

A Literature Review on Factors Influencing the Green Innovation Adoption and Future Research Directions

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ABSTRACT: Green innovation (GI) has become a critical strategy for enhancing sustainability and competitiveness among Small and Medium-sized Enterprises (SMEs). This study conducts a systematic literature review of 47 peer-reviewed articles published between 2020 and 2025 to synthesize the current knowledge on the drivers, barriers, and contextual factors influencing the adoption of GI in SMEs. Guided by the PRISMA 2020 protocol, the review integrates bibliometric analysis using VOSviewer to map research trends and disciplinary directions. Findings reveal five major categories of determinants: organizational capabilities, external institutional pressures, technological readiness, stakeholder influence, and resource availability. Despite growing attention to GI, significant gaps remain, particularly in theoretical integration, SME-specific evidence from developing economies, and the use of advanced longitudinal and mixed-method approaches. Methodologically, PLS-SEM dominates empirical studies, complemented by econometric models and emerging hybrid techniques such as SEM-ANN. The review highlights the need for a deeper exploration of GI as a mediating mechanism, stronger contextual diversification, and broader performance measurements beyond self-reported indicators. This study contributes a comprehensive conceptual framework and outlines future research directions to strengthen the understanding of GI adoption in SMEs.

KEYWORDS: Green innovation adoption, literature review, PRISMA flow diagram, SMEs, VOSviewer.

I. INTRODUCTION

In the context of the global community facing severe environmental challenges such as climate change, resource pollution, and ecosystem degradation, GI has become an increasingly important strategic orientation toward sustainable development. Unlike traditional forms of innovation that primarily emphasize economic growth, GI simultaneously integrates environmental, social, and economic considerations into the innovation process of technologies, products, processes, business models, and management (Paunov et al., 2025; Sun et al., 2023; Xie et al., 2019). According to many recent studies, the adoption of GI not only helps enterprises minimize negative environmental impacts but also enhances competitiveness, improves operational efficiency, and strengthens brand image in the eyes of stakeholders (Thomas et al., 2021). Therefore, research on GI has increasingly attracted the interest of scholars, policymakers, and the business community worldwide.

GI is an important concept, also referred to as ecological, environmental, or sustainable innovation focuses on developing new products, services, and processes that minimize harm to the environment throughout their entire life cycle. GI aims to enhance resource and energy efficiency, reduce waste, and lower environmental impact while maintaining ecological integrity (Cisneros Chavira et al., 2023; Guinot et al., 2022; Mediaty et al., 2023; Takov & Veleva, 2024). It has become an essential strategy for sustainable development, driven by stricter environmental regulations and increasing consumer awareness. While many firms now view GI as a source of competitiveness and long-term growth rather than a compliance obligation, limited resources continue to restrict some companies from fully engaging in environmental initiatives. ((Yousaf, 2021). Considering the benefits of sustainability-oriented activities, many companies around the world have begun initiating green practices. Nevertheless, the scarcity of resources in many firms has become a barrier preventing them from engaging in social and environmental activities (Bohn & Rogge, 2022). Although GI shares similarities with traditional innovation, it differs in purpose, complexity, and measurement approach, and it plays a pivotal role in advancing social and environmental sustainability (Jayaraman et al., 2023).

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However, not all enterprises have the same level of access to or adoption of GI. Whether a business successfully adopts GI depends on various factors, both internal and external to the organization. Identifying, analyzing, and measuring the factors that influence GI behavior, therefore, plays a particularly important role, as it helps explain why some firms are willing to transition toward green development models while others remain hesitant or passive. From an academic perspective, clarifying these factors also contributes to enhancing theoretical models of sustainable innovation while supporting managers in designing appropriate policies, strategies, and support mechanisms (Dwiputri et al., 2023; Gomes et al., 2024; Rustiarini et al., 2023).

Moreover, SMEs play a vital role in national economies, yet they often face greater challenges in adopting environmentally friendly innovations due to limited resources, capabilities, and technological readiness. Understanding the factors that influence their adoption of GI helps identify what motivates or hinders SMEs in transitioning toward sustainable practices. This topic is also valuable for policymakers, managers, and researchers because it provides insights into designing effective strategies, policies, and support mechanisms that promote GI adoption. By examining technological, organizational, and environmental determinants, the research contributes to both academic knowledge and practical solutions, ultimately supporting broader goals of environmental protection, climate change mitigation, and sustainable industrial growth (Baeshen et al., 2021; Huang et al., 2023).

II. LITERATURE REVIEW

A. *GI concept*

GI, often used interchangeably with environmental innovation (EI) or eco-innovation, is a key concept that has emerged from growing concerns about environmental degradation, resource depletion, and the need for sustainable development. It is viewed as an essential mechanism for putting environmentally friendly economic growth into practice (Sobaih et al., 2020; R. Ullah et al., 2023).

