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Environmental and Economic Impacts of Mountain Tourism: A Critical Review

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ABSTRACT

Research on the environmental and economic impacts of mountain tourism has surfaced as a subject of significant global relevance over the last forty years. This study employs bibliometric analysis, the VOSviewer software, to examine the changing trends and intellectual framework of this discipline, covering the timeframe from the initial recorded publication in 1978 to the forecast for 2025. By using Scopus data, 287 refined documents were selected for bibliometric mapping analysis. The results indicate a distinct exponential increase, with a notable rise commencing in 2019, and the peak publication activity anticipated for 2025 (38 documents). The most frequently utilized keywords encompass “tourism”, “tourism development”, and “climate change”, highlighting the significance of the climate nexus in research initiatives. The most prolific author, Daniel J. Scott (H-index 69), is highlighted, though the author network is generally highly fragmented. The journal *Sustainability Switzerland* stands out as the most prolific publication outlet, while *Tourism Management* is the most prestigious. Leading institutions include the Chinese Academy of Sciences (CAS) and the Universität Innsbruck, with China acknowledged as the foremost nation in terms of publication volume, significantly contributing to the recent worldwide increase. The results indicate a marked and growing emphasis on the sustainable management of mountainous ecosystems, suggesting that this topic will continue to be a key area of discourse due to its importance in relation to global climate change and regional economic growth.

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1. Introduction

Using Scopus data for the period spanning 1978 to 2025, this study offers an extensive bibliometric examination of global research endeavors related to environmental and economic impacts of mountain tourism. The analysis delves into the intellectual framework of the field through essential metrics, including temporal evolution (annual output and growth stages), thematic concentration (keyword co-occurrence and most cited documents), academic impact (authors and most active sources), and structural organization (geographical and institutional affiliations).

Mountain regions, covering approximately 27% of the earth's land surface, are crucial for global environmental and socio-economic balance, providing vital resources and supporting over 1.1 billion people (FAO, 2016). Despite their global importance, these areas face increasing pressures from climate change, poverty, and land degradation. Mountain tourism, which constitutes 15–20% of the global tourism sector (Senese et al., 2025), plays a key economic role by creating jobs, boosting local economies, and supporting cultural preservation (Senese et al., 2025; Apollo et al., 2025). However, as consistently highlighted in the scientific literature through an extensive analysis of Scopus-indexed publications, this growing popularity simultaneously exerts considerable pressure on their inherently fragile ecosystems, generating significant environmental impacts.

The complex interplay between tourism development, environmental fragility, and the pervasive impacts of climate change creates a pressing need for a deeper understanding of how to foster truly sustainable and resilient development in these vulnerable areas. Contemporary scientific literature consistently underscores these multifaceted environmental and economic implications. Key environmental concerns include ecosystem degradation pathways such as pollution (Aminu et al., 2015) and erosion (Brusak et al., 2024, 2022; Brusak & Shtuhlynets, 2021), challenges in waste management (Neupane et al., 2024; Kuniyal, 2005), and the critical issue of carrying capacity exceedance (Yang, 2014; Mohamad & Marzuki, 2018; Rogowski et al., 2025). Economically, while tourism serves as a crucial livelihood support and poverty alleviation tool (Bùi & Luong, 2025; Chibaya & Zhou, 2025; Apollo et al., 2025), it faces significant vulnerabilities, particularly from seasonality (Yang et al., 2014; Banki et al., 2016; Pegg et al., 2012) and the acute threats posed by climate change to winter tourism (Campos Rodrigues et al., 2018; Bonzanigo et al., 2016), driving observable cryospheric changes (Knowles et al., 2024) and demanding urgent adaptation strategies (Campos Rodrigues et al., 2018; Hoy et al., 2011). Furthermore, effective management necessitates addressing socio-cultural dimensions, including community engagement (Rout & Gupt, 2017; Sisay Takele, 2019), alongside

developing overarching sustainability frameworks that promote integrated planning and multi-stakeholder collaboration (Wyss et al., 2015; Poeta Fernandes, 2023; Neupane et al., 2024).

Although a substantial body of work examines multiple dimensions of mountain tourism, a comprehensive and integrated understanding of the evolving research landscape on its environmental and economic impacts—including its geographical focus and principal contributors—remains limited. This study conducts a systematic bibliometric analysis to address this gap. The methodology assesses the field's temporal development, maps its intellectual structure through keyword analysis, and identifies the most influential documents and contributors across authors, journals, and institutions. It also outlines the field's organizational structure by examining the most productive countries and their international collaboration networks. The findings will clarify dominant research themes, emerging trends, and persisting gaps essential for advancing the sustainability and resilience of mountain tourism systems.

2. Aim of the Study

The main objective of this research is to conduct a systematic and thorough bibliometric analysis of the worldwide scientific literature concerning environmental and economic impacts of mountain tourism, as indexed in the Scopus database, covering the period from 1978 to the 2025 projection. This investigation is guided by the necessity to map the field's intellectual structure and evolutionary dynamics, thereby identifying dominant research trends and persistent gaps. In particular, this research focuses on the subsequent research questions (RQs):

RQ1: What are the temporal trends of the field, specifically its growth phases and annual publication output from 1978 to 2025?

RQ2: What constitutes the intellectual structure of the research domain, as identified by the most prevalent and interconnected keywords?

RQ3: Which documents have the highest impact on the field, based on citation analysis?

RQ4: Which authors have demonstrated the highest productivity and influence in the field of environmental and economic impacts of mountain tourism?

RQ5: Which sources are the most productive and influential, considering both publication volume and journal prestige?

RQ6: Which institutions are the most productive in the field?

RQ7: What is the structural organization of the field, defined by the most prolific countries and their international collaborative networks?

3. Methodology

3.1. Study design

This study seeks to systematically map the changing trends in research and the intellectual framework related to the environmental and economic impacts of mountain tourism. Employing a quantitative research methodology, the study utilizes a bibliometric approach to analyze the literature indexed in the Scopus database, spanning the comprehensive period from 1978 through to the projection for 2025. To guarantee a clear and thorough procedure in the selection and enhancement of the corpus, the analysis adheres to the guidelines provided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Moher et al., 2009). The entire process of conducting the bibliometric mapping analysis, based on the PRISMA protocol, is detailed in Fig. 1.

The initial search in the Scopus database yielded 292 documents. A meticulous refinement procedure was then executed to ensure data quality, resulting in the exclusion of five records (3 retracted documents and 2 erratum documents). This created a conclusive collection of 287 documents generated worldwide, which were ultimately preserved for the conclusive bibliometric evaluation.

3.2. Data collection

This analysis is based on scientific publications indexed in the Scopus database, encompassing a wide range of document types, including articles, book chapters, conference papers, reviews, notes, and books. Notably, no specific temporal limitation established, covering the entire Scopus coverage period from 1978 up to the projection for 2025.

To ensure high thematic specificity, the search was strictly applied to the article title (TITLE) field. The objective was to target publications explicitly focused on the intersection of tourism and its environmental and economic impacts within mountain contexts. The structured search logic was defined as follows:

TITLE (((term or expression related *mountain*) AND (term or expression related *tourism*)) AND ((term or expression related *environmental impact*) OR (term or expression related *economic impact*))).

Table 1. Terms and expressions used in the search strategy by thematic component

Thematic Component	Search Terms and Expressions
Mountain	mountain, alpine, high-altitude, highland, peak, summit, upland
Tourism	tourism, destination, excursion, expedition, exploration, explorer, getaway, guest, tour, tourist, travel, traveler, trip, vacation, visitor
Environmental impact	environmental impact, environment, air pollution, avalanche risk, biodiversity loss, carbon footprint, carrying capacity, climate change, deforestation, ecocide, ecological impact, ecosystem services, environmental implication, environmental alteration, environmental burden, environmental consequence, environmental cost, environmental damage, environmental degradation, environmental destruction, environmental deterioration, environmental disturbance, environmental effect, environmental fallout, environmental footprint, environmental influence, environmental repercussion, erosion, fire risk, habitat degradation, land use change, over-extraction, noise pollution, pollution, soil compaction, solid waste, vegetation loss, waste management, water quality, water scarcity, wildlife disturbance, stress
Economic impact	economic impact, economy, business, finance, community development, cost of living, economic benefit, economic burden, economic consequence, economic cost, economic dependence, economic effect, economic fallout, economic implication, economic influence, economic ramification, economic repercussion, employment opportunity, employment opportunities, entrepreneurship, income, income generation, inflation, infrastructure development, leakage, livelihoods, local economy, local economies, poverty alleviation, poverty reduction, regional development, revenue, seasonality

The search was conducted on November 1, 2025, and initially yielded 292 results. Following this initial retrieval, a meticulous quality check and refinement procedure were executed to ensure data integrity. Five records were excluded: three retracted documents and two erratum documents. The final dataset thus consists of 287 publications, which form the definitive corpus for the bibliometric analysis.

