

Green Entrepreneurship Research: A Comprehensive Bibliometric Analysis and Knowledge Mapping

Vijayakumar V¹, Sreelakshmi M G¹

¹Department of Commerce, Nehru Arts and Science College Kanhanhad, Kerala, India

Abstract

Green entrepreneurship has emerged as a vital research domain that integrates entrepreneurial innovation with environmental sustainability and sustainable economic development. This study aims to systematically map the global research landscape of green entrepreneurship using bibliometric techniques based on 589 publications retrieved from the Scopus database covering the period 2002–2026. The dataset was analyzed using Biblioshiny and VOSviewer to examine publication trends, influential authors, leading publication sources, international collaboration networks, thematic evolution, and keyword co-occurrence patterns. The findings reveal a remarkable annual growth rate of 20.09%, with a substantial increase in publications after 2020, indicating rapidly expanding scholarly interest in the field. China and India emerged as the most productive countries, while Sustainability (Switzerland) was identified as the leading publication source. The thematic and keyword analyses demonstrate that sustainable development, green economy, green innovation, entrepreneurial orientation, and environmental performance constitute the principal knowledge domains, whereas green entrepreneurial intention and entrepreneurship education represent emerging research themes with considerable future potential. The study also highlights extensive international collaboration and the increasingly multidisciplinary nature of green entrepreneurship research, spanning entrepreneurship, sustainability, innovation, environmental management, and policy studies. The findings provide valuable insights into the intellectual structure, research trends, and future directions of green entrepreneurship, offering practical implications for researchers, policymakers, educators, and practitioners seeking to promote sustainable entrepreneurial ecosystems.

Keywords: Green entrepreneurship, Bibliometric Analysis, Biblioshiny, VOSviewer.

1. Introduction

Green entrepreneurship has emerged as one of the most influential concepts in contemporary entrepreneurship research, reflecting the growing integration of economic development with environmental sustainability (Bouten, 2012; Muo & Azeez, 2019). As nations confront pressing global challenges such as climate change, biodiversity loss, pollution, resource depletion, and increasing carbon emissions, entrepreneurship is increasingly viewed as a mechanism for generating innovative solutions that create both economic and ecological value (Dean & McMullen, 2007). Green entrepreneurship refers to entrepreneurial activities that prioritize environmental protection while simultaneously pursuing business growth, profitability, and social welfare (Bouten, 2012; Neumann, 2022). Unlike conventional entrepreneurship, which primarily emphasizes financial returns, green entrepreneurship incorporates sustainable production, eco-friendly innovation, responsible resource utilization, and environmental stewardship into the core of business operations (Dean & McMullen, 2007). Entrepreneurs are increasingly developing environmentally sustainable products, renewable energy technologies, waste management solutions, green manufacturing practices, organic agriculture, eco-tourism services, and circular economy business models that contribute to long-term sustainability (Hörisch et al., 2026). Governments, international organizations, financial institutions, and consumers have also become active stakeholders in promoting environmentally responsible enterprises through supportive policies, green financing, tax incentives, and sustainability-oriented investment programs (Dewiyani et al., 2025). Consequently, green entrepreneurship has evolved into a strategic approach that simultaneously addresses economic competitiveness, environmental conservation, and sustainable societal development.

The growing prominence of sustainability has significantly expanded academic interest in green entrepreneurship over the past two decades (Vasilescu et al., 2023). International initiatives such as the United Nations Sustainable

