

Assessing the Impact of Green Projects on Sustainable Development through Composite Indicator: a bibliometric study

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Abstract: Society has integrated the role of sustainable development in different fields of social, political and commercial interest, with a milestone being the sustainable development summit in 2015, where more than 150 countries committed to the 2030 agenda. However, interested parties, Both public and private, have yet to establish a standard methodology to measure performance in terms of green projects that contribute to their sustainability strategies. At the same time, stakeholders raise questions about its level of progress at a global level and, specifically, what influence it has on the green projects of organizations and companies. In the literature, there are different proposals for its measurement, and actors have prioritized using composite indicators due to their ability to include different simple indicators to measure accurately in their different fields of application. With the above in mind, this work aims to investigate how composite indicator techniques have measured the performance of green projects that impact sustainable development. This bibliometric study integrated 51 filtered documents from the Web of Science (WoS) and Scopus databases, limited to business and administration articles. The software implemented in this study are Tableau and VosViewer. The results show the principal methodologies used in the field of study, the primary authors, and the countries and institutions involved. The articles analyzed indicate the growing use of composite indicators for measuring green projects with an impact on sustainable development, identifying future research areas aimed at standardizing the use of composite indicators and their benefits.

Keywords: project management; sustainable development; composite indicators; green projects; bibliometric.

Medición del Impacto de Proyectos Verdes en el Desarrollo Sostenible mediante Indicadores Compuestos: un estudio bibliométrico

Resumen: La sociedad ha integrado el papel del desarrollo sostenible en diferentes campos de interés social, político y comercial, siendo un hito la cumbre de desarrollo sostenible de 2015, donde más de 150 países se comprometieron con la agenda 2030. Sin embargo, las partes interesadas, tanto públicas como privadas, aún deben establecer una metodología estándar para medir el desempeño en términos de proyectos verdes que contribuyan a sus estrategias de sostenibilidad. Al mismo tiempo, los interesados plantean interrogantes sobre su nivel de avance a nivel global y, en concreto, qué influencia tiene en los proyectos verdes de organizaciones y empresas. En la literatura existen diferentes propuestas para su medición, y los actores han priorizado el uso de indicadores compuestos debido a su capacidad de incluir diferentes indicadores simples para medir con precisión en sus diferentes campos de aplicación. Teniendo en cuenta lo anterior, este trabajo tiene como objetivo investigar cómo las técnicas de indicadores compuestos han medido el desempeño de proyectos verdes que impactan el desarrollo sostenible. Este estudio bibliométrico integró 51 documentos filtrados de las bases de datos Web of Science (WoS) y Scopus, limitado a artículos de negocios y administración. Los softwares implementados en este estudio son Tableau y VosViewer. Los resultados muestran las principales metodologías utilizadas en el campo de estudio, los autores principales y los países e instituciones involucradas. Los artículos analizados indican el uso creciente de indicadores compuestos para medir proyectos verdes con impacto en el

desarrollo sostenible, identificando futuras áreas de investigación encaminadas a estandarizar el uso de indicadores compuestos y sus beneficios.

Palabras clave: gestión de proyectos; desarrollo sostenible; indicadores compuestos; proyectos verdes; bibliométria.

Introduction

Today, green projects and sustainable development have become global imperatives, responding to the urgent need to mitigate the effects of climate change and promote practices that ensure the long-term viability of our natural and social environment. Researchers from various disciplines have contributed significantly to this field, developing innovative approaches and theoretical frameworks that address the complexities inherent in these challenges. This bibliometric study, a crucial tool in understanding the research landscape, analyzes several recent investigations that offer valuable perspectives and practical strategies to advance the implementation of green projects and sustainable development, measuring their performance with composite indicators.

Sustainability strategies include integrating green technologies to generate products and services that reduce environmental impact [1]. However, the policies and practices that promote its use are in a validation process for standardization and measurement. Innovation, a dynamic force in sustainability, not only drives the reduction of environmental damage but also promotes economic growth [2]. There are various proposals to measure green policies [3], [4] implemented by governments and the strategies companies implement to comply with regulations. Researchers conducted studies using advanced simulations [19] to generate a comprehensive evaluation of green projects and to identify patterns that influence the success of sustainability policy planning. The ability to predict outcomes and adjust strategies[20] based on accurate simulations represents a significant advance for developing practical green projects. On the other hand, optimizing sustainable development processes is sought [21], integrating key variables, such as economic, social, and environmental aspects, to make possible solutions holistic and adaptable in multiple contexts.

