

Green Innovation and ESG Performance: Trends, Themes, and Future Directions from a Bibliometric-Systematic Review

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Abstract

Purpose: This study aims to map the evolution, influential sources, dominant themes, mechanisms, and future research directions of Scopus-indexed studies examining the relationship between green innovation and Environmental, Social, and Governance (ESG) performance during 2015–2025.

Research Methodology: This study employed a PRISMA-guided bibliometric systematic review approach using Scopus-indexed journal articles. A total of 22 eligible articles were identified and analyzed through VOSviewer-based bibliometric mapping and thematic synthesis to reveal publication trends, intellectual structures, and emerging research themes.

Results: The findings indicate that GI–ESG research has experienced significant growth after 2022, with increasing attention to the roles of green finance, digital transformation, disclosure quality, governance mechanisms, and institutional support. The synthesis demonstrates that green innovation contributes more effectively to ESG performance when supported by organizational capabilities and contextual factors.

Conclusions: Green innovation has evolved into a strategic mechanism that enables firms to transform sustainability initiatives into measurable ESG outcomes.

Limitations: This study is limited to Scopus-indexed journal articles published between 2015 and 2025 and includes only 22 studies, which may exclude relevant evidence from other sources.

Contributions: This study contributes by integrating bibliometric analysis and thematic synthesis to develop a mechanism-oriented framework explaining how digital capability, governance, disclosure, and green finance strengthen the role of green innovation in improving ESG performance.

Keywords: *Bibliometric Analysis, ESG Performance, Green Innovation, Sustainability, Systematic Literature Review*

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1. Introduction

Environmental, Social and Governance (ESG) performance has evolved from a peripheral metric into a decision-relevant signal in capital markets and a primary target of strategic corporate planning ([Liu, Kumar, Liu, Li, & Zhou, 2025](#); [Chen, & Huang, 2024](#)). This shift is especially pronounced in emerging markets, where tightening disclosure regimes and heightened stakeholder scrutiny increasingly dictate market reactions ([Itan, Sylvia, Septiany, & Chen, 2025](#)). In this context, green innovation, defined as the development and diffusion of environmentally oriented products, processes, and technologies, has gained prominence as a practical pathway for firms to enhance environmental outcomes while simultaneously safeguarding their competitiveness and legitimacy ([Ren, Zhou, Si, Wang, & Guo, 2024](#); [Wu, Yi, Hu, Lyulyov, & Pimonenko, 2025](#)).

Consequently, the nexus between green innovation and ESG performance is no longer a peripheral concern; it is inextricably linked to global decarbonization agendas, investor valuation frameworks, and policy-finance instruments designed to steer corporate sustainability transitions ([Itan et al., 2025](#); [Liu et al., 2025](#)). Recent empirical evidence indicates a bidirectional relationship between these two constructs. On the one hand, green innovation can strengthen ESG performance by improving environmental efficiency, supporting social responsibility initiatives, and reinforcing governance credibility ([Liu, Liu, & Feng, 2024](#); [Liu et al., 2025](#)).

On the other hand, ESG-oriented signals and accountability mechanisms can also stimulate green innovation, for instance by easing financing constraints, strengthening external monitoring, and shaping managerial incentives toward greener R&D trajectories ([Ren et al., 2024](#); [Ruan, Yang, & Dong, 2024](#)). However, findings remain dispersed across disciplines, industries, and measurement approaches, making it difficult to derive cumulative insights that are useful for applied management and policy conversations. Despite the rapid growth of GI-ESG studies, the core gap is more specific than general.

Existing studies remain scattered across sustainability, finance, and management outlets and often position green innovation inconsistently as an antecedent, outcome, or mediating mechanism in ESG performance research, making it difficult to compare mechanisms and identify robust patterns across contexts ([Marzi, Balzano, Caputo, & Pellegrini, 2025](#); [Sauer, & Seuring, 2023](#)). Moreover, much of the evidence is still presented as isolated empirical associations, while the field lacks a transparent mapping of its intellectual structure and thematic connections ([Bukar, Sayeed, Razak, Yogarayan, Amodu, & Mahmood, 2023](#)). Consequently, the literature still lacks a mechanism-based and cross-level explanation of how, why, and under what conditions green innovation contributes to ESG performance across organizational contexts.

To address this specific gap, this study provides a PRISMA-guided bibliometric-systematic synthesis of Scopus-indexed journal articles published between 2015 and 2025 using VOSviewer-based science mapping and structured thematic interpretation ([Munyepwa, Mudzengerere, Ranganai, & Gwesu, 2026](#)). Unlike a descriptive bibliometric review alone, this study combines publication and keyword patterns with a close reading of the final corpus to explain how the field is evolving, which mechanisms are becoming central, and where future work is most needed ([Chen and Huang, 2024](#); [Yeye, & Egbunike, 2023](#)). This study advances prior reviews by shifting the GI-ESG discourse from descriptive associations to mechanism-based and cross-level explanations. Its originality lies in repositioning green innovation not merely as an isolated environmental practice or ESG correlate, but as a strategic mechanism that connects organizational capabilities, disclosure and governance systems, green finance, and institutional conditions with ESG performance outcomes ([Reddy, Srinivas, & Devi, 2025](#)).

2. Literature Review

Green innovation encompasses changes in products, processes, technologies, and management practices aimed at reducing environmental impact while maintaining corporate competitiveness. In the ESG context, green innovation primarily supports the environmental pillar through emissions reduction, resource efficiency, cleaner production, and improved energy use. However, its influence

may also extend to the social and governance pillars by enhancing stakeholder legitimacy, increasing the transparency of sustainability activities, and strengthening accountability in decision making. The relationship between green innovation and ESG performance is reciprocal.

