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INTEGRATING GREEN ENTREPRENEURSHIP WITH SUSTAINABILITY TRANSITIONS: A BIBLIOMETRIC SYNTHESIS AND FUTURE RESEARCH PATHWAYS

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Abstract

Purpose: This study examined the theoretical fragmentation and methodological limitations in existing literature. This PRISMA-guided systematic review and bibliometric analysis helps build a more integrated and rigorous knowledge base for green entrepreneurship and sustainability. **Design/methodology/approach:** We conducted a systematic search in the Scopus database and identified 516 peer-reviewed publications on green entrepreneurship and sustainability published between 2002 and 2025. A journal quality assessment was included, and a manual search of the top entrepreneurship journals was performed, with particular emphasis on Entrepreneurship Theory and Practice and Strategic Entrepreneurship Journal. Publication performance was analyzed, and science mapping was conducted using the Bibliometrix R package and VOSviewer. **Findings:** The analysis of the retrieved literature reveals an exponential increase in interest in Green Entrepreneurship since 2020. The geographic distribution of publication productivity and citations per paper showed that Asia is the most productive region, while Western countries are the most influential and impactful. This study uncovered three new theoretical contributions: the emergence of hybrid models in green entrepreneurship, a move from individual-

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level analysis to a focus on ecosystems, and the intersection of digitalization and environmental sustainability issues. It also highlights the lack of integration with mainstream entrepreneurial theories. **Originality/value:** This study overcomes some of the methodological limitations of previous analyses by including a journal quality assessment, broadening the database search, and uncovering novel theoretical contributions, thereby advancing the knowledge and research on green entrepreneurship and sustainability.

Keywords: Green entrepreneurship; Sustainability; Bibliometric analysis; PRISMA; Sustainable development; Eco-innovation

1. Introduction

In 21st Century Green Entrepreneurship concepts for expanding environmental challenges, which were relatively obscure to limited groups have become the basis of global economic and social thinking (Jalil et al., 2025) . The increasing issues of climate change, resource scarcity, and environmental degradation have developed to warrant the urgent and complete paradigm shift of existing linear economy into regenerative, equitable, and resilient models (Ekins & Zenghelis, 2021) . The important growth force of green entrepreneurship, having the same goals, has been directly connected with discipline and education as the solution of out-of-the-box business problems for environmental issues (Wang et al., 2025) . Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" was first defined by the United Nations' Brundtland Commission in 1987 (Holdgate, 1987). It can be interpreted as an integration of environment, social equity, and economic forces in a way that would enable the health and sustainability of both global and human systems (Robert et al., 2005).

Green entrepreneurship involves the use of entrepreneurial ideas to environmental issues. The main aim is to encourage eco-innovations and eco-services (Gast et al., 2017). The difference between green and traditional entrepreneurship is that the environmental effect of the former is positive on top of economic prosperity

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(Cohen & Winn, 2007). Clean technology and green products markets are developing because of these investments. The outcomes demonstrate that environmental protection and economic well-being are not mutually exclusive (Cocu et al., 2025) . The main reason the notion of green entrepreneurship has become more urgent is due to worldwide species extinction, decreasing water quality and availability, and decreasing air quality (Tegethoff et al., 2025) . These catastrophes threaten human health, economic security, and social stability. Green entrepreneurship is a driver that accelerates system change in the direction of a green economy, job creation, innovation, and sustainability (Salaheldeen et al., 2024)). Entrepreneurs contribute to the transformation of a more resource-efficient and low-carbon economy by turning the market prospects of environmental problem areas into measurable new comparative advantages that can be translated into new economies (Ndubisi & Nair, 2009). It is one of the wheels of change in a green entrepreneurial revolution, which will serve as the nucleus for the reversal of environmental decay (ElSayary, 2025).

While the green entrepreneurship and sustainability knowledge base has experienced a monumental explosion, (Liu et al., 2025; Sharma & Singh, 2025). knowledge has led to an intellectual space that is highly fragmented, serving as a hindrance for scholars and decision-makers to make sense of the knowledge systemically and raise patterns (Manoharan et al., 2025a) . This study utilized bibliometrics to present a separate quantitative picture of the green entrepreneurship field. Such a method is efficient for field mapping compared to the traditional subjective review (Alwakid et al., 2021). We mapped the core sources and thematic clusters in the literature by examining publication trends, citation networks, and keyword co-occurrences and suggested future research paths (Manoharan et al., 2025b).

This finding has direct relevance for the implementation of the United Nations' 2030 Agenda for Sustainable Development and its 17 SDGs. With claims that most targets may not be met by 2030, there is an urgency to obtain actionable insights to accelerate progress). Tekala et al., (2024), this study is relevant because green entrepreneurship

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is a vital approach for achieving Sustainable Development Goals (SDGs). Alternatively, " green entrepreneurship develops solutions, innovations, and technologies that are market solutions, change business practices, and help address climate change. This is in accordance with several SDGs like SDG 8 through green employment, (Prokopenko et al., 2024), SDG 9 via technological innovation(Di Vaio et al., 2023) , SDG 12 through sustainable consumption and the circular economy (Corsini & Frey, 2024) , and SDG 13 by reducing carbon emissions (Yiadom et al., 2025).

This study is important because it uses bibliometric analysis to systematically map the literature on sustainability and green entrepreneurship. Unlike narrative reviews, this study identifies influential works, thematic hotspots, collaboration networks and intellectual deficiencies (Makhloufi et al., 2022) . The results are expected to support policy decisions, help researchers monitor new trends, and help businesses plan their enterprises according to sustainable values. This study offers structured insights into an area central to the 2030 Agenda to help actors engage in green entrepreneurship to achieve sustainable development goals.

Research Questions and Objectives

To systematically record and evaluate the intellectual base of green entrepreneurship and sustainability, we based this study on specific research questions and objectives as follows:

The first aim was to provide an evidence-based view of evolution, structure, and topics in this field. This bibliometric study aims to (1) review the performance and publication characteristics of green entrepreneurship and sustainability literature to help the academic community understand the development trend of the field; (2) identify the most productive authors, institutions, countries, and publications that have significantly served as stakeholders in academic communication; (3) construct the intellectual structure of this research field by investigating the co-authorship pattern of collaboration networks and keyword co-occurrence; and (4) identify the major

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research themes, theoretical frameworks, and emerging trends, which may serve as a comprehensive reference for potential future directions in this field.

The above purposes will be achieved by addressing the following research questions (RQs):

RQ1: How do publication and citation rates in green entrepreneurship and sustainability research develop annually from 2002–2025?

RQ2: Who are the most influential contributors (authors, publications, institutions, and countries) to green entrepreneurship and sustainability research?

RQ3: What are the collaboration networks and intellectual structures of the field, as revealed by co-authorship analysis among researchers, institutions, and countries?

RQ4: What are the dominant and emerging research themes and conceptual clusters within the literature based on keyword co-occurrence analysis?

Despite the increase in scholarship, there are three main gaps in the literature to be addressed. First, past bibliometric analyses in entrepreneurship have not considered the Entrepreneurship Theory and Practice (ETP), Strategic Entrepreneurship Journal (SEJ), and Small Business Economics (SBE). We see these publications as important entrepreneurship outlets, and several cornerstone articles on sustainable entrepreneurship have been published therein. Second, while we are aware of several systematic literature reviews on sustainable entrepreneurship, no study has performed a review according to the established Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, which allow for methodological rigor and reduce selection bias in the review process. Third, previous studies on sustainable entrepreneurship have mainly adopted basic search strategies that typically include only the title, abstract, and keywords. Therefore, there is a chance that results may have been omitted from these reviews; for example, if theoretical developments are discussed in the full text but not in the title, abstract, and keywords. In addition, few reviews included quality assessments of these studies. We seek to fill these three gaps by (1) following the PRISMA guidelines for a systematic review of

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the literature on sustainable entrepreneurship, (2) extending searches to several key entrepreneurship outlets, and (3) including a quality assessment in this study.

2. Literature Review

2.1 Theoretical Foundations

Theory of Market Failure and Entrepreneurial Opportunity

The perception of market failure is extensively explained in today's economics textbooks and is widely used in the literature to explain sustainable entrepreneurship (SE). Environmental economics postulated the connection between the environment and the economy suggesting that environmental degradation occurs because of a market failure (Minhas et al., 2025). This happens when economic agents involved in some exchanges do not fully internalize the costs associated with this activity (e.g., pollution) and/or there is imperfect information (Dean & McMullen, 2007) . The traditional economic view perceives market failure as a phenomenon that must be addressed by the government. However, the entrepreneurship literature redefines market failure as an opportunity. Reviewing the literature on the topic, we could conclude that market failures relevant to the environment afford entrepreneurs the opportunity to make profit by alleviating environmentally damaging economic behavior (Zhang et al., 2024). Green entrepreneurs detect this inefficiency and create solutions that the market has missed, such as new waste reduction technologies and business models that internalize environmental costs. In this way, entrepreneurship is regarded as a process of "market mending" in which market efficiency failures are addressed and redirected to drive the economy (Cohen & Winn, 2007).