GI is commonly defined as the introduction of new or significantly improved products, processes, systems, technologies, or management methods designed to reduce negative environmental impacts and promote environmental sustainability. Unlike traditional innovation, GI places explicit emphasis on environmental objectives and aims to create “win-win” outcomes that support both economic growth and ecological well-being (Iqbal et al., 2023).

GI aims primarily to reduce environmental impacts by minimizing pollution, environmental risks, and excessive resource use. It enhances resource and energy efficiency across the product life cycle, helping firms operate more sustainably without compromising economic performance. At the same time, GI enables organizations to achieve a sustainable competitive advantage by adopting cleaner technologies and eco-friendly practices that improve production efficiency, conserve resources, and strengthen long-term competitiveness. Overall, GI supports both environmental protection and sustainable business growth (Le, 2022; Liao et al., 2022).

In summary, GI is a multifaceted concept encompassing technological, organizational, institutional, and strategic dimensions. Understanding these different types and how they interrelate enables organizations and policymakers to design more effective sustainability strategies and accelerate progress toward environmental goals.

Therefore, this research will answer those research questions (RQ):

RQ1: Which research disciplines have been the main focus of recent studies?

RQ2: What are the factors influencing the adoption of GI in SMEs?

RQ3: What research gaps remain, and what are the potential directions for future studies?

Through these questions, the study will extract current research themes, outline the roles of GI, and examine the factors that shape GI adoption in SMEs.

B. *Types of GI*

GI can be divided into several key categories that reflect different areas of organizational activity. The first category is Green Product Innovation, which involves creating new or substantially improved products or services with enhanced environmental performance (Le & Govindan, 2024). This type of innovation focuses on improving product design, quality, and safety to reduce environmental impact throughout the entire life cycle, from manufacturing to disposal (Al-Hakimi et al., 2022; Rodrigues & Franco, 2023). Examples include eco-friendly packaging, the use of non-toxic or biodegradable materials, improvements in recyclability or durability, and reductions in raw material consumption. Research consistently shows that green product innovation is positively associated with gaining competitive advantages and ensuring the success of new eco-friendly products (Achmad & Wiratmadja, 2025; Al-Hakimi et al., 2022; Jun et al., 2021; Le & Govindan, 2024; Muangmee et al., 2021; Rodrigues & Franco, 2023; Tu et al., 2025).

Another major category is Green Process Innovation, which refers to the adoption of environmentally sustainable production methods. Its primary goal is to improve production efficiency while minimizing environmental harm. Common

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examples include reducing energy and water consumption, lowering emissions, improving resource efficiency, shifting from fossil fuels to bioenergy, introducing waste treatment and recycling technologies, and converting production waste into new derivative products—a concept often described as “zero-waste.” (Achmad & Wiratmadja, 2025; Al-Hakimi et al., 2022; Hapsari et al., 2025; Khan et al., 2022; Rustiarini et al., 2023; Tu et al., 2025).

The third category, Green Managerial or Organizational Innovation, focuses on new management practices that promote environmental sustainability within organizations. This form of innovation involves changes in policies, organizational structures, and internal systems that support green initiatives. It may include developing strategic management approaches that embed environmental considerations into the firm’s core strategy (W. Ali et al., 2021; Jun et al., 2021; Le & Govindan, 2024).

In addition, Green Technological Innovation involves adopting advanced technologies and technical procedures that help reduce environmental costs. This includes investing in eco-friendly machinery, monitoring systems, and other innovative production technologies designed to minimize environmental harm (W. Ali et al., 2021; Jun et al., 2021; Le & Govindan, 2024).

III. METHODOLOGY

A. Research design

The paper utilized the PRISMA flow diagram (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) in Figure 1 to clearly and transparently report the process of identifying, screening, and selecting relevant studies (Page et al., 2021). Besides, VOSviewer, a software tool for constructing and visualizing bibliometric networks, was also used in this research to identify the theoretical foundations and show which research disciplines have been the main focus of recent studies.