The bibliographic data for the 287 publications were downloaded from Scopus. The raw data were subsequently processed and cleaned using Microsoft Excel to standardize formats, verify author names, and ensure consistency before specialized analysis.

The analysis aimed to quantitatively map the intellectual and structural development of the field. In order to accomplish this, the subsequent variables were methodically extracted and assessed: publication output (yearly production, growth phases), intellectual structure (most prevalent keywords and highly cited documents), scholarly influence (most prolific authors and high-impact journals), and structural organization (leading institutions and productive countries).

For each of these 287 sample publications, various data were downloaded, encompassing citation information, bibliographic details, abstracts, and keywords. The gathered file was subsequently prepared for analysis using specialized software, notably VOSviewer, to facilitate the quantitative examination and visualization of research trends in the environmental and economic impacts of mountain tourism.

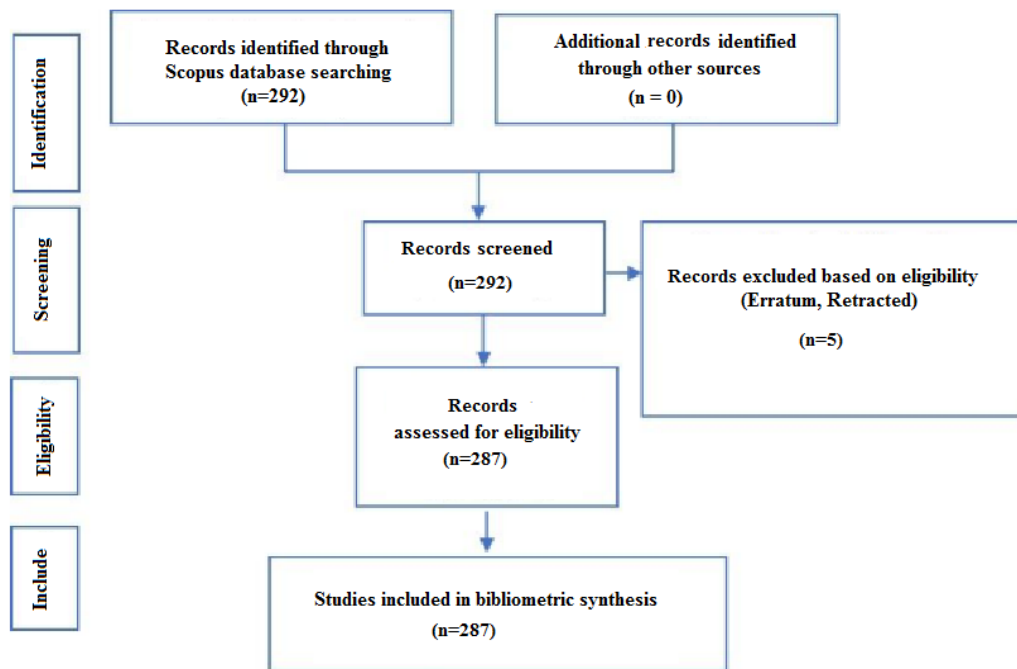


Fig. 1. PRISMA flow diagram of the present study

3.3. Data analysis

The research questions were addressed through a comprehensive examination of the refined corpus of 287 publications using established bibliometric methods. The initial quantitative data extraction and descriptive statistical assessments—such as examining the yearly increase in publications, pinpointing sources that exhibit the highest number of publications, and assessing the productivity levels of both institutions and authors—were performed and tabulated using Microsoft Excel.

A detailed citation analysis was conducted by tracking the total citation frequency for documents and authors, as indexed by Scopus. Crucially, in assigning authorship for productivity metrics, all individuals identified as authors were considered equally for each paper.

The Visualization of Similarities, VOSviewer (developed by Van Eck and Waltman, 2010), a widely adopted and openly available software, played a crucial role in the construction, analysis, and visualization of the bibliometric networks in this research. The software was used to perform network visualization, providing

graphical representations that are vital for illustrating the intellectual and structural development of the discipline. In particular, VOSviewer was utilized to visualize the following:

- intellectual structure: co-occurrence networks of keywords.
- scholarly influence: citation analyses to map influential documents and authors.
- structural organization: bibliographic merging visualizations to map networks of countries and institutions.

The selection of VOSviewer was driven by its widespread use and efficacy in producing clear, extensive bibliometric maps, which enabled the thorough observation and analysis of trends in research on environmental and economic impacts of mountain tourism.

4. Results

4.1. Publication and citation trends

This analysis addresses the question: “RQ1: What are the temporal trends of the field, specifically its growth phases and annual publication output from 1978 to 2025?”. It examines the dynamics of research productivity and influence within environmental and economic impacts of mountain tourism from 2000 to 2025, (data for “less than 2000” are noted separately in the accompanying table). The analysis tracks the annual number of documents (n publication) and citations (n cited)², as illustrated in the provided table and figure.

Table 2. Temporal evolution of publications and citations (1978–2025)

Year	N Publication	N Cited
<2000	21	38
2000	2	5
2001	0	5
2002	4	8
2003	2	6
2004	1	11
2005	5	10
2006	3	23

² Interpretation of the most recent data (particularly 2024 and 2025) requires standard bibliometric caution:

2025 publications: These figures are considered provisional and potentially incomplete due to ongoing indexing processes.

2025 citations: The count is inherently incomplete and artificially low relative to its potential due to the citation lag (the temporal delay required for newly published documents to be read, cited, and indexed). Nevertheless, the figure of 674 citations still represents the highest annual impact recorded, driven by the sustained influence of previously published works.

2007	3	25
2008	2	22
2009	3	31
2010	5	39
2011	7	44
2012	6	70
2013	11	89
2014	12	102
2015	8	125
2016	13	144
2017	12	158
2018	5	236
2019	21	309
2020	14	338
2021	22	388
2022	13	477
2023	19	511
2024	35	650
2025	38	674