Green innovation can improve ESG performance, while strong ESG performance and credible ESG disclosure can encourage green innovation by reducing information asymmetry, improving access to financing and strengthening managerial incentives ([Liu, Huang, Su, & Zhou, 2024](#); [Long, Feng, Gong, & Chang, 2023](#); [Ren, Zhou, Si, Wang, & Guo, 2024](#); [Ruan, Yang, & Dong, 2024](#)). The strength of this relationship is influenced by firms' internal capabilities and their external support. Digital transformation, intelligent manufacturing, disclosure quality, and governance credibility can help firms translate green innovation into measurable improvements in ESG performance.

In addition, green finance, green credit, regulations, market development, ownership structures, and industry characteristics may determine firms' capacity to implement green innovation ([Huang, Yang, & Ren, 2024](#); [Chen, & Huang, 2024](#); [Hao, Deng, & Zhang, 2024](#); [Ye, & Tian, 2025](#)). This relationship can be explained through dynamic capabilities theory, the natural resource-based view, stakeholder theory, institutional theory, and agency and signalling perspectives. These theoretical perspectives indicate that the effect of green innovation on ESG performance depends on firms' capacity to reconfigure resources, stakeholder pressure, institutional conditions, and credibility of ESG information.

Although research on green innovation and ESG continues to develop, the literature remains conceptually and methodologically fragmented. Green innovation has been positioned as an antecedent, an outcome, or a mediating variable, whereas ESG is often measured using an aggregate score. Organizational mechanisms are frequently examined separately from institutional conditions. Therefore, a bibliometric-systematic review is needed to identify publication trends and influential sources, map the conceptual and temporal structures of the research field, and connect the main themes with underlying mechanisms and future research agendas. This approach is expected to provide a more integrated understanding of the relationship between green innovation and ESG performance.

3. Methodology

3.1 Review Design

This study employed a Systematic Literature Review (SLR) design, combined with bibliometric science mapping, to synthesize and critically evaluate the Scopus-indexed knowledge base of green innovation and its association with ESG performance. A structured SLR is particularly suitable when evidence is dispersed across disciplines and study designs because it enables transparent decision-making, replicable procedures, and an explicit audit trail from search strategy to synthesis ([Kraus, Breier, & Dasí-Rodríguez, 2020](#); [Linnenluecke, Marrone, & Singh, 2020](#); [Yusran, Masnita, Ali, & Jatunilawati, 2025](#)). In line with recent guidance that encourages the integration of quantitative mapping with interpretive synthesis for stronger theory-building, this review followed a Bibliometric-Systematic Literature Review (B-SLR) logic to connect performance analysis (e.g., publication trends, influential sources) with network-based intellectual and conceptual structure mapping ([Bukar et al., 2023](#); [Marzi et al., 2025](#); [Masnita, Ali, Zahra, Wilson, & Murwonugroho, 2024](#)).

This design choice is also consistent with recent Scopus-based bibliometric reviews in adjacent management domains that use science mapping to consolidate fragmented knowledge and develop future research agendas ([Wati, Wandik, Aseanty, & Anggiani, 2025](#)). To ensure methodological transparency in the identification and selection of studies [Masnita, Kasuma, Zahra, and Leila \(2023\)](#), the review process was reported using the PRISMA 2020 guidelines ([Page et al., 2021](#)). The protocol followed a staged design that aligns established SLR decision points with a practical review workflow: First, scoping and question specification, second, systematic retrieval and screening, and third, synthesis and reporting ([Paul, Lim, O'Cass, Hao, & Bresciani, 2021](#); [Sauer & Seuring, 2023](#)). Specifically, the review combined quantitative mapping (keyword co-occurrence structures and temporal emphasis) with a narrative/thematic integration of cluster meanings, enabling an overview of

the field's structure and a deeper explanation of how and why core themes have evolved ([Linnenluecke et al., 2020](#); [Marzi et al., 2025](#)). This integrated design strengthens the contribution by linking the literature (networks, clusters, and trajectories) to its implications for future research on green innovation and ESG-oriented outcomes.

3.2 Data Source and Search Strategy

The search strategy was carefully designed and executed using the Scopus database, which offers access to a vast repository of peer-reviewed academic literature from international publishers, including Elsevier, Emerald Publishing, IEEE, SAGE, Springer Nature, Taylor & Francis, and Wiley ([Nishikawa-Pacher, 2022](#)). This review used Scopus as the sole bibliographic source to ensure a consistent, high-quality evidence base and replicable retrieval suitable for applied management and economics research ([Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021](#); [Gusenbauer & Haddaway, 2020](#); [Linnenluecke et al., 2020](#)). Scopus' structured indexing and exportable metadata also support hybrid designs that combine systematic screening with bibliometric mapping and transparent protocol reporting ([Marzi et al., 2025](#); [Paul et al., 2021](#); [Rojon, Okupe, & McDowall, 2021](#); [Sauer & Seuring, 2023](#)). The string combined core terms for green innovation and ESG performance using Boolean operators, and the query was executed in TITLE-ABS-KEY to capture studies where these constructs were central to the manuscript ([Donthu et al., 2021](#)).