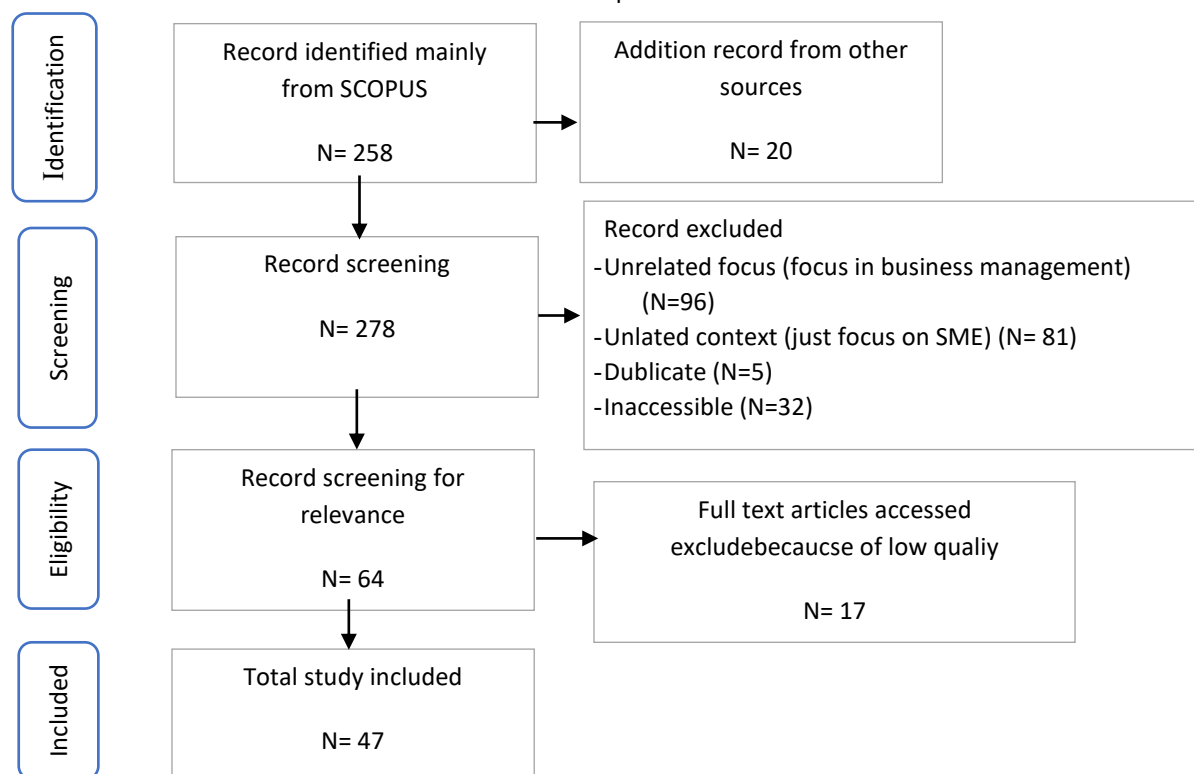


FIGURE 1: A PRISMA FLOWCHART OF LITERATURE SEARCH AND SCREENING

Source: Author's compilation

A total of 278 records were initially identified, including 258 articles retrieved from the SCOPUS database and 20 additional studies obtained from other sources. After the removal of unrelated studies and duplicates during the initial screening phase, 96 articles were excluded for having an unrelated research focus (primarily centered on general business management), 81 were removed due to an unrelated context focusing solely on SMEs, 5 were identified as duplicates, and 32 could not be accessed. This screening process resulted in 64 articles remaining for eligibility assessment. Full-text evaluation subsequently led to the exclusion of 17 studies due to low methodological quality. Ultimately, 47 studies met all criteria and were included in the final synthesis of the review.

B. Database and search strategy

Firstly, the study sets the date from 2020 to 2025 because during this period of time, the “GI” issue has grown significantly and become a hot topic. Then the data was collected mainly from SCOPUS, which is one of the most reputable scientific journal

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sources in the world, with a large database on GI. Moreover, I continue to search for some sources on Google Scholar. The keywords used mainly are “Green Innovation” OR “Eco-innovation” OR “GI” and “the impact factors” OR “factors influencing” OR “barriers” OR “drivers” and “SMEs” or “Small and Medium Enterprises”. With those keywords, the research engine will show similar results to what I want to find. The result is that there are about 278 articles that were identified.

C. Inclusion and exclusion criteria

Table 1 outlines the inclusion and exclusion criteria used to select studies for the systematic literature review on GI adoption. Five key criteria were applied: timeframe, subjects, themes, document type, and language. Studies published from 2020 to 2025 were included to ensure relevance, as this period reflects the latest developments in sustainability policies, technological trends, and increased global pressure on firms, especially SMEs, to adopt greener practices. Older studies were excluded to avoid outdated perspectives. The review focuses specifically on SMEs and micro-enterprises, excluding large firms, multinationals, and state-owned enterprises. Only studies examining factors, drivers, and barriers related to GI adoption were included, while technical research lacking organizational or behavioral insights was excluded. To maintain academic rigor, only peer-reviewed journal articles were considered, with books, theses, and conference papers excluded. Finally, only studies written in English or Vietnamese were included in the review.

TABLE 1: INCLUSION AND EXCLUSION CRITERIA

Criteria	Inclusion	Exclusion
Timeframe	The most recent 5 years (2020–2025) to ensure relevance.	Older studies, when the concept of “green” was not yet widely recognized.
Subjects	SMEs, micro-enterprises.	State-owned enterprises, multinational corporations, and large enterprises.
Themes	Factors influencing, barriers, and drivers of GI adoption.	Technical waste-treatment processes, product engineering, and design (purely technical).
Type of documents	Peer-reviewed journal articles.	Books, book chapters, conference papers (optional), theses/dissertations.
Accessibility	accessible DOI	inaccessible
Language	English, Vietnamese.	Other languages.