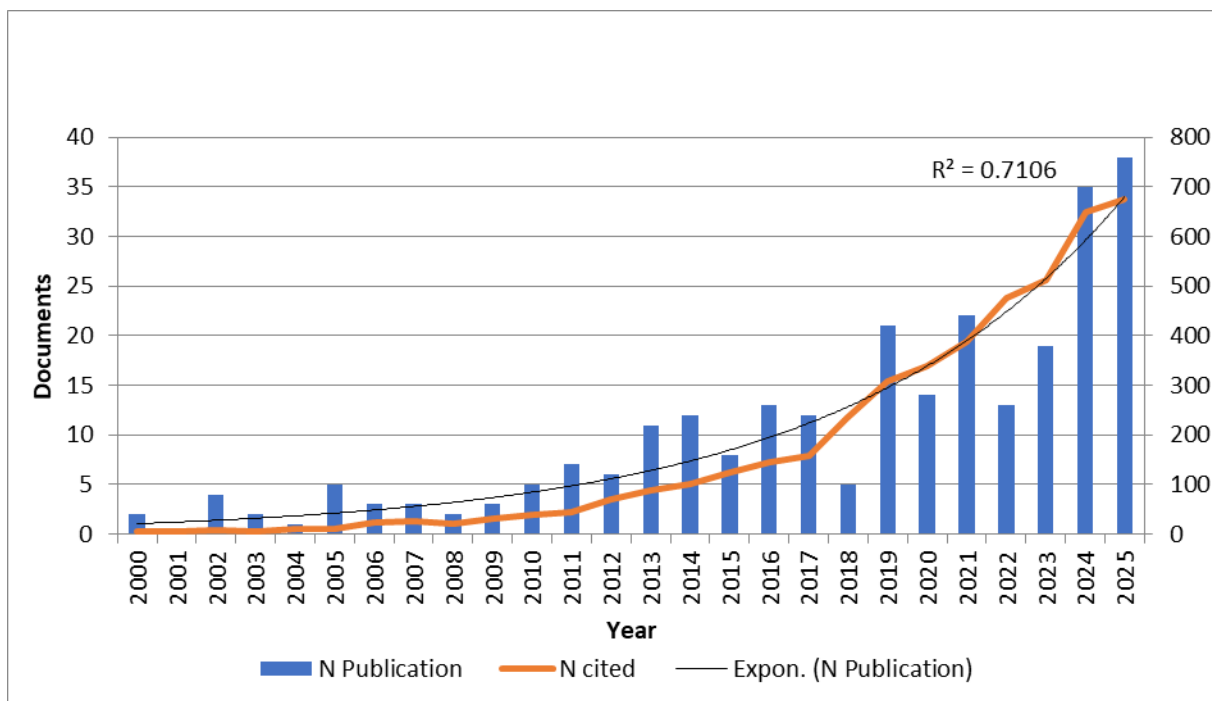


Fig. 2. Temporal evolution of publications and citations (2000–2025)

The field has demonstrably transitioned from a low-activity, latent phase to one characterized by rapid, exponential growth in both output and scholarly recognition.

4.1.1. Analysis of publication volume

The blue bars (n publication) highlight three distinct phases in the evolution of research output, confirming a major acceleration in scientific production:

- Early and latent phase (2000–2010): Activity was minimal and highly volatile. Annual production ranged from 0 to a maximum of 5 documents (in 2005 and 2010). Over this 11-year period, the average annual output was around 3 documents, reflecting an emerging or low-density research area.

- Establishment and moderate growth phase (2011–2018): Output became more consistent and saw moderate growth. Annual production steadily increased, generally plateauing between 8 and 13 documents (with peaks in 2014 and 2016). This phase marked the emergence of a stable and consistent research base.

- Accelerated and exponential growth phase (2019–2025): The field experienced a sharp surge in productivity, reaching its highest historical levels.

 - » output jumped significantly to 21 documents in 2019 and peaked at 22 documents in 2021;

 - » the figures for the most recent years confirm this explosive growth: 35 documents in 2024 and an all-time maximum of 38 documents projected for 2025.

The exponential trendline (expon. (n publication)) on the graph, supported by a high coefficient of determination ($R^2 = 0.7106$), visually confirms this exponential growth pattern, underscoring the rapid institutionalization and maturation of the research field.

4.1.2. Analysis of citation impact

The orange line (n cited) illustrates scholarly influence, which has also increased substantially, particularly since 2012, confirming the rising relevance of the research.

- Low to moderate impact (2000–2011): During this period, scholarly influence progressed slowly, with citations increasing modestly from 5 in 2000 to 44 in 2011. Overall recognition remained limited throughout these years.

- Acceleration of impact (2012–2018): Citation counts surged significantly, climbing from 70 in 2012 to 236 in 2018. This rapid increase highlights growing acknowledgment of the field's contributions by the broader scientific community, likely fueled by delayed recognition of earlier impactful work and an uptick in publication output.

- High and sustained impact (2019–2025): Citation counts are now maintained at a structurally high level. Annual citations surpass the 300-mark from 2019 (309) and

reach successive peaks: 477 in 2022, 511 in 2023, culminating in an unprecedented historical maximum of 650 in 2024 and 674 in 2025.

- Observation: The trend in citation impact illustrates a steady, near-exponential growth trajectory, closely tied to an increased volume of publications. This suggests that the boost in output has not only grown but is also receiving significant scholarly recognition. The citation-to-publication ratio has shown a clear improvement since 2018, further reinforcing the relevance of the research.

In conclusion, the research domain is currently in an advanced phase of accelerated, exponential development and institutionalization. This is characterized by:

- the highest volume of annual publications in its history (38 documents in 2025);
- the highest level of annual scholarly impact ever recorded (674 citations in 2025).

The field has successfully transitioned from a marginal topic to a highly dynamic discipline, marked by consistently increasing productivity and growing recognition.

4.2. Most used keywords

The following analysis is structured to address the core research question: “RQ2: What constitutes the intellectual structure of the research domain, as identified by the most prevalent and interconnected keywords?”. It integrates quantitative data from the provided frequency table and the qualitative VOSviewer visualization to map the intellectual structure of the domain.

The co-occurrence map and frequency table were generated using VOSviewer, based on a rigorously filtered set of indexed keywords. Keywords were included only if they achieved a minimum of 5 occurrences (as implicitly maintained for consistency with the analysis reference). This criterion resulted in the selection of 1925 keywords for the co-occurrence analysis, ensuring that the structural map is defined by only the most relevant and recurring concepts.

4.2.1. Quantitative assessment: Keyword frequency and link strength (Top 10)

The table presents the ten most frequently used keywords, offering insight into the recurrent terminology within the published documents.

Table 3. Top 10 most frequently used keywords (1978-2025)

Keyword	Occurrences	Total Link Strength
Tourism	69	293
Tourism development	37	150
Climate change	37	143
Sustainable development	35	148
Mountain region	30	148
China	28	106
Landforms	24	94
Ecotourism	23	116
Tourist destination	22	110
Sustainability	20	97

▪ Central thematic core: The unequivocally dominant term is *tourism* (69 occurrences, link strength 293), confirming its status as the foundational subject. It is immediately followed by the two pivotal conceptual drivers of the field: *tourism development* (37) and *climate change* (37).

▪ Sustainability and geographical nexus: The prominence of a socio-environmental approach is substantiated by the high frequency of *sustainable development* (35) and the geographical context of *mountain region* (30). Both terms exhibit high link strengths (148), indicating their strong interconnectedness with various sub-themes and concepts within the literature.

▪ Key sub-themes: The terms *ecotourism* (23) and *tourist destination* (22) highlight specific types of tourism and the spatial scales of the studies, while *sustainability* (20) reinforces the normative, long-term focus of the research agenda.

4.2.2. Qualitative and temporal interpretation

The co-occurrence map of the 66 keywords visually delineates the intellectual structure and identifies the emerging research frontiers:

