

Mapping the Evolution of Green Tourism and Sustainable Development: A Bibliometric and Science-mapping Review

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Abstract

This study maps the evolution, thematic structure, and emerging directions of green tourism and sustainable development research through bibliometric and science-mapping analyses. The dataset comprises 213 English-language publications indexed in Scopus between 1989 and 2025. Biblioshiny in R and VOS viewer were employed to examine publication and citation trends, the geographical distribution of research, leading journals and highly cited documents, keyword co-occurrence, and temporal thematic evolution. The findings show that scholarly output has expanded substantially, with particularly rapid growth after 2022 and a high concentration of research activity in China and other Asian countries. Six major thematic clusters were identified: sustainable tourist behaviour and market dynamics; carbon emissions, energy use, and climate change impacts; green economy and public policy; low-carbon planning and sustainable tourism development; macroeconomic growth, innovation, and environmental sustainability; and energy efficiency and green tourism supply chain management. Temporal analysis reveals a progressive shift from broad concerns with sustainability, tourism development, and environmental management toward carbon measurement, decarbonisation, renewable energy, behavioural responses, green marketing, waste management, and supply chain practices. These shifts broadly correspond with evolving global sustainability agendas, including the Sustainable Development Goals, the Paris Agreement, pandemic recovery, and carbon-reduction commitments. By integrating performance analysis with science mapping, this study clarifies the development and fragmentation of the field, identifies opportunities for stronger integration across behavioural, technological, operational, and institutional perspectives, and highlights priorities for future research and evidence-based sustainable tourism policy.

Keywords: Bibliometric Analysis, Green Tourism, Low-carbon Tourism, Sustainable Development, Sustainable Tourism.

Introduction

In recent decades, green tourism has emerged as a prominent research domain at the intersection of tourism management, environmental sustainability, and sustainable development. As tourism activity has expanded, concerns regarding carbon emissions, energy consumption, ecosystem degradation, and other environmental pressures have become more prominent. Carbon-emission analyses, life-cycle assessments of tourism activities, and cross-destination studies document substantial environmental pressures associated with tourism development (1–3). These concerns have encouraged scholars and policymakers to reconsider conventional growth-oriented tourism models and to place greater emphasis on approaches that reconcile economic development with environmental protection and broader sustainability objectives. Within this context, green

tourism has attracted growing scholarly attention as an environmentally oriented approach to sustainable tourism. For the purpose of this review, green tourism is operationally defined as the implementation of sustainability principles through practices such as resource efficiency, environmental conservation, emission reduction, and environmentally responsible tourism management and consumption. Recent studies illustrate these dimensions across destination, institutional, and rural tourism contexts (4, 5). Because green tourism overlaps conceptually with sustainable tourism, ecotourism, regenerative tourism, and low-carbon tourism, the boundaries among these concepts are specified in the methodology and used to justify the search strategy adopted in this review. Existing research can be broadly organised into three interconnected

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streams. The first examines environmental and economic outcomes and explores technological pathways for improving tourism sustainability, including renewable energy integration, energy-efficient infrastructure, and low-carbon tourism planning (6–8). The second focuses on behavioural and demand-side factors, examining tourists' values, perceptions, attitudes, environmentally responsible behaviour, sustainability communication, and the role of digital and immersive technologies in shaping green tourism experiences and intentions (9–14). Earlier studies drawing on protection motivation theory and international tourist behaviour provide important foundations for this research stream (15, 16). The third addresses operational and market-based sustainability practices, including circular economy strategies, waste management, green tourism supply chains, technology adoption, sustainability certification, and green marketing (17–21). At a broader level, macroeconomic studies investigate the relationships among tourism development, economic growth, energy use, environmental quality, and the feasibility of tourism decarbonisation (22–24).

Despite this expanding body of research, the knowledge base remains distributed across distinct behavioural, technological, environmental, economic, and operational perspectives. This creates several limitations in understanding the field as a whole. First, it remains unclear how these perspectives are connected within the broader thematic structure of green tourism research and where opportunities for conceptual integration exist. Second, recent computational review research has applied methods such as machine-learning-based topic modelling to sustainable tourism literature (25), but a comprehensive mapping that combines research productivity and impact, keyword co-occurrence structure, and temporal thematic development remains valuable for understanding how the field has evolved. Third, the thematic development of green tourism research has received limited attention in relation to broader sustainability agendas, including climate commitments, the Sustainable Development Goals, pandemic recovery debates, and carbon-neutrality priorities. Addressing these gaps is important for identifying established and emerging research areas and for clarifying where further theoretical, empirical, and policy-oriented

research is needed. Accordingly, this study conducts a bibliometric review of Scopus-indexed research on green tourism and sustainable development published between 1989 and 2025. Four research questions guide the analysis: (a) how have research productivity and citation impact evolved over time; (b) which countries, journals, and documents are most prominent in the field; (c) which thematic clusters constitute its thematic structure and how have research attention shifted over time; and (d) how do the identified themes relate to the Sustainable Development Goals and broader sustainability policy agendas?

This study makes three main contributions. Theoretically, it uses bibliometric mapping to identify the principal thematic perspectives within green tourism research and to highlight areas in which stronger conceptual integration may be needed. Methodologically, it provides a transparent account of the search strategy, screening process, data-cleaning procedures, and analytical parameters, allowing the review to be replicated and updated. Practically, it translates the mapping results into implications for future research priorities, interdisciplinary collaboration, and evidence-based sustainable tourism policy.

Methodology

Conceptual Boundaries of Green Tourism

Green tourism is used in the literature alongside several adjacent concepts, and the boundaries between them determine which studies belong in a review of this kind. Sustainable tourism is the broadest of these terms and denotes tourism that balances economic, environmental and socio-cultural objectives over the long term. Green tourism is narrower: it refers to the environmental operationalisation of that agenda through resource efficiency, emission reduction, conservation practices and environmentally responsible consumption (4, 5). Ecotourism is narrower still and site-based, centred on nature-based experiences, the conservation of protected areas and benefits for host communities, as in early work on community-based tourism in Japanese protected areas (26). Low-carbon tourism is an outcome-defined subset of green tourism, delimited by measurable reductions in carbon intensity across transport, accommodation and

activities (7, 24). For the purpose of this review, regenerative tourism is treated as extending beyond impact minimisation towards net-positive ecological and social outcomes; it is therefore conceptually broader than the operational green or low-carbon focus used for retrieval.