Table 1. Scopus database search string

Source	Search String
Scopus	TITLE-ABS-KEY (((("green innovation" OR "environmental innovation" OR "eco-innovation" OR "eco innovation" OR "green technological innovation") AND ("ESG performance" OR ESG OR "environmental social governance")))) AND PUBYEAR > 2014 AND PUBYEAR < 2026 AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (LANGUAGE, "English"))

As outlined in Table 1, the search utilized combinations of targeted keywords such as “green innovation,” “environmental innovation,” “eco-innovation,” and “ESG performance,” further refined by filters including publication year (2015-2025), English language, journal article type, and final publication status. Therefore, the corpus was defined by transparent database filters rather than by open-access status alone, improving replicability and alignment with the actual search protocol.

3.3 Inclusion and Exclusion Criteria

This review applied a priori inclusion and exclusion criteria to ensure that the evidence base was comparable, policy-relevant, and methodologically consistent for Scopus-based bibliometric mapping of the green innovation-ESG performance nexus. In management-oriented SLRs, explicit criteria reduce selection discretion and strengthen reproducibility, particularly when the review is coupled with science mapping techniques and performance analysis ([Marzi et al., 2025](#); [Paul et al., 2021](#); [Sauer & Seuring, 2023](#)). In line with PRISMA the 2020s emphasis on transparent eligibility decisions, all screening rules were defined to be operationalizable through Scopus filters and were consistently applied during title/abstract and full-text checks ([Paul et al., 2021](#)).

First, the review restricted the publication window to 2015-2025 to capture the contemporary phase of GI-ESG research, where ESG measurement, reporting practices, and sustainability-finance mechanisms have become central to management scholarship and applied policy debates ([Marzi et al., 2025](#)). This timeframe is consistent with the dataset boundary used in the Scopus query and subsequent eligibility screening in this study. Second, only peer-reviewed journal articles were retained (document type: article; source type: journal; publication stage: final) because bibliometric indicators and network structures depend on stable bibliographic metadata and fully vetted scholarly outputs ([Marzi et al., 2025](#); [Sauer & Seuring, 2023](#)). This decision excludes conference outputs and other non-article formats that can be less consistent in indexing and methodological details for synthesis. Third, the review was limited to English-language publications to maintain terminological comparability across ESG and innovation constructs during coding and thematic interpretation ([Paul](#)

et al., 2021; Sauer & Seuring, 2023). The detailed inclusion and exclusion criteria applied in this study are presented in Table 2.

Table 2. The inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Year	2015-2025	Before 2015
Document Type	Article	Conference paper, retracted, book
Source Type	Journal	Conference proceeding, book series, book
Publication Stage	Final	Article in press
Language	English	Non-English

3.4 Screening and Selection Process

The screening and selection processes followed the PRISMA 2020 guidelines to improve transparency and replicability in study identification, screening, retrieval, and eligibility assessment (Paul et al., 2021).

Figure 1 summarizes the flow of records at each stage. In the identification stage, Scopus retrieved 486 records. After removing 182 duplicates and other pre-screening items, 304 records were screened based on their titles and abstracts. Of these, 74 records were excluded for thematic misalignment, leaving 230 reports for full-text retrieval. Of these, 149 reports were not retrieved because accessible full text was not available. 81 reports were assessed for eligibility. 57 reports were excluded for no ESG-performance outcome, and 2 reports were excluded for non-English, resulting in 22 studies included for bibliometric mapping and thematic synthesis.

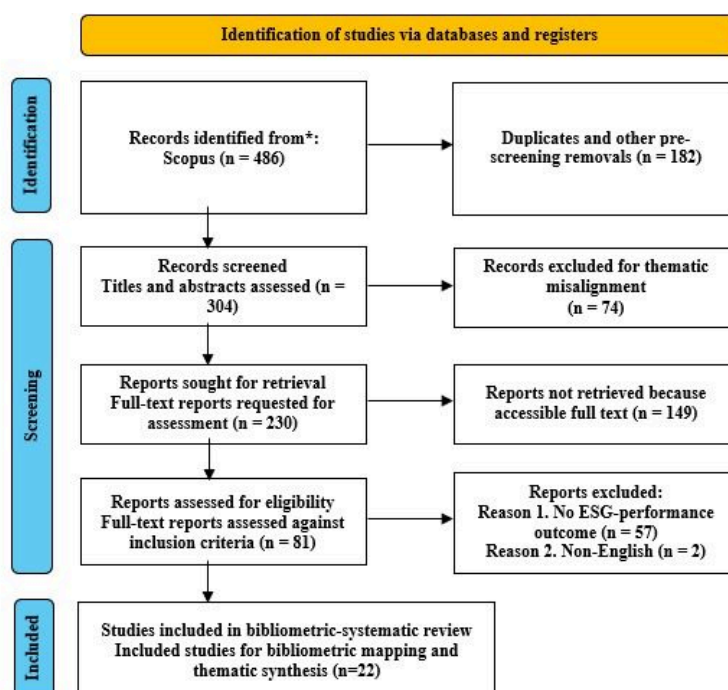


Figure 1. PRISMA 2020 flow diagram

Full texts were successfully retrieved for 81 reports, whereas 149 reports could not be assessed at the full-text stage because accessible versions were not available through institutional or open-web links at the time of screening. The eligibility assessment excluded 59 reports, primarily because they did not report ESG-performance outcomes (n=57) or were non-English (n=2), resulting in 22 studies included for bibliometric mapping and thematic synthesis. Because the study objective was to map bibliographic patterns and thematic structures rather than estimate effect sizes, a formal risk of bias appraisal was not performed.