Development Goals (SDGs), the Paris Climate Agreement, and numerous national green growth strategies have encouraged researchers to examine the role of entrepreneurial innovation in achieving environmental sustainability (Singh et al., 2025). Green entrepreneurship has become an interdisciplinary research domain encompassing entrepreneurship, management, environmental science, economics, public policy, innovation studies, engineering, and sustainability research (Lotfi et al., 2018). Scholars have explored a wide range of themes including green entrepreneurial intention, sustainable innovation, eco-innovation, environmental leadership, green business models, renewable energy entrepreneurship, institutional support, green financing, consumer behavior, corporate sustainability, environmental education, and climate-resilient enterprises (Gupta & Dharwal, 2022). The increasing diversity of research topics demonstrates that green entrepreneurship has moved beyond being a specialized area of entrepreneurship and has become an essential component of sustainable economic transformation (Maisaroh et al., 2022). As governments and businesses continue to invest in environmentally responsible innovations, scholarly interest in understanding the drivers, challenges, and impacts of green entrepreneurship continues to grow rapidly (Tien et al., 2023).

Green entrepreneurship is fundamentally characterized by its ability to transform environmental challenges into entrepreneurial opportunities (Makhloufi et al., 2022). Green entrepreneurs identify unmet environmental needs and develop innovative products, services, and technologies that reduce ecological footprints while creating economic value (Makhloufi et al., 2022). These ventures frequently focus on renewable energy systems, clean technologies, sustainable agriculture, biodegradable products, water conservation, recycling, electric mobility, green construction, and low-carbon manufacturing processes (Yasir et al., 2023). Unlike traditional enterprises that often consider environmental compliance as a regulatory obligation, green businesses integrate sustainability into their organizational mission, operational strategies, and value creation processes. Such enterprises not only contribute to environmental preservation but also generate employment opportunities, encourage technological innovation, enhance resource efficiency, and strengthen regional economic development (Salaheldeen et al., 2024). The increasing awareness of environmentally conscious consumers and the rapid diffusion of digital technologies have further accelerated the adoption of sustainable business practices across industries. As a result, green entrepreneurship is widely recognized as a catalyst for achieving a circular economy and promoting inclusive, resilient, and environmentally responsible economic growth (S. Mondal, 2023).

The rapid expansion of research on green entrepreneurship has produced an extensive and multidisciplinary body of scientific literature. Researchers have investigated numerous factors influencing green entrepreneurial success, including government regulations, environmental policies, institutional quality, entrepreneurial ecosystems, access to finance, technological innovation, sustainability education, stakeholder engagement, and environmental awareness (Muo & Azeez, 2019). Recent studies have also explored emerging themes such as climate entrepreneurship, circular entrepreneurship, sustainable supply chains, green digital transformation, environmental social governance (ESG), artificial intelligence for sustainability, carbon-neutral innovation, and green entrepreneurial ecosystems (Singh et al., 2025). The diversity of theoretical perspectives and methodological approaches has significantly enriched the field but has also resulted in a fragmented body of knowledge dispersed across multiple disciplines and journals. Consequently, researchers often encounter difficulties in identifying the most influential contributors, major research themes, collaboration networks, and emerging directions within this rapidly evolving field (Singh et al., 2025). A systematic synthesis of the literature is therefore essential to understand the intellectual development of green entrepreneurship and to identify future research opportunities (Jiang et al., 2024).

The present study focuses on the global scholarly literature related to green entrepreneurship indexed in the Scopus database (Burnham, 2006). The analysis includes peer-reviewed journal articles, conference papers, book chapters, and other relevant scholarly publications published during the selected study period. The scope of the study extends beyond merely counting publications by systematically examining publication growth, citation impact, influential authors, productive journals, leading institutions, contributing countries, international collaboration networks, and thematic evolution within the field (Hassan & Duarte, 2024). Furthermore, the study investigates the intellectual structure of green entrepreneurship through advanced bibliometric mapping techniques such as co-authorship analysis, co-citation analysis, bibliographic coupling, keyword co-occurrence

analysis, thematic mapping, and trend analysis (Passas, 2024). By providing a comprehensive overview of the evolution of green entrepreneurship research, the study seeks to identify knowledge gaps, emerging research themes, and future directions that can support researchers, educators, policymakers, entrepreneurs, and funding agencies in promoting environmentally sustainable entrepreneurial development (Donthu et al., 2021).