This review therefore targets green and low-carbon tourism research that explicitly engages sustainable development, rather than the whole of sustainable tourism scholarship. Ecotourism and regenerative tourism studies enter the dataset only where they are indexed under the retrieved terms, which explains why ecotourism appears as a keyword inside the thematic clusters rather than as a separate search term.

Data Source, Search Strategy and Screening

To establish the final dataset for analysis, this study collected data from the Scopus database, which is widely recognized as one of the most comprehensive and reliable sources of peer-reviewed literature in the fields of tourism, sustainability, and environmental studies. Scopus was used as the single data source because its structured author, affiliation, keyword and cited-reference fields support all of the analyses reported below; the consequences of relying on one database are addressed in the limitations. A structured search strategy was applied to the subject fields of article title, abstract, and keywords in order to ensure broad yet relevant coverage of the literature while maintaining a clear focus on the research topic. The search query was formulated as follows:

TITLE-ABS-KEY ("green tourism" OR "low-carbon tourism") AND TITLE-ABS-KEY ("sustainable development" OR "sustainability")

This search string was designed to capture studies explicitly addressing green tourism and low-carbon tourism, while simultaneously ensuring a clear focus on sustainable development and sustainability-related outcomes. By combining these terms, the search strategy aimed to retrieve publications that examine tourism from an environmental and sustainability-oriented perspective, rather than general tourism studies without an explicit sustainability focus.

The Scopus search was conducted on 15 January 2026. No lower publication-date limit was imposed; 1989 represents the earliest indexed record matching the search criteria. The search

initially retrieved 286 records. No lower date limit was imposed; 1989 is simply the year of the earliest indexed record matching the query. The search initially retrieved 286 records from Scopus. Screening then proceeded in three stages. The first stage applied language and document-type criteria, resulting in the exclusion of 31 records that did not meet the predefined eligibility criteria. The remaining 255 records were screened for topical relevance based on their titles, abstracts, and keywords. A record was retained if it substantively examined green tourism or low-carbon tourism in relation to sustainability or sustainable development. Records were excluded if the search terms appeared only incidentally, if tourism was not a central research context, or if the study did not examine an environmental or sustainability-related issue. This screening process resulted in the exclusion of 42 records, leaving 213 documents for bibliometric analysis. The final stage assessed the completeness of the metadata required for bibliometric analysis, and no additional records were excluded. Consequently, 213 documents constituted the final dataset for subsequent bibliometric analysis.

Data Cleaning

Data cleaning was conducted prior to the bibliometric analysis to improve the consistency and reliability of the bibliographic metadata. Because the dataset was retrieved from a single Scopus search, no separate automated deduplication procedure was applied. Potential duplicate records were nevertheless checked by comparing DOI information and publication titles before the final bibliometric analysis, and no duplicate records requiring removal were identified. Data cleaning subsequently focused on standardizing the bibliographic fields used in the reported analyses. Author names were reviewed and harmonised by consolidating variant forms of the same authors, including differences in initials, diacritics, hyphenation, and transliteration. Affiliation information was standardised at the institutional and country levels to improve the consistency of geographical analyses. Keyword fragmentation was addressed using a VOS viewer thesaurus file to merge evident synonyms, singular and plural forms, spelling variations, and acronym variants while retaining conceptually distinct terms for subsequent keyword co-occurrence and thematic analyses.

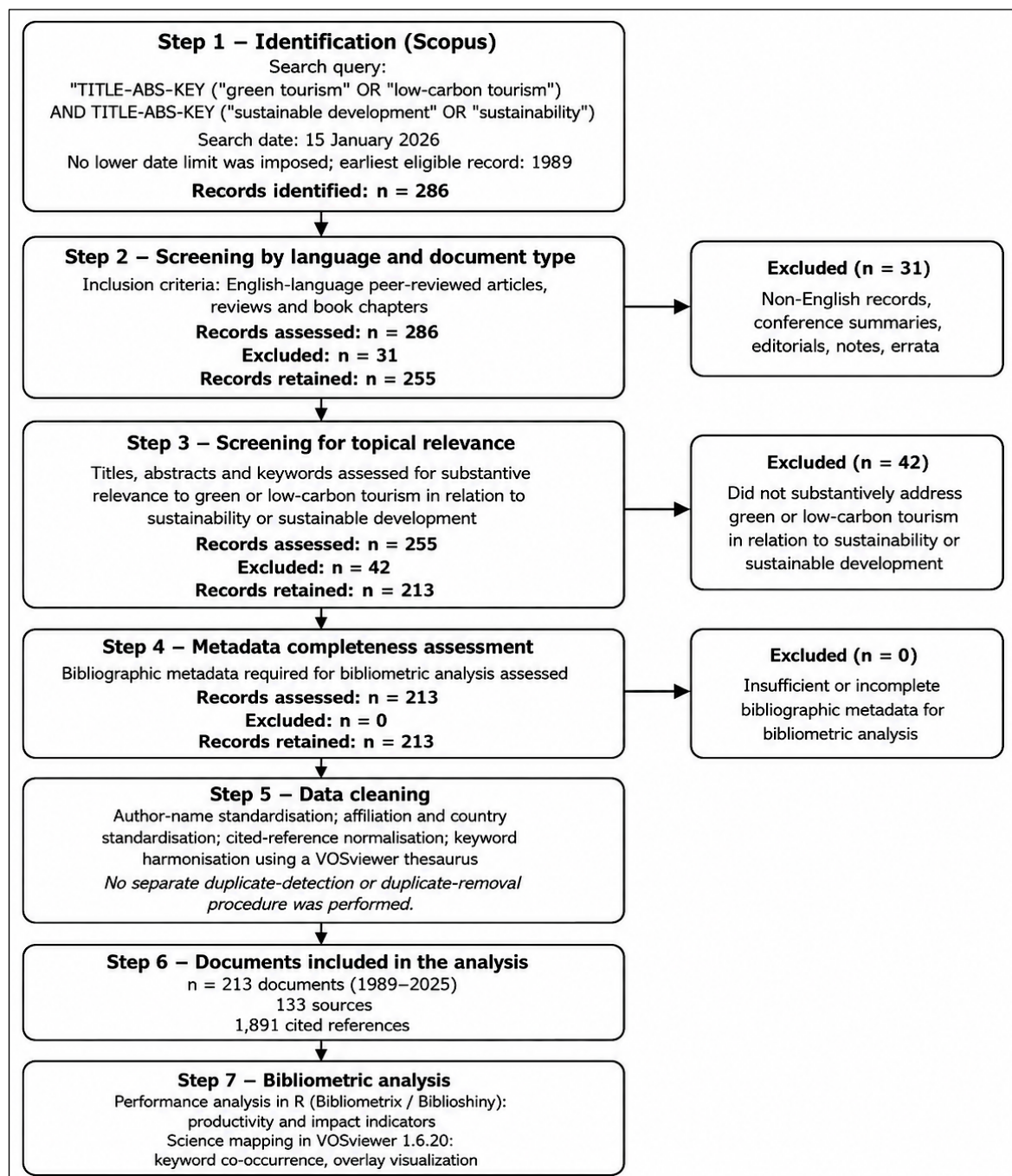


Figure 1: Methodological Flow Chart of The Search, Screening, Cleaning and Analysis Process

Figure 1 summarizes the methodological procedure adopted in this review, including the search strategy, screening stages, inclusion and exclusion criteria, data-cleaning procedures, and subsequent bibliometric analyses.