Source: Author's compilation

D. Reporting Phase

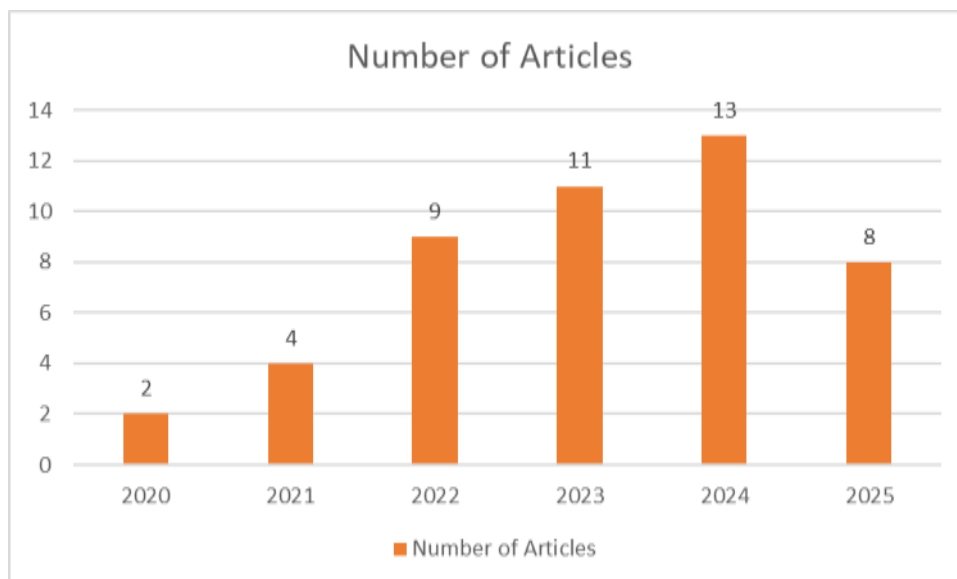


FIGURE 2: NUMBER OF ARTICLES RELATED TO FACTORS INFLUENCING GI ADOPTION IN SMES FROM 2020 - 2025

Source: Author's compilation

The number of studies on factors influencing GI adoption in SMEs has increased steadily over time. Research output was still low in 2020 and 2021, with only two and four articles published. Interest grew strongly from 2022 onward, rising to nine articles in 2022 and continuing upward to eleven in 2023. The highest number of publications appeared in 2024, with thirteen studies, showing that this topic gained significant attention from researchers.

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Although the number of articles decreased slightly to eight in 2025, it is still much higher than in the early years. Overall, the trend shows that GI adoption in SMEs has become an increasingly important research area, attracting more academic interest and providing a stronger foundation for understanding the key factors influencing this process.

TABLE 2: DISTRIBUTION OF ARTICLES BY JOURNAL NAME

Journal name	No. of articles	Percentage
Sustainability (Switzerland)	4	8.51%
Journal of Innovation and Knowledge	3	6.38%
Journal of Open Innovation: Technology, Market, and Complexity	3	6.38%
Cogent Business and Management	2	4.26%
Economic Research-Ekonomika Istraživanja	2	4.26%
European Journal of Innovation Management	2	4.26%
International Journal of Innovation Science	2	4.26%
Journal of Cleaner Production	2	4.26%
Technological Forecasting and Social Change	2	4.26%
Asian Economic and Financial Review	1	2.13%
Business Strategy and the Environment	1	2.13%
Corporate Social Responsibility and Environmental Management	1	2.13%
E a M: Ekonomie a Management	1	2.13%
Economic Alternatives	1	2.13%
Economies	1	2.13%
Environment, Development and Sustainability	1	2.13%
Frontiers in Environmental Science	1	2.13%
Frontiers in Psychology	1	2.13%
Green Finance	1	2.13%
Intellectual Economics	1	2.13%
International Entrepreneurship and Management Journal	1	2.13%
International Journal of Energy Economics and Policy	1	2.13%
International Journal of Management and Sustainability	1	2.13%
Journal of Economic and Administrative Sciences	1	2.13%
Journal of Logistics, Informatics and Service Science	1	2.13%
Journal of Manufacturing Technology Management	1	2.13%
Journal of Small Business Strategy	1	2.13%
Natural Resources Forum	1	2.13%
Problems and Perspectives in Management	1	2.13%
Research in International Business and Finance	1	2.13%
Research on the World Agricultural Economy	1	2.13%
Small Business Economics	1	2.13%
SN Social Sciences	1	2.13%
Systems	1	2.13%

Source: Author's compilation

The reviewed articles were published across a wide range of journals (Table 2). Sustainability (Switzerland) has the highest contribution with 4 articles (8.51%). Two journals, which are the Journal of Innovation and Knowledge and the Journal of Open Innovation, each published 3 articles (6.38%). Several journals, such as Cogent Business and Management, Economic Research, European Journal of Innovation Management, and Journal of Cleaner Production contributed 2 articles each (4.26%). All remaining journals contributed only 1 article each (2.13%), reflecting a broad and diverse distribution across innovation, sustainability, management, and economics fields. Overall, the studies are spread widely across journals, showing that GI adoption in SMEs is a multidisciplinary research topic.