On the other hand, the primary global objective, a pressing and urgent concern, is to mitigate the reduction of specific emissions of carbon and other greenhouse gases [5] through the inclusion of new methodologies and technologies. These methodologies and technologies allow global production processes, products, and services to innovate, resulting in sustainable economic activity. In some cases, indicators encompassing multiple dimensions of sustainable development have been defined, providing a comprehensive assessment that allows for a deeper understanding of the impacts and benefits of various policies and practices [22]. These methodologies help identify areas of improvement and establish comparisons between different regions or sectors, highlighting the importance of continuous and detailed evaluation to achieve long-term sustainable objectives. Consequently, various countries are innovating to create intelligent cities[6] to improve living standards. The challenge is to define the technologies involved and their interrelationship, internally and externally. Based on the above, specialists integrate indicators that allow monitoring and controlling the progress of smart cities [7], [8].

On the other hand, green projects must measure their efficiencies and advanced statistical models [23], such as composite indicators, since they allow the identification of variables that influence efficiency and, in turn, can accurately predict performance and contribute to the approach to effective sustainability strategies. Based on the above, the concept of circular economy is an essential consideration in sustainability recognized by the OECD (Organization for Economic Cooperation and Development)[9]. The circular economy approach allows the reincorporation of resources based on a sustainable economy, so the sustainable development of countries is crucial [10]. Like the concepts mentioned above, the drive towards sustainable development includes the circular economy [11], [12], [13], [14], and, consequently, measuring it is crucial for implementing and deploying it. Various

authors have considered a group of sustainable indicators for measurement. Among these are the social, environmental, and economic spheres [11], [12], [13], [14].

Consequently, increasing attention towards sustainability is warranted, focusing on how current practices can be adapted to meet contemporary environmental and social standards [24], [25]. Visualizing emerging trends and society's expectations regarding sustainability provides a panoramic view of the challenges and opportunities that organizations face today. Given the global importance of the topics discussed, this research aims to visualize the development of composite indicators [15], [16] to measure green projects focused on sustainable development. The implications of this work extend beyond academia: governments, countries and companies worldwide strive to align themselves with sustainability. The triple impact on society, the environment and the economy underline the urgency and importance of this research [17], [18]. The bibliometric study aims to identify the advances involving these crucial terms, highlighting the primary authors, countries, institutions, keywords, and contributions to the research topic.

This document comprises the introduction section, laying the foundations for composite indicators and the administration of green projects that positively impact sustainable development. The methodology section describes the four phases of the study, which involve the collective effort of the researchers and the use of two databases, WoS and Scopus, recognized for their quality. The results section presents the bibliometric maps, a visual representation of the knowledge and collective contributions of the principal authors, keywords, institutions, and countries. Finally, the conclusions section invites us to continue discussing and researching, showing the panorama of interest of this article, its relevance, and its future lines of research through case studies and data analysis, which relate to the integration of clean technologies and processes. Efficient that impacts not only the environmental field but also improves the competitiveness and profitability of companies through education for sustainability.

Methodology

Bibliometrics, a methodology widely used in the analysis of specialized literature across various fields [23], [24], plays a crucial role in studying sustainable development and green projects. It is a scientific discipline that provides quantitative bibliographic indicators, enabling us to delve into scientific production [24]. Through bibliometric studies, we can trace the evolution of research in our field over time, pinpointing key contributors such as authors, countries, institutions, and keywords. Additionally, bibliometric mapping, a powerful tool, aids in the visualization and comprehension of data through various software [25], [26]. The study is structured into three phases: exploration, organization, and information analysis [27].

Based on the above, we conducted the first phase of this study by searching for information in the Scopus and WoS databases, known for their quality. This information considers the keywords composite indicators, sustainable development, and green projects according to the search rules of each database. The result of these two databases yielded 81 documents. The present bibliometric study is carried out under four phases; the first phase involves the definition of constructs of the study topic, which will allow the information in the literature to be visualized and delimited [22]. In the second phase, the constructs are searched as a set in the WoS and Scopus databases. It is worth mentioning that these two databases are recognized for the quality of their content. In the third phase, a segregation of the documents is carried out to identify duplication and prepare the database for study in the fourth phase, with the Tableau and Vos Viewer software.

