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Research Article

Mapping Global Research Trends in Green Business for Sustainable Development: A Bibliometric Analysis

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Abstract: The concept of green business performance has been an interesting topic for research among well-known scholars. Green business has become crucial for advancing sustainability and fostering innovation. Green business performance has become the global requirement due to the recent economic disaster, and green measures have been considered the leading solution for it. This study aims to explore how sustainability intersects with strategic business practices, offering actionable insights for aligning environmental sustainability with economic growth. To find worldwide research trends, bibliometric analysis was performed using R studio and VOSviewer software on 3007 scientific publications from Scopus from 2021 to 2024. Bibliometric analysis uses key words to enable the study of specific details, within the main topics of research, within a domain, and relationships at the micro-level. These methods facilitated an in-depth exploration of the evolution and impact of green business for sustainability. This study bridges existing gaps by providing actionable insights into how green business drive sustainable development, offering value to researchers, policymakers, and business leaders seeking to integrate environmental sustainability with economic growth.

Keywords: Bibliometric Analysis; Green Business; Research Trends; Sustainability; Sustainable Development

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1. Introduction

In this increasingly complex modern era, sustainability and social responsibility have become crucial elements in assessing the success of a country. Business is not only an important perpetrator of the environmental problems, but it also plays a key role in successfully addressing them. The concept of green business performance has transitioned from a niche concern within the academic and corporate realms to a central, global strategic imperative. This evolution is not a result of a gradual philosophical shift but has been dramatically accelerated by a series of acute global crises. While the seeds of sustainability consciousness were planted decades ago, the profound vulnerabilities exposed by the recent economic disruptions particularly the global COVID-19 pandemic served as a critical inflection point. The pandemic did not merely present a health crisis; it exposed the fragility of traditional, cost-optimized global supply chains, the inherent risks of dependence on fossil fuels, and the lack of resilience in established economic models. In this context, green measures and sustainable practices were re-evaluated, moving from a position of optionality to one of strategic necessity for building resilience and ensuring future business continuity. This re-evaluation has been a primary catalyst for the surge in academic inquiry documented in the present study.

The integration of green business practices has spurred a profound strategic shift, moving beyond a simple compliance-driven model to one centered on competitive advantage and value creation. Instead of viewing environmental responsibility as an external constraint or a financial burden, an increasing number of businesses are now leveraging it as a source of innovation, market differentiation, and long-term value creation. This strategic reorientation is manifest in key research themes that have dominated the academic discourse in recent years, as revealed by the bibliometric analysis.

A central focus of this shift is the concept of green innovation. Firms are increasingly exploring how they can leverage new technologies, processes, and business models to achieve environmental goals while simultaneously creating a competitive edge. The research

highlights how an entrepreneurial mindset, characterized by a proactive and innovative orientation, is a key determinant in a firm's ability to successfully implement green strategies. Furthermore, the analysis of keyword co-occurrence within the scholarly literature reveals a strong interconnectedness between "green innovation" and other critical business functions, such as "green marketing," "corporate social responsibility" (CSR), and the "circular economy". This strong co-occurrence suggests a maturing field where sustainability is no longer an abstract ideal but is being translated into concrete, operationalized business activities. The academic and professional communities are actively exploring how strategic business functions, from customer-facing marketing to internal operations and supply chain management, can be systematically aligned with sustainability goals to generate both economic and environmental returns.

While a vast and diverse body of literature exists on the subject of green business, there remains a critical need for a systematic, data-driven synthesis of the most recent research trends. This report addresses that need by providing a structured and comprehensive analysis of the scholarly landscape between 2021 and 2024. The study employs bibliometric analysis, a robust, data-centric methodology that enables the identification of specific details and micro-level relationships within a given domain. Using sophisticated software tools, namely R Studio and VOSviewer, the analysis systematically explores the evolution and impact of green business for sustainability, based on a dataset of 3007 scientific publications from the Scopus database.

The value proposition of this report lies in its ability to bridge existing knowledge gaps by moving beyond a simple literature review. By providing a quantitative and qualitative mapping of research fronts, it offers actionable insights to a broad audience. Researchers can identify promising new avenues of inquiry, policymakers can develop more effective incentive structures, and business leaders can gain a clear understanding of how to integrate environmental sustainability with economic growth. The report's findings provide a foundational analysis that can inform strategic decisions and future academic work, providing a clear roadmap for stakeholders seeking to navigate the complex and dynamic landscape of green business.

