

## MAPPING THEMATIC TRENDS IN SUSTAINABLE DEVELOPMENT GOALS LITERATURE: A BIBLIOMETRIC STUDY

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### ABSTRACT

*This research paper employs a comprehensive bibliometric analysis to explore the thematic trends and research dynamics within the realm of SDGs (Sustainable Development Goals). Using data retrieved from the Web of Science Core Collection up to March 12, 2024, the researcher analysed 35,586 records to identify key research areas, emerging topics, and gaps in the SDG literature. The study utilized VOS viewer 1.6.19 software to create network, overlay, and density visualizations showing the relationships and prominence of various SDG keywords. The findings reveal that "SDG," "Sustainable Development," "Governance," and "Sustainability" are the most central terms, indicating a strong focus on these core concepts. Key analytical tools and evaluative measures such as "Indicators," "Trade-offs," and "Science" frequently co-occur, highlighting their importance in SDG research. Emerging areas of interest, particularly "Climate Change" and "Energy," are identified through overlay visualizations, reflecting their increasing relevance in the global sustainability agenda. Density visualizations pinpoint well-established research areas, with significant clusters in health, education, and governance, while identifying less explored topics like sustainable tourism and global governance. The analysis underscores the necessity for integrated policy approaches that account for the interdependencies among SDG targets. It also stresses the critical role of effective monitoring and data collection systems in ensuring substantive progress. By mapping the current state of SDG research, this study provides a strategic framework for future research directions, emphasizing the need to address identified gaps and enhance the overall impact of sustainable development efforts. This work serves as an important and valuable resource for academicians, researchers, and policymakers aiming to fructiferous and advance the global sustainability agenda.*

**Keywords:** Sustainable Development Goals (SDGs), Sustainable Development, Governance, Indicators, Trade-offs.

### 1. INTRODUCTION

The history of sustainable development has often revolved around efforts centred on a single important point, sidelining other elements. Typically, these efforts involved a narrow range of participants and overlooked the present need for systemic changes. In the 1990s, Agenda 21 implementation focused on governments addressing transnational environmental issues and international development through trade policies. This led to new trade agreements and UN conventions on various ecological challenges. However, the Johannesburg Summit introduced a different approach, emphasizing voluntary transnational partnerships involving UN agencies, international organizations, donors, and NGOs, with less emphasis on policy coherence [Horan, 2019].

The SDGs (Sustainable Development Goals) offer a comprehensive, evidence-driven framework of targets and indicators designed to facilitate national planning and reporting [Allen et al., 2019]. The SDG systems model is structured around the interplay among SDG targets. Through correlation analysis, pairs of globally representative synergies and trade-offs are identified and converted into directional connections that influence the model's development. These connections are subsequently merged into the initial SDG systems model [Anderson et al., 2022].

The primary aim of the SDGs is theoretically centred around achieving "sustainable development." However, there's a common interpretation of "development" that aligns with the ongoing growth trajectories of "developed" nations, primarily focusing on GDP expansion, rather than emphasizing the fundamental concept of enhancing overall quality of life [Kubiszewski et al., 2022]. Within the 2030 Agenda, the UN (United Nations) has expressly made it mandatory for Member States to implement new regulatory frameworks regarding non-financial reporting practices within their jurisdictions [Pizzi et al., 2021].

The United Nations General Assembly embraced the 2030 Agenda in September 2015, outlining an ambitious vision to effect transformative change to achieve a sustainable future by 2030.

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This agenda encompasses 17 primary sustainable development goals (SDGs), 169 associated targets, and over 230 indicators designed to track their advancement [Bennich et al., 2020].

The SDG indicators influence government and stakeholder behaviour strategically. There's a concern that only measurable aspects receive attention, potentially leading to progress on paper but not in reality. These indicators could also deter the transformative change sought by the 2030 Agenda by prioritizing existing data over collecting new data essential for change. It's crucial to acknowledge these drawbacks when developing and using indicators [Kim, 2023]. To enact policy effectively, it is imperative to assess the interdependencies among the goals, considering potential interactions both within and across the Goal of Sustainable Development. In the year 2015, the Statistical Commission of the United Nations established the Inter-agency and Expert Group on SDGs (IAEG-SDGs), with the responsibility of formulating and executing a worldwide indicator framework to track the advancement towards achieving the 17 SDGs. Subsequently, in 2017, the global indicator framework crafted by the IAEG-SDGs was endorsed by the General Assembly of the United Nations. Within this framework, a multitude of socio-ecological indicators have been delineated and linked with the targets of the SDGs [Estoque, 2020]. The integration of environmental considerations into the Goals of Sustainable Development was extensive, featuring expansive and ambitious targets that underscored environmental concerns across the entirety of the SDGs [Elder & Olsen, 2019].

The significance of the SDGs in global governance lies in their achievement of a normative transformation. They have redefined development as a universal aspiration for comprehensive and sustainable human advancement, supplanting the MDG-centric view of development as a dichotomy between the North and South aimed solely at meeting basic needs to alleviate poverty. Furthermore, their importance stems from initiating a methodological transition, specifically through the utilization of global goal setting to establish norms, thereby progressing towards a paradigm of 'governance by numbers'. The SDGs marked the pioneering use of goal setting as a mechanism for formulating and negotiating a UN development agenda, purposefully embracing numerical language to articulate global standards [Fukuda-Parr & McNeill, 2019].