Bibliometric Analysis

The bibliometric analysis comprised two complementary components: performance analysis and science mapping. Performance analysis was conducted using Biblioshiny, the web-based interface of the Bibliometrix package in R, to

examine annual publication and citation trends, country-level scientific production, leading journals, and highly cited documents. To distinguish research output from scholarly influence, productivity indicators, including publication counts by year, country, and journal, were analysed separately from citation-based impact indicators, such as total citations and average citations per document.

Science mapping was subsequently conducted using VOS viewer through keyword co-occurrence

analysis. Author keywords and indexed keywords were analysed jointly after thesaurus-based harmonisation. A minimum occurrence threshold of five was applied using the full counting method. Co-occurrence relationships were normalised using the association strength measure, and clusters were generated using the VOS clustering algorithm with a resolution parameter of 1.00 and a minimum cluster size of one. An overlay visualisation based on the average publication year of each keyword was also used to distinguish relatively established themes from more recently prominent areas of research.

The resulting keyword clusters were interpreted to identify the principal thematic streams and their relationships within green tourism and sustainable development research. Cluster labels were assigned independently by two researchers based on the most prominent keywords within each cluster and were finalised through discussion and consensus. No formal inter-coder reliability coefficient was calculated because cluster labelling was treated as an interpretive component of bibliometric mapping rather than as a formal qualitative coding procedure.

Table 1: Main Information about the Dataset

Timespan	1989:2025
Sources (Journals, Books, etc)	133
Documents	213
Annual Growth Rate %	11.42
Average Document Age (years)	5.47
Average citations per documents	18.37
References	1891

To distinguish research activity from scholarly influence, productivity and citation-based impact are considered separately throughout the following analyses. Publication counts are used to assess the development and distribution of research output, whereas citation indicators are used to examine accumulated scholarly impact. Because the search was conducted on 15 January 2026, late-2025 records may still be affected by indexing delays, and recent publications naturally have had less time to accumulate citations.

Publication and Citation Trends

Because publication activity before 2015 was highly sporadic, Figure 2 focuses on the period 2015–2025 to improve visual readability. Nevertheless, the descriptive statistics reported in Table 1 cover the complete 1989–2025 dataset. Figure 2 further illustrates the development of the

Finally, the six thematic clusters were interpretively mapped onto relevant Sustainable Development Goals and targets by comparing the dominant keywords and thematic meaning of each cluster with the official descriptions of the SDGs and their targets. This procedure was intended to identify thematic alignment rather than to measure actual progress toward the SDGs.

Results

Descriptive Statistics

Table 1 provides an overview of the dataset and establishes the scale and maturity of the research field. The review comprises 213 publications published between 1989 and 2025 across 133 sources, with an annual growth rate of 11.42%. The average document age of 5.47 years indicates that a substantial proportion of the literature is relatively recent, while an average of 18.37 citations per document suggests that the field has also developed a visible citation base. Taken together, these indicators point to a research domain that has expanded substantially while continuing to attract new scholarly attention.

field by comparing annual publication output with average citations per article. Publication activity remained relatively limited from 2015 to 2018, followed by a modest increase in 2019 and 2020 and a temporary decline in 2021. From 2022 onward, publication output increased markedly, reaching its highest level in 2025. This pattern indicates that the overall growth reported in Table 1 has been driven largely by a recent acceleration in research activity rather than by continuous growth throughout the entire period.

The citation pattern follows a different trajectory. Average citations per article fluctuated considerably in the earlier years, with notable peaks in 2018 and 2020, before declining substantially from 2021 onward. This decline should not be interpreted as evidence of reduced scholarly relevance, as more recent publications

have had considerably less time to accumulate citations. Overall, Figure 2 therefore shows a contrast between rapidly increasing recent

publication output and citation impact that remains more visible among earlier publications because of their longer citation exposure.