The primary objective of this study is to systematically analyze and map the global research landscape of green entrepreneurship using bibliometric methods. Specifically, the study aims to examine the growth and distribution of scientific publications, identify the most influential authors, journals, institutions, and countries, evaluate collaboration patterns among researchers, assess citation performance, and explore the thematic evolution of green entrepreneurship research over time. Bibliometric analysis serves as a powerful quantitative methodology for revealing the intellectual structure and knowledge dynamics of a research field through statistical analysis of scholarly publications. Using advanced visualization tools such as Biblioshiny and VOSviewer, the present study maps co-authorship networks, co-citation relationships, bibliographic coupling, keyword co-occurrence patterns, thematic clusters, and emerging research frontiers (H. Mondal, 2025). These analytical approaches provide a comprehensive understanding of the historical development, current research trends, and future trajectory of green entrepreneurship while offering valuable insights for academics, policymakers, industry practitioners, and entrepreneurs committed to advancing sustainable innovation and environmentally responsible economic development (Guleria & Kaur, 2021).

2. Materials and Methods

The present study employed a bibliometric research design to systematically examine the global scientific literature on green entrepreneurship. The Scopus database was selected as the primary source of bibliographic data because of its extensive coverage of high-quality peer-reviewed publications across multiple disciplines (Guz & Rushchitsky, 2009). Data retrieval was conducted using the search query TITLE-ABS-KEY ("Green entrepreneurship"), which searched for the exact phrase within the title, abstract, and author keywords of indexed documents. The initial search yielded 650 publications. To ensure the inclusion of relevant scholarly contributions, the PRISMA framework was applied for the screening and selection process. Publications categorized as reviews (27), books (20), retracted documents (4), errata (4), conference reviews (3), editorials (2), and notes (1) were excluded from the analysis. The final dataset comprised 589 publications, including 408 journal articles, 130 book chapters, and 51 conference papers. Following the screening process, the cleansed bibliographic dataset was exported from Scopus in CSV format for subsequent bibliometric analysis.

The exported dataset was analyzed using two widely recognized bibliometric software packages: Biblioshiny (the web interface of the Bibliometrix R package) and VOSviewer (Thomas et al., 2025). Biblioshiny was utilized to generate descriptive bibliometric indicators, including annual scientific production, source impact, author productivity, citation analysis, country and institutional contributions, thematic evolution, trend topics, and conceptual structure (Wulantika, 2026). VOSviewer was employed to construct and visualize bibliometric networks, including co-authorship, co-citation, bibliographic coupling, and keyword co-occurrence maps, enabling the identification of collaboration patterns, influential knowledge clusters, and emerging research themes (Zhan et al., 2024). The combined application of these complementary tools provided a comprehensive quantitative and visual assessment of the intellectual structure, research trends, and knowledge development of green entrepreneurship research (Cherian et al., 2025).

3. Findings

3.1. Key Information of the Investigation

The key bibliometric indicators reveal that green entrepreneurship has evolved into a rapidly expanding and increasingly influential research field during the period 2002–2026. The dataset comprises 589 publications published across 350 scholarly sources, reflecting broad academic interest spanning entrepreneurship, sustainability, environmental management, and innovation studies. The field recorded a remarkable annual growth rate of 20.09%, indicating a substantial increase in research output driven by growing global concerns over sustainable development and green innovation. The average document age of 3.19 years demonstrates that the

literature is relatively recent and continues to expand, while the average of 19.51 citations per document and a total of 63,481 references highlight the field's strong scholarly impact and well-established intellectual foundation. The conceptual richness of the research is evidenced by 1,523 author keywords and 1,465 Keywords Plus, indicating diverse research themes related to eco-innovation, sustainable business models, circular economy, renewable energy, and environmental entrepreneurship. Authorship analysis shows that 1,654 researchers contributed to the literature, with only 72 single-authored publications and an average of 3.26 co-authors per document, reflecting a strong collaborative research culture. Furthermore, the 32.6% international co-authorship rate demonstrates considerable global scientific collaboration, emphasizing the international relevance of green entrepreneurship in addressing sustainability challenges. Among the document types, journal articles constitute the largest share (408; 69.3%), followed by book chapters (130; 22.1%) and conference papers (51; 8.7%), indicating that peer-reviewed journals remain the principal channel for disseminating research while books and conference proceedings continue to contribute to the advancement of knowledge in this dynamic field.

