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A Bibliometric and Visualization Analysis of Knowledge Management for Sustainable Innovation

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Abstract

Purpose: To examine the relationship between knowledge management (KM) and sustainable innovation by mapping the intellectual structure of the field. **Methodology:** A bibliometric and science-mapping study of 314 publications from the Web of Science (snapshot: October 2025), using VOSviewer co-occurrence, overlay, and density visualizations. **Findings:** Scholarly output has grown continuously since 2016, peaking during 2020–2025. A small set of highly cited authors leads the field. Core outlets include Sustainability, Journal of Cleaner Production, and Business Strategy and the Environment. Geographically, Asia—driven by China—leads productivity, followed by Europe. Keyword maps identify green innovation and knowledge management as central hubs, with emerging themes in AI, digital transformation, and dynamic capabilities. Overall, KMSI has matured into a multilevel domain linking managerial, environmental, and technological perspectives. Research limitations: 1.Reliance on a one-off WoS snapshot introduces coverage and recency biases that can distort publication trends, rankings, and keyword structures. 2.Co-occurrence and citation maps reflect associations rather than causation—and may be confounded by common shocks or omitted variable

Value: Provides an up-to-date, visual, and comprehensive overview of KMSI's thematic structure and evolution, highlighting leading sources, regions, and emerging topics to guide scholars and practitioners.
Keywords: Knowledge Management, Sustainable Innovation, Bibliometric Analysis

Introduction

The Paris Agreement under the UNFCCC—particularly Article 2—was adopted in 2015 and commits Parties to prevent the global average temperature from rising above 2 °C relative to pre-industrial levels and to pursue efforts to limit the increase to 1.5 °C (United Nations Framework Convention on Climate Change, 2015). Whereas the establishment of the NDC cycle, the implementation of the Global Stocktake, and newly introduced jurisdiction level disclosure requirements such as CSRD and ISSB standards have managed to strengthen the bond between corporate strategy and environmental responsibility. The CSRD came into force in January 2024 and is being applied gradually to large firms and selected SMEs in the EU, while the ISSB standards, which also took effect in January 2024, set a global baseline for sustainability-related disclosures (European Commission & IFRS Foundation, 2023–2024).According to IEA data, corporate investment in non-fossil-fuel power-generation technologies increased by 18% in 2023, indicating a strong role of regulation in corporate decision-making (International Energy Agency, 2024).

While external knowledge search and recombination processes are associated with higher levels of green innovation and environmental performance (Ben Arfi et al., 2018), learning mechanisms and capability building decisively influence the extent and durability of these outcomes (Albort-Morant et al., 2016; Yu et al., 2022). Knowledge management—meaning the systematic creation, sharing, codification, and application of knowledge—has become a key factor in driving green technologies and eco-process transformation in this context (Abbas & Sağsan, 2019;Shahzad et al., 2020). There is supportive evidence that synergy between the acquisition of green knowledge and green-technology innovation enhances environmental performance (Sahoo et al., 2023) and that policy and network conditions determine how knowledge flows result in green patenting and collaborative outcomes (Fabrizi et al., 2018).

In recent years, scholars have increasingly focused on the relationship between KM and sustainability. However, major shortcomings remain in theorization and epistemic development. First, the discipline still has not developed an integrative conceptual framework that might unambiguously link the linear KM processes of knowledge acquisition, dissemination, codification, and use with sustainability outcomes and dynamic capabilities growth. Without such integrative perspectives, it is impossible to trace how knowledge flows interact with organizational routines in producing sustainability transformation. The second limitation goes to the content of the literature that still studies the impact of KM on sustainability-oriented innovativeness as one-dimensional-for instance, studying absorptive capacity (Albort-Morant et al., 2018) or external knowledge sources affecting green innovation performance (Yu et al., 2022).

In addressing these gaps, the present study performs a comprehensive bibliometric and science-mapping analysis of 314 publications extracted from the Web of Science database focusing on the role of KM in fostering sustainability-oriented innovation. Following established methodologies (Donthu et al., 2021; van Eck & Waltman, 2010; Aria & Cuccurullo,

2017), we systematically analyze several dimensions like research trends and patterns, leading authors and institutions, core journals, highly influential articles, and country-level contributions in this domain. All the visualization analyses-network, overlay, and density-are performed using VOSviewer, making the analysis transparent, reproducible, and rigorous to reach an advanced understanding of the thematic and intellectual growth of the domain over time. The review thus provides a broad overview of primary research areas, detects emergent hot topics, and delineates future research directions. These also explain the processes through which KM leads to sustainability-oriented innovation and have some useful inputs for stakeholders and policy makers.

The rest of the paper is organized as follows. The next section describes the data and sources used in the research, the research design, methodologies, techniques, and tools adopted for reaching the aims of the study. The next section reports the results of the bibliometric and visualization analyses-around network mapping and thematic development-and discusses the main findings in light of their theoretical value and practical relevance within the wider frame of KM and sustainability-oriented innovation. Conclusions sum up the primary contributions of the study and indicate recommendations for future research.

Research Methods and Data Collection

Bibliometric analysis is one of the methods that might help quantify the intellectual structure of a research domain, the dynamics of knowledge, and the influence of scholars within a particular domain. It does this by applying statistical techniques on publication and citation patterns. Therefore, by this method, researchers are able to identify the main authors, the most important journals, highly cited papers, newly uprisen thematic clusters among others. In comparison with traditional narrative reviews, this data-driven approach brings additional objectivity, reproducibility, and comprehensiveness, while the longitudinal view helps indicate the distribution of scholarly ideas and the evolution of research frontiers over time (Zupic & Čater, 2015; Donthu et al., 2021).