The UN adopted the "Transforming our World: Agenda for Sustainable Development 2030" on January 1<sup>st</sup>, 2016, committing to implementing seventeen sustainable development goals (SDGs) globally. As per the Report of 2018's Sustainable Development Goals, various diverse outcomes have been identified and observed worldwide. Positive developments include significant reductions in child marriages in South Asia, doubled access to electricity in the least developed countries, and decreased maternal mortality rates in Sub-Saharan Africa. However, challenges persist, with billions lacking access to basic sanitation and a substantial population practising open defecation. Additionally, urban areas face severe air pollution, while factors like climate change, droughts, and conflicts contribute to increased undernourishment, affecting millions globally [Sinha et al., 2020].

The absence of peace has both direct and indirect repercussions on health, extending to health workers, civil society, and the broader community, all of whom play vital roles in fostering peace. During times of conflict, resilient systems related to health are very crucial for reaching populations in need, while compromising SDG 16 would render the achievement of SDGs unfeasible. Health and peace are intertwined, with the attainment of each reliant on the other [Takian & Rajaeieh, 2020]. Water, sanitation, and hygiene (WASH) constitute three interconnected foundations of preventive health. Widespread instances of inadequate sanitation and hygiene practices are evident, exemplified by the nation's recent designation as the global epicentre of open defecation. [Wada et al., 2022].

## **2. UNDERSTANDING OF BIBLIOMETRIC**

This study utilized bibliometric analysis, a method growing in popularity for tracking the research output across various scientific domains and establishing a basis for enacting impactful policy interventions. [Kawuki et al., 2021]. Bibliometrics employs statistical methodologies to conduct quantitative assessments of research papers centred around a chosen specific subject. [Yu et al., 2020]. Bibliometric studies are garnering considerable attention among researchers. [Denche-Zamorano et al., 2022].

Bibliometric analysis, while not a new approach in recent years, has become widely implemented and adopted in diverse scientific fields, including education, due to its time efficiency. [Wu & Chung, 2023]. The examination of bibliometric data informative offers valuable perception into the evolving patterns and key areas of focus within specific research domains. By analyzing publication frequency and citation metrics, bibliometric studies illuminate the ongoing advancement within various fields or disciplines [Kumar & Choudhary, 2024].

The study employed the Web of Science Core Collection (WoS), a comprehensive scientific citation indexing database [Harzing & Alakangas, 2016]. Renowned for its extensive coverage, the Web of Science (WoS) provides access to publications from leading scientific journals [Feng et al., 2022].

### **3. MATERIALS AND METHODS**

#### **3.1 Collection of Data**

This research paper on bibliometric analysis collected data from the Web of Science database up to March 12, 2024. The author chose the Web of Science as their primary database due to its reputable standing and widespread use in academic circles. This is known for its high-calibre research publications, it serves as a vital source of bibliographic information.

#### **3.2 Identification of Relevant Data**

To locate dataset number 36,003 on the Web of Science platform, researchers utilized the platform's search feature, employing keywords and criteria specific to the dataset to ensure precise retrieval of information.

#### **3.3 Screening and Cleaning of Data**

After retrieving a total of 36,003 identified records, the screening phase of the present study resulted in the exclusion of 417 sets of data/papers. In the process of exclusion due to various reasons 86 records/papers were removed due to being letters, news items, retracted publications, reprints, or retractions. Additionally, 331 data entries were excluded because these studies were not in the required language (English).

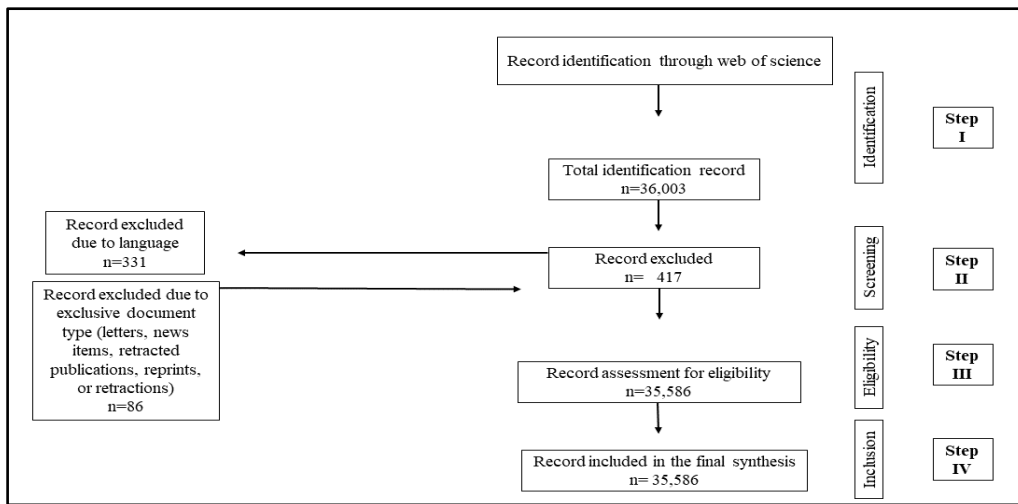
#### **3.4 Record Assessment for Inclusion**

In the next stage related to the selection process, 35,586 datasets were reviewed. Among these, researchers determined that 36,003 were suitable for inclusion in our analysis. This indicates that the majority of the datasets examined met the criteria established for our study.