3.2. Annual Scientific Production

Figure 1 illustrates the annual scientific production on green entrepreneurship from 2002 to 2026, revealing a strong and sustained upward trajectory in research output. The field remained in its formative stage between 2002 and 2012, with only one or no publications in most years, indicating limited scholarly attention during its early development. A gradual increase became evident from 2013 onwards, with publications rising from 4 in 2013 to 17 in 2019, reflecting growing academic interest in sustainable entrepreneurship, environmental innovation, and green business practices. Research output accelerated markedly after 2020, increasing from 28 publications in 2020 to 36 in 2021, 57 in 2022, 77 in 2023, 102 in 2024, and reaching its highest level of 136 publications in 2025, highlighting the increasing global emphasis on sustainability, climate action, circular economy initiatives, and green economic development. Although 2026 records 81 publications, this figure represents an incomplete publication year rather than a decline in research activity. Overall, Figure 1 demonstrates that green entrepreneurship has evolved from an emerging research topic into a rapidly expanding and well-established field with substantial scholarly momentum and promising future growth.

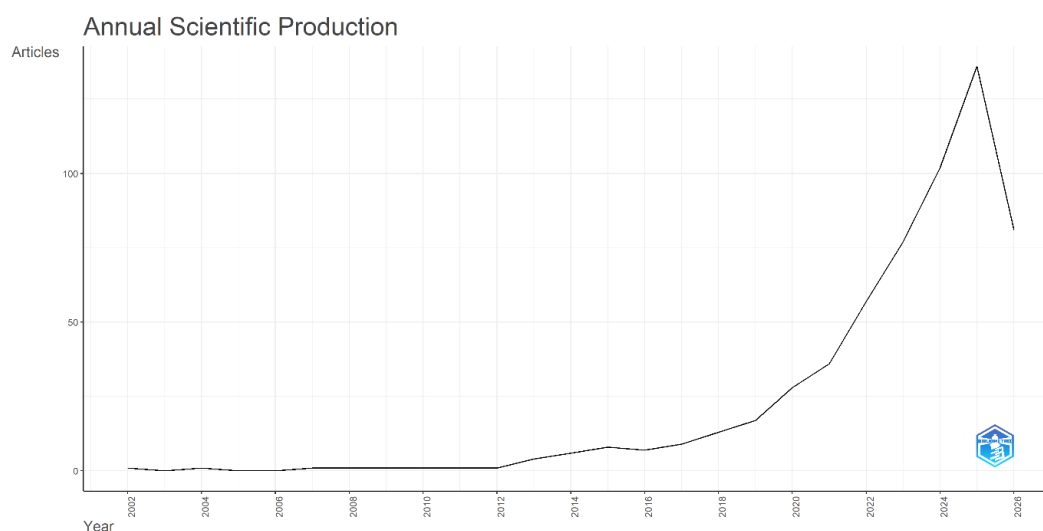


Figure1. annual scientific production

3.3. Most Relevant Authors

Table 1 presents the most prolific authors in the field of green entrepreneurship research based on the number of publications. Alvarez-Risco A emerged as the leading contributor with 10 publications, demonstrating a sustained research focus and significant scholarly influence in the field. Del-Aguila-Arcentales S and Mondal S jointly secured the second position with 9 publications each, followed by Singh S with 8 publications. Gupta H and Makhoulfi L each contributed 7 publications, reflecting their active involvement in advancing research on green