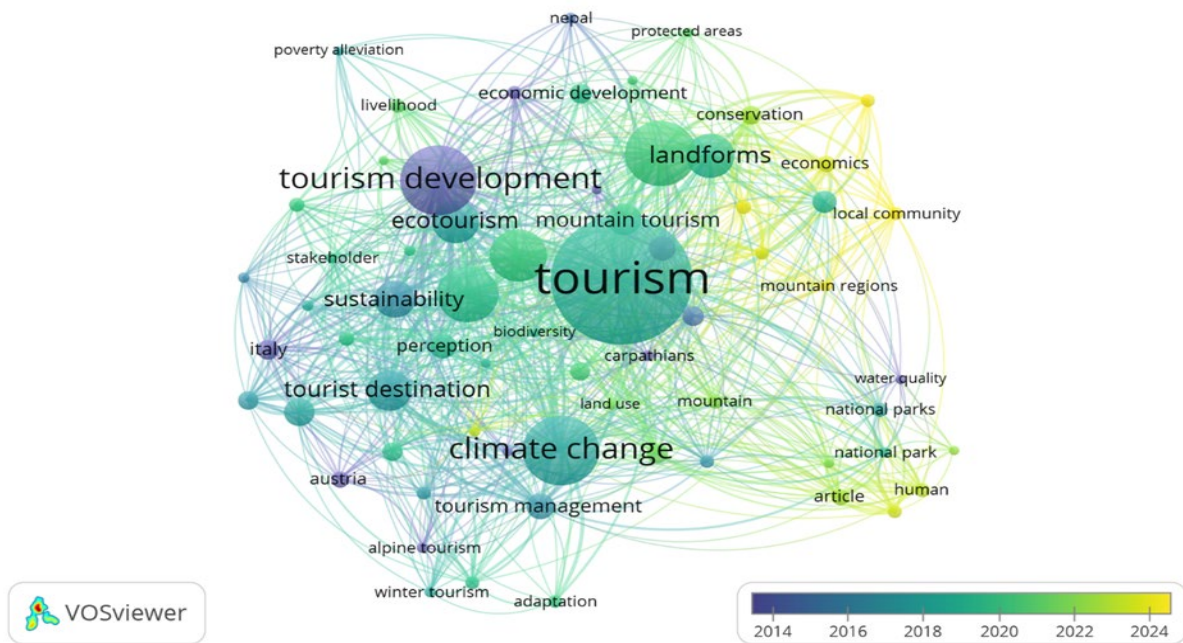


Fig. 3. Visualization depicting the co-occurrence of keywords

4.2.3. Thematic relevance and intellectual structure

- Central clusters (node size): The size of the nodes on the map confirms the intellectual dominance of *tourism*, *tourism development*, and *climate change* as the central themes shaping the research domain.

- Linkages to impacts (clusters): The central nodes exhibit strong connections to terms closely related to the analysis's emphasis on economic and environmental aspects:

- » development and economics: The cluster centered on *tourism development* is strongly linked to terms such as *economic development*, *poverty alleviation*, and *livelihood*, confirming the social and economic focus.

- » environment and destinations: The clusters surrounding *climate change* and *mountain region* are connected to concepts like *landforms*, *conservation*, *protected areas*, and *national parks*, validating the environmental and geographical focus.

4.2.4. Research fronts (temporal shift)

- Chronological layering: The color gradient (ranging from dark blue (2014) to yellow (2022)) indicates the average publication year for each keyword, revealing temporal shifts:

- » historical foundations (blue/green): Nodes such as *tourism*, *ecotourism*, *mountain tourism*, and *tourism development* display cooler colors (blue/light green),

suggesting they constitute the historical foundation and core theoretical base of the research field.

» current research frontiers (yellow): Nodes shaded yellow (indicating an average publication date closer to 2022 and beyond) signal the current research fronts. These recent themes include: *economics, local community, Nepal, poverty alleviation*, and specific geographic mentions like *Himalayas* and *China*.

These recent research fronts confirm a trend towards application, specificity, and detailed outcome assessment, shifting the focus from general concepts to the detailed socio-economic and ecological impacts within specific geographical contexts (e.g., the Himalayas, Alps, China).

In conclusion, the analysis, based on 1925 filtered keywords, establishes *tourism, tourism development, and climate change* as the core thematic elements. The research domain is distinctly focused on investigating the intersection of these concepts through the lens of sustainable development in mountain regions. The current trend shows a clear move toward examining specific socio-economic and ecological impacts applied to recent and specific case studies (yellow nodes).

4.3. Most highly cited document

This section addresses the question: “RQ3: Which documents have the highest impact on the field, based on citation analysis?”. This analysis details the most influential and highly-cited documents (Table 4, updated with complete titles), which have established the foundational methodologies, conceptual frameworks, and core thematic focus areas within the research on the environmental and economic impacts of mountain tourism.

Table 4. Top 10 most cited documents (1978-2025)

Authors	Title	Year	Source title	Cited by
Scott, D.; Jones, B.; Konopek, J.	Implications of climate and environmental change for nature-based tourism in the Canadian Rocky Mountains: A case study of Waterton Lakes National Park	2007	Tourism Management	271
Geneletti, D.; Dawa, D.	Environmental impact assessment of mountain tourism in developing regions: A study in Ladakh, Indian Himalaya	2009	Environmental Impact Assessment Review	211
Zoderer, B.M.; Tasser, E.; Erb, K.-H.; Lupo	Identifying and mapping the tourists' perception of cultural	2016	Land Use Policy	150

Stanghellini, P.S.; Tappeiner, U.	ecosystem services: A case study from an Alpine region			
Luthe, T.; Wyss, R.; Schuckert, M.	Network governance and regional resilience to climate change: Empirical evidence from mountain tourism communities in the Swiss Gotthard region	2012	Regional Environmental Change	126
Steiger, R.; Knowles, N.L.B.; Pöll, K.; Rutty, M.	Impacts of climate change on mountain tourism: a review	2024	Journal of Sustainable Tourism	118
Jaafar, M.; Rasoolimanesh, S.M.; Lonik, K.A.T.	Tourism growth and entrepreneurship: Empirical analysis of development of rural highlands	2015	Tourism Management Perspectives	99
Duglio, S.; Beltramo, R.	Estimating the economic impacts of a small-scale sport tourism event: The case of the Italo-Swiss mountain trail CollonTrek	2017	Sustainability (Switzerland)	96
Qian, C.; Sasaki, N.; Jourdain, D.; Kim, S.M.; Shivakoti, P.G.	Local livelihood under different governances of tourism development in China – A case study of Huangshan mountain area	2017	Tourism Management	95
Bachi, L.; Carvalho-Ribeiro, S.C.; Hermes, J.; Saadi, A.	Cultural Ecosystem Services (CES) in landscapes with a tourist vocation: Mapping and modeling the physical landscape components that bring benefits to people in a mountain tourist destination in southeastern Brazil	2020	Tourism Management	92
Pegg, S.; Patterson, I.; Vila Gariddo, P.	The impact of seasonality on tourism and hospitality operations in the alpine region of New South Wales, Australia	2012	International Journal of Hospitality Management	88

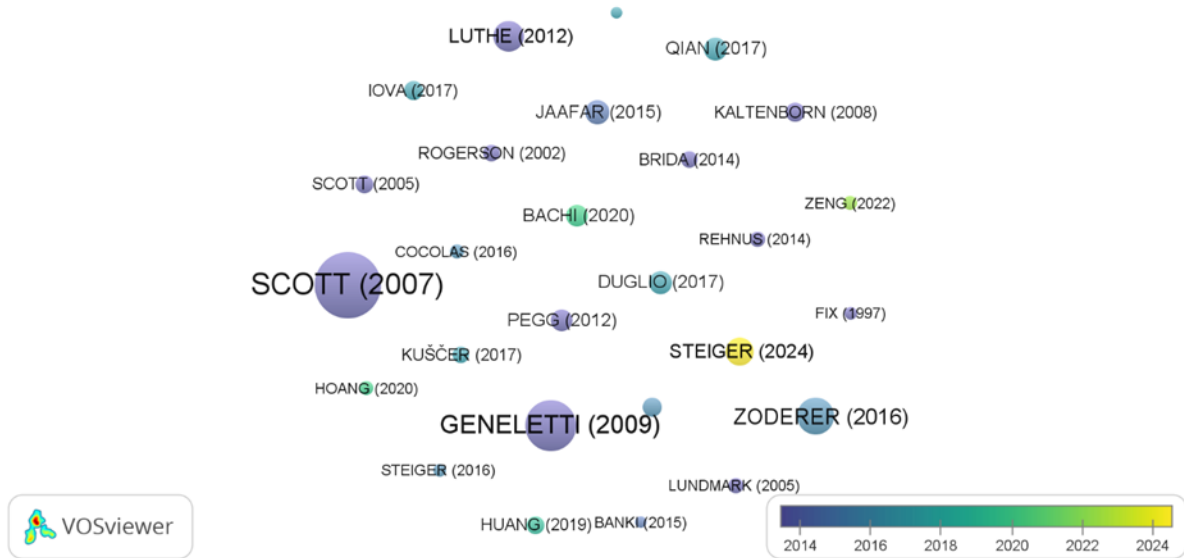


Fig. 4. Bibliometric map of author cited document

4.3.1. Core thematic pillars and foundational research

The top-cited literature crystallizes the field's focus on three interconnected pillars, all centered on mountain regions:

(1) Climate change and resilience (the leading axis)

- Foundational study: Scott et al. (2007), with 271 citations, established the climate-tourism nexus as the primary concern of the domain. Their focus on the implications of climate and environmental change for nature-based tourism provided the initial methodological framework for site-specific vulnerability assessments.

