keywords not only appear frequently but are also highly connected to other keywords, reflecting a complex research network.

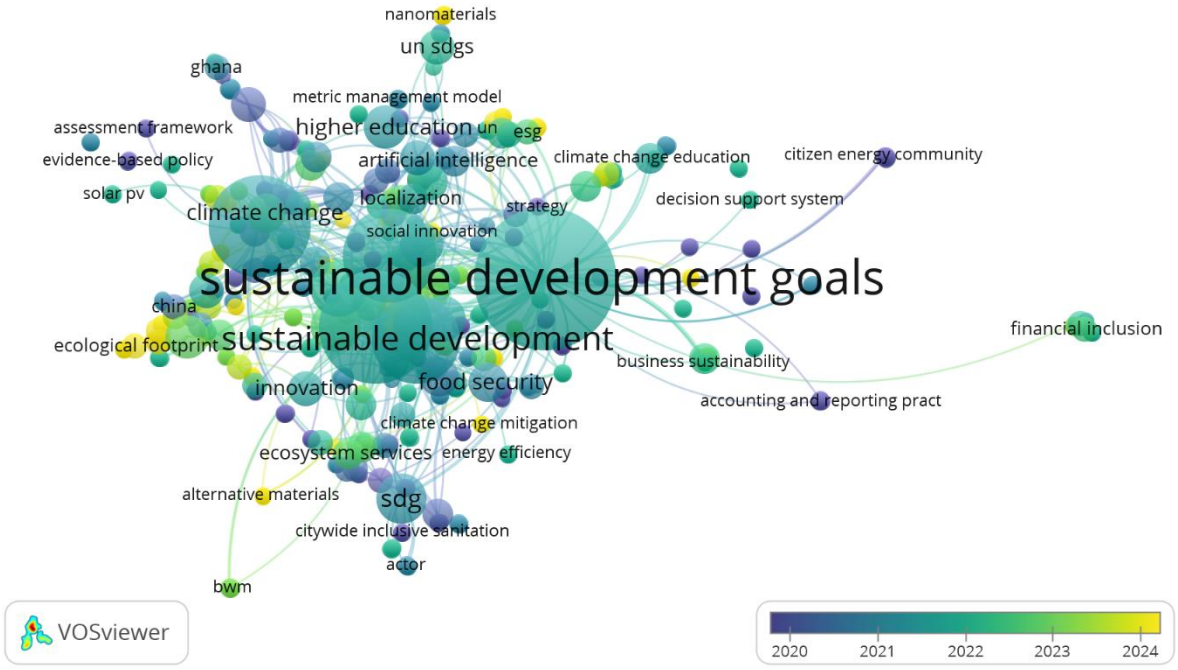

Figure 3. Overlay visualization

The overlay visualization shows keyword trends by year: green-to-yellow nodes indicate relatively newer keywords such as "artificial intelligence," "higher education," and "digital transformation." This suggests that recent research explores technology and digital transformation within the context of sustainable development, including SDG strategies in higher education and social innovation. Top keyword analysis highlights terms such as "bibliometric analysis," "circular economy," "2030 agenda," and "corporate social responsibility (CSR)." Although these terms occur less often than core SDG keywords, they still point to specific research directions and practical applications of sustainable development.

3.3. Research Trend Comparison

The next finding concerns emerging keywords that have begun to appear in recent sustainability research but remain less frequently discussed, as shown in Table 2.