In order to visualize and make sense of these bibliometric connections, the present study resorts to VOSviewer, a software very likely to be the most common in scientific research for bibliometric visualizations and interpretations. The application developed by van Eck and Waltman is particularly skilled in constructing and studying networks of authorship, citation, and keyword co-occurrence based on similarity mapping and clustering methods. The ability to handle large data sets and create clear knowledge maps has made VOSviewer a science mapping tool (van Eck & Waltman, 2010; Waltman et al., 2010). Moreover, the counting and normalization methods accepted in the bibliometric literature that are taken as a basis for the current analysis (Perianes-Rodríguez et al., 2016) are those which further improve the comparability and consistency of the results and guarantee their reliability as well. It was based on the bibliometric dataset that was taken from the Web of Science (WoS) Core Collection, which is a database curated with care and well known for its structured metadata and comprehensive citation indexing to support robust and reproducible analyses together (Birkle et al., 2020; Mongeon & Paul-Hus, 2016; Harzing & Alakangas, 2016). However, still, prior research suggests even in the WoS and Scopus, some discrepancies in metadata are available and they might have committed certain mistakes in indexing, thus, data cleaning and validation before their analysis is always recommended (Franceschini et al., 2016). Data were interviewed in October 2025 to capture the newest publications available at the time of

analysis. A Boolean query was used to connect the key terms related to KM ("knowledge management," "knowledge sharing," "knowledge transfer,"knowledge creation") with sustainability-oriented innovation("green innovation,""eco-innovation,""environmental innovation," "sustainable innovation," "green technological innovation," "green technology innovation") within the WoS Core Collection.(Fig 1).The search initially yielded 422 records; after exclusion of non-article document types and non-English publications, the final dataset contained 314 peerreviewed articles. The search process and reporting methods followed the emerging best practices for transparent and reproducible literature retrieval (Rethlefsen et al., 2021).

In a nutshell, the bibliometric approach, through the VOSviewer-based visualization and based on the validated counting and normalization standards, provides a sound and replicable basis for delineating the intellectual territory of knowledge management in sustainability-oriented innovation.

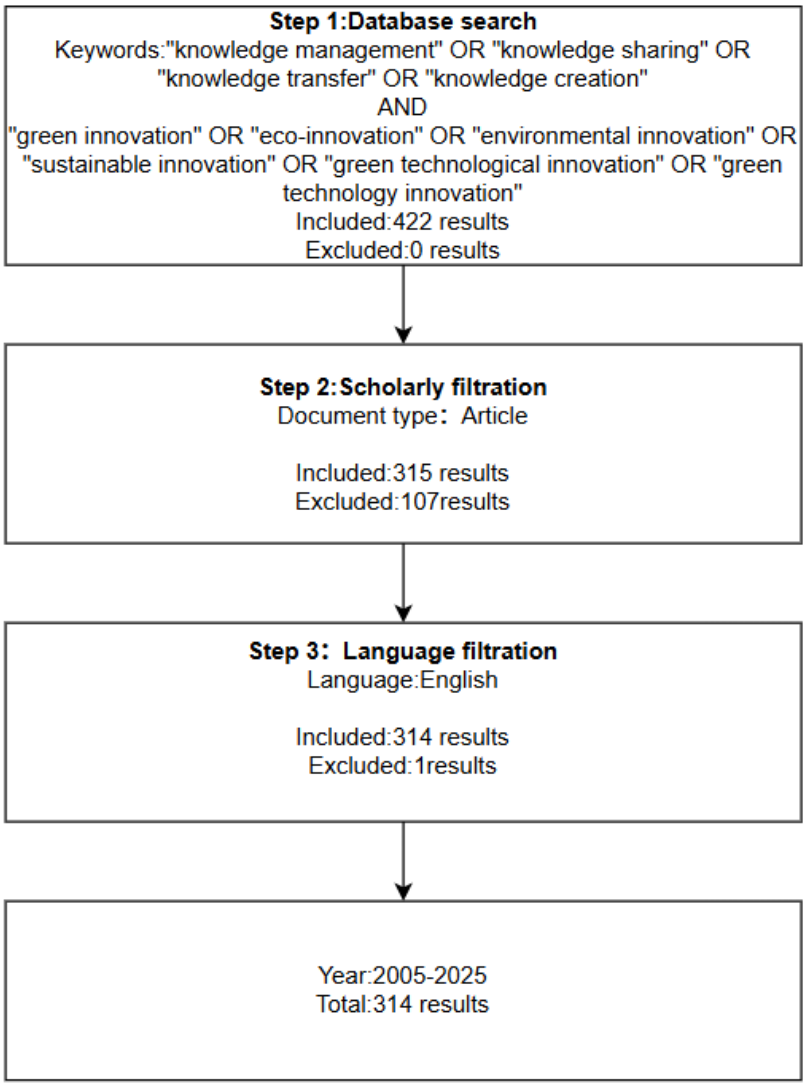

Fig 1.Search and filtration process in WOS database

Results and Discussion

Research trend and growth 2005-2025

Figure 2 illustrates the temporal development of scholarly publishing on Knowledge Management for Sustainable Innovation between 2011 and 2025, based on a clear upward trend in academic attention. During the first period under observation (2011–2015), the scientific output was occasional and limited, indicating that at that time, the field had not reached maturity and was still finding its place among scholars. Afirst significant increase in the upward trend is observed from 2016, which marked the beginning of a more sustained research effort. After 2018, when knowledge management started to be viewed as a strategic driver of sustainability-oriented innovation, a further pick-up ensued. This culminated in the first significant peak during 2020– 2021, when the world saw much policy interest and scholarly attention around sustainable development and green transitions. There was a very low output of publications in the year 2022, but volumes soon regained quickly to all-time highs in the years 2024-2025. This consistent increase does not bear witness to an accumulating literature body in solitude; instead, it mirrors the crystallization of the field itself into a sharp interdisciplinary research area that crosses the lines management theory, environment studies, and innovation literature (Bornmann & Mutz,2015; Fortunato et al., 2018). The thus-illustrated trend also calls for an indication that knowledge management is no longer a peripheral object of research but a central analytical framework by which sustainability challenges and innovation process are judged.