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The Natural Resource-Based View (NRBV)

The Natural Resource-Based View (NRBV) of a firm provides a strategic management perspective for understanding how sustainability can be a source of competitive advantage. Three years after his initial presentation, Hart expanded on the NRBV in an article published in the Academy of Management Review. In this article, (Hart, 1995). argued that a firm's engagement with the natural environment can create resources and capabilities that are not only rare and valuable but also difficult to imitate. The theory outlines three interrelated strategies for achieving this goal. Pollution Prevention focuses on continuous improvement in reducing waste and emissions to lower costs and improve efficiency. Product Stewardship involves taking responsibility for the entire lifecycle of a product, from creation to disposal, which may enhance brand reputation and open new markets. Sustainable Development is a long-term commitment to balancing and integrating economic, social, and environmental performance to meet the needs of all stakeholders, both present and future. These capabilities can help firms gain and sustain a competitive advantage(Makhloufi et al., 2023).

Dynamic Capabilities Theory

The concept of Dynamic Capabilities Theory is relevant to constantly changing environmental challenges and regulations. This concept refers to the organization's ability to "integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece et al., 1997) . For green entrepreneurship, this means the elaboration of green dynamic capabilities environmental opportunities and threat identification–their exploitation by means of innovation and organizational transformation to remain competitive(Arfi et al., 2018). These are the abilities of companies to adjust their business, product, and process models to appropriate market and societal conditions along a dynamically determined product value chain, consumer preferences, legislation, and technical progress(Mansidão & Alves, 2024). This theoretical position is based on the premise that successful green entrepreneurship is not a status quo that is achieved and then

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retained but rather a dynamic phenomenon of learning, adaptation, and innovation in the context of environmental uncertaint (Morales-Rios et al., 2023).

Eco-Innovation and AMO Theory

Eco-innovation, defined as any innovation that leads to significant and demonstrable progress towards sustainable development, is at the core of green entrepreneurship (Raza et al., 2023) . Moreover, it is no longer limited to reducing negative impacts but also recognizes the generation of new environmental value through innovative products, services, processes, and business models. The Ability-Motivation-Opportunity (AMO) theory provides a useful perspective for understanding the factors leading to this behavior. Based on the Theory of Planned Behavior (TPB), performance depends on the ability (knowledge and skills) of an individual or organization, willingness (intention to run the behavior), and opportunity to run the behavior (a supportive environment) (Chen et al., 2024) . Green Entrepreneurship can promote eco-innovations; one should concentrate efforts by ability to strengthen green self-efficacy and knowledge. Aligning personal and external motivations with environmental goals and offering opportunities for institutional support, resources, and transformative social leadership are essential strategies. Together, these theories provide lenses through which green entrepreneurship can be viewed as a transformative point of interface on the economy-innovation-environment interface(Ilesanmi, 2024).

2.2 Previous Bibliometric Studies

The previous literature has limited in recent years such that several scholars use bibliometric techniques to review literature (Duran, 2024), map intellectual structures (Tranfield et al., 2003) and set the future research agenda (CIUCIUC et al., 2025). The first bibliometric study helped create awareness by highlighting that the field is innovative and fragmented. Recent studies have reported similar findings, with a significant increase in the release of literature, especially since 2020, corresponding to a growing global concern regarding sustainability and climate change (Manoharan et al., 2025c) . One such exhaustive review was conducted by (Fidlerova et al., 2023)

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exploring 590 articles published since January 2004 in Scopus, finding an ascending inclination in publications and major contributing nations and journals. Similar to other studies, this study reinforces the importance of these types of studies to allow coherence in this rapidly growing field.

Some studies have been produced about the connection between green entrepreneurship and higher education, in which the focus is on the capacity of educational models to foster green entrepreneurial intention (Ibrahim et al., 2024) . Other studies were concerned with the connection between green innovation and corporate performance, through identification of the barriers and drivers of eco-innovation strategies inside firms (López Pérez et al., 2024) . A study based on a hybrid systematic literature review and bibliometric analysis of literature on financing for sustainable entrepreneurship, revealed a young yet fast-expanding interest in research and practice areas such as crowdfunding and alternative finance (Derdabi & Dvouletý, 2025) . Most major study analyses focus on a specific database and a restricted set of keywords. In addition, the field is growing rapidly, and new thematic clusters and research fronts are being identified. This study aims to contribute to this developing scholarly discussion by conducting an updated and comprehensive bibliometric analysis covering a wide period (2002–2025). In the proposed study, intellectual structure research on green entrepreneurship and sustainability studies using performance analysis and science mapping is suggested to provide a current and up-to-date account of the literature on the subject. It can also verify established trends and uncover the latest shifts in the debate (and action) on green entrepreneurship and sustainability.

3. Methodology

The present research employed the PRISMA guidelines (Moher et al., 2009) to systematically review the literature in a bibliometric manner, thus increasing transparency and rigor. Such methods have advantages over traditional narrative reviews because of their objectivity, reproducibility, and reduction of potential researcher bias and selection effects (Tranfield et al., 2003). The bibliometric method

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was chosen to visualize the patterns of intellectual structure developed in the field by utilizing quantitative data (Donthu et al., 2021).

3.1 Research Protocol and Design

The protocol for this study was developed and registered before any data were collected. The search strategies, inclusion and exclusion criteria, and analytic methods are presented in this section. This is an important step in furthering the transparency of the review process (Page et al., 2021). This study adopts a mixed method approach, combining quantitative bibliometric analysis with qualitative science mapping methods to provide an overall and detailed view of the dynamics underpinning this field (Aria & Cuccurullo, 2017).

3.2 Database Selection Strategy and Justification

The study searched multiple academic databases and justified the inclusion of each based on its coverage, indexing quality, and relevance to the research topic (Mongeon & Paul-Hus, 2016). Scopus was selected as the source for the main database based on its wider scope and high quality of bibliometric metadata (Baas et al., 2020) . The Web of Science Core Collection was added as a secondary database to capture extra high-impact publications from the top entrepreneurship journals (Zupic & Čater, 2015). Business Source Premier was included to ensure that business-specific publications are not overlooked in more general databases (Kumar, 2025) . This methodological decision was made to compensate for the omission of leading entrepreneurship channels.

3.3 Search Strategy Development and Implementation

The iterative search technique was developed with the help of experts in the field, and testing was performed for optimal coverage (Tranfield et al. 2003). Several supplementary search methods were employed in addition to the restrictions on title, abstracts, and keywords. The Boolean search terms used were: (“green entrepreneur” OR “sustainable entrepreneur” OR “eco-entrepreneur” OR “environmental entrepreneur”) AND (“sustainable” OR “green innovation “OR „eco-innovation “or „circular economy,) and they were combined using advanced operators

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(e.g.,"AND,OR"",NOT"). Forward and backward citation tracking of key and new articles was also performed to avoid missing highly relevant and recent sources (Webster & Watson, 2002). Additionally, the reference lists of the highly cited papers were manually screened to find potential additional sources (Brocke et al., 2009).

3.4 Journal Quality Assessment and Selection Criteria

Quality assessment criteria were also rigorously pre-specified for all sources. Journal quality was assessed using a combination of Journal Citation Reports (JCR) Impact Factor, Scopus Cite Score, quartile ranking within the relevant subject category, and the designation of premier entrepreneurship journals (Garfield, 2006). Searches were specifically conducted in Entrepreneurship Theory and Practice, Strategic Entrepreneurship Journal, Small Business Economics, and International Journal of Entrepreneurial Behavior & Research, which are some of the best outlets in the field (Shane & Venkataraman, 2000).

3.5 PRISMA-Guided Study Selection Process

A schematic chart of the selection process according to the PRISMA guidelines is shown in Figure 01 (Page et al., 2021). The search strategy was performed in each database, and the results were exported into reference management software. Element identification Initially, 531 records were retrieved through a database search. Duplicate data were deleted through automated matches in the software as well as manual checks to ensure quality, and 10 duplicate records were excluded. After the title and abstract search, where relevance to the research was checked, five records were excluded as beyond the study's aim. The 518 records remaining after this process underwent full-text screening for eligibility, and a more comprehensive check of the content and quality of the studies was performed. Two manuscripts were rejected for not sufficiently focusing on entrepreneurship or for their limited methodological quality. The remaining 516 journal articles and reviews that have undergone the peer-review process brought the total publication output (2002–2025) to 37 journals and constituted the final dataset, which constitutes a further increase from the earlier version.