### **4. ANALYSIS OF DATA**

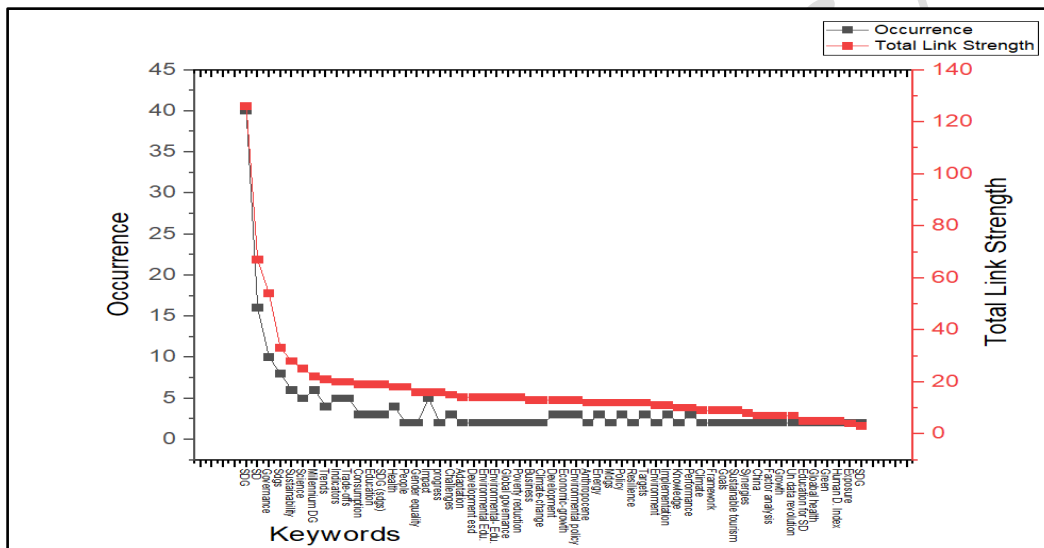
In the present research, the authors were particularly interested in determining the frequency of specific keywords in studies related to sustainable development goals. This analysis enabled us to identify commonly discussed topics within this field. Furthermore, the study aimed to visually represent the evolution of knowledge over time within sustainable development goal research. To accomplish this, we employed bibliometric analysis, which involves analyzing patterns in the published literature to map connections between publications, authors, and keywords. The selected approach of the study provided valuable insights into the interactions and influences among these elements.

The researcher utilized VOS Viewer 1.6.19 software for our analysis, as it is designed to handle large datasets and generate visual maps, including network visualization, overlay visualization, and density visualization, to illustrate relationships within the data. Overall, this methodology facilitated a comprehensive exploration of the extensive scientific output within the domain of SDGs, yielding valuable insights to guide future research studies and advancements in the field.



**Fig. 1: Display of the process followed to choose the documents for our study**

## 5. RESULTS



**Fig. 2: Graphical Depiction of Keyword Co-Occurrence in Sustainable Development Goals**

The graph illustrates which words are commonly mentioned together when discussing Sustainable Development Goals (SDGs). Each circle represents a word, and the lines between circles show that those words often appear together in discussions about SDGs. By seeing the graph deeply, we can understand which concepts, views and ideas are significantly and closely connected in conversations about making the world a better place for everyone.

**Table 1: Co-occurrence of the Keywords related to the Sustainable Development Goals**

S. No.	Keywords	Occurrence	Total Link Strength
1	SDG	40	126
2	SD	16	67
3	Governance	10	54
4	SDGs	8	33
5	Sustainability	6	28
6	Science	5	25
7	Millennium DG	6	22
8	Trends	4	21
9	Indicators	5	20
10	Trade-offs	5	20
11	Consumption	3	19
12	Education	3	19
13	SDG (SDGs)	3	19
14	Health	4	18
15	People	2	18

16	Gender Equality	2	16
17	Impact	5	16
18	progress	2	16
19	Challenges	3	15
20	Adaptation	2	14
21	Development ESD	2	14
22	Environmental Edu.	2	14
23	Environmental-Edu.	2	14
24	Global governance	2	14
25	Poverty reduction	2	14
26	Business	2	13
27	Climate change	2	13
28	Development	3	13
29	Economic-growth	3	13
30	Environmental policy	3	13
31	Anthropocene	2	12
32	Energy	3	12
33	MDGs	2	12
34	Policy	3	12
35	Resilience	2	12
36	Targets	3	12
37	Environment	2	11
38	Implementation	3	11
39	Knowledge	2	10
40	Performance	3	10
41	Climate	2	9
42	Framework	2	9
43	Goals	2	9
44	Sustainable Tourism	2	9
45	Synergies	2	8
46	China	2	7
47	Factor analysis	2	7
48	Growth	2	7
49	Un data revolution	2	7
50	Education for SD	2	5
51	Global Health	2	5
52	Green	2	5
53	Human D. Index	2	5
54	Exposure	2	4
55	SDG	2	3
<b>Total</b>		<b>212</b>	<b>934</b>