entrepreneurship. Phani B.V., Potluri S., and Zhang X-E each authored 6 publications, while De Las Mercedes Anderson-Seminario M. completed the list of the ten most productive researchers with 5 publications. The distribution of publications among these leading authors indicates that green entrepreneurship research is driven by a relatively diverse group of scholars rather than being dominated by a single individual, highlighting the collaborative and multidisciplinary nature of the field. These prolific researchers have made substantial contributions to expanding the knowledge base of green entrepreneurship through studies on sustainable innovation, environmental sustainability, entrepreneurial ecosystems, and green business development.

Table 1. Most Relevant Authors

Author	Articles
Alvarez-Risco A	10
Del-Aguila-Arcentales S	9
Mondal S	9
Singh S	8
Gupta H	7
Makhloufi L	7
Phani Bv	6
Potluri S	6
Zhang X-E	6
De Las Mercedes Anderson-Seminario M	5

3.4. Most Relevant Sources

Table 2 presents the most relevant publication sources in green entrepreneurship research, highlighting the journals and book series that have made the greatest contribution to the field. Sustainability (Switzerland) is the leading source with 34 publications, reflecting its strong emphasis on sustainability, environmental management, and green innovation. It is followed by Business Strategy and the Environment with 18 publications, demonstrating the growing integration of environmental sustainability into business and entrepreneurship research. The International Entrepreneurship and Management Journal ranks third with 15 publications, while the Journal of Cleaner Production contributed 14 publications, underscoring the importance of sustainable production and environmental performance in green entrepreneurship studies. The edited volume Incentives and Benefits for Adopting Green Entrepreneurship Practices accounts for 12 publications, indicating the increasing scholarly interest in policy support and organizational adoption of green entrepreneurial practices. Other notable sources include Environmental Footprints and Eco-Design of Products and Processes and Small Business Economics, each with 8 publications, followed by Lecture Notes in Networks and Systems, Sustainable Development, and Sustainable Futures, each publishing 7 articles. The predominance of journals specializing in sustainability, environmental management, entrepreneurship, and cleaner production demonstrates the multidisciplinary nature of green entrepreneurship research and its close association with sustainable business development, innovation, and environmental policy.

Table 2. Most Relevant Sources

Sources	Articles
Sustainability (Switzerland)	34
Business Strategy and the Environment	18

International Entrepreneurship and Management Journal	15
Journal of Cleaner Production	14
Incentives and Benefits for Adopting Green Entrepreneurship Practices	12
Environmental Footprints and Eco-Design of Products and Processes	8
Small Business Economics	8
Lecture Notes in Networks and Systems	7
Sustainable Development	7
Sustainable Futures	7

3.5. Thematic Map

Figure 2 presents the thematic map of green entrepreneurship research, categorizing the major research themes according to their centrality (relevance) and density (development). The Motor Themes quadrant is dominated by the cluster comprising "sustainable development," "green economy," and "green development," which appears as the largest and most central cluster in the map. Its position indicates that these themes are both highly developed and strongly interconnected with the overall research field, making them the principal drivers of knowledge development in green entrepreneurship. Another important cluster, consisting of "entrepreneur," "sustainability," and "innovation," is positioned close to the basic themes quadrant with moderate density, suggesting that these topics form the conceptual foundation of the discipline while continuing to evolve. In contrast, the cluster containing "entrepreneurship," "environmental sustainability," and "climate change" occupies the upper-central region, indicating a well-developed but comparatively specialized theme that contributes substantially to the theoretical advancement of the field.