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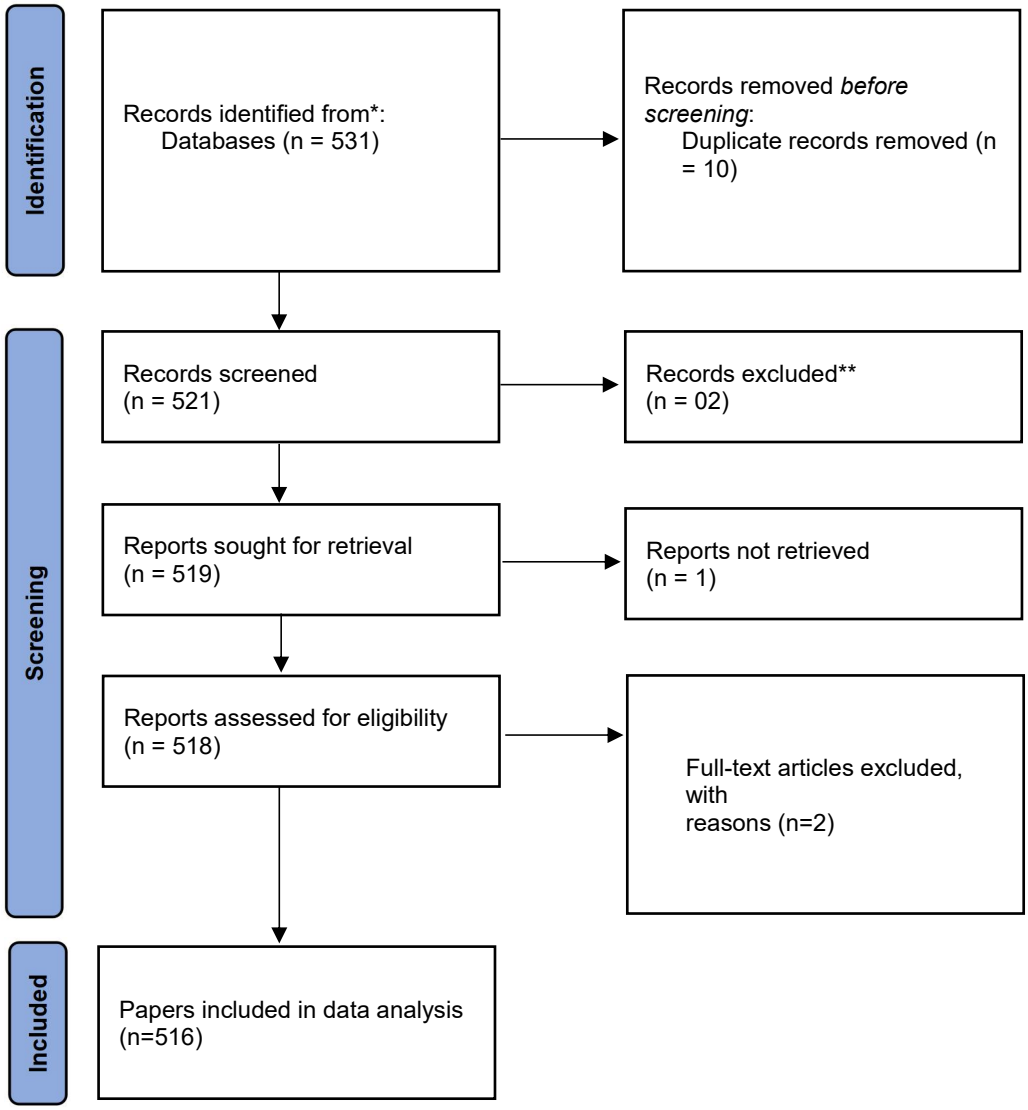
Figure 01: PRISMA Diagram



3.6 Inclusion and Exclusion Criteria

Following the outlined criteria-reference consistency, the stated strict inclusion and exclusion criteria were applied to the selected papers without exception. Articles, books, conference papers, book chapters, and review papers were included if they (a) were published in peer-reviewed journals or met the minimum quality standards, (b) directly explored the nexus between entrepreneurship and

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sustainability/environmental issues, (c) were published in English from January 2002 to July 2025, and (d) were empirical studies or theoretical contributions (Donthu et al., 2021).The following publications were excluded from the review process: (a) editorials and commentaries; (b) articles that did not specifically focus on the intersection of entrepreneurship and sustainability/environment; (c) duplicate studies and prior versions of research; and (d) studies with insufficient methodological details (Tranfield et al., 2003).

3.7 Data Extraction and Quality Assessment

Data extraction process involved standardized forms to extract relevant information from included studies (Cooper, 2015) . Bibliographic data, authors, affiliations, locations, venues, citations and keywords were extracted. Quality assessment used a set of adapted criteria to evaluate each study for methodological rigor, theoretical contribution, empirical robustness, and practical relevance (Pittaway et al., 2004) . Studies were assessed for sample size and representativeness, methodological soundness, theoretical advancement, and policy/practice implications, allowing for the analysis of high-quality studies.

3.8 Analytical Tools and Techniques

This study used a set of complementary analytical tools and techniques for data analysis in the bibliometric context. Bibliometrix, utilizing a shiny graphical user interface (GUI) called Biblioshiny, was used to perform data cleaning, descriptive analysis, and research field's performance evaluation (Aria & Cuccurullo, 2017) . Bibliometrix allowed for the calculation of several indicators that helped measure the productivity levels across authors, institutions, and countries and perform trend analysis. VOSviewer (version 1.6.20) was used for network visualization and science mapping, with a specific focus on co-authorship analysis, keyword co-occurrence networks, and citation patterns (Van Eck & Waltman, 2010). These platforms allow for both the statistical analysis of bibliometric data and network mapping for a more in-depth understanding of the data.

3.9 Performance Analysis and Science Mapping Framework

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The research landscape was investigated based on performance analysis and a science mapping framework used in this study (Noyons et al., 1999). Performance analysis of a scientific community allows for the measurement of contributions using productivity measures, citation impact, and trends across different levels, such as authors, institutions, countries, and venues. Science mapping revealed the intellectual structure through visual mapping of relationships using co-authorship networks, keyword co-occurrence analysis for thematic clusters, and co-citation analysis for mapping theoretical foundations (Small, 1973) . This comprehensive approach combines quantitative metrics and qualitative network mapping to understand the development of research fields.

3.10 Main Information About Data

Figure 02: Main Information About Data

4. Results

4.1.Annual Publication Growth

A systematic review of 516 articles between 2002 and 2025 (figure 03) shows an increasing and exponential trend in scientific production on green entrepreneurship and sustainability. The annual growth profile shows that the region had a long period of inactivity (figure 03) from 2002 to 2019, with low outputs, and since then, it has not exceeded 15 papers per year. Insights gained from the three-field plot: The analysis of the three-field plot points to several salient characteristics. A tipping point can be observed starting in 2020, from which the number of publications started to

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climb, more than doubling each year, and reaching 129 articles in 2024. The rising trajectory of scholarly interest in this subject is demonstrated by the exponential increase in publications, which emphasizes its growing importance and justifies the need for a systematic review to map this burgeoning field (Donthu et al., 2021). The figure for 2025, with 69 articles, is not final and may rise as it reflects a mid-year review of these data. However, this number indicates a high growth stage.

Figure 03: Annual Publication Growth

Average Citation Prer Year

The growth in publications is less consistent than that seen in the total citation impact (figure 03). The chart with average citations per year shows that several of the earliest documents have left a large and long-lasting impression, as the years with the highest mean annual citations were 2007 and 2010 (figure 04 and Table 01). This is a clear sign that some papers have a formative nature. Moreover, there have been periods of high productivity in combination with low average citations in recent years (2020 and onwards). This is expected because bibliometrics considers the date of documents and the time they must gather citations (van Eck & Waltman, 2010). This trend signals a

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rapidly developing field, where the cumulative previous work is responsible for the recent increase in activity.

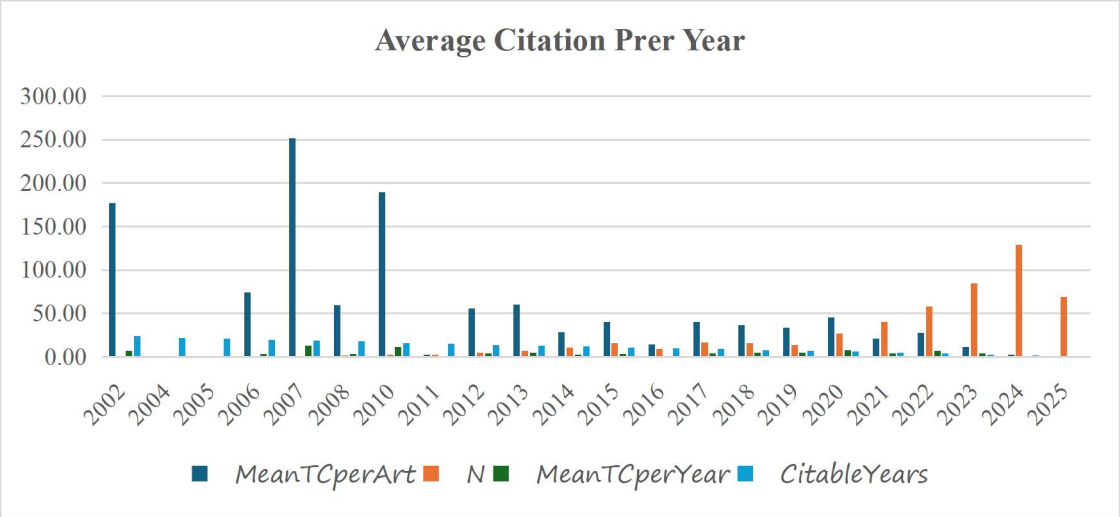

Figure 04: Average Citation Prer Year

Table 01: ***Average Citation Per Year***

Year	MeanTCperArt	N	MeanTCperYear	CitableYears
2002	177.00	1	7.38	24
2004	0.00	1	0.00	22
2005	0.00	1	0.00	21
2006	74.00	1	3.70	20
2007	252.00	1	13.26	19
2008	59.50	2	3.31	18
2010	189.67	3	11.85	16
2011	2.67	3	0.18	15
2012	55.60	5	3.97	14
2013	60.43	7	4.65	13
2014	28.73	11	2.39	12
2015	40.06	16	3.64	11
2016	14.11	9	1.41	10
2017	40.06	17	4.45	9