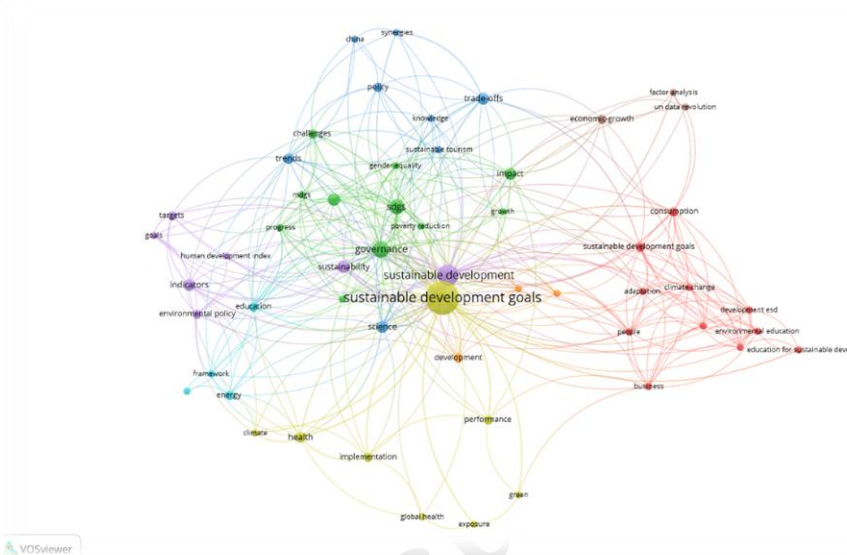
Table 1 presents the co-occurrence of keywords which are related to (SDGs), showcasing their frequency and total link strength. The table is instrumental in elucidating the interconnectedness and prominence of various thematic areas within the discourse on sustainable development. Let's investigate the analysis of the keywords from serial numbers 1 to 55:

1. **SDG (Sustainable Development Goals):** With 40 occurrences and an observed total link strength (TLS) of 126, SDG represents a very important framework related to the efforts of global development aimed at addressing social, economic, and environmental challenges.
2. **SD (Sustainable Development):** This abbreviation appears 16 times with an observed total link strength (TLS) of 67, serving as a shorthand reference to Sustainable Development in discussions related to sustainable development goals.
3. **Governance:** With 10 occurrences and an observed total link strength (TLS) of 54, governance refers to the systems and processes by which decisions are made and implemented, playing a crucial role in achieving sustainable development objectives.
4. **SDGs (Sustainable Development Goals):** This term appears 8 times with an observed total link strength (TLS) of 33, emphasizing the plurality of goals within the sustainable development agenda and their interconnectedness.

5. **Sustainability:** With 6 occurrences and an observed total link strength (TLS) of 28, sustainability encompasses the balance between environmental preservation, social equity, and economic prosperity, very essential to achieving SDGs.
6. **Science:** Appearing 5 times with an observed total link strength (TLS) of 25, science plays a vital role in informing evidence-based decision-making and innovation for SD.
7. **Millennium DG (Millennium Development Goals):** This term appears 6 times with an observed total link strength (TLS) of 22, possibly referencing the Millennium Development Goals, which preceded the 4. SDGs and focused on poverty alleviation and social development.
8. **Trends:** With 4 occurrences and observed total link strength (TLS) of 21, trends provide insights into the evolving nature of SD challenges and opportunities over time.
9. **Indicators:** This term appears 5 times with an observed total link strength (TLS) of 20, serving as measurable benchmarks for tracking progress towards sustainable development goals and evaluating the effectiveness of policies and interventions.
10. **Trade-offs:** Mentioned 5 times with an observed total link strength (TLS) of 20, trade-offs highlight the complex choices and compromises involved in pursuing one sustainable development goal over another.
11. **Consumption:** With 3 occurrences and observed total link strength (TLS) of 19, consumption patterns influence resource use and environmental impacts, requiring attention in sustainable development strategies.
12. **Education:** Appearing 3 times with an observed total link strength (TLS) of 19, education is a fundamental tool for empowering individuals and communities to contribute to SD efforts.
13. **SDG:** This variant appears 3 times with an observed total link strength (TLS) of 19, reinforcing the prominence of SDGs in discussions and literature.
14. **Health:** With 4 occurrences and an observed total link strength (TLS) of 18, outcomes related to health are closely linked to sustainable development, requiring integrated approaches to ensure well-being for all.
15. **People:** Mentioned 2 times with observed total link strength (TLS) of 18, people-centred approaches prioritize human well-being and equity in sustainable development initiatives.
16. **Gender Equality:** Appearing 2 times with an observed total link strength (TLS) of 16, gender equality is essential for the achievement of SDGs and ensuring inclusive progress.
17. **Impact:** With 5 occurrences and an observed total link strength (TLS) of 16, impact assessment is crucial for understanding the effectiveness and outcomes of sustainable development interventions.
18. **Progress:** Mentioned 2 times with observed total link strength (TLS) of 16, progress tracking is essential to the success and effectiveness of SD efforts.
19. **Challenges:** With 3 occurrences and an observed total link strength (TLS) of 15, challenges represent barriers and obstacles that must be addressed to advance sustainable development goals.
20. **Adaptation:** This term appears 2 times with an observed total link strength (TLS) of 14, highlighting the need and importance of adapting to environmental changes and building resilience in sustainable development strategies.
21. **Development ESD:** With 2 occurrences and observed total link strength (TLS) of 14, ESD (Education for Sustainable Development) promotes learning and skills development for sustainability.
22. **Environmental Edu.:** Mentioned 2 times with observed total link strength (TLS) of 14, environmental education fosters awareness and understanding of environmental issues and solutions.
23. **Environmental-Edu.:** This variant appears 2 times with an observed total link strength (TLS) of 14, reinforcing the importance of environmental education in sustainable development efforts.
24. **Global Governance:** With 2 occurrences and an observed total link strength (TLS) of 14, GGM (Global Governance Mechanisms) are very crucial for coordinating international efforts and addressing global challenges.
25. **Poverty Reduction:** Mentioned 2 times with observed total link strength (TLS) of 14, poverty reduction is a central objective of sustainable development, requiring targeted interventions and inclusive growth strategies.