The lower-left quadrant contains the Emerging or Declining Themes, represented by "green entrepreneurship" and "sustainable entrepreneurship," together with a smaller cluster consisting of "students," "green entrepreneurial intention," and "entrepreneurship education." Their low centrality and density suggest that these topics are either emerging areas with growing research potential or mature topics experiencing relatively slower development compared with the dominant themes. The prominence of themes related to entrepreneurial intention and entrepreneurship education indicates increasing scholarly attention toward understanding the behavioral and educational factors that encourage environmentally responsible venture creation. Overall, Figure 23 reveals that green entrepreneurship research is progressively shifting from conceptual discussions toward broader sustainability-oriented agendas, with sustainable development, green economy, and innovation emerging as the primary knowledge hubs that are likely to shape future research directions.

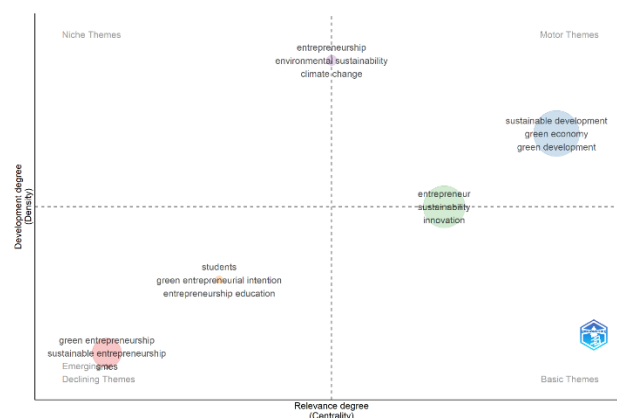
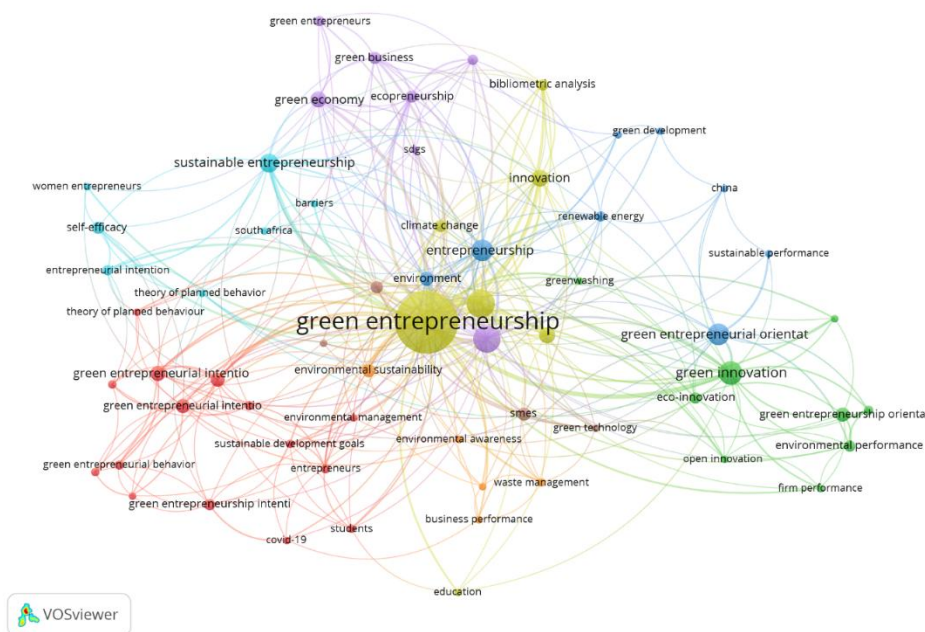