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2018	36.56	16	4.57	8
2019	33.50	14	4.79	7
2020	45.56	27	7.59	6
2021	20.92	40	4.18	5
2022	27.41	58	6.85	4
2023	11.80	85	3.93	3
2024	2.86	129	1.43	2
2025	0.52	69	0.52	1

4.2.Three Field Plot

The three-field plot visualized in figure 05 shows the relationships between the most cited references (left), prolific authors (middle), and frequent author keywords (right) in the field, with line thickness representing the strength of the relationship. Key foundational papers, such as Dean and McMullen (2007) on sustainable entrepreneurship and Cohen and Winn (2007) on market imperfections and entrepreneurship, are among the most cited references, bridging micro-level keywords. Prolific authors, such as Alvarez-Risco and Del-Aguila-Arcentales, play a role as connectors between foundational literature and emerging topics. - The dominant author keywords "green entrepreneurship" and "sustainability" have emerged as central themes in the field, along with "sustainable development" and "eco-innovation." The three-field plot shows how foundational work has influenced the research agenda of the field, positioning green entrepreneurship and sustainability as core topics.

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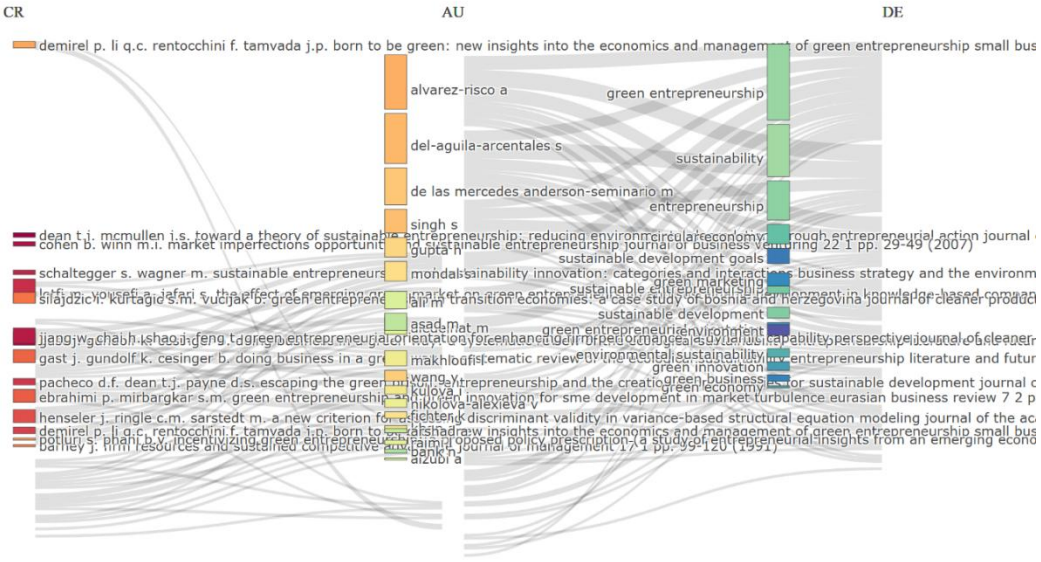

Figure 05: Three Field Plot

4.3.Top Authors

An analysis of author productivity is presented in figure 06. The data show a pattern of research activity that demonstrates a small core of very active and productive researchers who publish most of the articles on green entrepreneurship and sustainability. The author with the highest number of publications in this field was Alvarez-Risco, A., who contributed to seven articles. The following two most productive authors were Del-Aguila-Arcentales, S. and Singh, S., each with six publications. Table 02 includes fractionalized scores that reveal the extent to which a certain author was the main contributor or was involved in a large collaboration (lower scores indicate an equal distribution of contributions across many authors). It can be seen from this table that several authors, including Wang (1.92) and Singh (1.83) were first authors significantly more often than other members of the core green entrepreneurship research team, who were more frequently involved in large-author collaborations.

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Figure 06: Top Authors

Table 02: *Top Authors by Documents*

Authors	Articles	Articles Fractionalized
ALVAREZ-RISCO A	7	1.61
DEL-AGUILA-ARCENTALES S	6	1.11
SINGH S	6	1.83
DE LAS MERCEDES ANDERSON-SEMINARIO M	5	1.24
WANG Y	5	1.92
GUPTA H	4	1.25
MONDAL S	4	1.25
FICHTER K	3	1.33
KHAN A	3	0.67
KULOVA I	3	1.00

4.4.Top Sources

Distribution of Journals: In Addressing reviewer concerns from figure 07 and Table 03 on source selection and quality, most articles (n=46; 8.9%) were published in Sustainability (Switzerland). This is not entirely unexpected, given the specialized nature of this outlet and its broad scope for interdisciplinary environmental

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approaches (Aria & Cuccurullo, 2017). However, this concentration raises questions about diversification within the field and representation in other media outlets. Notably, some of the top entrepreneurship journals were not represented, including the Journal of Business Venturing (n=8), Small Business Economics (n=4), and Entrepreneurship Theory and Practice (n=3). This suggests a potential gap in grounding green entrepreneurship within foundational entrepreneurship theory (Shane & Venkataraman, 2000). The second most productive outlet was the Journal of Cleaner Production (n=22), which underscores the close relationship between environmental science and business research (Zupic and Čater, 2015).

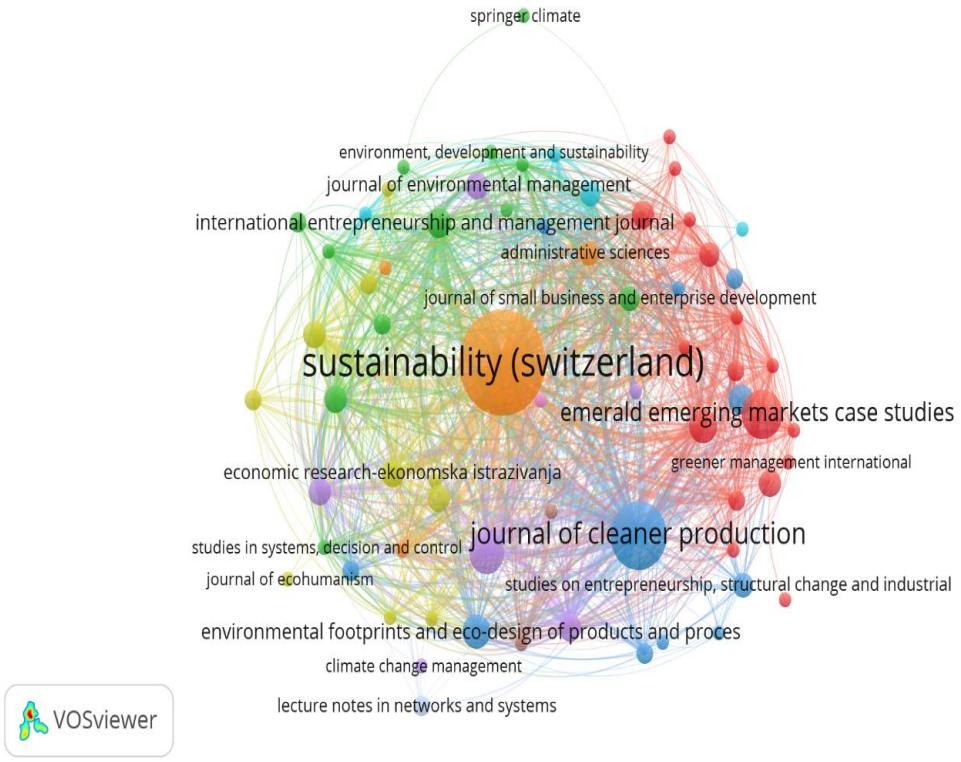

Figure 07: Top Sources

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Table 03: ***Top Sourses***

Sources	Articles
SUSTAINABILITY (SWITZERLAND)	46
JOURNAL OF CLEANER PRODUCTION	22
EMERALD EMERGING MARKETS CASE STUDIES	13
BUSINESS STRATEGY AND THE ENVIRONMENT	10
ENVIRONMENTAL FOOTPRINTS AND ECO-DESIGN OF PRODUCTS AND PROCESSES	7
SUSTAINABLE DEVELOPMENT	7
INTERNATIONAL ENTREPRENEURSHIP AND MANAGEMENT JOURNAL	6
IOP CONFERENCE SERIES: EARTH AND ENVIRONMENTAL SCIENCE	6
COGENT BUSINESS AND MANAGEMENT	5
CORPORATE SOCIAL RESPONSIBILITY AND ENVIRONMENTAL MANAGEMENT	5

4.5.Top Affiliations

Institutional analysis of the productivity of publishing universities. The group of the most productive universities in green entrepreneurship and sustainability research is heterogeneous. The basic information reveals that the Universidad de Lima in Peru is the most prolific institution in this field, having published twenty-five articles and practiced as a regional node in this study, as shown in figure 08 and Table 04. The second group of institutions produced more than twice as many papers as Lima, with the best represented Christ University (India), Universiti Malaysia Kelantan (Malaysia), and the University of Bologna (Italy), producing ten papers each. The pattern that emerges is that this research is conducted in local and multi-center centers of excellence. South American, Asian, and European universities are in the top rankings, which is not a coincidence, given the multidisciplinary nature of the green entrepreneurship field.