This section moves beyond the quantitative data to provide a qualitative analysis of the most prominent themes identified in the bibliometric study. It explores the causal relationships and the broader implications of the research findings for both theory and practice.

This report views "Green Business Performance" as a multi-dimensional construct, extending beyond conventional financial metrics to encompass a firm's environmental and social outcomes. At its core, it represents the successful integration of ecological principles into core business operations, a process that is vital for advancing sustainability and fostering innovation. The growing body of research on this topic, as highlighted by a bibliometric analysis of over 3,000 scholarly publications, demonstrates a clear recognition within the academic community that green business is not an alternative to economic growth but a crucial mechanism for achieving it in a sustainable and resilient manner. This foundational premise guides the subsequent analysis and underscores the significance of understanding the evolving research landscape in this field.

The concept of sustainable development achieved widespread recognition among scientists and professionals after the World Commission on Environment and Development's 1987 report Our Common Future was published. That report warned that humanity's rate of resource use was so high that future generations might inherit too little. It defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". This definition has since been widely disseminated and adopted by international organizations such as the United Nations, and it remains prominently featured on official UN platforms. Often, the term "sustainability" has come to replace "sustainable development" in everyday language. In this context, while "development" alone implies growth, sustainable development emphasizes minimizing the negative impacts of economic growth while still allowing growth to continue. At the global scale, sustainable development is embodied by the United Nations' Sustainable Development Goals (United Nations, 2016). These goals address a broad range of worldwide challenges not only climate change and environmental degradation but also issues such as poverty, inequality, and the promotion of peace and justice (Piwowar-Sulej et al., 2021).

This paper aims to address this gap by analyzing the current state and evolution of research in this field. Specifically, it seeks to answer the following questions: (1) What are the global publication trends and main contributors in green business research? (2) Which journals, countries, and authors have been most influential in shaping the intellectual structure of this field?? (3) How have research themes evolved, and what gaps remain for future studies?

The rest of this paper is organized as follows: Section 2 presents a literature review; Section 3 describes methods; Section 4 analyzes the results and discussions; Section 5 concludes this paper.

2. Literature Review

Business leaders increasingly recognize that environmental sustainability must be integrated into core strategy. Climate change and resource depletion threaten economic stability, prompting calls for a triple-bottom-line approach that balances economic, environmental, and social goals (Elshaer et al., 2023). For example, surveys find that over 75% of CEOs believe their firm's future growth depends on shifting to a low-carbon economy, and major institutions have formally revised corporate purpose statements to emphasize environmental stewardship (Westerman et al., 2021). In this context, green strategy, the coordinated business strategy that incorporates environmental concerns, has emerged as a key pillar of sustainable business practice. The natural resource based view (NRBV) of the firm holds that environmental capabilities can become valuable, rare, inimitable resources conferring competitive advantage. Similarly, stakeholder theory predicts that firms face pressure from investors, regulators, employees and communities to adopt eco-friendly practices. Together, these theories support conceptualizing green strategy as voluntarily integrating environmental considerations into decision-making and organizational culture to achieve long-term sustainability (Ye et al., 2022a). In short, companies are urged to align all three dimensions of performance: economic success, environmental integrity, and social equity.

Formal SDG frameworks reinforce this call. The United Nations' Sustainable Development Goals (SDGs) explicitly "call on companies everywhere to advance sustainable development through the investments they make, the solutions they develop, and the business practices they adopt". In other words, global policy now frames corporate strategy as a vehicle for achieving goals like climate action and responsible production. For example, SDG 12 (responsible consumption and production) pressures industries to redesign processes to reduce waste and pollution. Green strategy therefore often directly targets SDG objectives: Green & Erasmus note that firms in waste-intensive sectors must modify business models and societal impacts to meet SDG 12 requirements. A recent review of corporate SDG strategy confirms that the literature on SDG-aligned business practices is growing rapidly, with particular attention to governance, social dimensions, and climate change (SDG 13) . In practice, then, green business strategy is understood as the corporate commitment to fulfill these broader sustainable development goals alongside financial objectives.