Therefore, the final number of 22 studies should be interpreted as the outcome of a deliberately narrow and protocol-based eligibility process, not as a weakness of the search strategy. Many initially identified records discussed green innovation, sustainability, ESG disclosure, or environmental performance separately but did not directly examine the green innovation–ESG performance nexus required by this review. This confirms that GI–ESG performance research remains an emerging niche field, with most eligible studies appearing after 2022.

3.5 Data Extraction and Analysis

Data were extracted from the Scopus export file (CSV) and organized into a structured extraction matrix capturing such as bibliographic metadata (authors, year, journal, affiliations), impact indicators (citations, source metrics where applicable), and conceptual descriptors (author keywords, index keywords, titles, and abstracts). Prior to analysis, records were cleaned and harmonized through standard bibliometric protocols, standardizing author names, unifying keyword variants (e.g., “ESG performance” vs “ESG”), and checking for residual duplicates to ensure consistent network construction and replicable results ([Donthu et al., 2021](#); [Lim, Kumar, & Donthu, 2024](#)).

Bibliometric mapping was then conducted to identify the intellectual, social, and conceptual structures of the green innovation-ESG performance literature. Network analyses focused on co-authorship (collaboration structure), co-citation and bibliographic coupling (knowledge bases), and keyword co-occurrence (thematic structure), using transparent threshold settings (minimum occurrences/citations) to retain interpretable networks. VOSviewer was used to generate and interpret network, overlay, and density visualizations, which are widely applied for rigorous science mapping and trend detection in management research ([Bukar et al., 2023](#); [Moral Muñoz, Herrera-Viedma, Santisteban Espejo, & Cobo Martín, 2020](#)).

To complement the science mapping results, cluster outputs and the most central documents within each cluster were examined to derive applied themes relevant to management and policy (regulatory drivers, governance mechanisms, green finance instruments, and capability-based pathways linking innovation to ESG outcomes). This “map-to-meaning” step followed best-practice guidance for integrating bibliometric evidence with structured interpretive synthesis, strengthening the credibility of the thematic claims and research-gap articulation ([Marzi et al., 2025](#); [Page et al., 2021](#)).

4. Results and Discussions

4.1 Number of Publications by Year

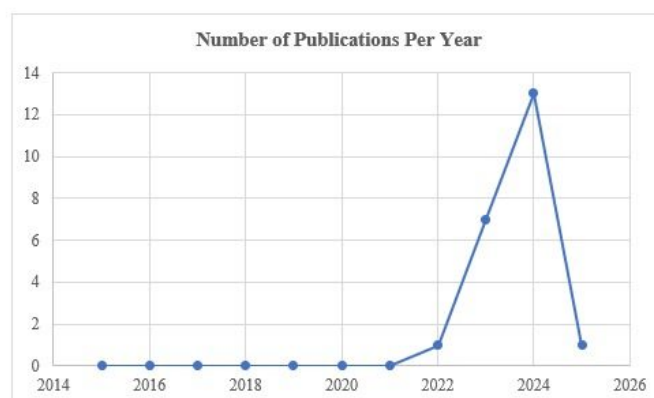


Figure 2. Publication frequency by year

Figure 2 reports the yearly distribution of Scopus-indexed studies on green innovation and ESG performance for 2015-2025. Overall, the topic shows a late but rapid takeoff. No publications were captured during 2015-2021, indicating that the GI-ESG linkage was still emerging and rarely explicitly addressed under these combined keywords in Scopus-indexed journal articles. The first visible output appeared in 2022 (n=1), suggesting an initial consolidation of this research intersection.

A sharp growth follows in 2023 (n=7) and peaks in 2024 (n=13), signaling a strong acceleration of scholarly attention to how innovation-oriented environmental practices align with multidimensional sustainability evaluation through ESG metrics. The apparent decline in 2025 (n=1) should be interpreted cautiously, as publication counts for the most recent year are often affected by indexing delays and incomplete year coverage within database searches. Taken together, the pattern highlights that GI-ESG research has transitioned from a nascent stage to a rapidly expanding stream, with 2023-2024 representing the most active period in the current dataset.