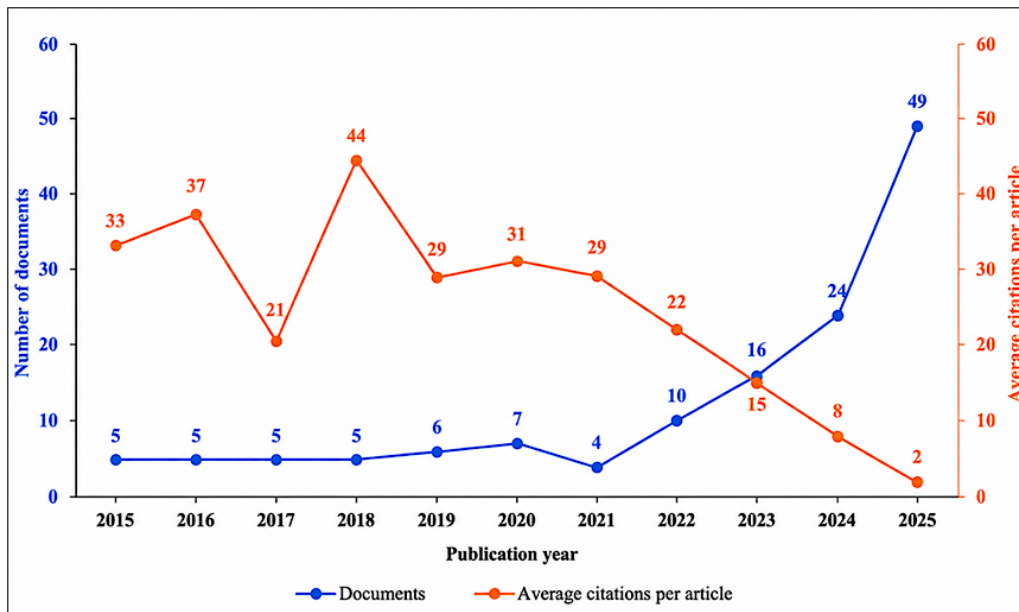


Figure 2: Annual Publication Output and Average Citations Per Article

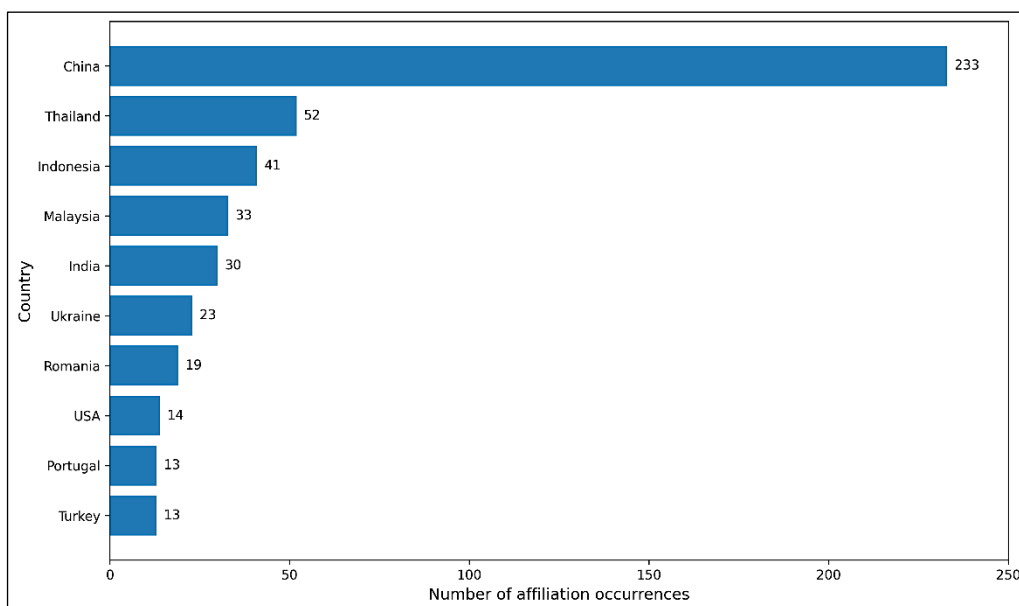


Figure 3: Scientific Production of Countries

Geographical Distribution of Research Production

The recent expansion of the literature is geographically uneven. As shown in Figure 3, China records the largest number of author-affiliation occurrences [233], followed by Thailand [52], Indonesia [41], Malaysia [33], and India [30]. This concentration indicates that the growth of green tourism and sustainable development research has

been particularly pronounced in Asia, especially China and Southeast Asia.

Research participation nevertheless extends beyond Asia. Ukraine [23], Romania [19], the United States [14], Portugal [13], and Turkey [13] also contribute to the field, demonstrating a broader international distribution of research activity. Because these values are based on author affiliations rather than unique publications, the country totals may exceed the 213 documents included in the dataset. Thus, Figure 3 should be

interpreted primarily as an indicator of geographical research participation and productivity rather than citation impact.

Most Productive Journals

The geographical concentration of research is accompanied by an uneven distribution across publication outlets. Figure 4 and Table 2 show that Sustainability (Switzerland) is the most productive journal, with 34 articles, representing approximately 16% of the entire dataset. Environmental Science and Pollution Research follows with 8 publications, while the Journal of Sustainable Tourism and Sustainable Development contribute 5 articles each.

The remaining leading outlets include both tourism-focused and sustainability- or environment-oriented journals. This distribution indicates that green tourism research does not belong to a single disciplinary publication community; rather, it is positioned across tourism management, sustainability, environmental studies, and related interdisciplinary areas. At the same time, the substantial difference between Sustainability and the other journals shows that research output is concentrated more strongly in one broad sustainability outlet than in any individual tourism journal.

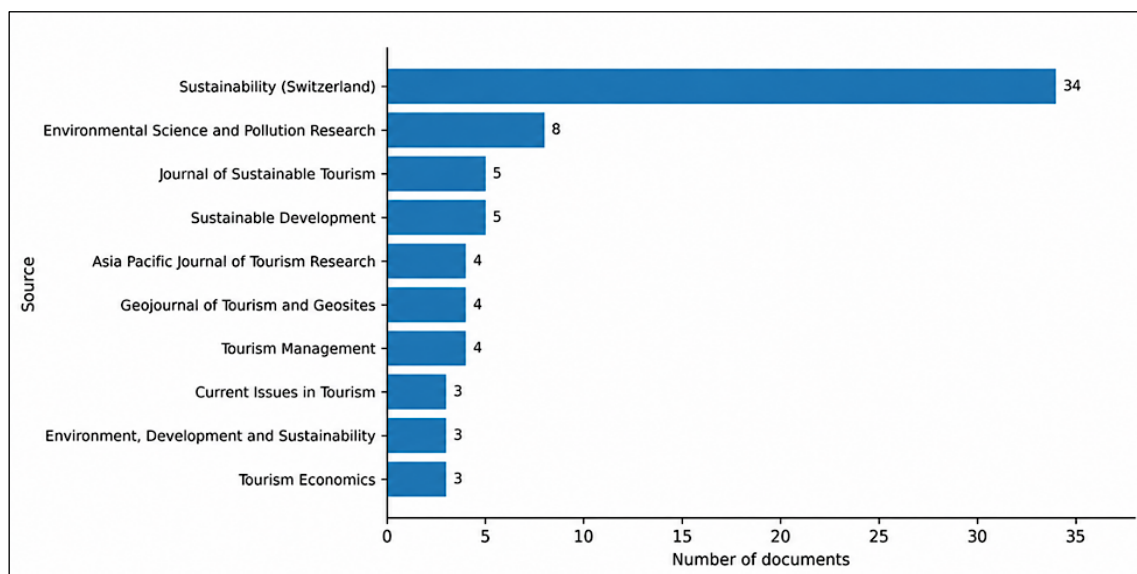


Figure 4: Most Productive Sources

Table 2: Top 10 Journals Publishing

Sources	Articles
SUSTAINABILITY (SWITZERLAND)	34
ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH	8
JOURNAL OF SUSTAINABLE TOURISM	5
SUSTAINABLE DEVELOPMENT	5
ASIA PACIFIC JOURNAL OF TOURISM RESEARCH	4
GEOJOURNAL OF TOURISM AND GEOSITES	4
TOURISM MANAGEMENT	4
CURRENT ISSUES IN TOURISM	3
ENVIRONMENT, DEVELOPMENT AND SUSTAINABILITY	3
TOURISM ECONOMICS	3