Strategic Integration of Green Strategies

Integrating green strategy into business involves rethinking all functions – marketing, operations, HR, innovation, etc. Scholars describe green organizational strategy (GOS) as a coordinated plan that embeds environmental priorities across the firm. In effect, GOS reshapes traditional strategy (which historically ignored nature) by including ecological risks and sustainability in decision criteria (Ye et al., 2022). For instance, companies may adopt green procurement policies, redesign products for eco-efficiency, or incorporate environmental metrics into performance management. Green strategy often works hand-in-hand with corporate social responsibility (CSR) initiatives and technological innovation. Le (2022) empirically demonstrates that firms which integrate green strategy, "green CSR," and green innovation in a unified model achieve higher sustainable performance. In this model, CSR and innovation act as mediators that translate a firm's green strategic intent into better environmental and financial outcomes.

Putting green goals into action also means changing organizational culture. Conceptually, a green market orientation extends the traditional market orientation to include ecological concerns. Firms with a strong green orientation recognize environmental issues facing their industry and respond by offering eco-friendly products and processes. In practice, this might involve intensive communication and education: Dangelico and colleagues emphasize that companies pursuing green marketing must communicate the environmental benefits of their products and fight perceptions that "green" means inferior quality. Similarly, human-resource and operational policies are "greened" for example, by retraining staff on sustainability or optimizing supply chains for low-carbon logistics. In every case, green strategy is not isolated: it is a comprehensive orientation that aligns innovation, consumer engagement and internal practices with environmental stewardship. Studies consistently find that such holistic green integration helps firms differentiate themselves. As one review notes, adopting green and sustainable practices enables firms to gain competitive advantage and improved market performance. In other words, green strategy supports long-term business value by appealing to evolving consumer preferences and preempting regulatory risks.

Industry and Sector Applications

Research shows green strategy yields benefits across sectors. In services, small- and medium-sized hospitality firms provide a clear example. Elshaer et al. (2023) find that in hotels and travel agencies, green management practices (GMPs) significantly improve performance on all three bottom-line dimensions – environmental, economic, and social – especially when employees engage in pro-environmental behavior. In their study, firms that foster an "environmental stewardship" culture and involve staff in green initiatives achieved higher sustainable performance. This aligns with broader findings that effective green management meets sustainability principles (Westerman et al., 2021). It also underscores that even resource-constrained SMEs can benefit: SMEs contribute 60–70% of global pollution but often lack research attention. In fact, Green & Erasmus (2024) highlight that the literature has largely focused on large companies' CSR programs, while small businesses which produce much of the world's employment and pollution have received far less scrutiny. Studies in emerging-market SMEs likewise show positive green strategy effects. For example, a survey of South African small food establishments found that a stronger green market orientation led to significantly better environmental performance. That study even demonstrated that "green practices" mediate the link between green orientation and firm performance. Likewise, a conceptual model for SMEs suggests that integrating green strategy, competencies and manufacturing practices can boost efficiency, reduce environmental impacts, and enhance competitiveness.

In manufacturing and heavy industry, green strategy often means retooling production. The automotive sector provides a striking case: Lukin et al. (2022) report that the top five global carmakers have aligned their business models to meet most of the UN SDGs through their sustainability strategies. In practice, this meant overhauling operations (from green supply chains to electric vehicles) so that corporate goals explicitly map to SDG targets. The result is not only environmental compliance but brand enhancement – companies become perceived as "green," adding extended customer value to their brands. In sum, across industries large and small, the evidence indicates that well-implemented green strategies can improve both sustainability outcomes and competitive standing.

Green Strategy and the SDGs

Crucially, green business strategies often directly support the Sustainable Development Goals. By design, reducing emissions, managing waste, and conserving resources advance goals such as SDG 12 (responsible consumption/production) and SDG 13 (climate action). For instance, the green strategy in the food and beverage study above is explicitly linked to SDG 12, with managers urged to consider flexible, sustainable business models to meet responsible-production targets. Likewise, Domingo-Posada et al. (2024) emphasize that the SDGs call on every company to reorient investments and practices toward sustainable development. In practice, firms are increasingly reporting how their green initiatives map to SDGs. As noted, leading automakers' sustainability plans meet most SDG targets. Similarly, the conceptual SME model discussed earlier was framed explicitly in the SDG context, examining how green competencies and innovation help SMEs achieve sustainability goals within the UN framework. These examples illustrate that green strategy provides a practical pathway for businesses to "operationalize" the SDGs turning high-level goals into concrete practices and products that advance environmental and social objectives, while also improving firm performance.