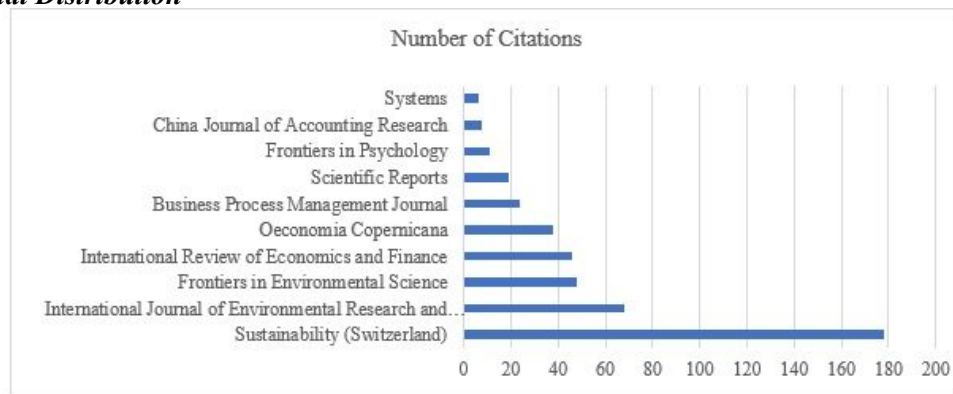


Figure 3 shows a highly concentrated citation pattern across the journals. Sustainability (Switzerland) dominates the citation landscape with 178 citations, indicating that it is the primary high-visibility outlet for GI-ESG studies in this dataset. The second most-cited source is the International Journal of Environmental Research and Public Health with 68 citations, followed by Frontiers in Environmental Science (48 citations) and the International Review of Economics and Finance (46 citations). A mid-range contribution is observed for Oeconomia Copernicana (38 citations) and the Business Process Management Journal (24 citations), suggesting that GI-ESG research also intersects with economics and process/operations perspectives. The remaining outlets show comparatively limited citation traction: Scientific Reports (19 citations), Frontiers in Psychology (11 citations), China Journal of Accounting Research (8 citations), and Systems (6 citations), which may reflect fewer contributions to the dataset and/or more recent entry into the GI-ESG conversation. Overall, the figure indicates that GI-ESG knowledge diffusion is anchored in sustainability-oriented journals while also gaining meaningful attention within environmental and finance-focused outlets.

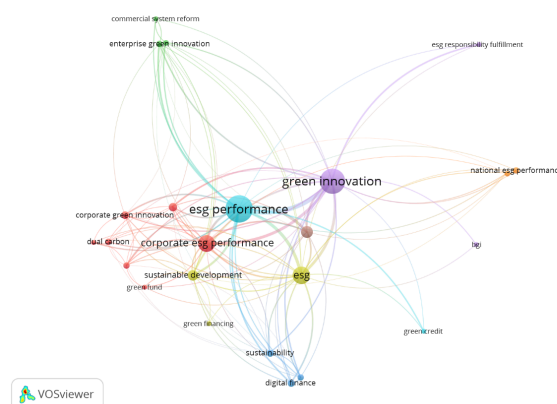


Figure 4 presents a keyword co-occurrence network generated using VOSviewer, mapping the thematic landscape of research on green innovation and ESG (Environmental, Social, and

Governance) performance. The visualization is based on the co-occurrence of keywords in the literature, with nodes representing keywords and their size reflecting frequency, while the links illustrate co-occurrence strength. The clusters are color-coded, each indicating a thematic focus in the field. The central position of terms such as green innovation, ESG performance, and corporate ESG performance highlights their dominance and interconnectedness across different research streams.

Cluster 1 (purple) is centered on green innovation, linking related themes such as enterprise green innovation and commercial system reform, suggesting that innovation at both the enterprise and systemic levels is a critical driver of sustainability transitions. Cluster 2 (blue) emphasizes the connection between sustainability, digital finance, and green financing, reflecting growing scholarly interest in the role of financial systems and technology in enabling sustainable innovation. Cluster 3 (red) highlights corporate ESG performance and dual carbon initiatives, illustrating the link between corporate strategies, carbon reduction goals and green investment practices. Cluster 4 (yellow) connects ESG with governance-related concepts such as green credit, indicating the role of policy instruments and financial regulations in promoting sustainable practices. Finally, Cluster 5 (orange) focuses on national ESG performance and responsibility fulfillment, situating ESG research within broader institutional and policy frameworks.

Overall, this network reveals that research on green innovation and ESG performance is multifaceted, integrating perspectives from corporate governance, financial mechanisms, national policies and sustainability strategies. The strong linkages between the clusters suggest that ESG outcomes and green innovation are interdependent, with innovation serving as both a driver and an outcome of ESG initiatives. This visualization underscores the importance of exploring cross-cutting themes, such as the role of digital finance, carbon reduction strategies, and policy-driven ESG frameworks, in shaping the trajectory of sustainable development. Future research could further investigate how these clusters interact dynamically, particularly by examining the effectiveness of ESG-driven innovation in achieving long-term environmental and economic resilience.

Figure 4 presents an overlay (time-based) visualization of keyword co-occurrences in the green innovation and ESG performance literature generated using VOSviewer. The map highlights how the central concepts in this research stream have shifted over time, with the color gradient indicating the average publication year of each keyword, ranging from dark blue (earlier) to yellow (more recent). Although the final dataset spans 2015-2025, the overlay suggests that the most intensive keyword activity in the retained sample is concentrated in the more recent period (2023-2024).

At the center of the map, “green innovation” is the most dominant and persistent keyword, functioning as a hub that connects multiple themes. Closely linked to it are “ESG performance,” “corporate ESG performance,” and “ESG,” indicating that the field is organized around firm-level innovation activities and their alignment with ESG outcomes. The green shades around these core terms suggest that the GI-ESG linkage has become increasingly salient in more recent publications captured in this review.

The overlay also reveals a thematic broadening from core GI-ESG concepts toward finance- and policy-related mechanisms. Keywords such as “digital finance” and “sustainability” appear in earlier tones (blue), suggesting that they form part of the earlier conceptual basis within the sample, while terms such as “green credit,” “national ESG performance,” and “dual carbon” appear in more recent tones (yellow to yellow-green), reflecting growing attention to regulatory instruments, decarbonization agendas, and macro-level ESG frameworks. In addition, the presence of “enterprise green innovation” and “corporate green innovation” indicates continued interest in firm-level innovation strategies, while the emerging emphasis on policy/finance terms suggests a movement toward more integrative explanations linking organizational practices to broader institutional settings.

Overall, Figure 4 indicates a temporal progression in which the literature increasingly positions green innovation as an operational or strategic practice within firms and as a component embedded in wider financial governance and national sustainability contexts. This time-based mapping complements the

cluster structure like seen in Figure 4 by showing that recent research is moving toward more integrated discussions that connect GI-ESG outcomes with decarbonization priorities, green finance instruments, and institutional ESG performance, highlighting promising avenues for future work that explicitly models these cross-level linkages.