TABLE 3: DISTRIBUTION OF ARTICLES BY PUBLISHER

Publisher	No. of articles	Percentage
Elsevier	10	21.28%
MDPI	8	17.02%
Emerald Publishing	6	12.77%
Springer	4	8.51%
John Wiley and Sons Ltd	3	6.38%
Cogent OA	2	4.26%
Taylor and Francis Ltd.	2	4.26%
American Institute of Mathematical Sciences	1	2.13%
Asian Economic and Social Society	1	2.13%
Conscientia Beam	1	2.13%
Econjournals	1	2.13%
Frontiers Media S.A.	1	2.13%
LLC CPC Business Perspectives	1	2.13%
Mykolo Romerio Universitetas	1	2.13%
Nan Yang Academy of Sciences Pte. Ltd	1	2.13%
Small Business Institute	1	2.13%
Success Culture Press	1	2.13%
Technical University of Liberec	1	2.13%
University of National and World Economy	1	2.13%

Source: Author's compilation

The distribution of publishers for the articles included in the literature review (Table 3), shows the number of articles each publisher contributed and their percentage share of the total publications. Elsevier is the most prominent publisher, contributing 10 articles, which account for 21.28% of the total. MDPI follows with 17.02%, and Emerald Publishing ranks third with 12.77%. Other major academic publishers, such as Springer and John Wiley and Sons Ltd contributed 4 articles (8.51%) and 3 articles (6.38%), respectively. Several other publishers, including Cogent OA, Taylor and Francis Ltd., and a variety of academic institutes, each contributed 1 to 2 articles, representing 2.13% to 4.26% of the total. These publishers include specialized academic societies, universities, and smaller research institutions

The review of 47 articles shows that researchers used diverse methodological approaches to study GI adoption in SMEs. Nearly 20% of the studies applied PLS-SEM, supported by other techniques such as systematic reviews and econometric modeling. Most empirical studies collected survey data using 5- or 7-point Likert scales targeting SME managers, with some employing multi-respondent designs or translation procedures. Convenience and purposive sampling were most common, though some studies used random or snowball sampling. Data analysis was largely dominated by PLS-SEM, which enabled complex modeling with small samples. Researchers commonly assessed measurement validity, tested mediation and moderation, and checked for common method bias. Some studies included additional techniques like PCA and T-tests. A number of articles adopted advanced quantitative methods, including SEM-ANN hybrids and econometric models such as PCSE, FGLS, system GMM, ARDL, and DFE, especially for panel data. Several studies also utilized secondary datasets like Eurostat's CIS, Vietnam's CIEM SME survey, WIND, and CSMAR.