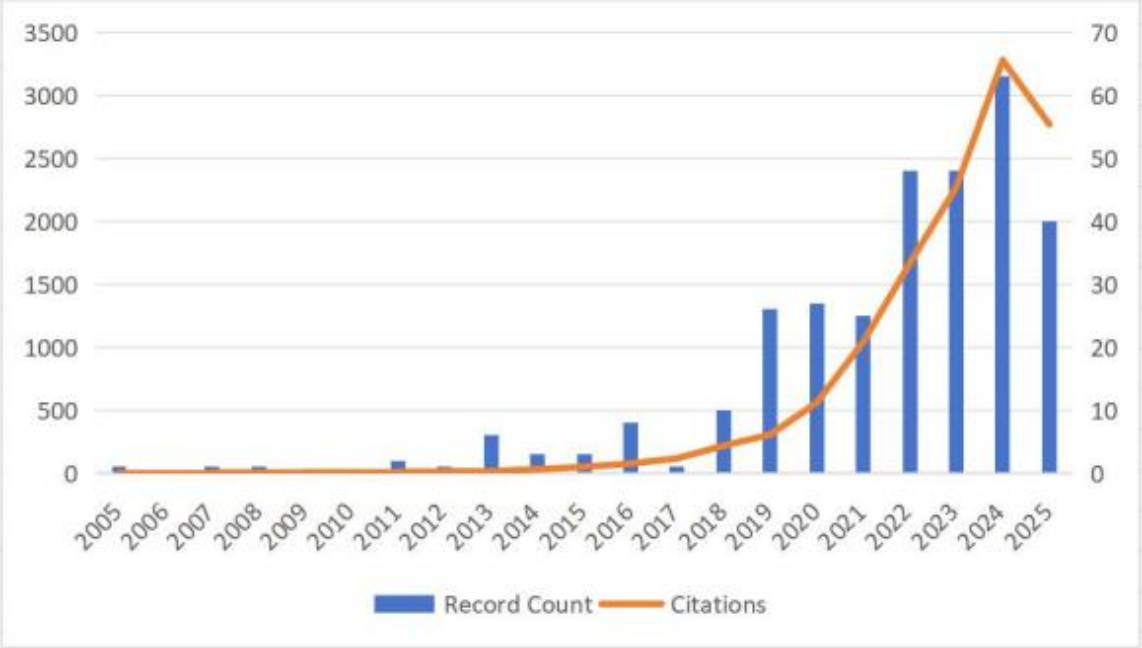

Fig.2 Annual distribution of publications (2005–2025)

Note: The data was extracted from WOS database in 0ctober 2025, covering publications up to that date.

Leading Journals

The main contributors regarding the subject of Knowledge Management for Sustainable Innovation（Table 1）, in the sense both of volume of documents, and academic impact Shahzad Mohsin has the highest productivity of any author in the database, with five publications generating 994citations, and the highest citation impact (Waltman, 2016). Qu

Ying can also be noticed to have had five publications, with close academic influence, based on his 985 cites and very similar citation record. Other established scholars,like Jianhua Zhang, Makhloufi Lahcene,and five by Zafar Abaid Ullah, producing citation ranges of 167 to 974, respectively,signifying sustained action and investment in the arena..Besides these great characters, there are other writers like Marco Lajara Bartolome, Martínez-Falcó Shehzad Muhammad Usman, Asier Baquero, and Scuotto Veronica each have authored four papers, which bears testimony to their active role and sustained interest in contributing to the researcher. Based on the citation performance, the author with the maximum average is Zafar Abaid Ullah number of cites to papers ratio: CPP = 243.5, Shahzad Mohsin at CPP = 198.8 and Qu Ying at CPP = 197.0; the former provides evidence of their central role in the formation of the intellectual tradition of the field (Hutchins et al., 2016).

Leading Journals

The most contributing journals to the knowledge management for sustainable innovation in Table 2, which presents the dynamic publication environment at the interzione of sustainability, management, and innovation studies (Gaviria-Marín et al., 2019). It is the most prized outlet, having produced 48 articles and consequently being the chief location of cross-cutting studies of knowledge management and sustainability-focused innovation (Jia et al., 2019). t is followed by the Journal of Cleaner Production (16 papers, IF = 10.0, JCI = 1.54) and Business Strategy and the Environment (15 papers, IF = 13.3, JCI = 2.76), both widely recognized for advancing theoretical and practical conversations on sustainable business strategies (Bhatt et al., 2020).

Contributions from the Journal of Knowledge Management (14 publications, IF = 9.5, JCI = 2.04) and Technological Forecasting & Social Change (7 publications, IF = 13.3, JCI = 2.53) signify the gradual convergence of knowledge-based and future-oriented approaches in sustainability research. In addition, the Journal of Innovation & Knowledge, European Journal of Innovation Management, EEE Transactions on Engineering Management, and Business Process Management Journal each published five papers, indicating broad disciplinary engagement and methodological diversity that is shaping the field (Song et al., 2025).