- Governance and adaptation: Luthe et al. (2012), with 126 citations, advanced the discourse beyond physical impacts by linking climate change adaptation to network governance and regional resilience. This paper emphasizes that an effective response to climatic stress is shaped by socio-political structures, not solely technological solutions.

- Current research front: The review by Steiger et al. (2024), with 118 citations, although recently published, quickly gained significant attention. This underscores that the climate change nexus—particularly the resulting environmental and economic impacts on mountain tourism—remains the most critical and actively synthesized topic, highlighting the urgent need for consolidated, forward-looking knowledge.

(2) Environmental assessment and ecosystem services

- Methodological blueprint: Geneletti et al. (2009) (211 citations) provides the crucial methodological blueprint through its focus on environmental impact assessment of mountain tourism in developing regions. This paper highlights the

sustained importance of robust, context-specific EIA in areas facing significant development pressure (e.g., Indian Himalaya).

- **Integrated valuation:** The work by Zoderer et al. (2016) (150 citations) and Bachi et al. (2020) (92 citations) integrates environmental protection with human valuation. By focusing on identifying and mapping the tourists' perception of cultural ecosystem services (CES), this literature emphasizes that economic sustainability in mountain areas is intrinsically linked to preserving the natural and cultural landscape for its amenity value.

(3) Socio-economic effects and local livelihoods

- **Economic quantification:** Duglio and Beltramo (2017), with 96 citations, provide methodological depth by focusing on estimating the economic impacts of specific, small-scale tourism events (e.g., a mountain trail), advancing research towards quantifiable, granular financial analysis.

- **Community and governance:** Qian et al. (2017), with 95 citations, addresses the core social dimension by examining local livelihoods under different governances of tourism development in China. This study confirms the academic priority on analyzing direct economic dependency and differential outcomes based on regulatory frameworks.

- **Entrepreneurship:** Jaafar et al. (2015), with 99 citations, adds the critical business dimension by analyzing tourism growth and entrepreneurship, highlighting the role of small and medium enterprises in rural highland development.

4.3.2. Publication outlets and disciplinary alignment

The journals housing these top-cited documents underscore the interdisciplinary nature of the field, though leaning heavily toward high-impact tourism management publications:

- **Core tourism management:** *Tourism Management* (4 documents: Scott, Qian, Bachi) serves as the primary outlet for conceptual and management-focused papers.

- **Sustainability and policy:** *Journal of Sustainable Tourism*, *Sustainability* (Switzerland), and *Land Use Policy* (3 documents: Steiger, Duglio, Zoderer) confirm the field's explicit orientation toward policy implications and sustainability science.

- **Environmental specialization:** *Environmental Impact Assessment Review* and *Regional Environmental Change* (2 documents: Geneletti, Luthé) host the foundational methodological work on environmental and climatic risk.

In conclusion, the analysis of the most-cited literature demonstrates that the intellectual framework of mountain tourism research is both well-established and highly influential. The research impact is concentrated in three key areas: climate

change adaptation and resilience, the development and application of environmental assessment methodologies (particularly CES), and the quantification of localized socio-economic impacts and livelihoods within varying governance frameworks. The rapid and significant citation of the 2024 review underscores that research offering syntheses on the climate nexus is currently the most valued within the scholarly community.

4.4. Most productive authors

This section addresses the question “RQ4: Which authors have demonstrated the highest productivity and influence in the field of environmental and economic impacts of mountain tourism?” This analysis examines the contributing authors' productivity (documents ≥ 3) and influence (citations and H-index), integrating the disciplinary alignment and geographic spread to assess the overall structural maturity of the field.

4.4.1. Author productivity and global influence

Table 5 (based on authors with $N \geq 3$ documents) provides key information regarding productivity in this specific domain and overall global impact (H-index).

Table 5. Most prolific authors (minimum 3 publications)

Author	Documents	Citations	Affiliation	Country	H index
Scott, Daniel J.	3	348	University of Waterloo	Canada	69
Steiger, Robert	3	174	Universität Innsbruck	Austria	29
Loomis, John B.	3	71	Colorado State University System	United States	54
Wang, Yaobin	3	26	Northwest Normal University China	China	7
Gan, Chang	3	17	Wuhan Polytechnic University	China	12
Pelfini, Manuela	3	16	Università degli Studi di Milano	Italy	31
Brusak, V.	3	3	Ivan Franko National University of Lviv	Ukraine	2
Cheng, Zhanhong	3	3	Shanxi University of Finance and EcoNomics	China	5
Singh, Amrik	3	0	Lovely Professional University	India	16

- Low core productivity: The entire list represents authors with the highest possible productivity in this corpus, yet all contributed only $N=3$ documents. This

confirms a fundamental structural characteristic of the field: highly influential global experts are tangentially involved in this specific research domain, often contributing only a few papers without high concentration.

- H-index leaders (global influence): The analysis highlights authors with exceptionally high global impact, indicating the domain successfully attracts top-tier scholars:

- » Scott, Daniel J. (H=69): Clearly the most influential author globally, largely driven by his seminal 2007 paper on climate change (271 citations). His work is foundational to the field.

- » Loomis, John B. (H=54): A prominent scholar from the United States, confirming the tangential involvement of highly experienced researchers.

- » Pelfini, Manuela (H=31): Represents strong influence from Italian research institutions, maintaining consistent contributions in environmental studies.

4.4.2. Thematic relevance

Authors with moderate-to-high H-indices who are directly linked to the core themes include Steiger, Robert (H = 29), confirming sustained contribution to climate change research. Authors with lower H-indices, such as Wang, Yaobin (H = 7), Gan, Chang (H = 12), Brusak, V. (H = 2), Cheng, Zhanhong (H = 5), and Singh, Amrik (H = 16), demonstrate peripheral involvement in the field.

4.4.3. Geographic and institutional diversity

The corpus demonstrates an extensive geographic spread, indicating wide international interest, but also revealing localized research clusters.

- Geographic dispersion: The selected authors represent research from seven distinct countries (Canada, Austria, United States, China, Italy, Ukraine, and India).

- Leading influence by country: Based on the highest H-index values among the top-productivity group, the greatest cumulative influence stems from Canada (H=69), the United States (H=54), and Italy (H=31), suggesting these nations host the most globally recognized expertise engaging with the topic.

- Geographic concentration (local clusters): The presence of three authors affiliated with China (Wang, Gan, Cheng) indicates a significant localized research cluster focused on Chinese mountain tourism contexts, confirming findings from the keyword analysis.

4.4.4. Collaboration network analysis



Fig. 5. Collaboration network of authors (thresholds: 2)

The VOSviewer co-authorship map (based on the threshold of $N \geq 2$ documents) visually confirms the structural organization of the field.

- **Fragmentation confirmed:** The visualization is characterized by numerous, distinct, and largely isolated clusters (nodes of different colors and minimal connecting lines between them). This signifies a highly fragmented network and a low level of inter-group collaboration across the international landscape.

- **Siloed research:** Research is predominantly conducted within small, closed groups or individual silos. Key high-impact scholars (e.g., Scott, Daniel J., Loomis, John B., Kaltenborn, Björn Petter) are positioned within their own isolated clusters, confirming the structural weakness of the collaborative effort beyond their immediate research teams.

- **Cluster examples:** Distinct clusters include the central Scott group (Scott, Abegg), the Scandinavian cluster (Kaltenborn, Bjerke), and several emerging Chinese clusters (Wang, Li, Gan, Cheng). The limited number of links between these clusters illustrates a lack of robust international co-production.

In conclusion, the bibliometric analysis reveals a pronounced structural paradox in this research domain. The field successfully attracts scholars of exceptionally high global impact (H-index up to 69) from numerous countries.

However, their contribution to this specific corpus is minimal ($N \leq 3$ documents), indicating tangential involvement. This leads to a highly fragmented collaborative network, confirmed by the VOSviewer analysis. The domain is characterized by low collaborative maturity, as research is conducted in isolated silos, lacking significant inter-group connection despite the presence of scientific leaders.