Table 2. Emerging keywords in recent sustainability research

Cluster	Emerging Keywords	Interpretation
Sustainable Environment & Materials	bioplastic, sustainable packaging, alternative materials, carbon footprint	Focuses on eco-friendly material innovations. Bioplastics and alternative materials indicate emerging research trends aimed at reducing carbon footprint. Sustainable packaging is part of business strategies for environmental impact reduction. Carbon footprint shows studies still emphasize quantification rather than practical interventions.
Low-Carbon Consumption & Sustainability Awareness	sustainability consciousness, low-carbon food consumption, climate change mitigation	Highlights consumer behavior and awareness toward sustainability. Research is limited, focusing on the relationship between environmental consciousness and consumption choices, particularly low-carbon diets.
ESG Factors Analysis	environmental factors, social factors, governance factors, economic factors	Covers Environmental, Social, Governance (ESG) assessment in business and investment. Emphasizes holistic quantification of these factors in recent research trends.
Education & Learning Technology	education, learning, pedagogy, engineering	Focuses on curriculum and methods integrating sustainability or new technologies. Shows emerging trends in incorporating eco-friendly topics into engineering and science education.
Nanotechnology & Advanced Materials	nanotechnology, nanomaterials, nanowires, nanosensors, nanoscience	Cutting-edge research in material science at the nano-scale, enabling improved material efficiency, environmental sensors, and next-generation bioplastics.
Analysis & Methodologies	citation analysis, flow vergence model, SDG network, techno-economic analysis	Reflects new methods for assessing research trends and technology potential, including applications in Sustainable Development Goals.
Ecology & Spatial Variation Analysis	evenness, spatial and temporal variation, synergies and trade-offs	Focuses on ecological and environmental system analysis, particularly spatial-temporal variability, still rare in material and consumer behavior research.

3.4. Research Recommendations

Based on these results, there are several opportunities for future research:

1. Technology Integration with the SDGs: Further research can explore how artificial intelligence, big data, and digital transformation support the implementation of the SDGs, particularly in higher education, resource management, and social innovation.
2. Multidimensional Approach to Sustainability: Research opportunities remain that link environmental, social, and economic aspects simultaneously. For example, the influence of corporate social responsibility (CSR) on climate change mitigation and food security.
3. Global Collaboration Analysis: With high total link strength, research can map collaborations between countries or institutions, identify countries or institutions that play a central role, and examine collaborative research patterns.
4. SDG Implementation in Local Contexts: There is still little research that highlights the implementation of the SDGs in local contexts, such as the role of communities, cities, and specific actors in achieving sustainable development goals.
5. Non-Article Research Gap: Given that most publications are articles, research in the form of books, book chapters, or editorials can be developed to expand academic and societal impact.

Conclusions

Based on the bibliometric analysis, research in sustainable development shows a dynamic but uneven trend. Of the 186 documents analyzed, comparable full-year publication output increased from 2020 and peaked in 2022, decreased in 2023, and showed a modest recovery in 2024. The 2025-2026 records were treated as partial Scopus-indexed data and were not interpreted as complete annual trends. The majority of documents are scientific articles, indicating that journals remain the primary medium for disseminating knowledge in this field. Keyword analysis revealed two main groups: a core cluster focused on traditional topics such as sustainable development goals, climate change, sustainability, and food security, and emerging clusters related to artificial intelligence, digital transformation, and higher education. These findings directly address the research objective by mapping dominant SDG research themes and identifying newer directions that connect sustainability with technology, education, and practical environmental applications.

Yellow nodes, or new, less frequently discussed keywords, such as bioplastics, sustainable packaging, nanotechnology, sustainability consciousness, low-carbon food consumption, and techno-economic analysis, indicate research areas with significant potential. These topics offer opportunities for innovation in sustainable materials, the development of nanotechnology for environmental monitoring, the analysis of consumer behavior toward low-carbon consumption, and the evaluation of ESG and SDG implementation using analytical and techno-economic methods.

Based on these findings, it is recommended that future researchers focus on under-discussed topics. Researchers can develop sustainable materials and nanotechnology, examine low-carbon consumer behavior and sustainability awareness, and explore ESG and techno-economic approaches to implementing the SDGs. Furthermore, integrating higher education and social innovation presents a strategic opportunity to implement sustainability effectively. Future bibliometric work should also add co-authorship and co-citation analyses to strengthen evidence on collaboration networks and intellectual structures in SDG research.

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