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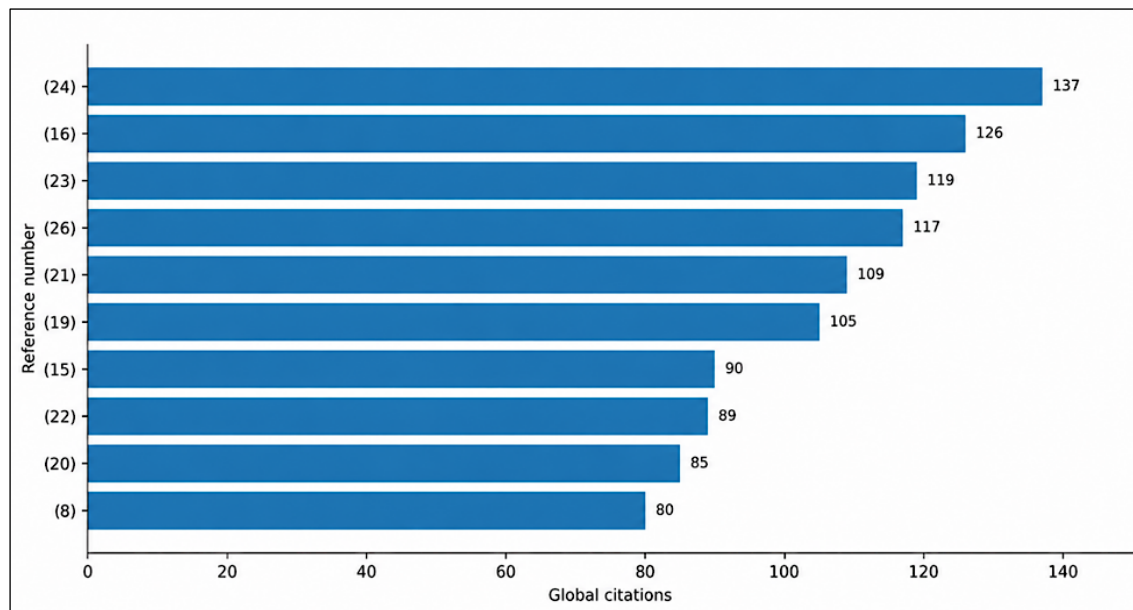


Figure 5: Most Cited Documents

Table 3: Top 10 Documents by Total Citations

Journal	Article Title (English)	Total Citations	References
Journal of Sustainable Tourism	Can tourism be part of the decarbonized global economy? The costs and risks of alternate carbon reduction policy pathways	137	(24)
Sustainability	Sustainability of green tourism among international tourists and its influence on the achievement of green environment: Evidence from North Cyprus.	126	(16)
Journal of Sustainable Tourism	Tourism, growth and environment: Analysis of non-linear and moderating effects.	119	(23)
Society and Natural Resources	Community-based tourism: A pathway to sustainability for Japan's protected areas	117	(26)
Journal of Hospitality Marketing and Management	The Implementation of Green Marketing Tools in Rural Tourism: The Readiness of Tourists?	109	(21)
Computers and Industrial Engineering	Big data empowering low-carbon smart tourism study on low-carbon tourism O2O supply chain considering consumer behaviors and corporate altruistic preferences	105	(19)
Asia Pacific Journal of Tourism Research	Energy saving and carbon reduction behaviors in tourism: A perception study of Asian visitors from a protection motivation theory perspective	90	(15)
World Development Sustainability	Dynamic impacts of economic growth, energy use, tourism, and agricultural productivity on carbon dioxide emissions in Egypt	89	(22)
Journal of Hospitality and Tourism Management	The benefits and challenges of sustainable tourism certification: A case study of the green tourism business scheme in the West of England.	85	(20)
Sustainable Energy Technologies and Assessments	An energy-efficient smart city for sustainable green tourism industry	80	(8)

Most Cited Documents

Publication volume, however, does not directly correspond to scholarly impact. Figure 5 and Table 3 show that the most highly cited documents are distributed across several journals and thematic areas rather than being concentrated within the most productive outlet. Reference number 24 is the most cited document (24), with 137 citations, followed by studies on green tourism behaviour (16), the tourism-growth-environment relationship (23), community-based tourism and sustainability (26), and green marketing in rural tourism (21).

The remaining highly cited publications address low-carbon tourism supply chains and big-data applications (19), energy-saving and carbon-reduction behaviour (15), tourism-energy-emissions relationships (22), sustainable tourism certification (20), and energy-efficient smart-city

infrastructure (8). This diversity indicates that scholarly influence within the field has developed through multiple research streams, including environmental, behavioural, economic, technological, and operational perspectives.

Eight of the ten most cited documents were published before 2022, reinforcing the importance of citation exposure time when interpreting scholarly impact. Accordingly, the citation ranking captures accumulated influence within the published literature rather than the current importance or quality of individual studies. The contrast between rapidly increasing recent productivity and citation impact concentrated among earlier studies provides a useful transition from performance analysis to the thematic structure of the field.

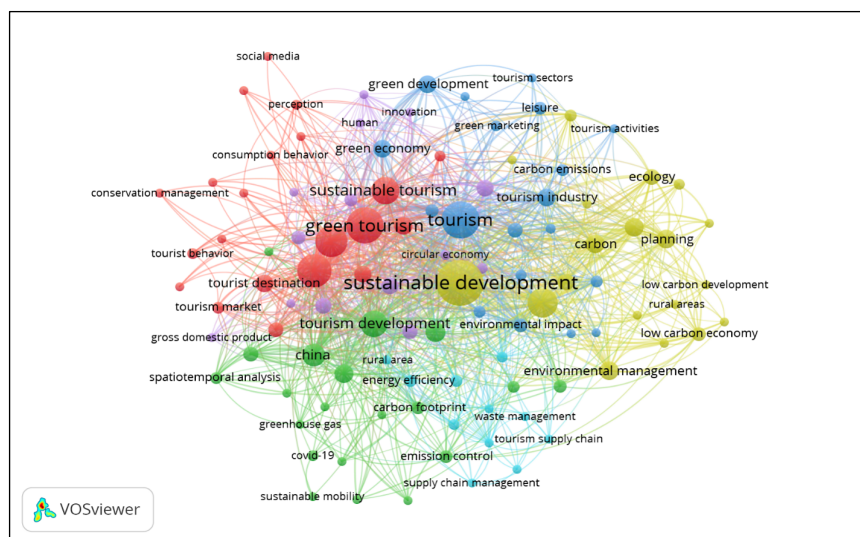


Figure 6: Keyword co-occurrence Network

Keyword Co-occurrence Analysis

The thematic structure underlying this expanding literature is revealed by the keyword co-occurrence network in Figure 6. Six clusters were identified, showing that the field is organised around several interconnected but distinct research perspectives. The key keywords, main themes, and sub-themes associated with these six clusters are summarised in Table 4.