IV. RESULTS AND DISCUSSION

A. Main focus: Research disciplines of recent studies

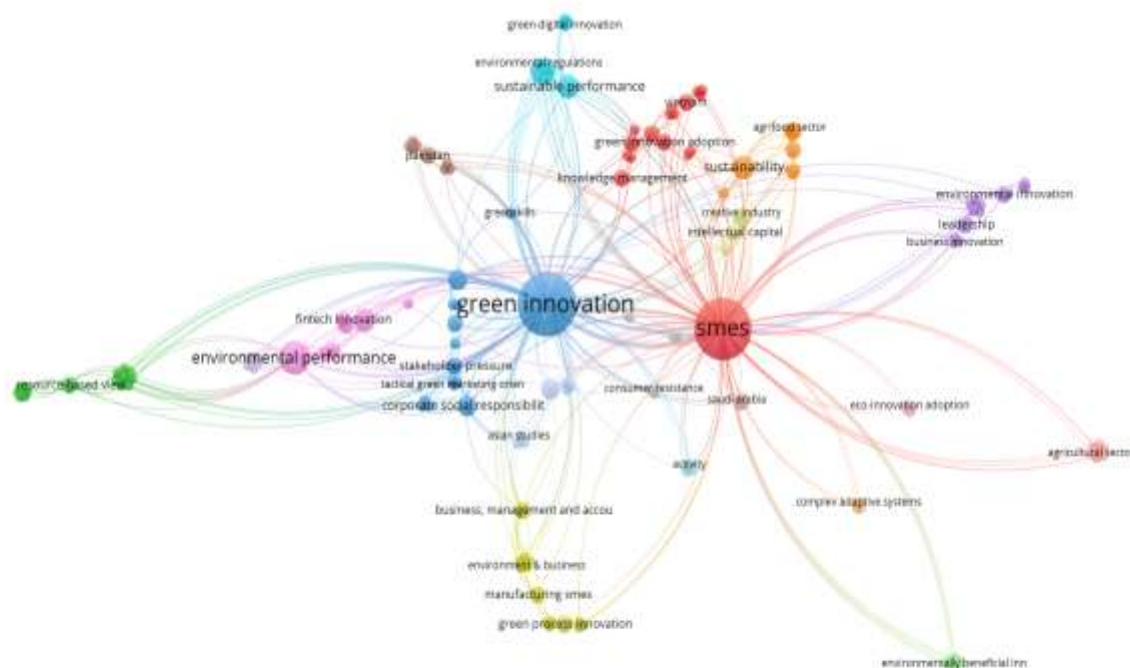


FIGURE 3: THE NETWORK OF CO-OCCURRING KEYWORDS

Source: VOSviewer

The VOSviewer bibliometric map highlights the key research themes connecting GI and SMEs. At its center is a strong linkage between SMEs and GI, showing the growing emphasis on how these firms adopt and implement green practices. Surrounding this core are several thematic clusters. One cluster focuses on internal capabilities—such as knowledge management, intellectual capital, and sustainability-oriented practices—demonstrating the importance of organizational resources in driving GI. Another cluster reflects external pressures, including stakeholder expectations, environmental regulations, and corporate social responsibility, which shape firms’ environmental strategies. Additional clusters emphasize the role of leadership and managerial influence, sector-specific studies (particularly in agriculture and agrifood), and theoretical or performance-related themes like the resource-based view and environmental performance. Overall, these clusters illustrate that current GI research adopts a multidimensional perspective, integrating internal capabilities, external pressures, leadership factors, and industry contexts, with SMEs positioned at the center of sustainability and innovation discourse.

B. Factors impact GI adoption in SMEs

Leadership, Human Capital, and Organizational Culture

Green transformational leadership and strong managerial commitment are key drivers of GI. Leaders who emphasize environmental sustainability help integrate green values into organizational strategies and motivate employees to adopt eco-friendly practices. In SMEs, flexible management structures and new ways of organizing work also increase the chance of implementing eco-innovation. Additionally, when executives view environmental issues as strategic opportunities, they are more likely to support proactive environmental strategies and promote GI (Al Koliby et al., 2025; Awwad Al-Shammari et al., 2022; Baeshen et al., 2021; Huawei et al., 2023; Jun et al., 2021; Lutfi et al., 2023a; Rodríguez-Espíndola et al., 2022; Singh et al., 2022; Sobaih et al., 2020).

Sustainable human capital is another essential determinant of GI adoption, as employees' environmental knowledge and skills directly influence a firm’s green capabilities. The presence of skilled personnel with strong environmental competencies is often a primary motivator for implementing GI. Continuous training, acquisition of external knowledge, and reward systems for eco-friendly behavior further strengthen staff motivation and enhance their ability to contribute to GI efforts (Antara et al., 2024; Baeshen et al., 2021; Khanh & Cuong, 2025; Rodríguez-Rebés et al., 2024).

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The organization's internal structure and culture also shape its capacity to pursue environmental goals. Organizational support, which includes ensuring the availability of technical and financial resources for green projects, substantially promotes GI and often stems from top management's commitment to resource allocation. A strong green organizational culture, where environmental protection is embedded as a core value, facilitates the adoption of green management practices and amplifies their impact on GI. Cultures that embrace innovation, learning, and digitalization enable SMEs to develop a positive attitude toward adopting new environmental practices, ultimately strengthening their GI performance (Al-Hakimi et al., 2022; Baeshen et al., 2021; Ghobakhloo et al., 2021).

Organizational Capabilities and Resources

Effective knowledge management and strong absorptive capacity help firms acquire, share, and apply knowledge for innovation. For SMEs, external knowledge from networks, consultants, and research institutions is vital to overcome limited in-house expertise. Sharing and applying this knowledge through training and communication strengthens green product and process innovation. Green Absorptive Capacity, a firm's ability to absorb and use environmental knowledge, is particularly important because it directly improves environmental knowledge management and overall GI performance (Achmad & Wiratmadja, 2025; Baeshen et al., 2021; Rodríguez-Rebés et al., 2024).

Innovation capabilities also play a decisive role in a firm's ability to pursue GI. General innovation capability enables organizations to develop new products, processes, and business models in response to market and technological changes, positioning them to integrate environmental solutions more rapidly. Prior experience with eco-innovation emerges as one of the most influential internal determinants, highlighting the importance of organizational learning and knowledge transfer. In addition, green creativity, which is the ability to generate novel and practical sustainability-oriented ideas, serves as a crucial precursor to successful GI adoption. It amplifies the value of internal assets, such as Green Intellectual Capital, and helps SMEs respond more effectively to environmental challenges (Achmad & Wiratmadja, 2025; Baeshen et al., 2021; Rodríguez-Rebés et al., 2024).

Finally, although SMEs often face financial constraints, the availability of internal financial resources remains an essential driver of GI investment. Access to capital encourages decision-makers to pursue green technologies and strategies, viewing GI as an opportunity to enhance competitiveness and develop eco-friendly products. Moreover, the motivation to reduce costs related to energy use and material consumption frequently prompts firms to implement GI, as such innovations can yield substantial efficiency gains and improved profitability (Baeshen et al., 2021; Khan et al., 2022; Rodríguez-Rebés et al., 2024; S. Ullah et al., 2022).