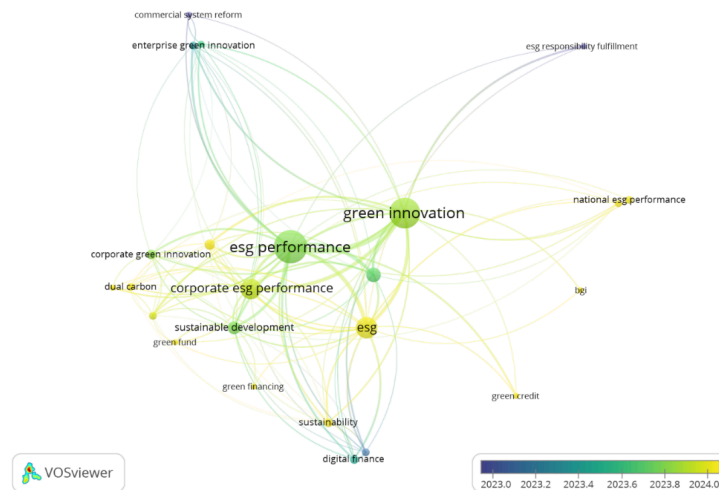


Figure 5. Mapping central keywords over time

Building on the keyword co-occurrence structure in Figure 4 and temporal overlay map in Figure 5, the GI-ESG evidence base can be consolidated into an applied antecedent-mechanisms-outcomes framework. This synthesis moves beyond descriptive mapping by showing that green innovation usually operates as a transmission mechanism through which disclosure quality, digital capability, green finance, and governance arrangements are converted into observable ESG outcomes under various institutional conditions. The thematic categorization of the reviewed studies based on their key antecedents, mechanisms, and outcomes is summarized in Table 3.

Table 3. Thematic categorization of studies

Block	Subtheme / Key Constructs	Analytical Focus	Sources
Antecedents	ESG disclosure quality, transparency, analyst/media attention	How the information environment and external scrutiny shape incentives for green innovation and ESG upgrading	(Ruan et al., 2024; Xue, Lakkanawanit, Suttipun, & Huang, 2024)
	Digital transformation / intelligent manufacturing	How technology adoption strengthens operational/data capabilities that support GI and translate into stronger ESG performance	(Huang, Yang, & Ren, 2024; S. Wu & Li, 2023)
	Green finance / green credit allocation	How financing conditions and policy-linked credit instruments relax constraints and incentivize higher-quality GI (quantity and quality)	(Hao, Deng, & Zhang, 2024)
	Peer effects / spillovers within industries	How ESG and GI diffuse through competitive/benchmarking pressures, reinforcing adoption and innovation intensity	(Zhu & Yang, 2024)
Mechanisms	Green innovation as a mediating channel	How GI transmits the effects of disclosure, technology, and finance into observable ESG outcomes (applied “channel” logic)	(Huang et al., 2024; S. Wu & Li, 2023; Xue et al., 2024)

Block	Subtheme / Key Constructs	Analytical Focus	Sources
Mechanisms	Bidirectional GI↔ESG linkage	How ESG can induce GI (via incentives/constraints) and GI can raise ESG (via cleaner products/processes and governance signaling)	(L. Wu et al., 2025; J. Zhang & Liu, 2023)
	Financing-constraint and policy-finance transmission	How disclosure and credit instruments affect GI through financing constraints, costs of capital, and monitoring intensity	(Hao et al., 2024; Ruan et al., 2024)
Outcomes	Corporate ESG performance (overall and pillars)	How GI and capability-building translate into measurable ESG improvements	(Huang et al., 2024; M. Wang, Wang, & Wen, 2024)
	Green innovation performance / quality	How ESG and finance-policy channels relate to GI outputs (including quality-oriented GI)	(Hao et al., 2024; J. Zhang & Liu, 2023)
	Firm value / enterprise value effects	How GI and ESG interact as complements in value creation and market valuation	(Xue et al., 2024; F. Zhang, Qin, & Liu, 2020)

4.4 Emerging Research Streams

Figure 5 indicates that the GI-ESG literature is becoming more cross-level and policy-facing, with keyword activity concentrated in 2023-2024 and a thematic broadening from core GI-ESG terms toward finance, digital transformation, and institutional conditions. This pattern suggests that the field is moving from a narrow firm-level innovation perspective to a mechanism-based explanation of how green innovation generates ESG improvement.

Three trajectories dominate this emerging agenda: First, studies increasingly model a technology-enabled ESG pathway, where digital transformation and advanced manufacturing capabilities strengthen ESG outcomes via green innovation and related collaboration/visibility mechanisms (Huang, Yang, & Ren, 2024; Chen, & Huang, 2024). Second, recent work advances the GI-ESG mechanism view, showing that ESG performance can stimulate corporate green innovation, while green innovation also translates into higher corporate ESG performance (Liu, Liu, & Feng, 2024; Zhu, & Yang, 2024). Third, a diffusion and monitoring stream is emerging in stakeholder and network settings, documenting spillovers from customers to suppliers and the role of external attention and regulated sectors in shaping innovation incentives and outcomes (Sun, 2024; (Wang, Wang, & Wen, 2024); Ren, Zhou, Si, Wang, & Guo, 2024; Xue, Lakkanawani, Suttipun, & Huang, 2024; Zhang, Qin, & Liu, 2020).