Finally, the results section integrates the graphs obtained and their discussion. In this case, the WoS and Scopus databases provide the appropriate format to integrate the .cvs, .rif and .bib files into the analysis software. Through bibliometric mapping, researchers identify areas in development depending on the research areas. Bibliometric methods add value to interpreting information collected and processed to summarize the findings of scientific knowledge over time. The information search was conducted by applying specific keywords composite indicators, development sustainable and green projects, in the WoS and Scopus databases, with the boolean connector 'AND' used between each keyword. Both databases house collections of high-quality indexed documents equipped with tools for evaluation and analysis. The search spanned from 2005 to the current year, 2024. We obtained 51 documents in the WoS, and 30 in the Scopus database. In the next phase, we will join the databases, leaving 51 documents to analyze. These were then filtered based on number, DOI, and title, and duplicate documents were discarded, resulting in 51 documents. Files such as .cvs, .bib, and .ris were extracted from both databases for processing in Tableau and VOS viewer software.

Results

In the first phase of this bibliometric study, we carried out the data search, filtering and selecting the data to avoid duplicating documents. After this phase, we entered the file prepared to integrate the data containing the specified keywords. It is worth mentioning that researchers use this software for extensive data analysis. Figure 2 shows the first result obtained in Tableau, Figure. 1, which shows the documents prepared for 2005-2024. This graph shows the production of documents per year and the number of citations made. With this result, observers can note that scientific production in the area studied ranges from 1 to 4 documents. However, the level of citations is at an average of 66, reaching its maximum in 2009. Based on the history of these data, it is predicted that in the coming years, the production will fluctuate between 5 documents and the number. The average number of citations will be 70.

Figure 2. Historical and forecast

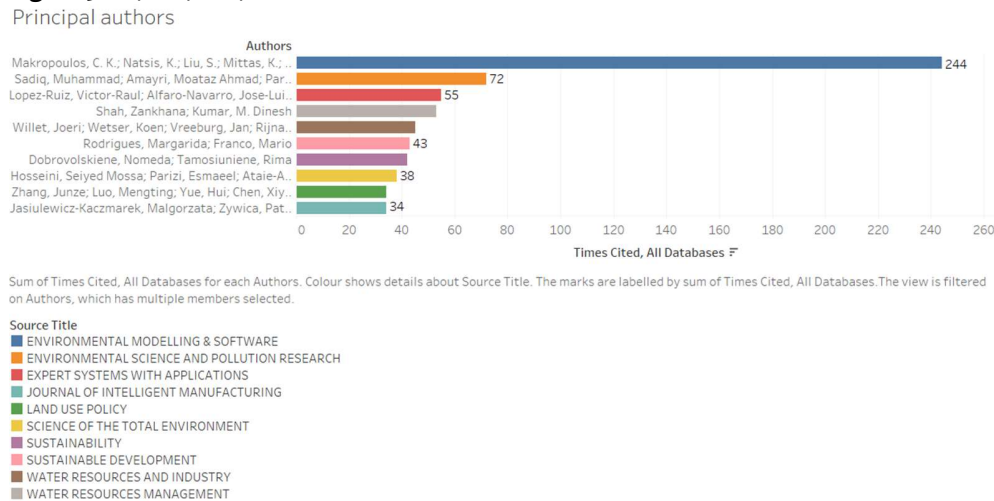


Source: Own elaboration, data analyzed in Tableau software.

Figure 3 shows the principal authors and the journals in which they have published. This figure shows the top 10 of the principal authors based on the number of citations. Firstly, it is [28] published in Environmental Modeling & software. This study proposes a tool based on composite indicators for decision-making to satisfy water supply demands and problems related to sustainability. In second place is [29] published in the journal Environmental Science and Pollution Research; this study aims to measure environmental deterioration; this research offers a study of carbon footprints and the development of green investments and renewable energy. Thirdly, in the

publication of the journal Expert Systems with Applications [30], in this study, an index of sustainable water use is generated by applying composite index methodologies. It emphasizes the importance of identifying the criteria with the most significant impact, the principal contributions, methodologies and results are found in Table 2.

Figure 3. Top 10 principal authors



Source: Own elaboration, data analyzed in Tableau software.

Table 1. Principals authors and their contributions.