Figure 3. Thematic Map



(15), Bangladesh (15), Australia (12), and the United Arab Emirates (11). The visualization reveals that China occupies a central position in the collaboration network, maintaining extensive research partnerships with countries such as the United States, Malaysia, Turkey, Thailand, and the Russian Federation. Similarly, India demonstrates strong collaborative ties with Malaysia, Australia, South Africa, Spain, Oman, and Qatar, reflecting its active participation in international sustainability research. Distinct regional collaboration clusters are also evident, including the Indonesia–Poland–Netherlands–Greece cluster and the Saudi Arabia–Spain–Colombia cluster, indicating both regional and cross-continental scientific partnerships. Overall, Figure 4 demonstrates that green entrepreneurship research is supported by extensive international collaboration, with Asian countries, particularly China and India, playing a pivotal role in advancing global knowledge while fostering strong research networks across Europe, the Middle East, and other regions. Overall, the bibliographic coupling map reveals a well-connected and evolving research landscape, where both foundational and recent studies contribute to a cohesive body of knowledge. The network underscores the progression from traditional image processing approaches to advanced AI-driven techniques, highlighting the dynamic nature of biomedical image processing research and the continuous integration of new methodologies into established frameworks.

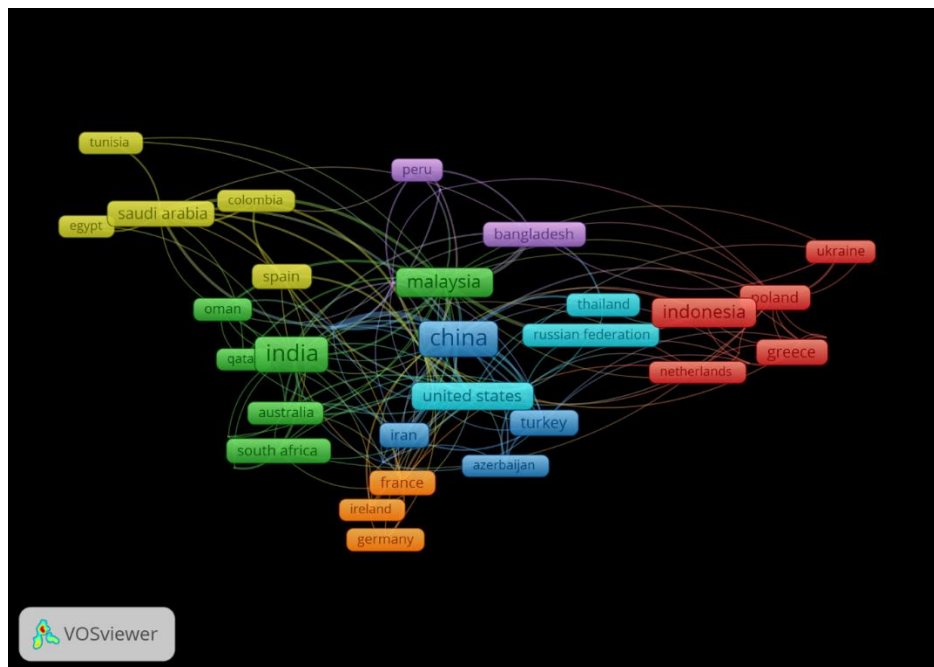


Figure 4. Bibliographic Coupling of Documents

4. Discussions

The findings demonstrate that green entrepreneurship has evolved from a niche research topic into a rapidly expanding and globally recognized field, particularly after 2020, with a remarkable annual growth rate of 20.09% and a sharp increase in scientific publications. This growth reflects the increasing global emphasis on sustainable development, climate change mitigation, green innovation, and the transition toward low-carbon economies. The dominance of journal articles and the presence of 350 publication sources indicate that green entrepreneurship has become an interdisciplinary research area spanning entrepreneurship, environmental management, sustainability, economics, and innovation studies. The leading contribution of journals such as Sustainability (Switzerland), Business Strategy and the Environment, and Journal of Cleaner Production further confirms that research in this domain is increasingly integrated with broader sustainability and environmental policy discussions. The collaborative nature of the field, reflected by an average of 3.26 authors per publication and 32.6% international co-authorship, highlights the growing recognition that environmental challenges require multidisciplinary and cross-national research partnerships to generate effective and scalable solutions.