4.5 Discussion of the Field's Development

The reviewed literature indicates a late but steep expansion of the green innovation-ESG field, with visible publication momentum emerging only after 2022 and reaching its peak in 2024. This pattern, which is consistent with the descriptive results of this review, suggests that the topic has moved from a peripheral sustainability issue to a cross-disciplinary agenda shaped by investor scrutiny, disclosure regimes, digitalization, and transition policy. Recent empirical studies reinforce this interpretation by showing that green innovation can improve corporate ESG performance, while ESG quality and disclosure can also stimulate green innovation, indicating that the relationship is increasingly reciprocal rather than strictly unidirectional (Liu, Huang, Su, & Zhou, 2024; Liu, Kumar, Liu, Li, & Zhou, 2025; Ruan, Yang, & Dong, 2024).

However, the reviewed evidence should not be interpreted uniformly. Several studies suggest that the GI-ESG relationship is conditional, rather than automatic. Green innovation can improve ESG performance when it is substantive, capability-based, and supported by digital transformation; however, its effect may weaken when innovation is symbolic, compliance-oriented, or constrained by short-term financial pressures. Similarly, ESG disclosure may encourage green innovation through reduced financing constraints and stronger external monitoring; however, disclosure can remain

ceremonial when it is not supported by internal governance capacity and operational change. These contradictory patterns indicate that green innovation does not always translate directly into stronger ESG performance; its effect depends on the quality of innovation, credibility of ESG disclosure, managerial commitment, and institutional environment in which firms operate ([Liu et al., 2024](#); [Ruan et al., 2024](#); [Xu, & He, 2025](#)).

At the thematic level, bibliometric and systematic synthesis points to three increasingly connected streams. The first treats digital transformation and intelligent manufacturing as capability amplifiers that help firms convert innovation efforts into measurable ESG outcomes. The second emphasizes disclosure quality, transparency, and governance signals that reduce information friction and strengthen analyst or investor monitoring. Third, it highlights green finance, green credit, and related policy instruments as allocation levers that relax financing constraints and improve the quality or scalability of green innovation. Recent studies are consistent with these streams, showing that digital transformation strengthens ESG-related innovation processes, ESG information disclosure fosters green innovation through financing and analyst-attention channels, and green finance reforms can improve ESG performance by supporting innovation upgrading ([Liu et al., 2025](#); [Ruan et al., 2024](#); [Ye, & Tian, 2025](#)).

This review also identifies several boundary conditions that explain why empirical findings differ across studies. The GI-ESG relationship appears stronger in firms with advanced digital capabilities, better access to green finance, stronger governance and disclosure systems, and supportive regulatory or market institutions. Conversely, the relationship may be weaker in firms with high pollution intensity, limited financial resources, weak institutional environments, or ESG practices that emphasize compliance over substantive transformation. This boundary condition perspective moves the discussion beyond a uniformly positive narrative and supports a more critical interpretation: green innovation is valuable for ESG performance only when it is embedded in organizational capability, financing support, governance credibility, and context-sensitive implementation ([Long, Feng, Gong, & Chang, 2023](#); [Wang, Wang, & Wen, 2024](#); [Tripopsakul, 2025](#); [Ye and Tian, 2025](#)).

These patterns suggest that green innovation should not be interpreted as a stand-alone technological output. Instead, the reviewed evidence supports a mechanism-based reading in which green innovation works with digital capability, disclosure quality, governance arrangements, and financing conditions. This interpretation aligns with the theoretical lenses summarized in Table 4. A dynamic capability view explains why firms need reconfiguration capacity to turn ESG intent into innovation and performance; stakeholder and signaling perspectives clarify why transparency and ratings matter; and institutional arguments explain why outcomes vary across regions, industries, and policy environments. In short, contextual heterogeneity is not peripheral to the GI-ESG nexus but central to its explanation ([Liu et al., 2024](#); [Wang, Zhang, Li, & Wang, 2024](#); [Xu and He, 2025](#)).

Accordingly, the main contribution of this review is not merely to map publications but to show that the field is moving toward mechanism-explicit explanations of how sustainability commitments become operational outcomes. This shift helps explain why recent studies have increasingly combined ESG, green innovation, digital transformation, and finance variables in the same empirical model. The most useful future work will likely be theory-driven and context-sensitive rather than based on direct bivariate relationships alone ([Liu et al., 2024](#); [Long et al., 2023](#); [Tripopsakul, 2025](#)). The theoretical perspectives identified across the reviewed studies and their contributions to explaining GI-ESG relationships are presented in Table 4

Table 4. Theoretical mapping

Theoretical Foundation	Analytical Focus	Representative Studies	Key Conceptual Contribution
Dynamic Capabilities Theory (DCT)	Resource reconfiguration and adaptability under technological and regulatory change: Digital transformation as a capability amplifier.	Recent GI-ESG studies emphasizing capability reconfiguration and adaptive responses	It positions green innovation as a capability channel linking ESG intent to ESG performance outcomes.
Natural Resource-Based View (NRBV)	Environmental resources/capabilities as strategic assets; green innovation as value-creating response to ecological constraints	(Bashir et al., 2025)	Justifies the integration of environmental accountability with competitiveness in GI→ESG logic.
Stakeholder theory	Stakeholder salience, transparency, and market expectations shape ESG management and innovation choices.	(Xi & Wang, 2024)	This study explains why firms invest in GI in response to stakeholder-driven ESG expectations.
Institutional theory	Regulatory/market institutions shaping ESG innovation pathways; heterogeneity across regions/marketization.	(Xu & He, 2025)	Supports attention to context effects (industry, region, disclosure regime) in GI-ESG results.
Agency & signaling	Information asymmetry, incentives, and governance mechanisms affect allocation to green innovation.	(Chen & Huang, 2024)	Clarifies when ESG acts as a credible signal that unlocks financing/commitment for GI and when it crowds out substantive innovation.