Insights and Future Research

The literature affirms that green strategy is a powerful component of sustainable development, but also points to gaps. Most studies agree that more empirical work is needed in diverse contexts. In particular, researchers note a shortage of studies on SMEs and developing economies, despite their outsized role in employment and pollution. For example, Elshaer et al. (2023) call for more research on how green management drives performance in small hospitality firms, noting that few such studies exist. Similarly, Green & Erasmus stress that small-business practices (e.g. their green market orientation and performance) require further investigation Methodologically, scholars suggest moving beyond cross-sectional surveys. Longitudinal studies could reveal the long-term impacts of green strategies on firm outcomes and sustainability. Theoretical work is also needed: Lukin et al. observe that corporate sustainability strategy is a new field and call for further conceptual development of sustainability principles in business models. Other open issues include how to measure a firm's contribution to specific SDGs, how digital technologies intersect with green initiatives, and what policy or governance structures best support green strategy adoption.

In summary, recent research (2020–2025) consistently shows that adopting a green strategy yields tangible benefits from higher environmental and financial performance to stronger market position while advancing the SDG agenda. Conceptually, green strategy is grounded in an expanded view of competitiveness that includes environmental value. Its strategic integration across organizational functions has proven effective in industries from

hospitality to automotive. Going forward, scholarship must bridge remaining gaps by studying a wider range of firms and by linking green business models quantitatively to SDG metrics. Such work will deepen understanding of how sustainable development can be achieved through strategic business transformation.

3. Research Method

This study uses a qualitative approach with bibliometric analysis. Bibliometric analysis is a method used to analyze a large volume of academic publications. By identifying patterns, trends, and networks in the literature, it provides insights into the development of a specific field of study. This study employs bibliometric techniques to explore the relationship between green business and sustainable development across the world. The analysis focuses on identifying key authors, publications, and thematic clusters within the research domain. (Sundoro et al., 2025)

The research process was divided into three distinct phases, beginning with a search of the Scopus database. Phase 1 served as the data collection stage, where we established specific search criteria to identify and refine the records. Subsequently, in Phase 2 (the data visualization stage), the retrieved documents were exported to Rstudio and VOSviewer software for a comprehensive bibliometric analysis of publications, authors, countries, institutions, and journals. The final stage, Phase 3, involved a detailed data analysis to determine the primary themes of research concerning green business and sustainable development.

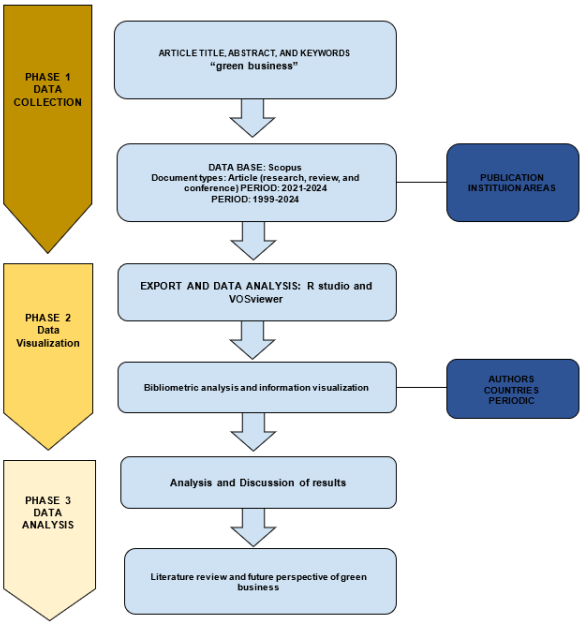

Figure 1. Methodology Phases Applied to the Present Work

This study utilized bibliographic data from the Scopus database from 2020 to 2025. A total sampling technique was employed to examine several variables, including publication titles, authors, abstracts, keywords, publication years, journals, and affiliations. Data was systematically extracted from the Scopus repository using Mendeley Desktop, with "green business" as the single query keyword. The search results were subsequently downloaded in a CSV format and synchronized with Mendeley Desktop.