Cluster 1 represents sustainable tourist behaviour and market dynamics. Keywords such as tourist behavior, perception, consumption behavior, public attitude, willingness to pay, marketing, and social media indicate a strong demand-side orientation. This cluster highlights the importance

of tourists' perceptions, attitudes, and market responses in understanding environmentally responsible tourism behaviour.

Cluster 2 focuses on carbon emissions, energy use, and climate change impacts in tourism. Its main keywords include carbon emission, carbon footprint, greenhouse gas, global warming, energy consumption, and climate change. The presence of methodological terms such as life cycle analysis and spatiotemporal analysis further indicates an emphasis on the measurement and assessment of tourism-related environmental impacts.

Cluster 3 centres on green economy, public policy, and tourism industry development. Keywords

such as green economy, public policy, green development, economic analysis, tourism industry, and developing countries reflect research examining the relationship between tourism development, economic transformation, and sustainability-oriented policy.

Cluster 4 represents low-carbon planning and sustainable tourism development. Keywords including low carbon tourism, low carbon economy, regional planning, environmental management, renewable energy resources, and rural tourism indicate an emphasis on planning, technological solutions, and environmentally sustainable tourism development across different spatial contexts.

Cluster 5 focuses on macroeconomic growth, innovation, and environmental sustainability. The presence of economic growth, gross domestic product, environmental degradation, environmen-

tal quality, innovation, and circular economy reflects research concerned with the relationship between economic development and environmental outcomes, as well as potential mechanisms for improving sustainability.

Cluster 6 represents an operational stream concerned with energy efficiency and green tourism supply chain management. Keywords such as energy efficiency, renewable energy, energy conservation, green tourism supply chain, supply chain management, and waste management indicate increasing attention to practical sustainability measures within tourism operations and value chains.

Taken together, the six clusters show that the conceptual structure of green tourism research extends from individual tourist behaviour to tourism operations, policy and planning, and broader economic and environmental systems.

Table 4: Thematic Clusters of Green Tourism and Sustainable Development Research

Cluster	Keywords	Main Theme	Sub-themes
Cluster 1 (Red)	conservation management; consumption behavior; ecotourism; environmental education; green tourism; hospitality industry; India; marketing; perception; public attitude; responsible tourism; social media; sustainability; sustainable tourism; Taiwan; tourism economics; tourism management; tourism market; tourist behavior; tourist destination; willingness to pay	Sustainable Tourist Behavior and Market Dynamics	(a) Tourist perception, attitudes, and pro-environmental behavior (b) Green marketing, destination-related perceptions, and willingness to pay
Cluster 2 (Green)	carbon emission; carbon footprint; China; climate change; COVID-19; cultural heritage; emission control; energy consumption; environmental economics; global warming; greenhouse gas; integrated approach; life cycle analysis; natural resource; spatiotemporal analysis; sustainable development; sustainable mobility; tourism development; tourist attraction	Carbon Emissions, Energy Use, and Climate Change Impacts in Tourism	(a) Carbon measurement, climate change, and environmental assessment (b) Energy consumption, mobility, and sustainable tourism development
Cluster 3 (Blue)	carbon emissions; commerce; developing countries; economic analysis; economic and social effects; energy; environmental impact; green development; green economy; green marketing; leisure; leisure industry; public policy; sustainable development; Thailand; tourism; tourism activities; tourism industry; tourism sectors	Green Economy, Public Policy, and Tourism Industry Development	(a) Green economy transition and policy-driven tourism development (b) Economic, social, and environmental impacts of tourism industries

renewable energy. This shift suggests that the field moved from broad sustainability framing toward more specific environmental measurement and decarbonisation issues.

More recent research attention is associated with terms such as green development, green marketing, social media, tourist behavior, consumption behavior, willingness to pay, waste management, and tourism supply chain. These keywords indicate a further diversification toward behavioural, market-oriented, and operational questions concerning how sustainability objectives can be implemented in tourism practice. Overall, the temporal development complements the cluster structure by showing that the field has not simply grown in volume; its research focus has also become progressively more differentiated. Broad concerns with tourism development and environmental sustainability have been supplemented by carbon and energy research and, more recently, by behavioural and operational approaches to sustainability implementation. This progression provides the basis for the policy and theoretical interpretation developed in the Discussion.

Discussion

Thematic Change and Shifting Policy Agendas

The temporal development identified in Figure 7 can be interpreted in relation to broader shifts in the international sustainability agenda. Earlier research was primarily concerned with the environmental implications of tourism development and with sustainability-oriented planning and management. From the mid-2010s onward, increasing attention to carbon measurement, environmental assessment, and sustainability targets coincided with the growing prominence of international climate and sustainable development agendas, including the Paris Agreement and the 2030 Agenda for Sustainable Development. This broader policy context is consistent with the increasing scholarly attention given to carbon emissions, energy efficiency, and low-carbon tourism.

Subsequently, research increasingly incorporated issues related to carbon reduction, energy transition, and the sustainability implications of tourism disruption and recovery. The appearance of COVID-19 within the keyword structure

indicates that pandemic-related concerns became incorporated into the sustainability research agenda. More recent attention to low-carbon development, green development, and renewable energy is also consistent with the growing policy emphasis on decarbonisation and carbon-reduction commitments, including research addressing China's "dual carbon" goals (10) and broader pathways for tourism decarbonisation (24).

The most recent thematic developments indicate a further movement toward sustainability implementation. Keywords such as willingness to pay, green marketing, waste management, and tourism supply chain suggest increasing attention to the behavioural, organisational, and operational mechanisms through which sustainability objectives may be translated into tourism practice. Overall, the temporal pattern suggests a progression from broad sustainability concerns toward environmental assessment and decarbonisation, followed by increasing attention to implementation-oriented solutions. This progression also points to the need for future research to evaluate whether emerging behavioural, technological, and operational interventions generate measurable sustainability outcomes.