Table 1
Leading authors in Knowledge Management for Sustainable Innovation

Rank	Authors	TP	TC	CPP
1	shahzad, mohsin	5	994	198.8
2	Makhloufi, Lahcene	5	167	33.4
3	Jianhua Zhang	5	260	52
4	Qu, Ying	5	985	197
5	MARCO LAJARA, BARTOLOME	4	135	33.75
6	Martínez-Falcó, Javier	4	135	33.75
7	Shehzad, Muhammad Usman Usman	4	260	65
8	Zafar, Abaid ullah	4	974	243.5
9	Asier Baquero	4	51	12.75
10	Zaragoza-Saez, Patrocinio	4	135	33.75
11	scuotto, veronica	4	247	61.75
12	De Marchi, Valentina	4	549	137.25

Note： Notable authors with 4 or more publishers articles

The Most Influential Articles

The most important and extensively cited publications in the field of knowledge management for sustainable innovation are listed in Table 3 as the top ten most-cited papers. These publications not only indicate but also significantly contribute to the evolution of this research area's thematic and intellectual foundations. First place is taken by the work of Ben Arfi et al. (2018), titled "External knowledge sources, green innovation, and performance," published in Technological Forecasting & Social Change. The paper has been cited 471 times and set an empirical marker early in the discussion by showing that external knowledge acquisition has a direct positive impact on green innovation performance, thus influencing later debates around innovation strategy and sustainability .

Second most-referenced article, the article by Abbas and Sağsan in 2019 is released in Journal of Cleaner Production (465 references), that give crucial empirical validation of the thesis that knowledge-management practices are crucial not only to environmental innovation but also to business sustainability.Then there is Albort-Morant et al. (2016) in the Journal of Business Research (438 references), that examines variables in relation to Internet of Things at the confluence of manufacturing, organizations, and users. Inclusion among others, the above Shahzad et al. (2020) and Sahoo et al. (2023)the Journal of Knowledge Management and Business Strategy and the Environment, respectively—is among the most influential works, the former studying the function of green innovation as an arbitrator that bridges KM procedures and sustainable performance,while the other one aims at learning green knowledge and its general good influence upon the environment. In mention a few others, the papers by Fabriziet al. (2018), Awan et al. (2021), and Yin and Yu (2022) suggest the continuous blending of three streams—knowledge-management practices, technological innovation, and sustainability performance—within different industrial and policy patterns; the former is also evidenced (Xie et al., 2019 ; Chen et al., 2006).

Country-Wise Analysis

Table 4 presents the geographical spread of studies in knowledge innovation management for sustainable innovation by continent and by country. Based on the findings, there is an evident concentration of the publications in certain regions, with Asia and Europe combined having contributed to over 94% of the entire (Alkathiri et al.,2024). The leader is Asia, with 223 articles (71.02%), and the runner-up is Europe with 74 articles (23.57%). The remaining regions of the world—i.e., North America (28,8.92%), South America (15, 4.78%), and Africa (10, 3.18%)—have published relativelyless papers; however, their inclusion shows increasing international acceptance of the strategic role of the sustainability transition in the knowledge management .A closer look at the detailed country analysis (Figure 3) reveals that China ranks first author of 105 papers, indicative of an enduring subsidy by the government for innovation for sustainability and the integration of systems of knowledge into national economic restructuring plans . National governments in Europe like Spain (33) and Italy (29) are equally integral, emphasizing the continent's vibrant research heritage in studies of innovation and knowledge. Other major shares come from the UK (28), Pakistan (26), the USA (19), India (14), Australia (13), Malaysia (13), and France (12), for a diverse network of research centers and cooperation.

Table 2
Leading journals in Knowledge Management for Sustainable Innovation

Rank	Journal	TP	Journal Citation Indicator (JCI)	Impact Factor (IF)
1	SUSTAINABILITY	48	0.68	3.3
2	JOURNAL OF CLEANER PRODUCTION	16	1.54	10.0
3	BUSINESS STRATEGY AND THE ENVIRONMENT	15	2.76	13.3
4	JOURNAL OF KNOWLEDGE MANAGEMENT	14	2.04	9.5
5	TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE	7	2.53	13.3
6	JOURNAL OF INNOVATION & KNOWLEDGE	5	3.81	15.5
7	EUROPEAN JOURNAL OF INNOVATION MANAGEMENT	5	1.18	5.7
8	IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT	5	1.12	5.2
9	KYBERNETES	5	0.47	2.9
10	BUSINESS PROCESS MANAGEMENT JOURNAL	5	1.23	5.8
11	KNOWLEDGE AND PROCESS MANAGEMENT	5	0.61	1.7

Note: Leading journals with six or more published articles in Knowledge Management for Sustainable Innovation

Table 3
The most influential articles in Knowledge Management for Sustainable Innovation

Rank	Authors	Title	Journal name	TC
1	Ben Arfi et al., 2018	External knowledge sources, green innovation and performance	TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE	471
2	Abbas & Sagsan, 2019	Impact of knowledge management practices on green innovation and corporate sustainable development: A structural analysis	JOURNAL OF CLEANER PRODUCTION	465
3	Albort-Morant et al., 2016	The antecedents of green innovation performance: A model of learning and capabilities	JOURNAL OF BUSINESS RESEARCH	438
4	Shahzad et al., 2020	Exploring the influence of knowledge management process on corporate sustainable performance through green innovation	JOURNAL OF KNOWLEDGE MANAGEMENT	392
5	Sahoo et al., 2023	How do green knowledge management and green technology innovation impact corporate environmental performance? Understanding the role of green knowledge acquisition	BUSINESS STRATEGY AND THE ENVIRONMENT	333
6	Shahzad et al., 2020	Relation of environment sustainability to CSR and green innovation: A case of Pakistani manufacturing industry	JOURNAL OF CLEANER PRODUCTION	322
7	Awan et al., 2021	Enhancing green product and process innovation: Towards an integrative	BUSINESS STRATEGY AND THE ENVIRONMENT	299

		framework of knowledge acquisition and environmental investment		
8	Fabrizi et al., 2018	Green patents, regulatory policies and research network policies	RESEARCH POLICY	279
9	Albort-Morant et al., 2018	Absorptive capacity and relationship learning mechanisms as complementary drivers of green innovation performance	JOURNAL OF KNOWLEDGE MANAGEMENT	274
10	Yin & Yu, 2022	An adoption-implementation framework of digital green knowledge to improve the performance of digital green innovation practices for industry 5.0	JOURNAL OF CLEANER PRODUCTION	257