4.5. Most active sources

This section addresses the question “RQ5: Which sources are the most productive and influential, considering both publication volume and journal prestige?” The analysis focuses on the 14 academic sources presented in the table, assessing their activity (n documents) and influence/prestige (SJR 2024).

Table 6. Most prolific sources (minimum 3 documents)

Source Title	Documents	SJR 2024	Publisher
Sustainability Switzerland	15	0.688	Multidisciplinary Digital Publishing Institute (MDPI)
Journal of Sustainable Tourism	11	2.733	Taylor & Francis
Revue De Geographie Alpine	7	0.252	Armand Colin Editeur
Journal of Outdoor Recreation and Tourism	6	1.220	Elsevier
Tourism Management	6	4.146	Elsevier
Tourism Recreation Research	6	1.036	Taylor & Francis
Environment Development and Sustainability	4	0.958	Springer Nature
Journal of Mountain Science	4	0.615	Science Press
Iop Conference Series Earth and Environmental Science	3	0.214	Institute of Physics Publishing
Journal of Resources and Ecology	3	0.419	Editorial office of Journal of Resources and Ecology
Mountain Research and Development	3	0.505	International Mountain Society
Progress in Geography	3	0.620	Editorial office of Progress in Geography
Tourism Management Perspectives	3	1.870	Elsevier
Tourism and Hospitality	3	0.449	Multidisciplinary Digital Publishing Institute (MDPI)

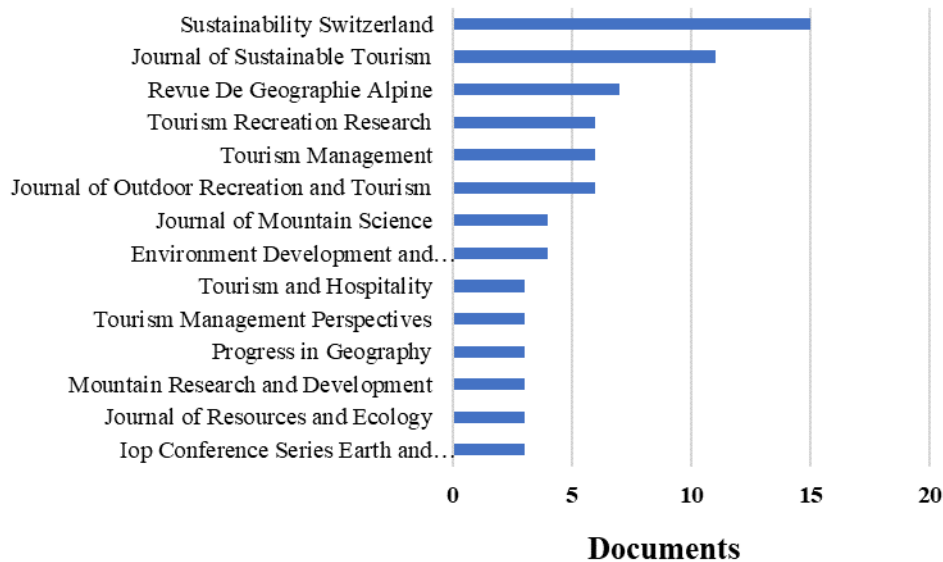


Fig. 6. Most prolific sources (minimum 3 documents)

4.5.1. Source activity and output (*n* publications)

The sample consists of a total of 77 documents across 14 sources. The activity is heavily concentrated in the top-ranking journals.

- **Thematic focus:** Research output is primarily published in journals specializing in sustainability and sustainable tourism. The two most prominent journals, *Sustainability Switzerland* (15 documents) and the *Journal of Sustainable Tourism* (11 documents), together represent a large portion (34%) of the total publications from journals with more than 3 documents (26 out of 77). This concentration emphasizes the substantial focus on sustainability in the research within this field.

- **Breadth of focus:** The remaining active sources show a mix of generalist tourism journals (*Tourism Management*, *Tourism Recreation Research*) and more niche publications (*Journal of Outdoor Recreation and Tourism*, *Revue de géographie alpine*).

- **Low-frequency sources:** A significant portion of the sample (8 out of 14 sources) consists of journals with only 3 or 4 publications. This may suggest stricter editorial selectivity, a more peripheral thematic connection to the study's core topic, or a focus on specific geographic areas, as seen with the *Journal of Mountain Science* (4 documents) and *Mountain Research and Development* (3 documents).

4.5.2. Source influence and prestige analysis (SJR 2024)

The SCImago Journal Rank (SJR 2024) serves as the core metric for assessing the influence and prestige of the publishing venues. Analysis of the most active sources reveals a notable activity-influence divergence within the field.

- Influence leadership: The highest academic prestige is clearly concentrated in mainstream, specialized tourism management journals. *Tourism Management* exhibits the strongest influence, with an SJR of 4.146, making it the most authoritative journal in the sample despite ranking fourth in publication volume (6 documents). The *Journal of Sustainable Tourism* likewise demonstrates substantial influence, with an SJR of 2.733, and ranks second in output with 11 documents.

- Activity–influence divergence: A central finding is the pronounced disconnect between publication volume and journal prestige:

- » *Sustainability* (Switzerland) is the most active source (15 documents), yet it exhibits a moderate SJR of 0.688. This profile—high output volume combined with a lower prestige score—is often characteristic of high-volume, open access journals like those published by MDPI.

- » *Tourism Management* displays lower activity (6 documents) but possesses a markedly superior SJR (4.146), suggesting a highly selective and impactful editorial policy.

- Lower prestige sources: The lowest SJR scores are recorded by sources that publish conference proceedings or have a more localized/general scope. Specifically, *IOP Conference Series: Earth and Environmental Science* (0.214) and *Revue de géographie alpine* (0.252) indicate the lowest relative academic influence compared to the top-tier, specialized management journals.

4.5.3. Publishing landscape (home publishing)

- Elsevier's role in prestige: Elsevier is the publisher associated with the three most prestigious journals in the tourism management field (*Tourism Management*, *Tourism Management Perspectives*, *Journal of Outdoor Recreation and Tourism*). Its journals set the standard for high-impact research in this area.

- MDPI's role in volume: MDPI (via *Sustainability Switzerland* and *Tourism and Hospitality*) is the publisher responsible for the largest volume of publications (18 documents total), reflecting its model as a major open access publisher focusing on rapid and high output.

- Taylor & Francis's presence: Taylor & Francis maintains a strong presence by publishing influential journals such as the *Journal of Sustainable Tourism* and *Tourism Recreation Research*.

In conclusion, the research corpus is characterized by a high volume of output on sustainability but is led in terms of prestige and influence by established journals in the tourism management sector, predominantly published by Elsevier.

4.6. Most productive affiliations

This section addresses the question “RQ6: Which institutions are the most productive in the field?”. Table 7 displays the affiliations with more than 4 documents that exhibit high productivity and influence in the realm of environmental and economic impacts of mountain tourism research.