4.6 Discussion of Future Research Directions

First, future studies should move beyond direct effect models and test richer mechanism-explicit frameworks. The present review shows that the literature increasingly invokes governance, disclosure, digitalization, green finance, and capability formation; however, these variables are still often examined in isolation. Future research should therefore test multi-path designs in which green innovation mediates the influence of ESG quality or ESG disclosure on firm outcomes, while digital transformation, internal control quality, financialization, shareholder activism, or marketization operate as moderators. This recommendation is grounded in recent findings that ESG disclosure affects green innovation through financing constraints and analyst attention, that digital transformation strengthens the ESG-innovation relationship, and that financialization can weaken the positive effect of green innovation on ESG performance ([Liu, Huang, Su, & Zhou, 2024](#); [Ruan, Yang, & Dong, 2024](#); [Xu, & He, 2025](#)).

Second, future research should address the measurement and design limitations that remain visible in the current corpus. Because many studies rely on single-country panels, composite ESG scores, and patent or disclosure proxies, stronger evidence is still needed on causality, comparability, and temporal sequencing. Subsequent studies should combine longitudinal panel models, quasi-natural experiments, and cross-country comparisons while distinguishing between radical and incremental green innovation and between aggregate ESG and its environmental, social, and governance sub-dimensions. This direction is especially important because recent studies have shown that different forms of green innovation do not contribute equally to ESG outcomes and that the ESG-innovation nexus varies across industries, ownership forms, pollution intensity, and regional conditions ([Liu et al., 2024](#); [Long, Feng, Gong, & Chang, 2023](#); [Wang, Zhang, Li, & Wang, 2024](#)).

Third, more evidence is needed from emerging markets and environmentally intensive industries. The bibliometric map still shows a strong concentration in China-centered and sustainability-oriented outlets, whereas comparative evidence from ASEAN and other developing settings remains limited. Future studies should examine manufacturing, energy, transport, mining, and finance separately and test whether disclosure mandates, green credit regimes, and institutional maturity alter the conversion of green innovation into ESG outcomes. This agenda is warranted because recent ASEAN evidence shows that environmental and governance disclosures are more strongly associated with green innovation than social scores, while green finance reforms materially reshape ESG performance through innovation and financing channels ([Tripopsakul, 2025](#); [Ye, & Tian, 2025](#)).

Finally, future research should consider ESG rather than treating it as a single composite outcome. Several recent studies suggest that environmental and governance dimensions are more innovation-relevant in some settings, whereas social and governance dimensions are dominant in others. A more disaggregated research design would help clarify when green innovation primarily improves environmental efficiency, strengthens social legitimacy, and when governance change remains symbolic rather than substantive. Such differentiation would also make bibliometric and systematic syntheses in this field more cumulative over time ([Tripopsakul, 2025](#); [Wang et al., 2024](#); [Xu and He, 2025](#)).

5. Conclusions

5.1 Conclusion

This review mapped the development of research on Green Innovation (GI) and ESG performance, identified key themes shaping the field, and outlined potential future directions. Using a PRISMA-guided bibliometric-systematic approach, this study highlighted the rapid expansion of the knowledge domain, particularly since 2022, with a peak in 2024. The findings reveal that the GI-ESG nexus is increasingly framed as a mechanism-oriented discussion, integrating green innovation with disclosure, governance, digital transformation, and green finance. The review emphasizes that the relationships between these elements are reciprocal and context-sensitive, with green innovation enhancing ESG performance and ESG disclosure stimulating green innovation by addressing financing constraints and enhancing strategic commitment. This study repositions green innovation as a strategic mechanism, rather than a standalone sustainability initiative.

5.2 Research Limitations

Despite the comprehensive nature of this review, several limitations must be acknowledged. First, the study was confined to Scopus-indexed articles, which may have excluded relevant publications from other databases. Second, the review's reliance on bibliometric analysis may overlook nuances in individual studies that are crucial for a deeper understanding of the GI-ESG connection. Additionally, the rapid evolution of this research area means that the findings may require updating as new studies emerge, especially those from emerging markets and high-impact industries that are less represented in the data analyzed.

5.3 Suggestions and Directions for Future Research

Future research should focus on developing mechanism-explicit models that better capture the dynamic interactions between green innovation and ESG performance. There is a need for more precise measurements of heterogeneous innovation and ESG dimensions that reflect the diversity of contexts in which these concepts are applied. Furthermore, expanding the evidence base to include emerging markets and industries with high environmental impact would provide valuable insights into how green innovation and ESG performance can be achieved more effectively across different contexts. Finally, the growing role of digital transformation, green finance reform, and ESG disclosure should be explored in greater depth, with attention to cross-context heterogeneity and its implications for policies and practices.

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Author Contributions

EW and MS jointly conceptualized the study, developed the theoretical framework, collected data, drafted the initial manuscript, and provided oversight throughout the research process. Finally, YM and HLY critically reviewed the manuscript, finalized the revisions, and approved the article for submission.

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