Theoretical Interpretation of The Thematic Structure

From a theoretical perspective, the bibliometric mapping suggests several broad analytical perspectives within green tourism research. One stream focuses on tourist perceptions, attitudes, values, and environmentally responsible behaviour, as illustrated by value-orientation and protection motivation research (9, 15). A second perspective emphasises technological and operational mechanisms, including renewable energy, low-carbon infrastructure, supply-chain management, and tourism operations (8, 17–19). A third addresses broader economic, planning, and policy-related dimensions of sustainable tourism development. Although these perspectives are individually well represented, the cluster structure suggests that their integration remains partial. This fragmentation creates an opportunity for future research to develop multi-level frameworks linking tourist behaviour, organisational and technological practices, and broader institutional and environmental conditions.

More specifically, the thematic structure indicates that individual-level explanations of sustainable tourist behaviour and system-level approaches to decarbonisation appear to have developed as complementary rather than fully integrated research traditions. Behavioural studies primarily seek to explain why tourists adopt or resist environmentally responsible practices, whereas technological and operational research focuses on how tourism organisations and destinations can reduce resource consumption, emissions, and other environmental pressures. Integrating these perspectives would allow green tourism research to move beyond parallel explanations toward multi-level models in which tourist responses, organisational capabilities, infrastructure, and institutional conditions are examined simultaneously. Such integration may also help clarify whether environmentally favourable attitudes and behavioural intentions at the individual level are translated into measurable sustainability outcomes at organisational, destination, or system levels.

A strong environmental orientation is evident across the literature. Research has extensively examined tourism-related carbon emissions, energy consumption, environmental pressure, and relationships between tourism growth and environmental outcomes (1–3, 22–24). At the same time, renewable energy, energy efficiency, and low-carbon tourism development have emerged as important pathways for reducing tourism-related environmental impacts (6–8). Together, these strands indicate that environmental assessment and decarbonisation remain central components of green tourism research, while also highlighting the need to connect environmental performance more explicitly with behavioural and organisational mechanisms.

The field also contains a substantial behavioural and demand-side stream. Studies demonstrate the importance of tourists' values, attitudes, sustainability perceptions, and motivations in shaping environmentally responsible tourism practices (9–12, 15, 16). Green marketing and related market mechanisms further illustrate how tourism businesses and destinations may influence responses to sustainability initiatives (21). These findings reinforce the role of tourists as active participants in sustainable tourism transitions, but

also suggest that behavioural outcomes should increasingly be examined in relation to the operational and institutional conditions that enable or constrain sustainable choices.

At the operational level, increasing attention has been given to circular economy strategies, waste management, technology adoption, and green tourism supply-chain management (17–19). This development extends the field beyond isolated environmental initiatives toward more coordinated approaches involving tourism businesses, supply chains, infrastructure, and destination-level systems. The growing visibility of these themes further supports the need for theoretical frameworks capable of connecting individual behaviour with organisational practices and system-level sustainability outcomes.

Alignment with the Sustainable Development Goals

The six thematic clusters can also be interpreted in relation to the United Nations Sustainable Development Goals. The carbon, energy, and climate-related cluster aligns most closely with SDG 13 on climate action and SDG 7 on affordable and clean energy. The energy-efficiency and green supply-chain cluster is relevant to SDG 12 on responsible consumption and production, particularly through its emphasis on waste management and sustainable business practices. The behavioural cluster relates to SDG 12.8 through its focus on awareness, attitudes, and environmentally responsible consumption. The green economy and public-policy cluster is relevant to SDG 8.9 on sustainable tourism, while the low-carbon planning cluster connects with broader objectives under SDG 11 and SDG 15. The macroeconomic cluster also reflects the decoupling objective expressed in SDG 8.4. These relationships should be interpreted as thematic alignments rather than as direct evidence of progress toward individual SDG targets.

The mapping further suggests that environmental dimensions of sustainable tourism are more visible than social and distributional dimensions. Keywords directly related to gender equality, inequality, labour conditions, and social inclusion are comparatively limited within the identified clusters. This indicates a need for greater attention to the social consequences of green tourism transitions alongside their environmental and economic effects. Partnership and collaborative-

governance themes are also less prominent than environmental and operational themes, suggesting further opportunities for cross-sector and multi-stakeholder research.

Overall, the findings indicate that green tourism and sustainable development research has evolved into a multidimensional field encompassing environmental assessment, tourist behaviour, energy transition, policy, economic development, and tourism operations. However, the partial separation among these perspectives suggests that future theoretical advancement will increasingly depend on integrating behavioural, technological, operational, and institutional mechanisms within a more coherent sustainability framework.

Practical and Policy Implications

The bibliometric findings provide several practical and policy implications. For research funders, the thematic structure suggests opportunities to support areas that have received comparatively less attention, particularly operational decarbonisation, energy efficiency, waste management, and sustainable tourism supply chains. At the same time, the geographical distribution of publications indicates uneven research coverage across regions, suggesting a need to strengthen research capacity and comparative evidence in under-represented contexts.

For universities and research managers, the partial separation among behavioural, technological, operational, and policy-oriented perspectives highlights the value of interdisciplinary collaboration. Research teams combining expertise in tourism management, environmental science, energy studies, and public policy may be better positioned to examine how individual behaviour, organisational practices, technological capabilities, and institutional conditions interact in shaping sustainable tourism outcomes.

For destination managers and policymakers, the identified clusters provide a useful framework for considering complementary areas of intervention, including transport and energy systems, waste and supply-chain management, visitor behaviour, destination planning, and sustainability governance. Rather than treating these areas as isolated policy domains, the findings suggest that green tourism strategies may benefit from greater coordination between environmental infrastructure, tourism business practices, visitor-oriented measures, and destination-level planning.

The temporal development of the literature also indicates increasing alignment between green tourism research and broader climate and sustainable development agendas. The growing prominence of carbon reduction, energy transition, green development, and implementation-oriented themes is consistent with the wider policy emphasis on decarbonisation, the Sustainable Development Goals, and carbon-reduction commitments. This alignment suggests that policymakers may increasingly draw on green tourism research to identify areas in which tourism can contribute to broader sustainability objectives, particularly climate mitigation, resource efficiency, and responsible production and consumption. However, these bibliometric patterns should not be interpreted as evidence that particular policy initiatives directly caused changes in research priorities or that the identified interventions are necessarily effective. Bibliometric analysis reveals thematic visibility and temporal correspondence, but policy effectiveness requires additional empirical evaluation using environmental, economic, and social performance indicators.

The SDG-related interpretation further indicates that existing green tourism research provides comparatively strong coverage of environmental and resource-efficiency dimensions, while social and distributional aspects remain less developed. This imbalance suggests that future tourism policies should consider not only emissions, energy use, and resource efficiency, but also employment quality, community participation, social inclusion, and the distribution of costs and benefits associated with green transitions.