For analysis, two distinct methods were used. First, descriptive analysis (covering annual publication trends, author productivity, and publisher journals) was performed using Microsoft Excel. Second, a topic trend map was generated using VOSviewer (version 1.6.19) based on a keyword co-occurrence analysis. This analysis provided a visualization of keyword network mapping and density (hotspots).

4. Results and Discussion

To provide a foundational overview of the domain, the following table summarizes the principal bibliometric indicators derived from the dataset spanning 2021 to 2024. This quantitative summary serves as the basis for the subsequent in-depth analysis of the field's growth, collaborative ethos, and intellectual characteristics.

Figure 2. Main Information Overview (Using R Studio)

The analysis reveals the publication of 3,007 documents within the three-year period, a figure that is indicative of a burgeoning scholarly community. This expansion is further underscored by a remarkable annual growth rate of 47.47%. The dissemination of these publications across 719 distinct sources further illuminates the field's characteristics. The authorship data presents a compelling case for the primacy of collaboration within this research domain. With a total of 12,392 authors contributing to the dataset, the average of 9.05 co-authors per document is an exceptionally high figure. This metric serves as a powerful proxy for the nature of the research being conducted. Such a high co-authorship index indicates that the scholarly work is inherently complex, resource-intensive, or requires a convergence of highly specialized expertise from multiple individuals or teams.

The data also indicates that 28.97% of the publications involve international co-authorship. This figure points to a significant level of global research networking, where scholars are extending their collaborative reach beyond national borders to work with international counterparts. The dataset includes 10,626 distinct keywords provided by authors, a number that demonstrates the intellectual diversity and rich thematic landscape of the domain. When considered against the 3,007 documents, this yields an average of approximately 3.5 keywords per document. The sheer number of distinct terms suggests that the field is still in the process of forming a standardized vocabulary and a canonical glossary.

The collective citation of 21,736 references across the published documents highlights a deep and active engagement with existing scholarship. With an average of approximately 7.2 references per document, it is evident that new research is not being conducted in an intellectual vacuum but is actively building upon and integrating knowledge from prior work. This high reference count is a crucial indicator for a young, fast-growing field. The dataset indicates an average of 14.76 citations per document. For a field with an average document age of only 2.02 years, this figure is remarkably high. Citation counts typically accrue over an extended period, which suggests that this high average may not be evenly distributed across all publications. The average age of documents, at a mere 2.02 years, definitively confirms that the field is in its early stages of development and is currently a locus of intense research activity.

The bibliometric analysis of the research domain from 2021 to 2024 collectively portrays a dynamic and intellectually vibrant field. The findings demonstrate a domain characterized by explosive growth, as evidenced by a nearly 50% annual publication growth rate. This rapid expansion is a testament to the surging scholarly interest and the vitality of the subject matter.

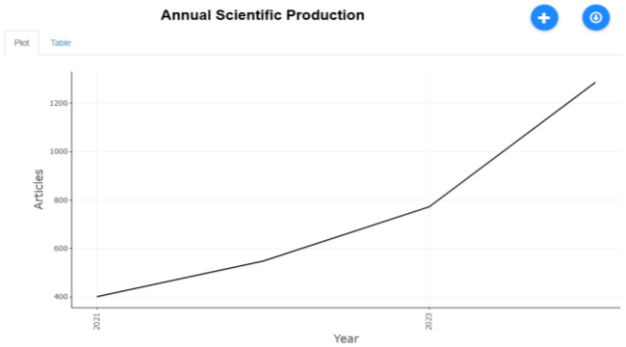

Figure 3. Annual Scientific Production (Using R Studio)

The graph of the annual scientific output from 2021 to 2024 reveals a distinct and rapid expansion in scholarly activity. The number of publications exhibited a steady upward trend, beginning with over 400 articles in 2021 and surpassing 700 by 2023. The most pronounced growth occurred in 2024, when the number of documents published exceeded 1,200, marking a significant acceleration in the field's research output. This pattern of exponential growth, particularly in the latter half of the period, is a clear indicator of burgeoning scholarly attention. This surge is likely attributable to factors such as the rise of new research themes, enhanced funding opportunities, or the increasing global relevance of the subject matter. The

positive publication trend is consistent with the notable 47.47% annual growth rate, underscoring both the expansion of the knowledge base and the escalating influence of this dynamic research domain.