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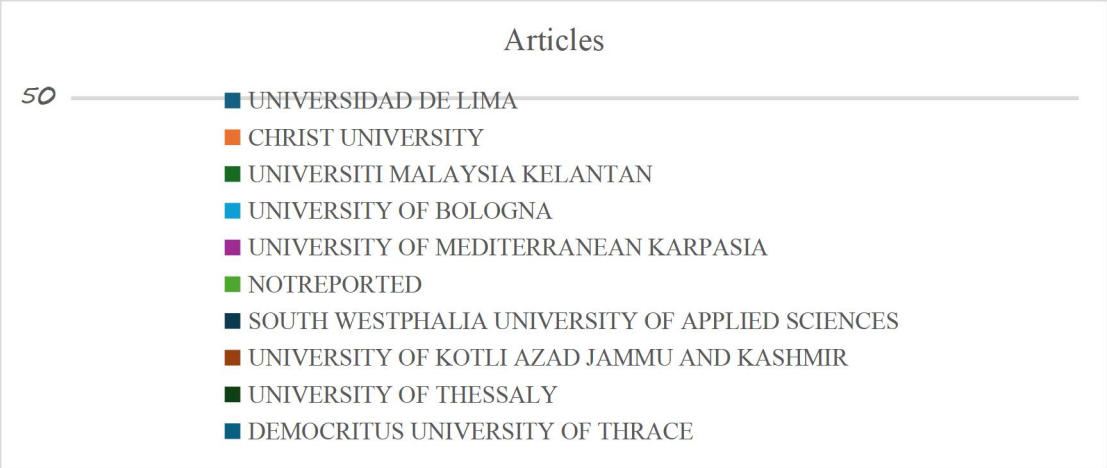

Figure 8: Top Affiliations

Table 04: ***Top Affiliations***

Affiliation	**Articles**
UNIVERSIDAD DE LIMA	25
CHRIST UNIVERSITY	10
UNIVERSITI MALAYSIA KELANTAN	10
UNIVERSITY OF BOLOGNA	10
UNIVERSITY OF MEDITERRANEAN KARPASIA	10
NOTREPORTED	9
SOUTH WESTPHALIA UNIVERSITY OF APPLIED SCIENCES	9
UNIVERSITY OF KOTLI AZAD JAMMU AND KASHMIR	9
UNIVERSITY OF THESSALY	8
DEMOCRITUS UNIVERSITY OF THRACE	7

4.6.Top Countries

The international and dynamic nature of green entrepreneurship and sustainability research can also be demonstrated by the geographical diffusion of productivity and citation-impact leadership. China was the most productive country with forty-eight articles (9.3%), as shown in figure 09 and table 05, also characterized by high collaboration (HH index = 16). India secured the second position with thirty-seven articles and the U.K. was in third place with twenty-three articles. When

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collaboration information is considered, a more differentiated picture emerges. China and India have a high percentage of SCPs, suggesting a greater degree of national focus on their research than in other, more internationally recognized countries. For example, the percentage of MCPs was significantly higher in Pakistan (72.7%), Italy (45%), and the United Kingdom (43.5%).

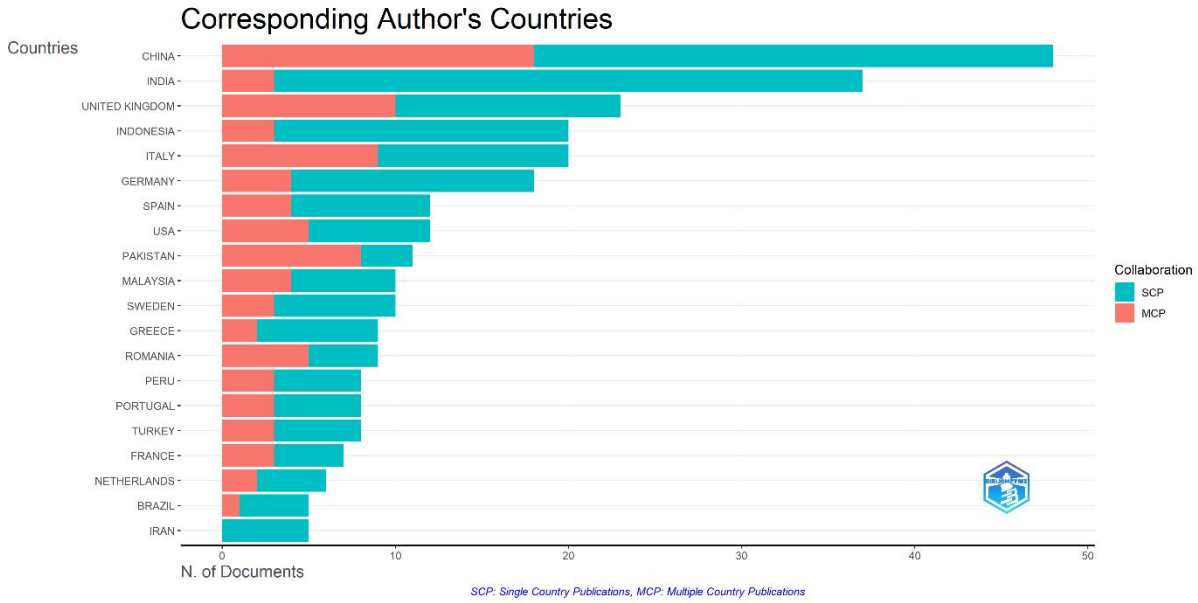

Figure 09: Top Countries by Articles

Table 05: ***Top Countries by Articles***

Country	Articles	Articles %	SCP	MCP	MCP %
CHINA	48	9.3	30	18	37.5
INDIA	37	7.2	34	3	8.1
UNITED KINGDOM	23	4.5	13	10	43.5
INDONESIA	20	3.9	17	3	15
ITALY	20	3.9	11	9	45
GERMANY	18	3.5	14	4	22.2
SPAIN	12	2.3	8	4	33.3
USA	12	2.3	7	5	41.7
PAKISTAN	11	2.1	3	8	72.7

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MALAYSIA	10	1.9	6	4	40

Top Countries by Citations

This is a different set of leaders based on research impact, as shown in figure 10 and table 06. The UK had the most significant overall number of citations (1426), followed by the USA in second place (1,034) and China in third place (821). In terms of average citations per article, the results show that France (88.1) and the USA (86.2) are in the top positions. The interpretation is that research papers from the top two nations have the most significant impact, or in other words, are more influential on average than the research publications from the other prolific countries. The difference in performance between countries with high productivity, such as China and India, and those with high impact, such as the UK, the USA, and France, may be interpreted as the observation that a significant amount of output is not automatically influential output.