Table 7. Most prolific affiliations (minimum 4 documents)

Affiliation	Country	Type	Documents
Chinese Academy of Sciences	China	Public	12
Universität Innsbruck	Austria	Public	9
University of Chinese Academy of Sciences	China	Public	8
University of Waterloo	Canada	Public	5
Università di Trento	Italy	Public	5
Colorado State University	United States	Public	4
Free University of Bozen-Bolzano	Italy	Public	4
Trondheim hovedkontor	Norway	Private (non-profit foundation)	4
Shanxi University of Finance and Economics	China	Public	4
Università degli Studi di Milano	Italy	Public	4
Eurac Research	Italy	Private (non-profit research center)	4
Lovely Professional University	India	Private	4
Høgskolen i Innlandet	Norway	Public	4
Chandigarh University	India	Private	4

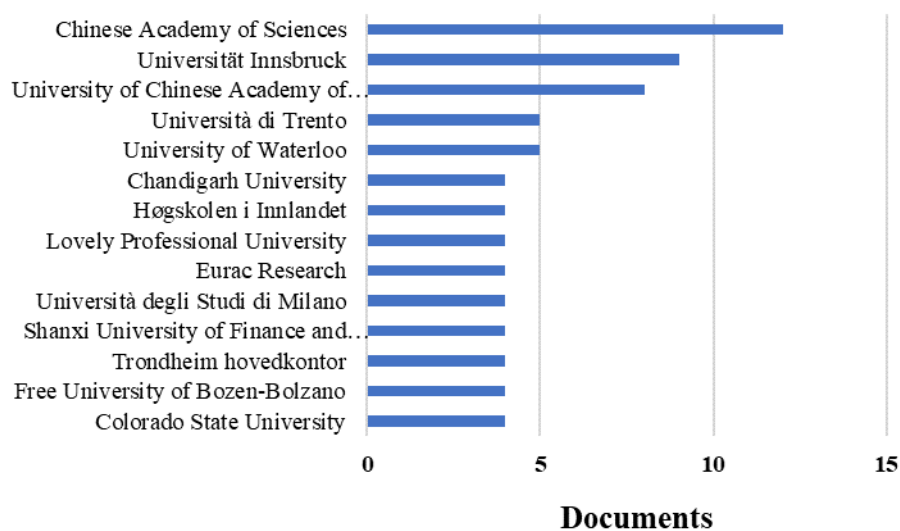


Fig. 7. Most prolific affiliations (minimum 4 documents)

Table 7 (and the corresponding bar chart) displays the top contributing institutional affiliations based on the number of published documents in the research field under study (inferred to be sustainable tourism, environmental sciences, and/or mountain studies).

4.6.1. Institutional productivity and global concentration

The analysis of the top 14 most productive institutions reveals a pronounced concentration of research output.

- **Dominance of Chinese institutions:** The Chinese Academy of Sciences (CAS) emerges as the leading global contributor with 12 documents. When combined with its affiliated institution, the University of Chinese Academy of Sciences (8 documents), the CAS network accounts for 20 documents within this select group. This signifies a substantial national commitment and focus on the research domain, likely related to resource management, ecology, or large-scale environmental planning, aligning with journals like the *Journal of Resources and Ecology* and *Journal of Mountain Science* from the previous data set.

- **European leadership in mountain studies:** The Universität Innsbruck (9 documents) holds the second-highest productivity. Given its geographic location and specialized research history in Alpine and mountain environments, this high ranking suggests a strong European contribution to the *Mountain Research and Development* and *Revue de géographie alpine* segments of the research area.

- **North American and Indian presence:** Institutions from North America (University of Waterloo, 5; Colorado State University, 4) and India (Lovely Professional University, 4; Chandigarh University, 4) show moderate but consistent contributions, indicating broader international engagement.

4.6.2. Geographical distribution and institutional typology

The top 14 productive affiliations originate from seven distinct countries (China, Austria, Canada, Italy, USA, Norway, India).

- **Prevalence of public institutions:** Academically, the research field is largely driven by state-funded entities. Ten of the fourteen institutions are classified as public universities or state-funded academies. This confirms that core disciplinary research relies heavily on governmental and public sector investment in China, Europe, and North America.

- **Strategic role of private foundations:** Significantly, the research is augmented by non-profit research centers/foundations. Both Trondheim hovedkontor and Eurac Research (an Italian research center) contribute 4 documents each. These entities,

classified as private (non-profit foundation/research center), possess a high level of specialization, which allows them to maintain high productivity in niche areas like environmental sustainability and regional development, bridging the gap between pure academic research and applied policy.

- Emerging private sector input: Contributions from private universities in India (Lovely Professional University and Chandigarh University, 4 documents each) are also notable, indicating the growing role of privately-funded higher education in global research output.

In conclusion, the analysis of institutional productivity reveals a dual-axial leadership structure: Asia (China) contributes the largest volume of publications, largely through its national research network (CAS), while Europe provides strong, specialized expertise, particularly in mountain and regional studies (Universität Innsbruck, Italian/Norwegian affiliations). The field is predominantly supported by public universities and research academies, with crucial, high-output contributions from specialized private (non-profit) research foundations.

4.7. Most productive countries

This section addresses the question “RQ7: What is the structural organization of the field, defined by the most prolific countries and their international collaborative networks?” The following analysis is based on the provided table (Top 10 countries/territories by document count) and the VOSviewer co-authorship map, which visualize the geographical distribution and collaboration patterns of the research output. The table clearly identifies the most prolific countries contributing to the corpus of documents under study.

Table 8. Top 10 most prolific countries

Country/Territory	Documents
China	62
Italy	26
India	25
United States	23
Austria	18
Germany	16
Undefined	15
France	13
United Kingdom	13
Switzerland	12

- **Dominance of China:** China is the unquestionable global leader in terms of sheer volume, contributing 62 documents, which is more than double the output of the second-ranked country, Italy (26 documents). This strong output aligns with the prevalence of Chinese institutions in the top-contributing affiliations.

- **Top 4 concentration:** The top four countries—China, Italy, India, and the United States—collectively contribute 136 documents.

- **Geographic groupings:**

- » **Asia (China, India):** Contributes 87 documents, confirming Asia as the most prolific continent in this specific research area.

- » **Europe (Italy, Austria, Germany, France, United Kingdom, Switzerland):** Contributes 108 documents (excluding the Undefined category), establishing Europe as a major regional contributor, with a balanced distribution across multiple countries.

- » **North America (United States):** Contributes 23 documents.

- **The undefined factor:** The presence of 15 undefined documents suggests a non-negligible portion of the research output could not be clearly attributed to a country, which is a common limitation in bibliometric studies.

4.7.1. International collaboration patterns

The VOSviewer network map visualizes the co-authorship links between countries, with node size indicating the volume of documents and link thickness representing the strength of collaboration (number of co-authored documents). Node color represents the average publication year (ranging from dark blue/purple for older publications to bright green for recent ones).

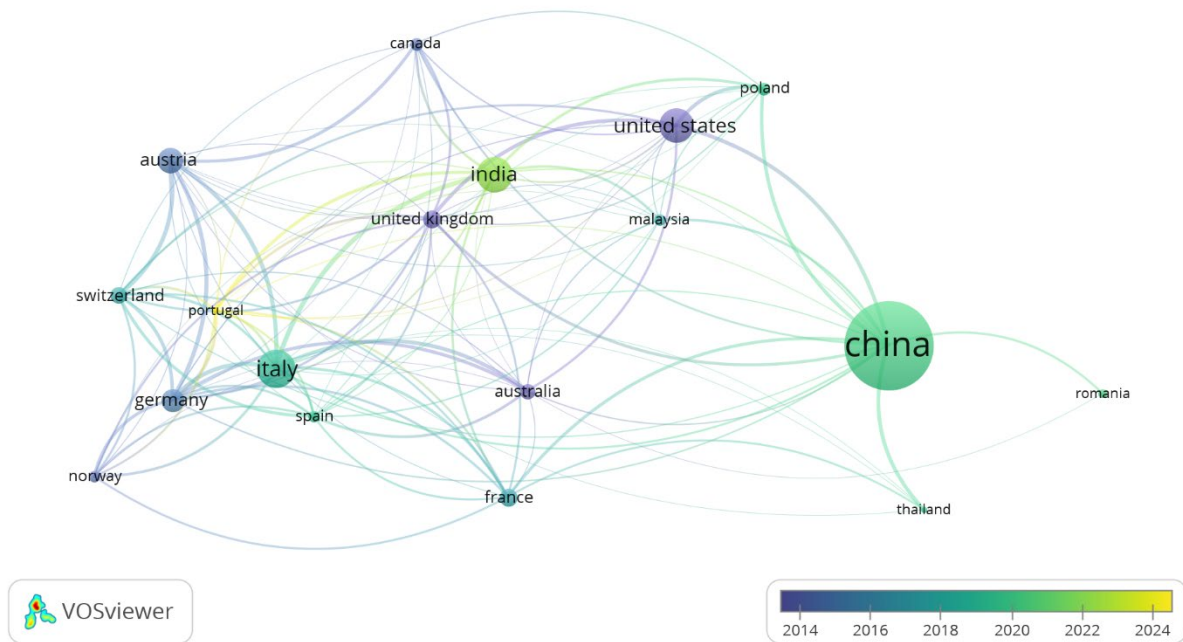


Fig. 8. Bibliographic coupling of the most productive countries

4.7.2. Centrality and cluster analysis

- **Central Node (China):** Consistent with the table, China is the largest node, signifying its highest document count. It occupies a central position, indicating numerous collaboration links across continents, particularly with the United States, Germany, and Australia.
- **Key clusters:** The map suggests a dominant European cluster comprising countries like Austria, Switzerland, Germany, Italy, and France. These countries show high internal interconnectivity (thick links between them), which points to strong intra-regional collaboration within Europe on this research topic.
- **Intercontinental links:**
 - » The link between China and the United States is highly visible and thick, representing a major transcontinental collaboration axis.
 - » Canada acts as a bridge, showing connections to both the European cluster (e.g., Austria) and Asian/Pacific countries.