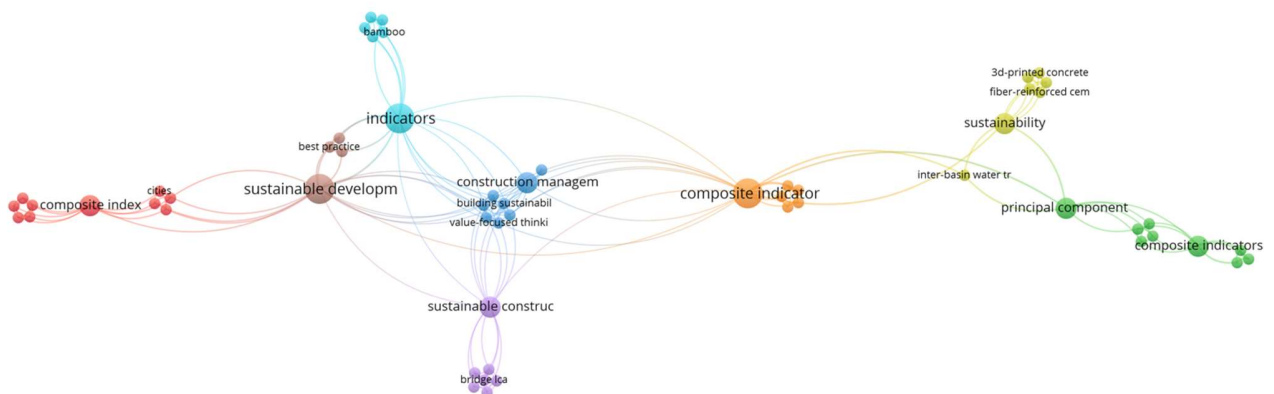
Authors	Main Findings	Methodology	Results
Makropoulos, C. K.; Natsis, K.; Liu, S.; Mittas, K.; Butler, D.	Conventional water management practices are insufficient to address current challenges. This study proposes integrated and sustainable approaches to improve the efficiency and resilience of urban water systems.	Integrated and sustainable approaches in water management.	Improved efficiency and resilience of urban water systems.
Sadiq, Muhammad; Amayri, Moataz Ahmad; Paramaiah, Ch; Nguyen Hong Mai; Thanh Quang Ngo; Thi Thu Hien Phan	A significant issue for governments in natural resource management is balancing economic development with environmental sustainability. This study addresses this issue through the implementation of new policies and technologies.	Implementation of new policies and technologies to balance economic development and environmental sustainability.	Balance between economic development and environmental sustainability.
Lopez-Ruiz, Victor-Raul; Alfaro-Navarro, Jose-Luis; Nevado-Pena, Domingo	Knowledge cities are the most capable of attracting talent and generating innovation. This study analyzes how these urban environments promote economic development and sustainability through efficient knowledge management.	Analysis of how knowledge cities foster economic development and sustainability.	Promotion of economic development and sustainability in knowledge cities.
Shah, Zankhana; Kumar, M. Dinesh	According to some estimates, there are 47,000 large dams worldwide that need reevaluation to ensure their safety and functionality. This study proposes a methodology for this reevaluation using advanced technology and risk analysis. The projected increase in industrial water demand poses significant challenges. This study investigates methods to efficiently manage water use in the industrial sector, proposing sustainable solutions to reduce consumption and improve reuse.	Reevaluation of large dams using advanced technology and risk analysis.	Improved safety and functionality of large dams.
Willet, Joeri; Wetser, Koen; Vreeburg, Jan; Rijnaarts, Huub H. M.	This study aims to systematize and analyze different methodologies used to evaluate sustainability in organizations, highlighting the importance of integrating social, economic, and	Investigation of methods to efficiently manage water use in the industrial sector.	Reduction in water consumption and improvement in reuse in the industrial sector.
Rodrigues, Margarida; Franco, Mario		Systematization and analysis of methodologies to evaluate sustainability in organizations.	Integration of social, economic, and environmental