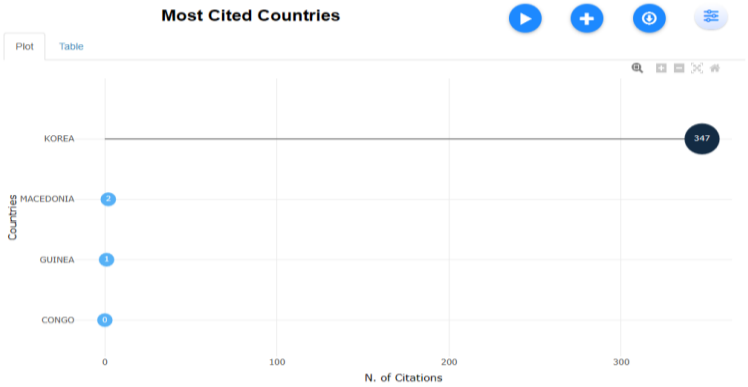

Figure 4. Most Relevant Sources (Using R Studio)

An examination of country-based citation impact reveals a highly disproportionate distribution of influence. Korea emerges as the most dominant contributor, with its research outputs garnering 347 citations. This notable prominence contrasts sharply with the minimal citation counts of other nations, such as Macedonia (2), Guinea (1), and Congo (0), underscoring a significant disparity in scholarly influence. Korea's leading position can be linked to its well-developed academic infrastructure, robust research investment, and the strategic alignment of its scholarly themes with global priorities. Conversely, countries with limited citation impact may face challenges related to funding and academic visibility. This uneven distribution highlights that academic influence is not widespread but is instead concentrated in a few key research hubs, reinforcing the distinction between a country's publication volume and its actual scholarly impact.

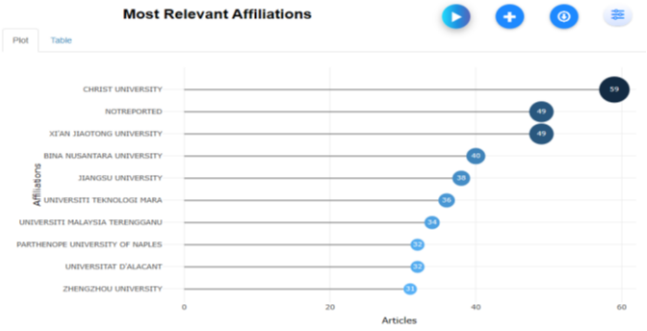

Figure 5. Most Cited Countries (Using R Studio)

An analysis of the most relevant affiliations reveals a globally distributed research landscape with a pronounced shift in the geography of knowledge production. The dataset is led by Christ University with 59 publications, followed by Xi'an Jiaotong University and a "Not Reported" category, each contributing 49 publications. The increasing role of Asian universities is evident through the significant contributions of institutions from Indonesia and China, such as Bina Nusantara University (40 publications) and Jiangsu University (38 publications), as well as two Malaysian universities, Universiti Teknologi MARA and Universiti Malaysia Terengganu, with 36 and 34 publications, respectively. European engagement is also present, represented by Parthenope University of Naples and Universitat d'Alacant, each with 32 publications. This institutional distribution illustrates a more polycentric academic environment, aligning with the notable rate of international co-authorship and highlighting how a limited number of prominent research hubs are driving the field's scholarly output.

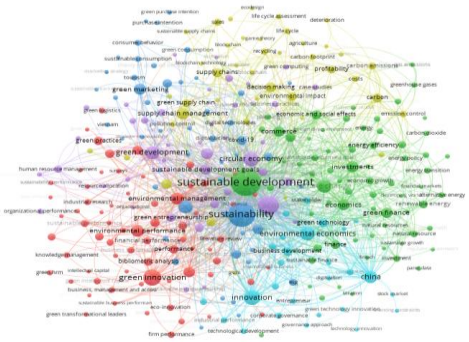

Figure 6. Network Visualization (Using Vos Viewer)