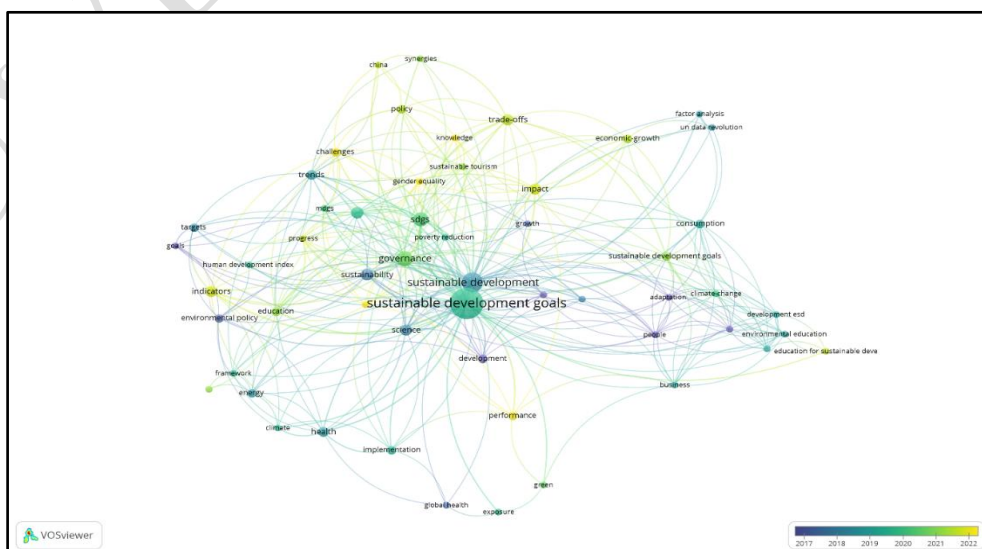
26. **Business:** With 2 occurrences and observed total link strength (TLS) of 13, private sector engagement is very essential for driving innovation and investment in sustainable development.
27. **Climate Change:** This term appears 2 times with an observed total link strength (TLS) of 13, emphasizing the urgency of addressing climate change as a key sustainable development challenge.
28. **Development:** Mentioned 3 times with observed total link strength (TLS) of 13, the development encompasses economic, social, and environmental progress towards sustainability.
29. **Economic Growth:** With 3 occurrences and an observed total link strength (TLS) of 13, economic growth must be pursued in a sustainable and inclusive manner to support sustainable development goals.
30. **Environmental Policy:** Appearing 3 times with an observed total link strength (TLS) of 13, different environmental policies are required and essential for guiding sustainable development efforts and addressing environmental challenges.
31. **Anthropocene:** This term appears 2 times with an observed total link strength (TLS) of 12, referring to the current geological epoch characterized by significant human impact on Earth's systems.
32. **Energy:** With 3 occurrences and observed a total link strength (TLS) of 12, sustainable energy is very essential to power SD and mitigating climate change.
33. **MDGs (Millennium Development Goals):** Mentioned 2 times with observed total link strength (TLS) of 12, MDGs were observed set of international development goals preceding the Sustainable Development Goals.
34. **Policy:** Appearing 3 times with an observed total link strength (TLS) of 12, policy coherence is important and essential for aligning actions with sustainable development goals.
35. **Resilience:** Mentioned 2 times with an observed total link strength (TLS) of 12, resilience is crucial for adapting to environmental and socio-economic changes in sustainable development.
36. **Targets:** With 3 occurrences and an observed total link strength (TLS) of 12, targets provide specific objectives to measure progress towards SDGs.
37. **Environment:** Mentioned 2 times with observed total link strength (TLS) of 11, environmental conservation is essential to achieve SDGs.
38. **Implementation:** With 3 occurrences and an observed total link strength (TLS) of 11, effective implementation is crucial for translating SDGs into action.
39. **Knowledge:** Mentioned 2 times with observed total link strength (TLS) of 10, knowledge sharing and capacity-building are essential for advancing sustainable development.
40. **Performance:** With 3 occurrences and an observed total link strength (TLS) of 10, performance monitoring is vital to evaluate the effectiveness of SDI (Sustainable Development Interventions).
41. **Climate:** Mentioned 2 times with observed total link strength (TLS) of 9, climate action is important and essential for achieving SDGs.
42. **Framework:** With 2 occurrences and observed total link strength (TLS) of 9, conceptual frameworks guide sustainable development planning and implementation.
43. **Goals:** Mentioned 2 times with observed total link strength (TLS) of 9, goals provide a roadmap for sustainable development efforts.
44. **Sustainable Tourism:** With 2 occurrences and an observed total link strength (TLS) of 9, sustainable tourism promotes responsible travel practices.
45. **Synergies:** Mentioned 2 times with observed total link strength (TLS) of 8, synergies between sustainable development goals enhance efficiency and effectiveness.
46. **China:** Appearing 2 times with an observed total link strength (TLS) of 7, China's role in sustainable development is significant due to its population and economic growth.
47. **Factor Analysis:** With 2 occurrences and an observed total link strength (TLS) of 7, factor analysis identifies underlying patterns in sustainable development data.
48. **Growth:** Mentioned 2 times with observed total link strength (TLS) of 7, inclusive growth supports sustainable development objectives.
49. **UN Data Revolution:** With 2 occurrences and observed total link strength (TLS) of 7, data revolutionizes monitoring and implementation of SDGs.