	environmental indicators in the evaluation process.		indicators in sustainability evaluation.
Dobrovolskiene, Nomedas; Tamosiuniene, Rima	The continuous growth of the world population and urbanization present challenges for sustainable resource management. This study examines policies and practices of sustainable urban planning, proposing improvements for city efficiency and resilience.	Examination of policies and practices of sustainable urban planning.	Improvements in the efficiency and resilience of urban planning.
Hosseini, Seiyed Mossa; Parizi, Esmaeel; Ataie-Ashtiani, Behzad; Simmons, Craig T.	The evaluation of environmentally sustainable management in the construction industry is crucial. This study develops a framework to measure and improve sustainability in construction projects, considering economic, social, and environmental factors.	Development of a framework to measure and improve sustainability in construction projects.	Measurement and improvement of sustainability in construction projects.
Zhang, Junze; Luo, Mengting; Yue, Hui; Chen, Xiyun; Feng, Chong	Ecological restoration projects must be based on a deep understanding of the affected ecosystems. This study presents an approach to plan and execute ecological restoration projects using predictive models and environmental impact analysis.	Planning and execution of ecological restoration projects using predictive models and environmental impact analysis.	Deep understanding of ecosystems for ecological restoration.
Jasiulewicz-Kaczmarek, Malgorzata; Zywicka, Patryk; Gola, Arkadiusz	Over the past five decades, sustainable manufacturing has evolved significantly. This study reviews current practices in the manufacturing industry, proposing strategies to improve sustainability and efficiency in production.	Review of current practices in the manufacturing industry and proposals of strategies to improve sustainability and efficiency.	Improved strategies for sustainability and efficiency in manufacturing production.

Source: Own Elaboration.

To identify the main keywords related to the topic of interest of this study, we created a bibliometric map in the VOSviewer software. Figure 4 shows the map of keywords grouped into 8 clusters; the distance between them shows their association, and the closer they are, the greater their relationship. In this map, observers note that the keyword "Sustainable development" has a higher density in the coffee cluster. This indicates that it appears more frequently in the studied database, and the documents simultaneously integrate the keyword indicators located in the light blue cluster, suggesting a strong relationship between these words; however, with the composite indicator keyword in the Orange cluster and the composite indicators keyword in the green cluster, it is distant and not directly related. We can observe that other keywords, such as sustainability, are linked between the clusters.

Figure 4. Map of keywords



Source: Own elaboration, data analyzed in VOSviewer.

China has made the most contributions to the literature on our topic of interest, which is more significant than the other countries and has a close relationship with the United States. These two countries make up a cluster. The green cluster comprises Germany, which has a close relationship with Japan and, more distantly, with Hong Kong. Finally, the South Africa cluster is with Italy. This map shows that researchers still need to develop the works prepared and found in the literature in alliance between countries, and it also reveals that this study can only visualize seven countries.

Figure 4. Map of countries



Source: Own elaboration, data analyzed in VOSviewer.

Conclusions

According to the results obtained from this bibliometric analysis, using composite indicators is one of the methodologies applied to measure different projects aimed at sustainable development, especially those focused on the efficient use of resources. Applying composite indicators and measuring project performance contributes to and supports decision-makers in selecting strategies that contribute to their objectives. The studies analyzed from the principal authors [24], [25], [26], [27], [28], [29], [30], [31], [32] reveal important approaches and methodologies for the measurement and management of green projects. These authors agree on the need to adopt composite indicators and multifactorial analyses to effectively evaluate sustainability projects. Their research highlights the importance of integrating advanced tools and interdisciplinary approaches to address environmental challenges.

This study aims to resolve the approach carried out since it has been identified that this issue is vital for different entities, such as institutions, government, and public and private companies. It was observed in the first instance that the number of documents in the selected WoS and Scopus databases is scarce, and they do not exceed 100 documents. On the other hand, in the scientific production graphs, the number of documents does not exceed 5. In this section, we can guide related research areas. On the other hand, the journals that have published the principal authors are not recurring; different journals publish each document in the top 10. The evaluation of these journals is in the Q1 classification. Therefore, the studies that were carried out and listed are of high quality and impact. Likewise, this is an indication for researchers who follow this line of research. According to the above, the countries with the highest production, including Italy, Germany and China, are studied. These countries have collaborated based on the bibliometric map created; however, their collaboration is still different.

Composite indicators stand out in the bibliometric maps; however, their influence on the clusters of other keywords, such as sustainable development and sustainability, is far away. The above means that their study relationship is developing, being a line of research detected from this bibliometric study. In summary, this study provides a solid foundation for the measurement and management of green projects, emphasizing the importance of composite indicators, international collaboration, and the integration of multiple dimensions in sustainability evaluation. These advanced approaches are essential for driving policies and practices that promote truly sustainable development. Based on the above, this study provides relevant information for monitoring various future lines that are under development and that, at the same time, the stakeholders involve governments and institutions interested in generating policies that promote sustainable development. Therefore, participation and regulation in the management of green projects have a tremendous social, environmental, and economic impact.

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