The image is a network map of co-occurrence or word network. It displays key terms and concepts connected by lines, indicating relationships between them, and is color-coded to group related terms. Colors: The nodes (words) are grouped by different colors such as purple, green, blue, red, and yellow, likely representing different clusters of green business topics. The network visualization of research on green business for sustainable development reveals six major clusters that represent interconnected thematic areas. The red cluster emphasizes green innovation and business model innovation, highlighting how technological and organizational changes create competitive advantage and improve financial performance. The green and yellow clusters focus on renewable energy, energy efficiency, carbon emissions, and life cycle assessment (LCA), reflecting the technological and environmental dimensions of sustainability. These clusters show how cleaner production, carbon reduction, and circular economy practices are central to reducing environmental impact. The blue cluster centers on green supply chain management, manufacturing, recycling, and environmental management, linking operational practices with sustainability. Meanwhile, the purple cluster anchors the discussion in sustainable development goals (SDGs), corporate social responsibility (CSR), and corporate sustainability, providing the normative and policy framework for green business. Finally, the cyan cluster highlights green marketing, consumer behavior, and purchase intention, illustrating how customer perceptions and values influence the adoption of sustainable products.

Taken together, these clusters form a complementary structure in which technological innovation (red, green, yellow) supports operational transformation (blue), which is legitimized by sustainability frameworks and CSR (purple), and ultimately accepted in the market through green marketing and consumer behavior (cyan). At the center of the network, "sustainable development" and "sustainability" act as the unifying concepts that bridge all clusters, underscoring that the ultimate purpose of green business is to contribute to global sustainability agendas. This reflects the broader trend in the literature, where research increasingly integrates innovation, environmental efficiency, supply chain practices, and consumer engagement under the umbrella of the SDGs. The visualization thus demonstrates how green business research has evolved into a multidisciplinary field that connects environmental, economic, and social dimensions to address the challenges of sustainable development.

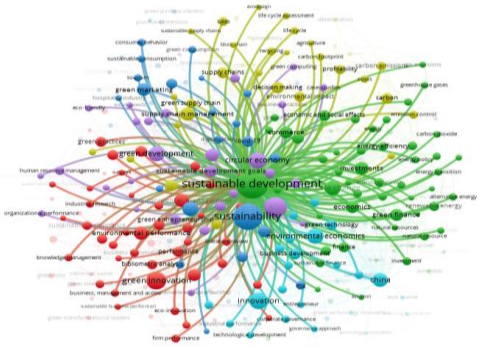

Figure 7. Network Visualization of Term Telemedicine (Using Vos Viewer)

This network visualization map illustrates the co-occurrence of keywords in the field of green business and sustainable development, with clusters representing distinct thematic areas. The central dominance of "sustainable development" and "sustainability" highlights their role as unifying concepts that connect various research streams. The green cluster emphasizes themes related to environmental economics, green finance, energy efficiency, and renewable energy, underscoring the growing importance of economic and financial

mechanisms in advancing sustainability goals. The blue cluster focuses on green marketing, supply chain management, and consumer behavior, indicating the intersection of business practices with sustainability-driven market dynamics. Meanwhile, the red cluster captures green innovation, entrepreneurship, bibliometric analysis, and organizational performance, reflecting the academic interest in linking innovation and business performance with sustainability transitions.

The visualization also reveals the interconnectedness of emerging topics such as circular economy, carbon emissions, and environmental policy within the yellow and purple clusters, showing their relevance in shaping current debates. The map demonstrates that while early research was more fragmented across specific domains (e.g., policy, technology, or marketing), recent studies increasingly emphasize cross-cutting linkages between business strategies, financial tools, and technological innovations. This suggests that the field of green business is evolving into a more integrated and multidisciplinary research area, where sustainability is no longer confined to environmental concerns but is deeply embedded in corporate strategy, financial models, and global economic development.