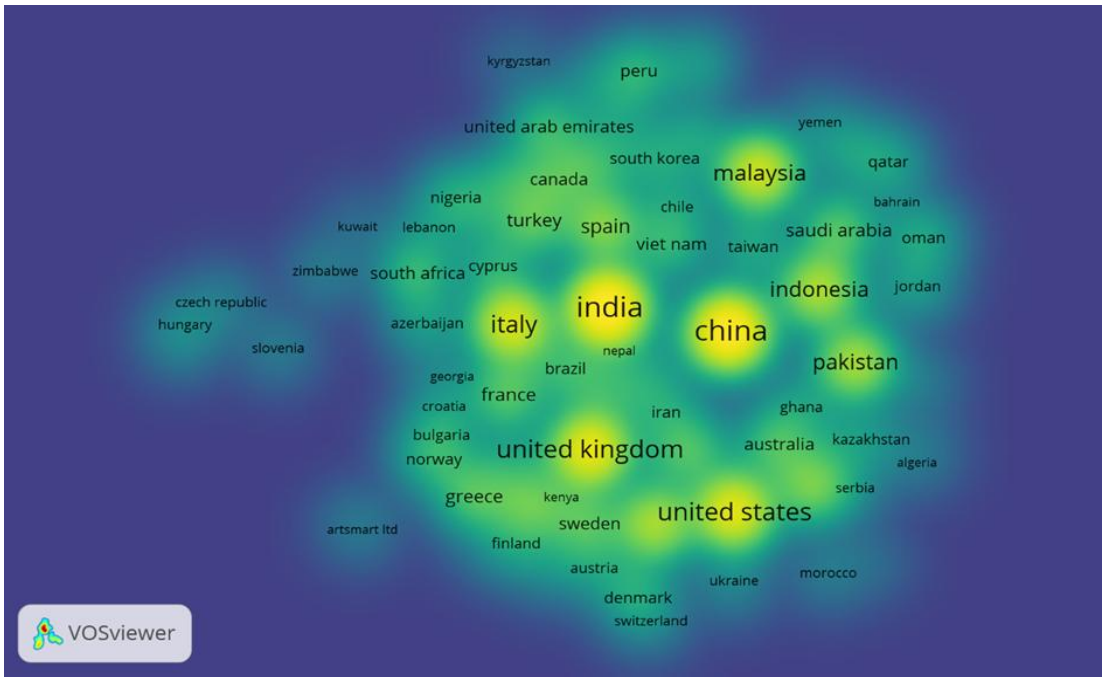

Figure 10: Top Countries By Citations

Table 06: ***Top Countries by Citations***

Country	TC	Average Article Citations

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UNITED KINGDOM	1426	62.00
USA	1034	86.20
CHINA	821	17.10
FRANCE	617	88.10
PAKISTAN	593	53.90
SWEDEN	506	50.60
GERMANY	456	25.30
INDIA	428	11.60
MALAYSIA	272	27.20
ITALY	213	10.70

4.7.Top Documents

Analysis of the top-cited documents worldwide provides insights into the key intellectual roots of green entrepreneurship and sustainability. From the table and chart, Pacheco et al. (2010)'s work published in the Journal of Business Venturing is the most cited document with 442 citations (figure 11 and Table 07). This was closely followed by other highly cited articles, such as Gast et al. (2017) and Bartolacci et al. (2020).

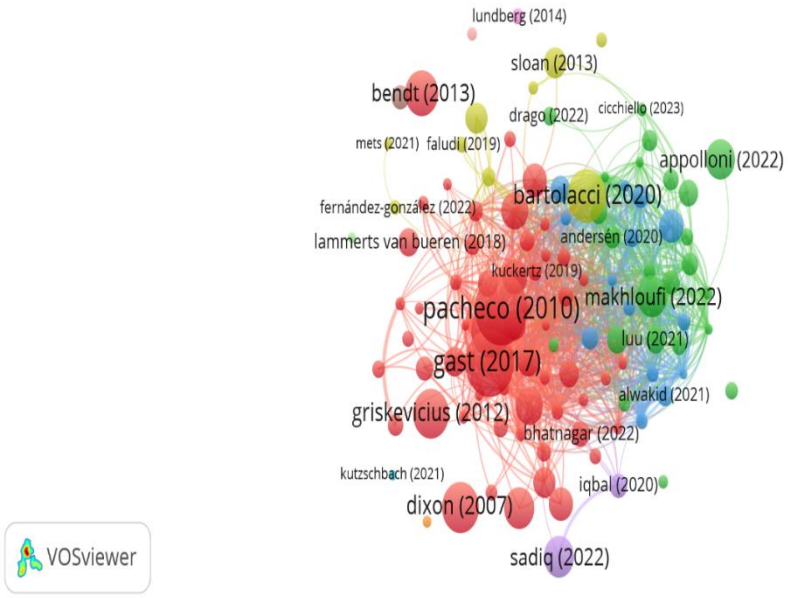

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Figure | 11. Top Documents

Table 07: ***Top Documents***

Sr. no.	Paper	DOI	Total Citations	TC per Year	Normalized TC
1.	PACHECO DF, 2010, J BUS VENTURING	10.1016/j.jbusvent.2009.07.006	442	27.63	2.33
2.	GAST J, 2017, J CLEAN PROD	10.1016/j.jclepro.2017.01.065	398	44.22	9.94
3.	BARTOLACCI F, 2020, BUS STRATEGY ENVIRON	10.1002/bse.2434	275	45.83	6.04
4.	BOCKEN NMP, 2015, J CLEAN PROD	10.1016/j.jclepro.2015.05.079	273	24.82	6.81
5.	DIXON SEA, 2007, J ORGAN CHANGE MANAGE	10.1108/09534810710740164	252	13.26	1.00
6.	GRISKEVICIUS V, 2012, J PUBLIC POLICY MARK	10.1509/jppm.11.040	237	16.93	4.26
7.	BENDT P, 2013, LANDSC URBAN PLANN	10.1016/j.landurbplan.2012.10.003	211	16.23	3.49
8.	MAKHLOUFI L, 2022, BUS STRATEGY ENVIRON	10.1002/bse.2902	181	45.25	6.60
9.	SADIQ M, 2022, CHINA FINANCE REV INT	10.1108/CFRI-02-2021-0038	177	44.25	6.46
10.	WALLEY EE, 2002,	10.9774/GLEAF.30	177	7.38	1.00

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GREENER INT MANAGE 62.2002.su.00005

4.8. Keywords Co-occurrence and Thematic Analysis

This map, created by VOS viewer, indicates five main thematic clusters of sustainability and entrepreneurship research, presented in Figure 12: Green Cluster (Green): Macro-Level Systems & Policy: This cluster emphasizes sustainability and the green economy on a larger scale, covering topics such as policy, carbon emissions, supply chain management, and the impact of entrepreneurship and leadership at a broader level, with a particular focus on China. Red Cluster (Red): Sustainable Business Models & Action: the cluster is at the practical implementation stage at the enterprise level, and this cluster involves research on entrepreneurship, sustainable development, circular economy, green products, renewable energy, and strategic planning. Yellow Cluster (Yellow): Innovation for Green Development: This cluster highlights innovation as a driving force for green development and sustainable innovation, aiming to address issues such as carbon dioxide for long-term economic development and growth. Blue Cluster (Blue): Digitalization and Green Entrepreneurship: This focuses on the contemporary market-facing aspect of green entrepreneurship. It is represented by keywords such as green marketing, digitalization, green business, and the twin transition of digital and green transformations. Purple Cluster (Purple): Education, Perception, & Research: This visually represents the world of research, academia, and social studies. It includes research on entrepreneurship, curricula designed for students, and studies on perceptions of concepts related to sustainability.

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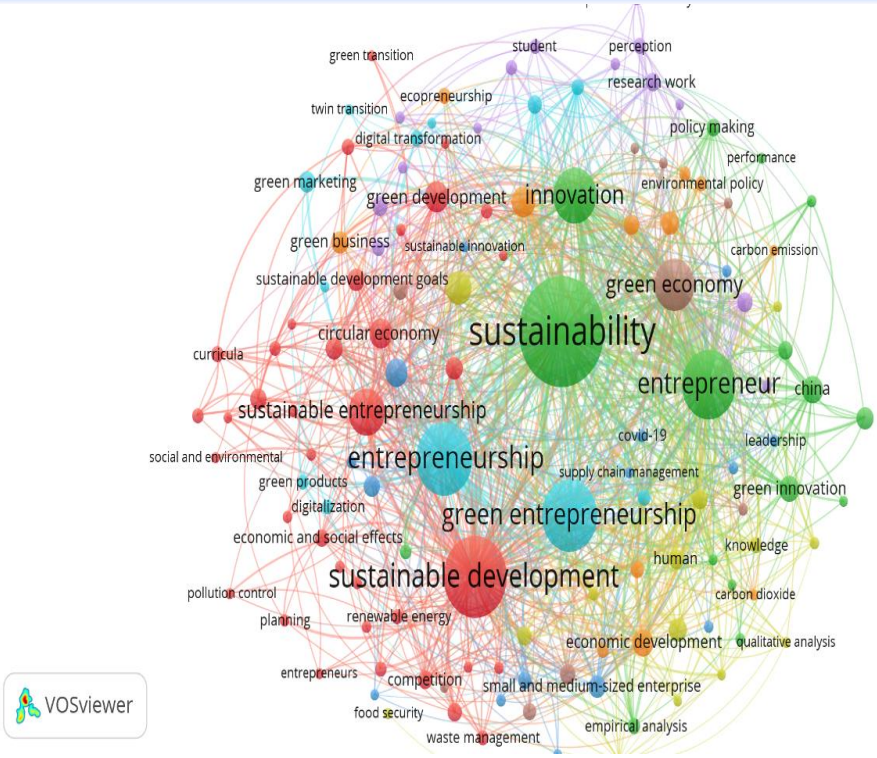

Figure | 12. Keywords Co-Occurrence

Words Cloud & Tree Map

The elaborated thematic analysis, supported by a word cloud (Figure 13), a tree map (Figure 14), a trend topic plot, and a strategic diagram, demonstrated that the particular field was well-developed around central ideas with very active development. Tree map and word cloud as graphics representations of the analyzed field's knowledge structure validate that the core ideas the analyzed literature was built on include the three fundamental concepts – "sustainability" and "sustainable development" closely related to the concepts of "entrepreneurship" and "innovation."