Regulatory and Governmental Influence

Governmental and regulatory influences represent one of the strongest external pressures encouraging SMEs to integrate GI practices (Jun et al., 2021; Lutfi et al., 2023b). Environmental laws and stricter regulations push firms to adopt GI by enforcing compliance and penalizing pollution through fines and taxes. GI helps firms avoid these costs, improve efficiency, and stay prepared for evolving standards. Regulations both deter non-compliance and encourage proactive environmental action. However, their impact differs by firm size: regulatory pressure strongly motivates large firms, but is often less effective for SMEs, which may lack the resources to fully respond to regulatory demands (Al Koliby et al., 2025; N. Ali et al., 2025; Barragán-Hernández & Aguilar-Fernández, 2024; Jun et al., 2021; Ngo, 2022; Rodríguez-Rebés et al., 2024).

Beyond regulatory pressure, direct government support plays a crucial role in promoting GI, particularly for resource-limited SMEs. Financial incentives such as subsidies, grants, tax reductions, and credit from public banks help reduce the cost of environmental investments and strongly encourage firms to adopt GI. In addition to financial assistance, governments provide technical and logistical support through training, pilot projects, technical guidance, and information sharing, helping SMEs overcome gaps in expertise and capability. Recent advances in green finance policies and the expansion of digital financial services, including fintech, have further improved access to green capital. These developments strengthen investment in eco-friendly technologies and facilitate broader and more effective implementation of GI (L. T. Ha et al., 2022; N. M. Ha et al., 2024; Hoang et al., 2025; Jun et al., 2021; S. Ullah et al., 2022; Wasiq et al., 2023).

Government interventions, especially public procurement (PP), aim to stimulate green GI Wasiq but often create unintended challenges for SMEs. Although PP is meant to provide stable demand, research shows that winning public contracts can increase financial pressure on innovative small firms. This is because PP typically requires high levels of pre-financing and working capital, which many SMEs cannot secure, thereby worsening existing funding constraints. As a result, PP may unintentionally hinder rather than support SMEs' GI adoption (Schäfer et al., 2024). To address this, policymakers recommend combining PP with grants, subsidies, or financial incentives to ease upfront costs. Additionally, administrative barriers such as excessive bureaucracy and slow procedures can further discourage SMEs from investing in GI. These findings underscore the need for PP systems that are both financially supportive and administratively efficient to truly foster GI (Thomas et al., 2021).

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Market and Customer Dynamics

Market forces driven by growing consumer awareness, competitive dynamics, and the pursuit of corporate reputation play a powerful role in motivating firms to adopt eco-innovation. Customer expectations, in particular, create a strong “market pull” effect that encourages the development and implementation of GI (N. M. Ha et al., 2024; Han & Chen, 2021; Rodríguez-Espíndola et al., 2022). Demand for environmentally friendly products and services is widely recognized as one of the most influential determinants prompting firms to pursue eco-innovative practices. Many consumers are willing to pay premium prices for sustainable products, providing firms with a compelling financial incentive to invest in GI. As the ultimate end-users, customers often exert more influence on manufacturers’ environmental decisions than other external stakeholders, making consumer-driven pressures a central force shaping firms’ GI strategies (N. Ali et al., 2025).

Competitive and reputational pressures strongly encourage firms, especially SMEs, to adopt GI. As sustainability becomes a key competitive factor, companies use GI to differentiate themselves and keep up with rivals’ increasing environmental standards. A good reputation and the need for legitimacy also motivate firms to adopt eco-innovation. Mimetic pressure pushes companies to imitate successful green practices from leading competitors, while normative pressure from industry associations, professional networks, and society further reinforces sustainable behavior. Together, these pressures make GI both a competitive necessity and a socially expected standard (N. Ali et al., 2025; Baeshen et al., 2021; Barragán-Hernández & Aguilar-Fernández, 2024; Jun et al., 2021).

External Partnerships and Financial Networks

Inter-firm collaboration and external knowledge networks are vital for supporting GI, especially among SMEs with limited internal resources. By partnering with customers, suppliers, universities, research institutions, and consultants, firms gain essential knowledge, expertise, and technical support that help them overcome capability gaps. Supply chain pressures also play a major role, as larger firms often require their smaller partners to improve environmental performance. Notably, research shows that non-contractual stakeholders such as competitors, universities, and industry networks tend to exert a stronger influence on GI adoption than contractual ones. Together, these collaborations and external networks create an environment that motivates, enables, and sometimes pressures firms to adopt GI (N. Ali et al., 2025; Baeshen et al., 2021; Barragán-Hernández & Aguilar-Fernández, 2024; Jun et al., 2021).

Accessing external funding for GI remains challenging for SMEs, but technological progress is improving opportunities. Fintech helps reduce information gaps, improves capital flow efficiency, and channels more financing toward green activities through tools like green lending and investment platforms. Despite rising global interest in sustainable finance, investors still have limited influence on SMEs’ GI decisions because SMEs often lack tangible collateral and suitable GI-focused financial products are still not widely available (Huawei et al., 2023; Thomas et al., 2021).