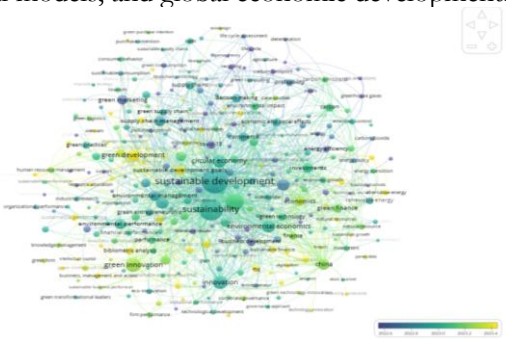

Figure 8. Overlay Visualization of Term Telemedicine (Using Vos Viewer)

Overlay visualization used in bibliometric, typically generated using VOSviewer. The overlay visualization shows that foundational themes in green business (colored purple/blue) correspond to earlier literature, while more recent topics (green/yellow) relate to emerging issues. Older, cooler-shaded keywords cluster around broad sustainability and policy concerns. For example, terms like "sustainable development," "environmental management," "environmental technology" and "public policy," "ecosystem," "ecology" appear in blue/purple, reflecting their prominence in earlier periods. In contrast, warmer-shaded keywords such as "green economy," "closed-loop economics," "energy efficiency," and "renewable energy" along with techno-centric terms like "AI," "IoT," and "big data" dominate the yellow/green end of the spectrum, indicating growing attention in the latest years. This shift is confirmed by bibliometric studies: earlier phases (circa 2010–2014) focused on broad sustainable development and general environmental planning, whereas later periods emphasize environmental technologies, green policy instruments, and circular-economy solutions. In short, the field has moved from general policy and ecosystem discourse toward specialized, technology- and market-driven topics over time.

These temporal shifts align with the clusters identified in the keyword network. The "Policy/Ecosystem" cluster (e.g. keywords like ecosystem, biodiversity, public policy) was one of the earliest focuses; its presence as blue/green keywords suggests a mature theme. Over time, this cluster's emphasis has broadened from high-level regulation to include more concrete mechanisms (e.g. tax incentives and environmental standards). The "Innovation/SME" cluster (with business model, green innovation, SMEs) also originated early, but in recent years has incorporated energy and circular economy concepts ("energy efficiency", "renewable energy", "cyclical business models"), marking a shift toward low-carbon technologies. Similarly, the "Supply Chain/Energy" cluster features longstanding interests (e.g. sustainable supply chain management, recycling) that are now joined by emergent terms like closed-loop and energy efficiency

Overall, the overlay map suggests a notable evolution: research has progressed from broad sustainability discourse to more technical and applied studies. Early keywords in purple reflect a focus on general sustainable development and policy challenges, whereas yellow-green keywords highlight recent emphasis on business innovation, clean energy, and even consumer-oriented topics (e.g. green marketing/behavior, which have intensified as the field matures). In other words, the green business literature has shifted from overarching policy/environment themes toward targeted solutions from global regulatory frameworks to firm-level green technologies and market behaviors. This indicates that as sustainable development has matured, scholarship has increasingly tackled practical, sector-specific issues (innovation, energy systems, supply-chain management, consumer engagement) in addition to earlier broad policy debates.

5. Conclusion

The bibliometric analysis highlights a clear evolution in the global research landscape on green business within the framework of sustainable development. Early studies were primarily conceptual, focusing on sustainability as a theoretical foundation and exploring environmental economics, green innovation, and organizational performance. Over time, the research emphasis has shifted toward more applied and practice-oriented themes such as circular economy, green finance, supply chain management, and consumer behavior. This transition indicates that the discourse has moved from abstract conceptualizations toward operational strategies that directly address sustainability challenges in business contexts.

Furthermore, the visualization of keyword networks demonstrates how sustainable development has consistently remained the central node, but the surrounding clusters have diversified significantly. Emerging topics such as carbon reduction, renewable energy, and digitalization in green practices show the increasing integration of technological, financial, and social dimensions into the field. This shift suggests a growing recognition that green business is not merely an environmental concern but a multidimensional driver of innovation, competitiveness, and global sustainability agendas. Overall, the research trends reflect a dynamic trajectory where theoretical frameworks are progressively translated into actionable pathways, aligning business practices with the broader goals of sustainable development.

This study contributes to the literature by providing a comprehensive mapping of how research on green business has progressed from foundational concepts to applied strategies, while also identifying emerging themes that will likely shape future scholarship. By highlighting these shifts, the analysis not only captures the dynamic trajectory of the field but also offers valuable insights for academics and practitioners seeking to align green business practices with evolving global sustainability priorities.

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