Table 4
Regional distribution of publications on Knowledge Management for Sustainable Innovation

Continent	Countries/Regions	Record Count	Percentage of Total (%)
Asia	28	223	71.02
Europe	29	74	23.57
Africa	4	10	3.18
North America	4	28	8.92
South America	5	15	4.78

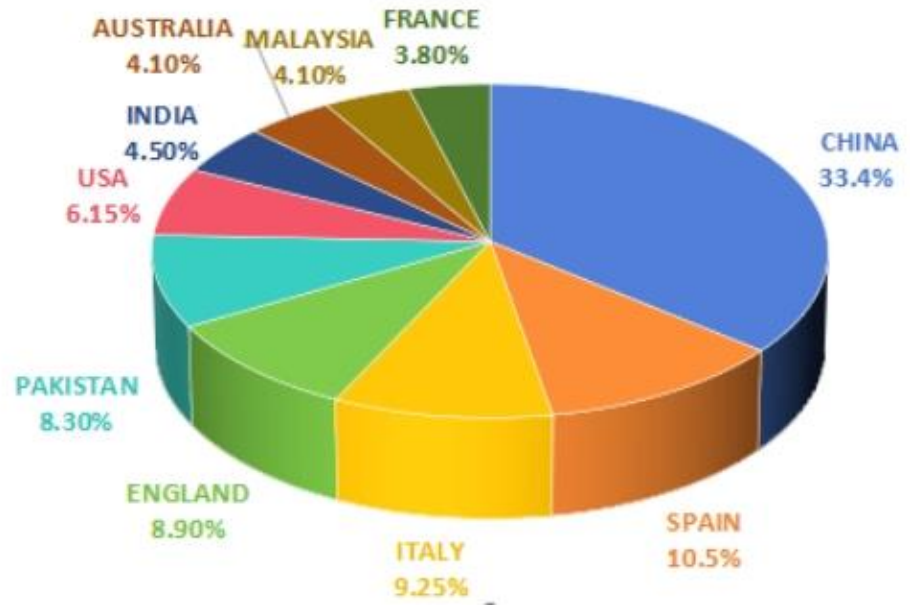

Fig.3Top 10 countries work in Knowledge Management for Sustainable Innovation

Themes and Future Research

VOSviewer-based network visualization of the co-occurrences of keywords, as shown in Figure 4, shows the visual map of the conceptual structure of the research literature on knowledge management for sustainable innovation. The network includes five clusters (Clusters 1–5) of keywords that are mutually connected(Table 5). The resulting cluster offers a various yet complementary thematic stream. The overall number of keyword occurrence frequency and their overall link strength indicate the relative salience of research areas and the strength of interrelations among them.

Cluster 1 (red) is related to green innovation performance (occurrences = 10, link strength = 15) and absorptive capacity (occurrences = 13, link strength = 24), emphasizing the dynamic links among acquisition, assimilation, and innovation. Cluster 2 (green) relates to corporate social responsibility (CSR) (occurrences = 10, link strength = 24) and environmental innovation (occurrences = 10, link strength = 13), indicating the convergence of ethical element and green strategy toward sustainability-based innovation (Li et al., 2017). Cluster 3 (blue) encompasses basic knowledge-management processes—knowledge creation (occurrences = 6, link strength = 10), knowledge sharing (occurrences = 20, link strength = 25), and organizational learning (occurrences = 8, link strength = 13)—verifying these processes as the foundation of innovation enablement (Song et al., 2020). Cluster 4 (yellow) comprises artificial intelligence (occurrences = 7, link strength = 13), dynamic capabilities (occurrences = 5, link strength = 4), and competitive advantage (occurrences = 5, link strength = 10), indicating the digital transformation and next-generation technologies as formers of KM-based sustainability strategies as their impact increases. Cluster 5 (purple) relates to open innovation (occurrences = 9, link strength = 16), sustainable development (occurrences = 21, link strength = 39), and structural equation modeling (SEM) (occurrences = 8, link strength = 9), indicating the integration of methodologies and convergence of fields as salient of the field (Greco et al., 2016; Henseler et al., 2016).

In all the clusters, the map of co-occurrence points out green innovation (co-occurrences = 93, connection strength = 110) and knowledge management (co-occurrences = 47, connection strength = 74) as the central hubs that join the network. The structure pattern shows that the field has evolved beyond the conventional KM-based tradition to a multifaceted paradigm that embraces technological advancement, sustainability, and strategic management perspectives. The thematic convergence that is evident in the map of co-occurrence points to a maturing research environment where the sophistication of methodologies and conceptual integration are hallmark characteristics of research scholarship.

Figure 5 shows the VOSviewer-generated overlay visualization of the evolutioin of research themes in knowledge management for sustainable innovation over time. The colors indicate the average year of publication of the keywords: light colors (yellow) are for recently explored topics, and darker colors (blue) are for older research agendas. The distribution of the keywords over time identifies an evident thematic progression, which mirrors the advancement of the field, over time, from basic thinking to digitally supported sustainability transformations (Chen, 2006).