50. **Education for SD:** Mentioned 2 times with observed total link strength (TLS) of 5, ESD (Education for Sustainable Development) fosters sustainability literacy.
51. **Global Health:** With 2 occurrences and observed total link strength (TLS) of 5, global health initiatives support sustainable development goals.
52. **Green:** Mentioned 2 times with observed total link strength (TLS) of 5, green technologies promote environmental sustainability.
53. **Human D. Index:** With 2 occurrences and an observed total link strength (TLS) of 5, the Human Development Index measures progress towards sustainable development.
54. **Exposure:** Mentioned 2 times with observed total link strength (TLS) of 4, exposure to environmental risks affects sustainable development outcomes.
55. **SDG:** With 2 occurrences and an observed total link strength (TLS) of 3, SDG represents the core framework for Global Sustainable Development (GSD) efforts.



**Fig. 3: Network visualization of SDGs: A Network Analysis of Co-Occurring Keywords**  
(Source: Prepared by Author using VOS viewer 1.6.19 software, 2024)

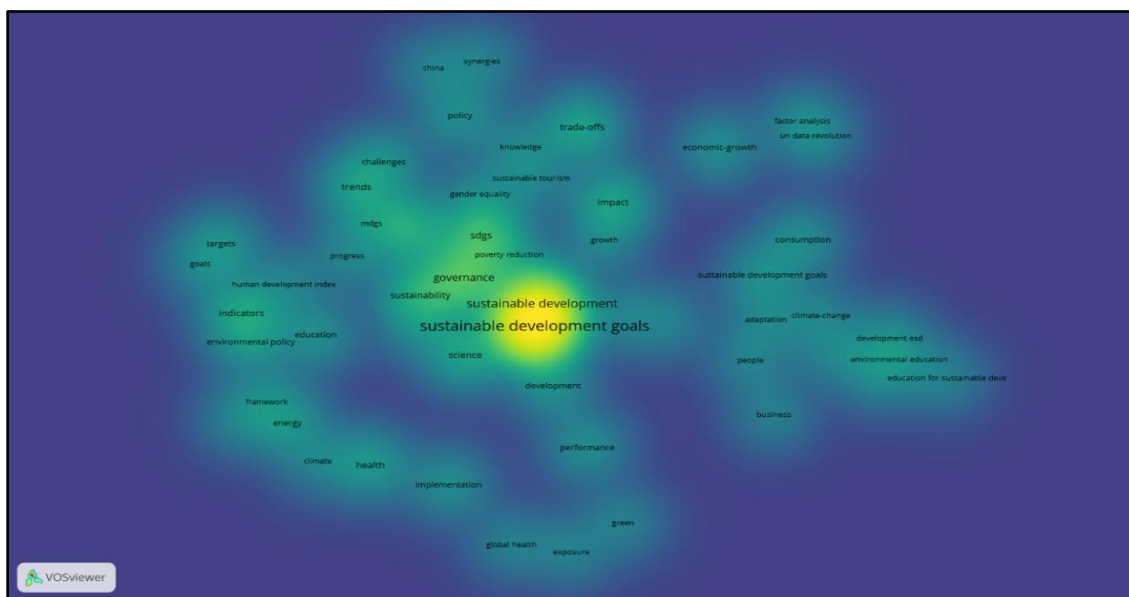
Fig. 3, The network visualization illustrates the interrelatedness of keywords relevant to Sustainable Development Goals (SDGs). This portrayal unveils the nuanced connections between these keywords, showcasing their semantic closeness and thematic groupings within discussions on SDGs. Through this graphical representation, researchers gain insights into core themes, recognize significant clusters of associated ideas, and explore the intricate web of relationships among SDGs. This approach fosters a holistic comprehension of the multifaceted dimensions which are related to sustainable development.