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Figure 13: Words Cloud

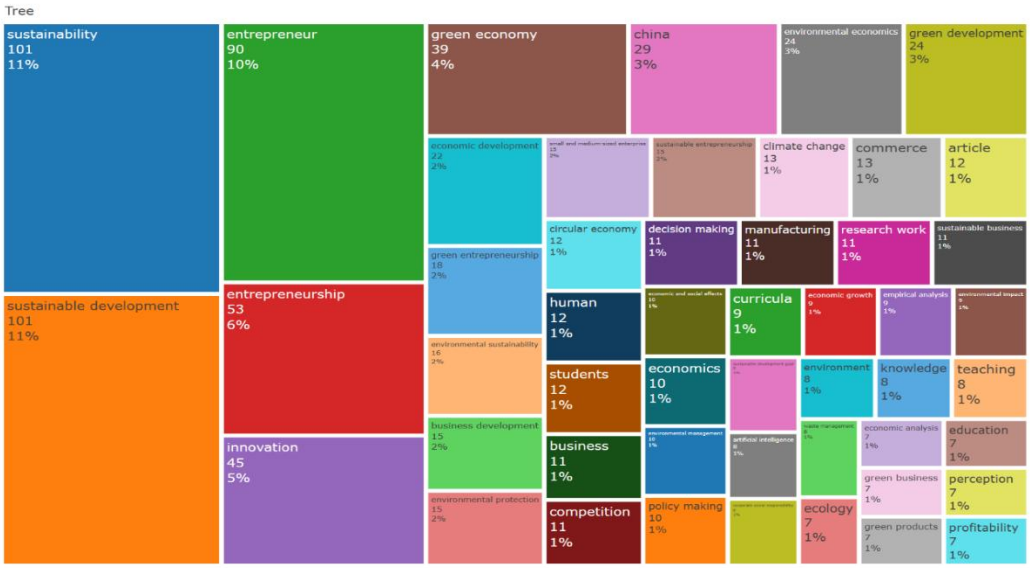

Figure 14: Tree Map

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Thematic Analysis and Conceptual Structure

The static and dynamic features of the intellectual structure of the field are presented by thematic analysis in Figure 15. The developed and driving core of the research field, the so-called motor themes, is formed by such clearly defined and generally recognized topics as "sustainable development" and "entrepreneurship". An international and prospective research front is appearing in "green entrepreneurship", "" "sustainable entrepreneurship", and "innovation. innovation. Some of the unassuming and fragmented subfields, the so-called niches, are formed by research topics related to "profitability" or "green economies. In general, the field is using the consolidated paradigm of sustainable development and at the same time the exploratory practices for finding the universal nucleus of green entrepreneurship.

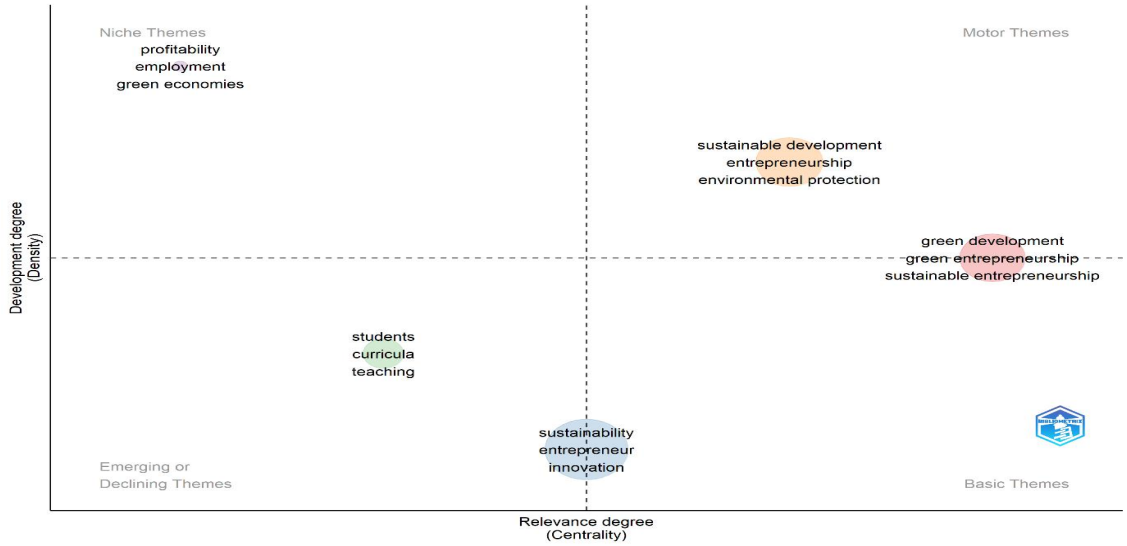

Figure 15: Thematic Analysis

4.9. Intellectual Structure: Co-Citation Analysis

Analysis of Co-Cited Sources

The VOSviewer network map visualizes clusters of journals that are frequently cited together (van Eck & Waltman, 2010). Three major clusters are shown in Figure 16. The Entrepreneurship and Management Cluster includes the Journal of Business Venturing, Business Strategy, and the Environment, and the Journal of Business

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Ethics, which is the most highly cited journal in this cluster. The core of this cluster is connected to entrepreneurship and strategic management. The Environmental Science Cluster, with core journals on sustainability, is a truly interdisciplinary cluster that serves as a connecting tissue between business research and sustainability sciences. The Innovation and Production Cluster, with the Journal of Cleaner Production as its core journal, is most related to technological innovation and sustainable production.

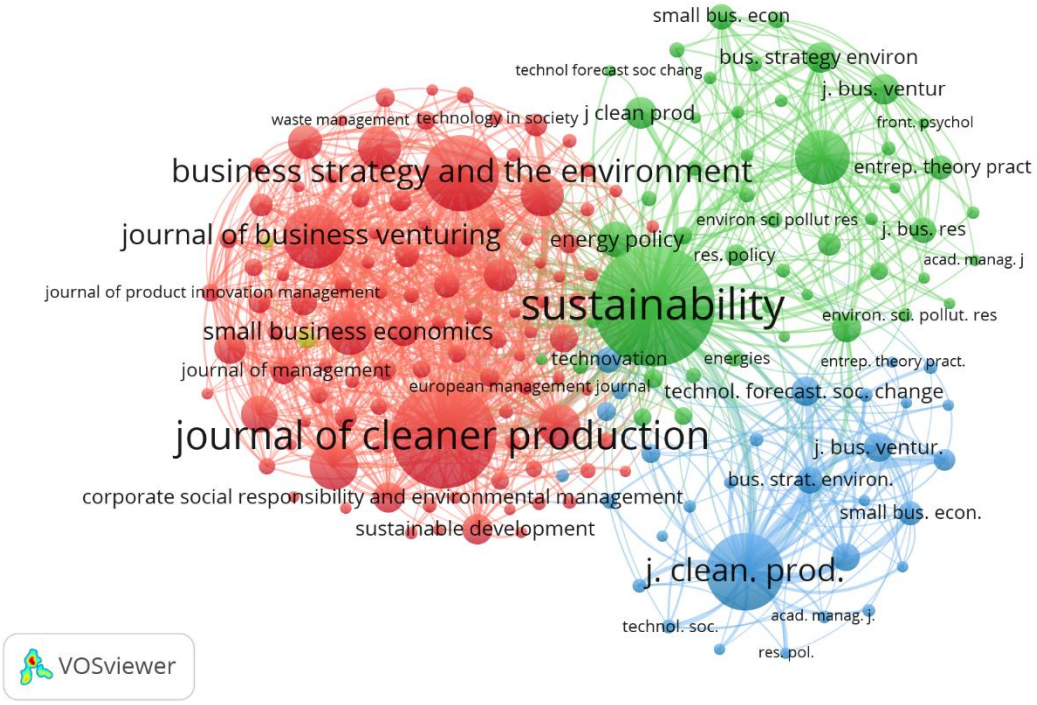

Figure | 16 Analysis Of Co-Cited Sources

Analysis of Co-Cited Authors

The co-citation network suggests several scholars who have made foundational contributions to the field because their works are often cited together, indicating that their thinking is organized coherently (Donthu et al., 2021). The three powerful communities are shown in figure 17. The Sustainable Entrepreneurship Cluster (green) where Schaltegger, Dean, Cohen and Shepherd define sustainable entrepreneurship and discuss opportunities derived from market failures. The Innovation and Strategy Cluster (red) where Hair, Ringle, and Sarkis present empirical analysis and green

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innovation strategies. The Corporate Sustainability Cluster (blue) where Lumpkin is cited for his work on entrepreneurial orientation. The thickness of the lines between the clusters shows that there is an integration of knowledge that cuts across entrepreneurship theory, strategic management, and environmental science fields.