The initial period (2011–2016) dealt with basic knowledge of the concepts of knowledge management, organizational learning, and innovation performance. Constructing the theoretical and conceptual foundation for the study of how procedures based on knowledge facilitate innovation was the central result of initial investigations. In the transitional period (2017–2020), the research agenda broadened significantly, incorporating green innovation, corporate social responsibility (CSR), and sustainable development as major connecting links. The period saw a paradigm shift, as environment- and society-based requirements were introduced in the study of KM (Ye et al., 2020).

The current time span (2021–2025) shows an overall change in the intellectual direction of the field. Emerging problems like digital transformation and artificial intelligence (AI) became very popular (Verhoef et al., 2021), while dynamic capabilities were re-introduced as the microfoundations of organizational value creation and change. Meanwhile, capability development by means of big data became much related to sustainability performance (Wamba et al., 2017), and the circular economy has come to the fore as aHolistic innovation and value co-creation across boundaries approach (Geissdoerfer et al., 2017).

Knowledge management for sustainable innovation research has increasingly advanced with these temporal evolutions into an extremely interdisciplinary and application-focused field. Increased digitalization and systemic sustainability viewpoints also imply a new model under which knowledge management is no longer locked down in intrinsically based processes, yet instead acts as a strategic innovation enablement engine across organizational boundaries as well as a long-term value-creation mechanism.

A keyword-based co-occurrence map of the density, presented in Figure 6, offers another perspective on the research landscape and overall themes. The map employs a color gradient that shows the relative intensity of research interest in regions where the activity is the strongest (red, yellow) to the lowest activity regions (blue) (van Eck & Waltman, 2014).
The map shows a very centralized structure of knowledge in which a small number of themes predominate. Green innovation and knowledge management are the hub centerpieces and the conceptual foundation of the practice, producing most of the theoretical output. Many smaller high-density areas are in the surrounding regions. Although less severe than the central node, their appearance suggests a new frontier where digital technologies and organizational flexibility are redefining the sustainability practices based on a foundation of knowledge .

In sharp contrast, peripheral low-density areas are characterized by technique-based words like structural equation modeling and an array of context-based terminologies. Even though these regions are not the center of current studies, they can be an indication of future studies' new trends and development of theory. In the meantime, the map of density is a useful analytical map that can identify both conventional centers of expertise and newly budding opportunities of academic advancement (Hair et al., 2019).