**Fig. 4: Overlay Visualization of SDGs A Network Analysis of Co-Occurring Keywords**  
(Source: Prepared by Author using VOS viewer 1.6.19 software, 2024)



Fig. 4. Presents an overlay visualization that superimposes keywords associated with different SDGs onto a unified representation. Through this visualization technique, researchers can compare and contrast the thematic alignment and divergence across various sustainability objectives. By identifying commonalities and distinctions between SDGs, this figure explores interdisciplinary linkages as well as integration related to diverse perspectives in addressing complex sustainability challenges. The overlay visualization provides valuable and important insights related to the holistic nature of sustainable development and facilitates the identification of synergistic opportunities for policy and practice.



**Fig. 5: Density Visualization of SDGs: A Network Analysis of Co-Occurring Keywords**  
(Source: Prepared by Author using VOS viewer 1.6.19 software, 2024)

Fig. 5 illustrates the density visualization of SDGs, highlighting the concentration and dispersion of keyword co-occurrences within the network. This visualization method enables researchers to discern regions of high density, indicating clusters of closely related keywords and themes of significant prominence within the SDGs discourse. Conversely, areas of lower density suggest thematic gaps or less explored topics, prompting further investigation and analysis. By visualizing the density distribution of keywords, this figure enhances researchers understanding of the thematic landscape of sustainable development and also informs strategic decision-making in policy formulation and implementation.

In graphical summary, the network, overlay, and density visualizations presented in Figures 3, 4, and 5, respectively, offer valuable insights into the semantic relationships, thematic alignment, and density distribution of keywords within the SDGs framework. These visualizations serve as essential analytical tools for researchers, policymakers, and practitioners, facilitating a comprehensive exploration of sustainable development challenges and opportunities.

## 6. DISCUSSION OF FINDINGS

The bibliometric analysis of Sustainable Development Goals (SDGs) research reveals significant insights into current trends and thematic priorities. The centrality of the term "SDG" underscores a cohesive research focus on the UN's framework, with keywords like "Sustainable Development," "Governance," and "Sustainability" highlighting the multifaceted nature of these goals. The frequent co-occurrence of "Indicators," "Trade-offs," and "Science" indicates the analytical tools used in this field, while thematic clusters around governance, health, and education demonstrate the interconnectedness of these areas [Horan, 2019; Allen et al., 2019; Anderson et al., 2022]. The overlay visualization identifies emerging trends, particularly in "Climate Change" and "Energy," pointing to their growing significance [Kubiszewski et al., 2022; Pizzi et al., 2021]. The density visualization reveals well-established research areas and gaps, with high-density clusters in health, education, and governance, and sparser coverage in sustainable tourism and global governance [Bennich et al., 2020;

Kim, 2023]. All these findings associated with the present study suggest and guided as out. The importance of integrated policy approaches and robust monitoring systems. The study is also helping to identify opportunities for conducting further research in underexplored areas to improve the overall impact of SDG initiatives [Estoque, 2020; Elder & Olsen, 2019].

## 7. CONCLUSION

This study's bibliometric analysis of Sustainable Development Goals (SDGs) research provides insights related to the current landscape and evolving priorities within this critical area. Our analysis underscores the centrality of "SDG" as the focal point in sustainable development discourse, with frequent keywords such as "Sustainable Development," "Governance," and "Sustainability" emphasizing the multidimensional and interconnected nature of these goals. The notable co-occurrence of terms like "Indicators," "Trade-offs," and "Science" highlights the importance of analytical and evaluative tools in advancing SDG research and implementation.

The visualization techniques applied—network, overlay, and density visualizations—reveal several key trends and gaps. Network visualizations elucidate the interrelatedness of core themes, showcasing significant clusters around governance, health, and education. Overlay visualizations bring to light emerging areas of interest, such as "Climate Change" and "Energy," indicating their rising importance in the sustainable development agenda. Density visualizations identify well-established research areas, with high-density clusters in health, education, and governance, while also pinpointing sparser regions like sustainable tourism and global governance, suggesting potential avenues for further exploration.

These findings collectively point to the necessity for integrated policy approaches that consider the synergies and trade-offs between various SDG targets. They also highlight the critical role of robust monitoring and data collection systems to ensure that progress is not only quantitatively measurable but also meaningful. Moreover, the identification of less explored areas provides a roadmap for future research, encouraging a more comprehensive approach to addressing global sustainability challenges. In conclusion, the study reaffirms the pivotal role of bibliometric analysis in mapping the trajectory of SDG research. By identifying key themes, emerging trends, and research gaps, the present study analysis not only provides guidelines to enhance one's understanding related to the current state of SDG research but also guides future efforts towards more effective and impactful sustainable development practices.