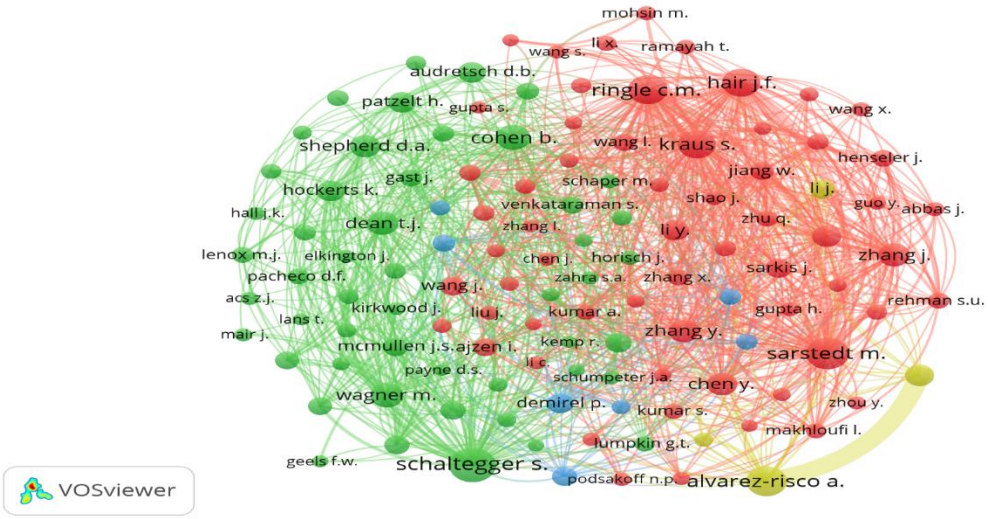

Figure | 17 Analysis Of Co-Cited Authors

4.10. Methodological Quality Assessment Results

Quality assessment of the body of work has provided insights into methodological characteristics that have implications for field development and future research. Quantitative research has been employed in 401 of the 516 included studies, with 45% being survey-based, demonstrating a high degree of empirical and positivist focus (Cooper, 2015). Regarding replicability, reporting was adequate for full replicability in 118 studies (23%), indicating that there is still scope for improvement (Tranfield et al., 2003). Twelve percent of studies used a longitudinal design, indicating that cross-sectional research has been predominant and may be narrow in its view of the entrepreneurial process (Pittaway et al., 2004). Finally, a conceptual contribution was made in 67% of the studies. However, in terms of the nature of theoretical advancement, 34% made a high contribution, 33% made a moderate contribution, and the remaining 33% made an incremental contribution to existing theory (Donthu et al., 2021).

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5. Discussion and Critical Analysis of Results

Green entrepreneurship and sustainability research is characterized by multipolarity, considerable division of labor, explosive growth, and ongoing dynamics in terms of structure and emerging themes. The following text critically discusses the major results, interprets them, and positions them in the context of the wider debate. The most eye-catching result is the accelerated growth in the number of publications after 2020. This indicates that the United Nations' SDGs (Sustainable Development Goals) have become the focus of increased attention in recent years (De-La-Cruz-Diaz et al., 2023). This is a dynamic research area that is attracting increased attention from the academic community and is thus undergoing a phase of rapid expansion.

However, the fact that papers published between the late 2000s and the early 2010s remain the most influential is also an indication that the field, with a new wave of literature, remains comparatively young. In fact, this pattern of "colossi" on the one hand and a modest average impact of a new wave of literature, on the other, can be considered a rather typical for young fields in a state of rapid change (development) and clear consolidation of the new directions of development within the original paradigm has taken place (Donthu et al., 2021).

The top map of green entrepreneurship and sustainability research reveals a multipolar system with a high degree of labor division. Asia is the core of large-volume research, with countries such as China and India having large and increasing research capacities. Meanwhile, the research impact (average number of citations per article) is higher in Western countries, including the USA, the UK, and France (Trikha & Kaushik, 2023) . This indicates that international collaboration might not take place in the form of a universalized community of scholars but rather through specific institutions.

Research Gaps and Future Directions

Future research on green entrepreneurship and sustainability can be directed towards the following:

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• **Technology and Digitalization:** The role of emerging technologies, such as artificial intelligence, blockchain, and the Internet of Things, in scaling green ventures and enabling circular economy business models.

• **SMEs and Sustainability:** Inclusive knowledge of the specific hurdles that SMEs face in turning green, including available policy instruments, technologies, and networks for SMEs.

• **Financing mechanisms:** To evaluate the role of different financial mechanisms, such as "green" bonds, impact investment, and fintech solutions, in increasing green startup access to finance.

• **Institutional Context and Comparative Studies:** Comparative studies with adequate consideration of the institutional context, oriented toward exploring the special dynamics of green entrepreneurship in emerging markets.

• **Longitudinal Impact:** Longitudinal studies that assess the actual environmental, social, and economic impact of green ventures, moving beyond research on firm entry and survival, are needed.

• **Human Capital Development:** Impact studies on green entrepreneurship education to determine effective pedagogies and curricula for cultivating the next generation of green entrepreneurs.

Theoretical Contributions

This study makes three highly cited theoretical contributions. The first contribution was the introduction of "hybrid entrepreneurship", the shift from "trade-off" to "institutional multiplicity" in economic, social, and environmental issues (Dean & McMullen, 2007). The second contribution is the application of digital technology as a facilitator of green entrepreneurship, which has become a bridge connecting technology entrepreneurship and sustainability research (Cohen & Winn, 2007). Third, the research perspective was expanded from a single person to an ecosystem perspective, from entrepreneurs to the institutional arrangement of entrepreneurship, from a single stakeholder to a stakeholder network, and from a closed system to an

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open enabling system, which has theoretical significance in the change of research concepts in green entrepreneurship (Hart, 1995).

This study empirically and visually maps the multidisciplinary theoretical foundations of the field's academic discourse. This finding confirms that the field's knowledge base is built on an integration of salient theories, including the theory of market failure (conceptualizing environmental problems as entrepreneurial opportunities), the Natural Resource-Based View (NRBV) of the firm (conceptualizing sustainability as a source of competitive advantage), and Dynamic Capabilities Theory. In addition, this study provides an affirmed storyline and a clear evidence-based narrative on the thematic development of this field. This demonstrates a theoretical shift from overarching, macro-level constructs that range widely, such as 'sustainable development' to narrower, more focused constructs such as the 'circulate economy,' eco-innovation, and the role of SME's in progressing towards sustainability.

Therefore, this study has implications for the components of the black box" of knowledge creation and transfer. This is evident in the relationship between the heuristically paradoxical fragmentation of clumpy patterns of authorship and authors'° strong and diverse networks with rich geography. This observation has implications for one of the central theoretical enigmas within this field, that is, how knowledge is co-produced and mobilized in a more globalizing and interdisciplinary world of scholarship. This review identified highly cited items, common themes, and deficiencies in the literature that permit the development of a validated empirical base for developing new conceptual models. This experiential foundation transcends narrative subjections and other literary review forms, opening a structural and methodological guide for future research to theoretical horizons of green entrepreneurship and sustainability.

Implications for Practice and Policy

The top research streams circular economy, eco-innovation, and green business models overlap with the highest profit markets. Environmental challenges that

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businesses face can be opportunities to enhance new products and services, drive innovation, and build a competitive position. However, as researchers' collaboration networks expand, they will have to work across slashes for stakeholders in technology, business, and environmental science, building multiple interconnected bridges simultaneously rather than fragmented ones so that consensus can be built around issues by these working groups. Policies no longer be restricted to financial inducements. To promote green entrepreneurship, the government must create an entire ecosystem that covers school syllabi, institutions, and simple single-window bureaucracy. This study adds to our understanding of SMEs. Governments can develop and deploy focused programs, including financial aid, technology advice, and knowledge exchange, to assist SMEs in overcoming obstacles to green adoption. The increasing prominence of "education" is a sign of its importance. Governments must also partner with universities to infuse sustainability and green entrepreneurship education into the curriculum, training students from all fields of study to possess the skills, knowledge, and mindset required for a green economy.

Limitations

This study had some limitations, like language criterion may preclude useful non-English studies, particularly in developing countries where green entrepreneurship is still emerging. Prioritizing high-impact journals may underrepresent innovative research published in newer journals. The fast-evolving nature of this field means that some cutting-edge developments may not yet appear in high-impact publications.

6.Conclusion

This study performed a bibliometric analysis to provide an overview of the intellectual structure, and thematic evolution of green entrepreneurship and sustainability-related research published between 2002 and 2025. The analysis encompassed 516 documents, and the results highlighted a vibrant and rapidly expanding field, particularly in recent years since 2020, characterized by a global, multi-polar research community. The key takeaways from this analysis are that (1) the intellectual core of the field is well-established with a strong grounding in the

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canonical theories of entrepreneurship and environmental management, while the research frontier is actively expanding, and (2) the thematic trends of the research clearly pivot away from the high-level generic principles of sustainable development towards the more operational firm-level concepts of eco-innovation, the circular economy, and the role of SMEs in particular.

Systematically identified the most influential contributors, core thematic clusters, and key thematic holes, involving a large and fragmented body of text data. This study dispels mysteries and yields a full-fledged and organized handbook of the SNA literature. This investigation further underscores the importance of green entrepreneurship in propelling worldwide sustainability initiatives and demonstrates the immediate imperative for additional focused academic research to inform practitioners and policymakers.

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