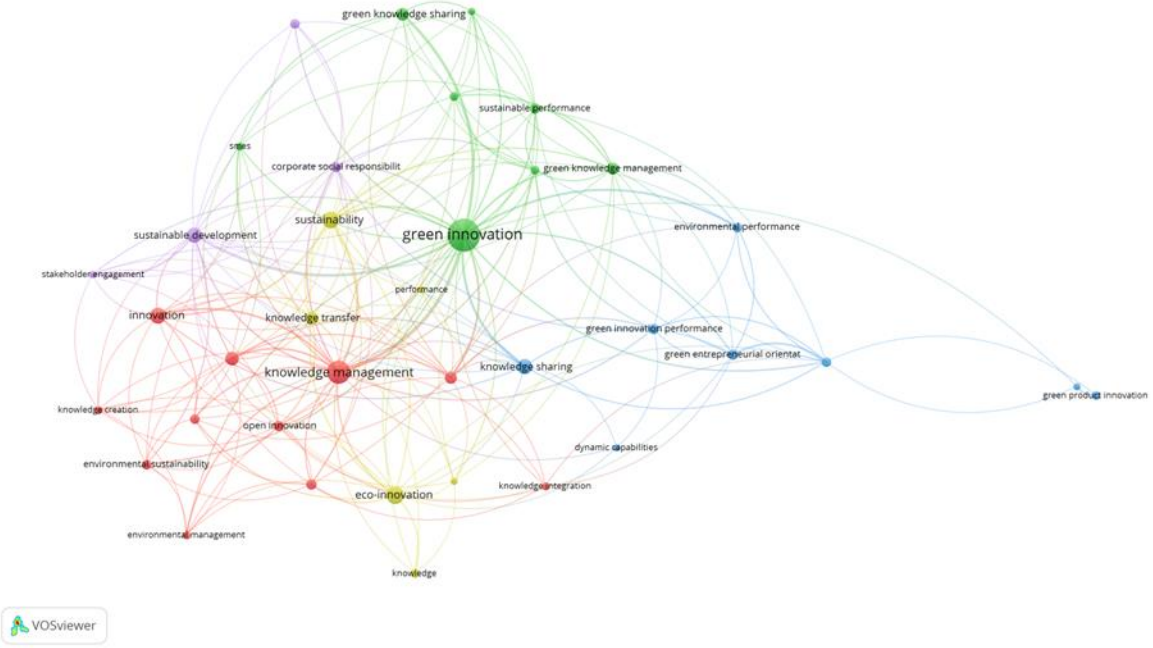

Fig.4 Network visualization produced by VOSviewer

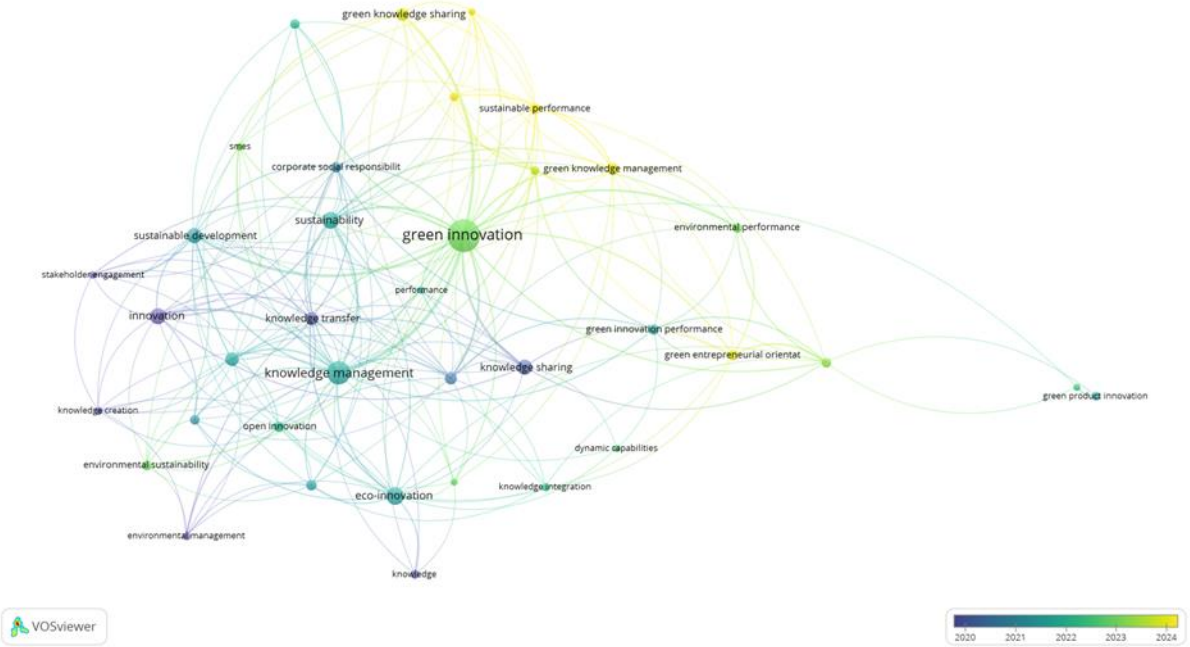

Fig.5 Overlay visualization produced by VOSviewer

Table 5
Five thematic clusters in the keyword co-occurrence network

Cluster1	Cluster2	Cluster3	Cluster4	Cluster5
absorptive capacity	artificial intelligence	Dynamic capabilities	competitive advantage	corporate social responsibility
environmental innovation	green innovation	environmental performance	eco-innovation	stakeholder engagement
environmental management	green intellectual capital	Green absorptive capacity	knowledge	structural equation modeling
environmental sustainability	green knowledge management	Green entrepreneurial orientation	Knowledge transfer	Sustainable development
innovation	green knowledge sharing	Green innovation performance	performance	
knowledge creation	green transformational leadership	Green process innovation	sustainability	
knowledge integration	sems	Green product innovation		
knowledge management	sustainable performance	Knowledge sharing		
open innovation				
organizational learning				
sustainable innovation				

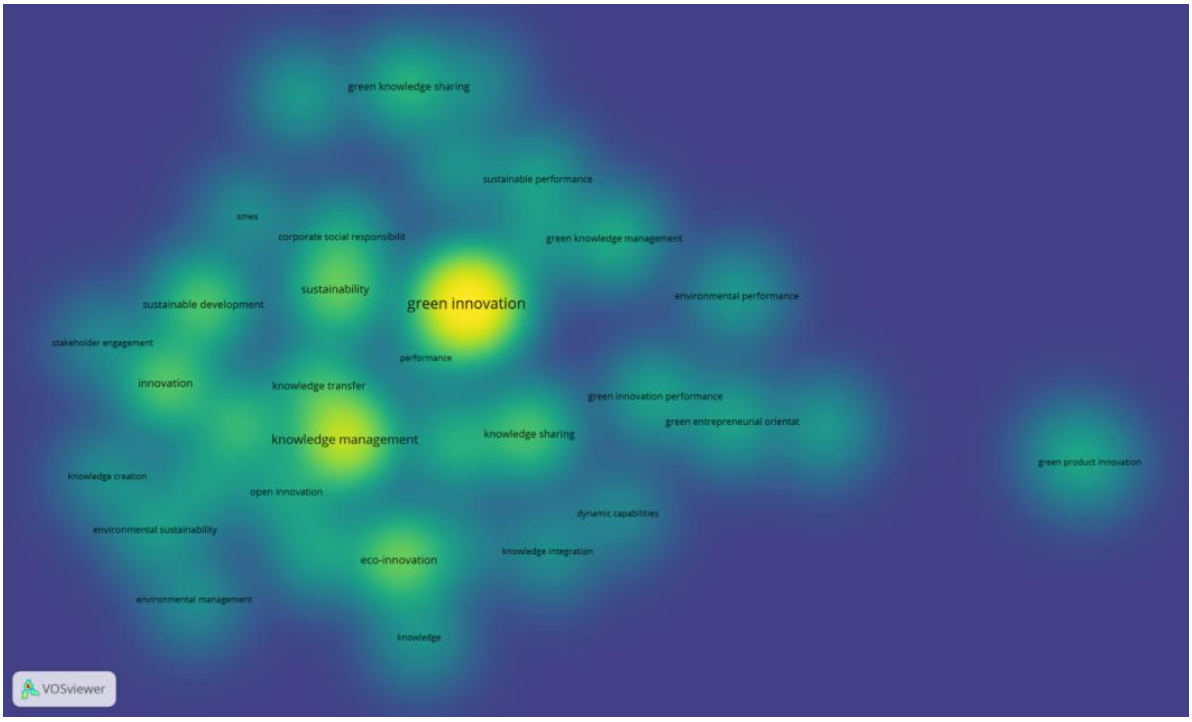

Fig.6 Density visualization produced by VOSviewer

Based on the above thematic analysis, we propose a simple conceptual model that summarises the basic pathway from knowledge management to sustainable innovation. As shown in Figure X, core knowledge management activities – knowledge acquisition, knowledge sharing, knowledge storage/codification and knowledge application – provide the informational and learning basis for firms to develop sustainable innovation, especially green product and green process innovation.