The thematic map and keyword co-occurrence analysis reveal a clear shift in the intellectual focus of green entrepreneurship research. Highly developed motor themes such as sustainable development, green economy, and green development now dominate the research landscape, indicating that the field has moved beyond conceptual discussions of entrepreneurship toward examining its contribution to broader sustainability transitions. At the same time, themes such as green innovation, green entrepreneurial orientation, environmental performance, firm performance, and circular economy have become increasingly interconnected, suggesting that contemporary research emphasizes organizational capabilities, innovation, and business performance as mechanisms for achieving sustainability objectives. Emerging themes related to green entrepreneurial intention, entrepreneurship education, and students indicate growing scholarly interest in understanding how entrepreneurial competencies and environmental awareness can be cultivated among future entrepreneurs. These findings suggest that the field is progressively integrating behavioral, technological, educational, and policy perspectives, thereby strengthening its multidisciplinary character and expanding its theoretical foundations.

Despite its rapid development, several research gaps remain evident. Although the thematic map identifies green entrepreneurial intention and entrepreneurship education as emerging themes, relatively limited attention has been devoted to translating entrepreneurial intentions into successful green venture creation and long-term business sustainability. Likewise, research remains concentrated on sustainability, innovation, and environmental performance, while comparatively fewer studies examine issues such as green entrepreneurial finance, digital transformation, artificial intelligence applications in green ventures, social inclusion, gender diversity, resilience of green enterprises, and the long-term impact of government policy interventions. Furthermore, the country collaboration network indicates that research output is dominated by a relatively small group of countries, particularly China, India, Malaysia, and several developed economies, suggesting limited representation from many regions of Africa, Latin America, and small developing economies. Future studies should therefore encourage broader international collaboration, comparative cross-country investigations, longitudinal analyses, and interdisciplinary approaches that integrate technological, institutional, and socio-economic dimensions to develop a more comprehensive understanding of green entrepreneurship across diverse contexts.

The findings also have important practical implications for policymakers, educators, researchers, entrepreneurs, and industry practitioners. The prominence of sustainable development, green economy, and innovation as the field's central themes suggests that governments should strengthen policies supporting green innovation ecosystems through financial incentives, incubation programs, green financing mechanisms, and entrepreneurship-friendly environmental regulations. Universities and higher education institutions should incorporate green entrepreneurship, sustainability, and circular economy concepts into entrepreneurship education to develop environmentally responsible entrepreneurial competencies among students. For businesses, the strong association between green innovation, entrepreneurial orientation, and environmental performance indicates that sustainability should be embedded within corporate strategies rather than treated merely as a compliance requirement. Finally, the extensive international collaboration observed in the study demonstrates the importance of strengthening global research partnerships, knowledge-sharing initiatives, and industry-academia collaborations to accelerate innovation and promote sustainable entrepreneurial ecosystems capable of addressing future environmental and economic challenges.

5. Conclusion

This bibliometric study provides a comprehensive overview of the evolution, intellectual structure, and research trends of green entrepreneurship based on 589 Scopus-indexed publications published between 2002 and 2026. The findings reveal that green entrepreneurship has developed into a rapidly expanding and multidisciplinary research field, with sustainable development, green economy, green innovation, and entrepreneurial orientation emerging as its principal knowledge domains. The study also demonstrates the growing importance of international collaboration, particularly among leading contributors such as China, India, and Malaysia, in advancing research on sustainable entrepreneurship. Future research should focus on interdisciplinary and cross-country investigations to address existing geographical and thematic gaps, particularly in emerging economies and underexplored research areas. Policymakers are encouraged to strengthen green entrepreneurial ecosystems

through supportive regulations, financial incentives, and innovation-oriented sustainability policies, while higher education institutions should incorporate green entrepreneurship and sustainability into entrepreneurship education to develop environmentally responsible entrepreneurs. Overall, the study offers valuable insights for researchers, educators, practitioners, and policymakers by identifying the current knowledge landscape and highlighting future directions for advancing green entrepreneurship research and practice.

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