## REFERENCES

- Allen, C., Metternicht, G., & Wiedmann, T. (2019). Prioritising SDG targets: assessing baselines, gaps and interlinkages. *Sustainability Science*, 14(2), 421–438. <https://doi.org/10.1007/s11625-018-0596-8>
- Anderson, C. C., Denich, M., Warchold, A., Kropp, J. P., & Pradhan, P. (2022). A systems model of SDG target influence on the 2030 Agenda for Sustainable Development. *Sustainability Science*, 17(4), 1459–1472. <https://doi.org/10.1007/s11625-021-01040-8>
- Bennich, T., Weitz, N., & Carlsen, H. (2020). Deciphering the scientific literature on SDG interactions: A review and reading guide. *Science of The Total Environment*, 728, 138405. <https://doi.org/10.1016/j.scitotenv.2020.138405>
- Denche-Zamorano, Á., Barrios-Fernandez, S., Galán-Arroyo, C., Sánchez-González, S., Montalva-Valenzuela, F., Castillo-Paredes, A., Rojo-Ramos, J., & Olivares, P. R. (2022). Science Mapping: A Bibliometric Analysis on Cyberbullying and the Psychological Dimensions of the Self. *International Journal of Environmental Research and Public Health*, 20(1), 209. <https://doi.org/10.3390/ijerph20010209>
- Elder, M., & Olsen, S. H. (2019). The Design of Environmental Priorities in the <scp>SDG</scp> s. *Global Policy*, 10(S1), 70–82. <https://doi.org/10.1111/1758-5899.12596>
- Estoque, R. (2020). A Review of the Sustainability Concept and the State of SDG Monitoring Using Remote Sensing. *Remote Sensing*, 12(11), 1770. <https://doi.org/10.3390/rs12111770>

- Feng, X.-W., Hadizadeh, M., Zheng, L.-H., & Li, W.-H. (2022). A Bibliometric and Visual Analysis of Exercise Intervention Publications for Alzheimer's Disease (1998–2021). *Journal of Clinical Medicine*, 11(19), 5903. <https://doi.org/10.3390/jcm11195903>
- Fukuda-Parr, S., & McNeill, D. (2019). Knowledge and Politics in Setting and Measuring the <scp>SDG</scp> s: Introduction to Special Issue. *Global Policy*, 10(S1), 5–15. <https://doi.org/10.1111/1758-5899.12604>
- Harzing, A.-W., & Alakangas, S. (2016). Google Scholar, Scopus and the Web of Science: a longitudinal and cross-disciplinary comparison. *Scientometrics*, 106(2), 787–804. <https://doi.org/10.1007/s11192-015-1798-9>
- Horan, D. (2019). A New Approach to Partnerships for SDG Transformations. *Sustainability*, 11(18), 4947. <https://doi.org/10.3390/su11184947>
- Kawuki, J., Ghimire, U., Papabathini, S. S., Obore, N., & Musa, T. H. (2021). A bibliometric analysis of childhood obesity research from China indexed in Web of Science. *Journal of Public Health and Emergency*, 5, 3–3. <https://doi.org/10.21037/jphe-20-95>
- Kim, R. E. (2023). Augment the SDG indicator framework. *Environmental Science & Policy*, 142, 62–67. <https://doi.org/10.1016/j.envsci.2023.02.004>
- Kubiszewski, I., Mulder, K., Jarvis, D., & Costanza, R. (2022). Toward better measurement of sustainable development and wellbeing: A small number of SDG indicators reliably predict life satisfaction. *Sustainable Development*, 30(1), 139–148. <https://doi.org/10.1002/sd.2234>
- Kumar, S., & Choudhary, R. (2024). Bibliometric Insights into Olympic Weightlifting Research Trends. *Journal of Ravishankar University (PART-A)*, 30(1), 43–53. <https://doi.org/10.52228/JRUA.2024-30-1-5>
- Pizzi, S., Rosati, F., & Venturelli, A. (2021). The determinants of business contribution to the 2030 Agenda: Introducing the SDG Reporting Score. *Business Strategy and the Environment*, 30(1), 404–421. <https://doi.org/10.1002/bse.2628>
- Sinha, A., Sengupta, T., & Alvarado, R. (2020). Interplay between technological innovation and environmental quality: Formulating the SDG policies for next 11 economies. *Journal of Cleaner Production*, 242, 118549. <https://doi.org/10.1016/j.jclepro.2019.118549>
- Takian, A., & Rajaeieh, G. (2020). Peace, Health, and Sustainable Development in the Middle East. *Archives of Iranian Medicine*, 23(4Suppl1), S23–S26. <https://doi.org/10.34172/aim.2020.s5>
- Wada, O. Z., Olawade, D. B., Oladeji, E. O., Amusa, A. O., & Olorunjoba, E. O. (2022). School water, sanitation, and hygiene inequalities: a bane of sustainable development goal six in Nigeria. *Canadian Journal of Public Health*, 113(4), 622–635. <https://doi.org/10.17269/s41997-022-00633-9>
- Wu, J.-F., & Chung, C.-Y. (2023). Art Therapy as an Intervention for Children: A Bibliometric Analysis of Publications from 1990 to 2020. *SAGE Open*, 13(4). DOI: <https://doi.org/10.1177/21582440231219143>
- Yu, Y., Li, Y., Zhang, Z., Gu, Z., Zhong, H., Zha, Q., Yang, L., Zhu, C., & Chen, E. (2020). A bibliometric analysis using VOSviewer of publications on COVID-19. *Annals of Translational Medicine*, 8(13), 816–816. <https://doi.org/10.21037/atm-20-4235>