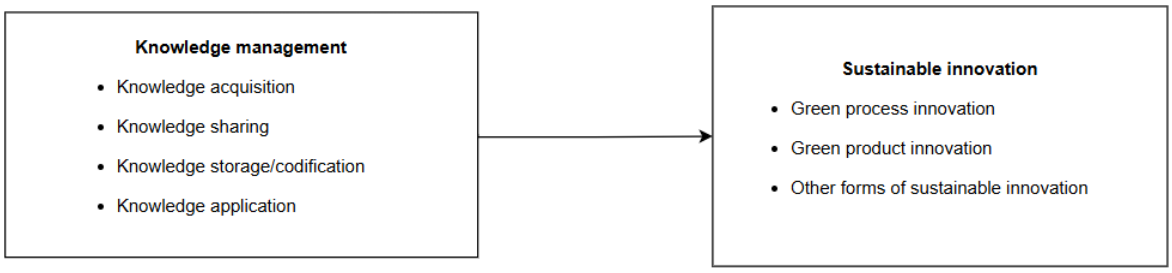

Fig.7 Conceptual model of KM for sustainable innovation

Conclusion

Scholarship on Knowledge Management for Sustainable Innovation (KMSI) has followed a sustained upward trajectory from 2011 to 2025, developing from a conceptual niche topic to one of the mainstream areas of interdisciplinary research. As per Figure 2, early studies were rare, while a marked acceleration after 2016 was followed by a sharp rise from 2018 onward, demonstrating that this field is now realizing wide recognition for knowledge management as a fundamental driver for sustainability-oriented innovation. By the period 2020–2025, the intellectual consolidation of the field had reached a stage where the fields of management, environmental studies, and innovation science merged into a coherent research domain.

Authors' analysis (Table 1) reflects that the intellectual landscape represents a selected but influential group of scholars, headed by Shahzad Mohsin, Qu Ying, and Zafar Abaid Ullah, whose works regularly exceed CPP 190 and thus have set the theoretical and empirical base for the majority of this cognizance. Journal-level patterns (Table 2) further demonstrate that the field has reached maturity in that Sustainability is now the dominant outlet at 48 papers; the Journal of Cleaner Production and Business Strategy and the Environment continue to be leading outlets for the advance of knowledge on sustainable management and innovation (Agostini et al., 2020).The pattern of research by geography (Table 4,Fig 3) shows a significant regional concentration of the disciplines with Asia and Europe totalling more than 94% of the publications. China by 105 papers has emerged as a geological point of the world KMSI research, next comes Spain, Italy, and the UK, which gives a clear indication of the growth of Asia as a research power and Europe's continuing influence (Zhou et al., 2021).

Thematic mapping (Figures 4-6) again sheds light on a very well formed and linked knowledge structure which consists of five major streams where research efforts have been brought together and they revolve around green innovation, knowledge management, corporate social responsibility, artificial intelligence, and sustainable development. The areas of green innovation (number of times occurred = 93, strength of link = 110) and knowledge management (47, 74) are the main points from which the whole structure is built. Through temporal overlay analysis, one can see a very clear shift-influence through knowledge from the grounding of foundational KM theories (2011-2016), to the absorption of sustainability principles (2017-2020), and then to the appearance of digital transformation and dynamic capabilities as the main research topics (2021-2025).

When looking at the findings from a wider perspective, we can see a field that has transformed significantly. Knowledge Management for Sustainable Innovation has not only cleared its way as a specialized theoretical concept for research but also become a prominent, data-driven and globally interconnected research domain.

Limitations and Suggestions for Future Research

The study is subject to two primary limitations. First, database coverage and collection are limited: using a one-off WoS snapshot can introduce publication trend distortion, core-journal/high-citation list misordering, and keyword network misrepresentation, hence the lack of robustness and generalizability for the conclusions. To refine, future updates should pull records in parallel from Scopus, Dimensions, and OpenAlex, time-stamp and version each pull, and de-duplicate across databases by DOI/title, and report a PRISMA-S–adherent search and cleaning process in the appendix to increase completeness, reproducibility, and robustness. Second, correlation is not causation: co-occurrence and citation maps depict associations and structural connections but not causal direction or mechanisms, and findings are subject to common shocks or omitted variables, biasing inference regarding the "KM → green innovation path. To increase credibility, we suggest incorporating causal identification and mechanism tests and, with systematic checks, to reassure the findings are not specification-driven and to increase causal interpretation.

Future empirical studies should go beyond simple correlations and test explicitly the mechanisms along the "KM → green innovation " path. For instance, researchers can apply either covariance-based SEM or PLS-SEM to study the mediation and moderation

relationships between KM practices, green innovation, and sustainability outcomes in survey or archival data. When suitable policy changes or institutional shocks are available for settings, difference-in-differences designs can be used to compare changes over time between treated and non-treated firms and thus get closer to the causal effects.Simpler approaches are appropriate for researchers new to this field or working with more limited data. These include multiple regression models with controls, basic mediation and moderation analysis, and longitudinal panel regressions exploiting repeated observations of firms or regions. Such a design can already provide evidence of value on how knowledge management supports sustainable innovation, and more advanced designs can be adopted when data quality and identification conditions allow.

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