C. Research Gap

The research gaps identified across the reviewed studies highlight the need for stronger theoretical integration, broader contextual coverage, and more advanced methodological approaches to better understand the complex and evolving nature of GI, especially within SMEs. Although the literature has expanded significantly in recent years, several critical limitations remain, preventing a holistic understanding of how GI emerges, how it functions within organizations, and how it influences environmental and organizational performance.

There are still major conceptual gaps in GI research. Many studies lack comprehensive models that clearly show how environmental commitment, innovation, and performance are connected. GI is often underexplored as a mediating factor in key relationships, such as between CSR and environmental performance (Al-Hakimi et al., 2022; Simmou et al., 2023). Scholars also call for more integrated frameworks that combine multiple determinants like knowledge management, innovation capability, green HRM, and digital learning. Research rarely distinguishes between different types of GI, and the moderating or mediating roles of innovation capabilities are still not well studied. Overall, more attention is needed on the quality and intensity of GI, not just whether it occurs (Achmad & Wiratmadja, 2025; Alshuaibi et al., 2024; Ngo, 2022; Rodríguez-Rebés et al., 2024; Yin et al., 2022).

GI research is still dominated by studies on large firms in developed economies, leaving SMEs, despite their major economic and environmental impact, understudied. There is also a lack of research in developing and high-risk regions, and a strong bias toward manufacturing sectors, while service and non-manufacturing SMEs receive little attention. Moreover, many studies overlook important external contextual factors such as political, cultural, and demographic influences, focusing mainly on internal drivers of GI adoption (Achmad & Wiratmadja, 2025; L. T. Ha et al., 2022; Hasan et al., 2024; Rodríguez-Rebés et al., 2024; Simmou et al., 2023; Wasiq et al., 2023; Yin et al., 2022).

Methodological limitations slow progress in GI research. Most studies use cross-sectional data, making it hard to determine causality or understand how GI develops over time. Longitudinal research is needed to capture long-term and

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dynamic innovation processes. There is also limited insight into how financial constraints interact with policies like public procurement. Measurement issues persist, as GI is often assessed with simple indicators that overlook its complexity, and the heavy reliance on self-reported data creates bias. Network effects and stakeholder influences remain underexamined, and many studies lack strong theoretical foundations, making it difficult to build cumulative, coherent knowledge (Elshaer et al., 2023; L. T. Ha et al., 2022; Huawei et al., 2023; Khan et al., 2022; Olekanma et al., 2024; Rustiarini et al., 2023; Schäfer et al., 2024; R. Ullah et al., 2023; Yin et al., 2022).

V. CONCLUSION AND FUTURE RESEARCH DIRECTION

A. Conclusions

Overall, the methodological review of 47 studies reveals a strong reliance on quantitative approaches-particularly PLS-SEM, the dominant analytical method for examining factors influencing GI adoption in SMEs. Survey-based designs remain the primary data collection method, supported by appropriate sampling strategies and rigorous validity checks. While traditional statistical tools are widely used, there is a growing trend toward advanced techniques. The increasing use of secondary datasets further demonstrates the expanding availability of structured innovation-related data. Collectively, these methodological choices reflect the complexity of studying GI adoption and highlight researchers' efforts to capture both linear and non-linear relationships, improve causal inference, and enhance the robustness of empirical findings.

B. Future research direction

Current literature often treats GI in isolation, indicating a need for future research to develop more comprehensive models that explain how and why GI functions. Scholars are encouraged to construct holistic frameworks that integrate multiple determinants rather than examining them separately. Specifically, future studies should connect Knowledge Management, Green Human Resource Management, and digital learning to innovation capabilities to better understand their combined influence on GI.

Moreover, there is a need to explore new mediators and moderators that may shape the relationship between GI and firm performance. These include internal factors such as leadership styles, organizational culture, and employee green behavior, as well as external influences like government policies, market pressures, energy policies, and various forms of stakeholder pressure. Another important direction is examining potential reverse causality, specifically whether successful green innovation leads to improved financial performance or whether strong financial performance enables firms to pursue green innovation more effectively. Further, researchers should move beyond binary classifications of GI by differentiating among its types and intensity, assessing how varying degrees of product, process, or organizational innovation affect organizational outcomes.

To broaden contextual coverage and reduce the bias toward large firms in developed economies, future research must capture the heterogeneity of global markets. Scholars should place greater emphasis on SMEs in developing economies and high-risk regions, where financial constraints and unstable conditions may significantly shape the adoption and effectiveness of GI. Expanding the sectoral scope is also essential, as much of the existing evidence centers on manufacturing. By including service industries and non-manufacturing SMEs, comparative studies can reveal industry-specific drivers and barriers to green innovation. Moreover, future models should incorporate external contextual influences, such as political stability, cultural norms, demographic changes, and public procurement policies, to better understand how broader environmental factors shape GI behaviors.

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