For tourism businesses and operators, the findings also suggest that sustainability strategies should extend beyond customer-facing green communication to operational practices that can be monitored and evaluated. Energy efficiency, renewable-energy adoption, waste management, and supply-chain coordination represent recurring areas of research attention and therefore provide relevant domains for organisational sustainability initiatives. Nevertheless, implementation decisions should be supported by context-specific evidence because the bibliometric results identify where research attention is concentrated rather than demonstrating the effectiveness of individual practices.

Limitations

This study contributes to the green tourism literature by mapping its thematic structure, thematic patterns, and emerging research directions. Nevertheless, several limitations should be acknowledged. First, the analysis relies exclusively on Scopus and is restricted to English-language publications; consequently, relevant studies indexed in other databases or published in other languages may not be represented. Second, although the search was conducted on 15 January 2026, records published toward the end of 2025 may still be affected by database indexing delays, while recent publications naturally have shorter citation windows and therefore fewer opportunities to accumulate citations. Third, bibliometric techniques have inherent methodological limitations: keyword co-occurrence identifies patterns of association rather than conceptual equivalence, cluster structures may vary depending on analytical thresholds and parameter settings, cluster labelling involves researcher interpretation, and total citation counts tend to favour older publications. These limitations should be considered when interpreting the findings and provide opportunities for future studies to extend and validate the present analysis. Fourth, the search strategy deliberately focused on publications explicitly indexed under “green tourism” or “low-carbon tourism” together with sustainability-related terms. Consequently, conceptually relevant studies framed exclusively through adjacent labels such as ecotourism, responsible tourism, regenerative tourism, or other forms of sustainable tourism may not have been retrieved unless they also contained the selected search terms. The findings should therefore be interpreted as a mapping of the explicitly green- and low-carbon-tourism literature rather than the entire sustainable tourism knowledge base.

Future Research

Building on the thematic patterns, conceptual gaps, and emerging areas identified through the bibliometric analysis, six directions for future research are proposed.

- (a) **Digital technologies and smart tourism:** Future studies should examine how digital technologies, smart tourism systems, mobile applications, augmented reality, and data-

driven tools can support sustainable tourism practices and influence tourists’ environmentally responsible behaviour, particularly in nature-based and rural destinations (13, 14). Beyond measuring attitudes and behavioural intentions, research should assess whether these technologies generate observable changes in travel choices, resource use, or other sustainability-related outcomes.

- (b) **Renewable energy and low-carbon infrastructure:** Further empirical research is needed on renewable energy integration, energy efficiency, and low-carbon technologies in tourism infrastructure, including accommodation, transport, and destination services (6, 8). Future studies should examine not only technical feasibility but also investment costs, economic returns, emission reductions, and long-term environmental performance in order to assess the practical viability of low-carbon tourism transitions.
- (c) **Psychological and cultural drivers of green behaviour:** Future research should further investigate tourists’ values, beliefs, emotions, social norms, motivations, and cultural differences using longitudinal, experimental, and cross-cultural research designs (9, 11, 15). Greater attention should also be given to the gap between stated intentions and actual behaviour, as well as to the conditions under which pro-environmental attitudes are translated into observable sustainable tourism choices.
- (d) **Supply chain and systems perspectives:** Greater attention should be given to green tourism supply-chain management, circular economy practices, waste management, and coordination among tourism businesses, suppliers, and destination actors (17–19). Future research could examine how these practices interact across tourism subsectors and how their environmental performance can be measured at organisational, supply-chain, and destination levels. Such work would help move the literature from isolated operational practices toward more integrated system-level approaches.
- (e) **Comparative and cross-national research:** Comparative studies are needed to examine how institutional, cultural, economic, and

developmental contexts influence green tourism transitions across countries and regions. Particular attention should be given to geographical contexts that remain comparatively under-represented in the existing literature. Cross-national research could also clarify whether behavioural, technological, and policy mechanisms identified in heavily studied Asian contexts operate similarly in other institutional and socio-economic settings.

- (f) **Methodological extension and theoretical integration:** Future reviews could integrate multiple bibliographic databases, including Web of Science and relevant regional indexing systems, and combine bibliometric analysis with systematic, qualitative, or content-based review methods. In addition, future empirical research should move toward multi-level designs that examine behavioural, technological, operational, and institutional mechanisms simultaneously. Such approaches would provide broader evidence coverage and help determine how individual tourist behaviour, organisational capabilities, infrastructure, and policy conditions interact in shaping measurable sustainability outcomes.

Conclusion

This bibliometric review provides a consolidated overview of how green tourism and sustainable development research has evolved over time. Drawing on 213 Scopus-indexed publications published between 1989 and 2025, the analysis shows that the field has moved beyond its earlier emphasis on general sustainability concerns toward a broader and more differentiated research agenda. Current scholarship spans environmental assessment, tourist behaviour, low-carbon development, policy, technological applications, and tourism operations, reflecting the increasingly interdisciplinary character of the field.

A key contribution of this review lies in demonstrating that the development of green tourism research is not defined only by growth in publication volume, but also by increasing thematic diversification and methodological breadth. The coexistence of behavioural, environmental, technological, economic, and operational perspectives indicates that green tourism has become a distinct and increasingly

mature area of sustainability research. At the same time, the uneven geographical distribution of publications and the concentration of accumulated citation influence among earlier studies underline the importance of interpreting research productivity and scholarly impact as related but distinct dimensions of field development.

Taken together, the findings position green tourism as an increasingly important research domain for understanding how tourism systems can respond to environmental and sustainability challenges. Continued progress will depend on broader geographical and methodological coverage, stronger connections across disciplinary perspectives, and greater attention to the practical conditions under which sustainability strategies can be implemented effectively. By clarifying the development and thematic structure of the field, this review provides a basis for more cumulative, comparative, and policy-relevant research on green tourism and sustainable development.

Abbreviations

SDG: Sustainable Development Goal.

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Author Contributions

All authors contributed substantially to the conception and design of the review, data curation and analysis, interpretation of the findings, and preparation and critical revision of the manuscript. All authors approved the final version and accept responsibility for the integrity of the work.

Conflict of Interest

The authors declare no conflict of interest

Data Availability

The cleaned dataset and VOS viewer files are available from the corresponding author upon reasonable request.

Declaration of Artificial Intelligence

(AI) Assistance

ChatGPT (OpenAI) was used only to assist with language editing, including grammar, wording, and clarity, as well as figure editing. The authors reviewed all outputs and take full responsibility for the originality, accuracy, interpretation, and integrity of the manuscript.

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