4.7.3. Temporal trends (color coding)

- **Recent focus:** Many of the most active nodes, including China, India, Italy, and Germany, show bright green or yellowish hues (closer to 2022–2024), suggesting that the bulk of the research activity in these top-producing countries is very recent. This indicates a high and increasing contemporary focus on the research topic globally.
- **Older activity:** Nodes with a darker blue color (e.g., some parts of the United States cluster) suggest that these countries were active earlier in the research

timeline, potentially establishing the foundational research before the current boom observed in China and India.

In conclusion, the bibliometric evidence demonstrates that research output on this topic is currently dominated by Asian countries, led by China in terms of absolute volume. However, the influence and collaboration network is highly complex, featuring a robust and cohesive European research cluster alongside significant global partnerships, most notably between China and the United States. The temporal analysis confirms that this research area is gaining significant momentum globally, with most contributions from the leading countries being published in the most recent years.

5. Discussion

This research offers a concentrated bibliometric examination of the developing research trends related to environmental and economic impacts of mountain tourism within the scientific literature indexed in Scopus. The study spans more than forty-five years, covering the period from the first recorded publication in 1978 through the projection for 2025. An exhaustive initial search identified 292 documents, after which a rigorous refinement process was conducted, leading to the exclusion of five records (three retracted documents and two erratum documents). This process resulted in a final corpus of 287 documents produced worldwide. The overall results underscore a significant shift from a low-activity, latent phase—where the pre-2000 documents received a limited total of 38 citations—to a contemporary phase characterized by rapid, exponential growth in both output and scholarly recognition.

The longitudinal examination of annual production substantiates this acceleration, especially highlighting the distinct shift into an accelerated and exponential growth phase that commenced in 2019. This timeframe witnessed the most vigorous research activity, leading to the highest anticipated publication count in history for 2025 (38 documents). The most significant annual spike in volume occurred between 2018 (13 documents) and 2019 (21 documents), representing a substantial increase of 8 publications (or a 61.5% jump). Over the past seven years (2019–2025), this ongoing increase in publications, along with the simultaneous rise in citation impact, validates that the environmental and economic impacts of mountain tourism has successfully transitioned from a marginal topic to a highly dynamic discipline undergoing rapid institutionalization in the 21st century.

Expanding on this temporal trajectory, the intellectual framework of the field is distinctly outlined by the most commonly utilized keywords. An analysis of

keywords indicated that *tourism* was the most frequently used keyword, unequivocally affirming its position as the foundational subject within this field. This specific keyword appeared 69 times, with an aggregate link strength of 293. The frequency of the term *tourism* is mainly due to its pivotal role as the central focus of researchers' inquiries, illustrating the essential scope of the literature. Following closely were keywords such as *tourism development* (37 occurrences, 150 total link strength) and *climate change* (37 occurrences, 143 total link strength). The prominence of a socio-environmental approach is further substantiated by the high frequency of *sustainable development* (35 occurrences) and the geographical focus on *mountain region* (30 occurrences). These findings collectively highlight the intellectual framework of the field, which is clearly centered on exploring the intersection of tourism, environmental change, and development in mountainous regions.

This thematic orientation is strengthened by the substantial influence of foundational contributions that articulate the core pillars of the field. Analysis of the most highly cited documents demonstrates the intellectual consolidation and significant scholarly impact of this research area, with influence centered on three interconnected pillars: climate change, environmental assessment, and socio-economic effects. The seminal paper by Scott et al. (2007), *Implications of climate and environmental change for nature-based tourism in the Canadian Rocky Mountains: A case study of Waterton Lakes National Park*, is the most cited work with 271 citations, firmly establishing the climate–tourism nexus as the field's dominant focus. When considering annual citation rates, the most notable result is the immediate visibility of the most recent contribution: the review by Steiger et al. (2024), *Impacts of climate change on mountain tourism: a review*, has already garnered 118 citations, yielding an exceptional rate of 118 citations per year. This unusually high initial rate confirms that integrative syntheses and forward-looking knowledge on the climate change nexus continue to represent the most valued contributions within the scholarly community. Moreover, the journals in which these top-cited studies are published—particularly *Tourism Management* (with four articles)—reflect the interdisciplinary profile of the field, though it remains closely aligned with leading tourism management outlets.

Nevertheless, the structural input from the research community uncovers an unexpected trend. An examination of the most prolific authors highlights a significant structural contradiction within the discipline. In contrast to fields with high concentration, the complete roster of leading contributors in this dataset each produced merely three documents, thereby affirming that the most impactful global specialists are only peripherally engaged in this particular research domain. Despite

this limited core productivity, the field continues to attract leading scholars, as demonstrated by the global influence indicators (H-index). Scott, Daniel J. emerges as the most influential author worldwide, with an H-index of 69, primarily attributable to his pioneering contributions on climate change, thereby reaffirming his foundational status in the field. This configuration produces a markedly fragmented collaborative network, in which major high-impact researchers work within isolated clusters, indicating low collaborative maturity even in the presence of established scientific leaders.

This body of research is disseminated primarily through two distinct categories of publication outlets. Examination of the most active sources reaffirms the thematic core of the field: the intersection of sustainability and tourism management. Sustainability Switzerland emerges as the most productive outlet, contributing 15 publications. In contrast, *Tourism Management* (6 publications) holds the highest prestige indicator (SJR 4.146). This pattern underscores a notable activity–influence divergence within the field: although MDPI journals dominate in terms of output volume, mainstream outlets such as *Tourism Management* and the authoritative *Journal of Sustainable Tourism* (11 publications, SJR 2.733) establish the highest scholarly standards. This emphasis reflects the need for expertise in sustainability science and economic planning, aligning with the core missions of the field's most active and most prestigious journals.

The institutional impetus for this research illustrates a clear global and structural leadership. An examination of the most productive institutions reveals a dual-axial leadership structure characterized by both high volume and specialized expertise. The Chinese Academy of Sciences (CAS) emerges as the foremost global contributor, having produced 20 documents (CAS network), indicating a significant national dedication from China toward the research domain, which dominates the overall output (62 documents). Following closely, the Universität Innsbruck (9 documents) demonstrates strong European leadership in specialized Alpine and mountain studies. Moreover, the domain of research is predominantly influenced by public institutions, with 10 out of the 14 leading contributors, which underscores a significant dependence on government funding, complemented by essential input from specialized private non-profit foundations like Trondheim hovedkontor and Eurac Research.

6. Conclusion

This bibliometric analysis explores the research landscape surrounding the environmental and economic impacts of mountain tourism covering a period

exceeding forty-five years, from 1978 to the projected year of 2025. The data unequivocally reveals a rapid, exponential growth in scholarly interest, particularly since 2019, with the peak publication activity projected for 2025 (38 documents). The keyword *tourism* predominates in the literature, alongside *tourism development* and *climate change*, indicating the importance of the climate nexus in research activities. The foundational paper, *Implications of climate and environmental change for nature-based tourism in the Canadian Rocky Mountains: A case study of Waterton Lakes National Park* by Scott et al. (2007), holds the highest number of citations, while the newest review by Steiger et al. (2024) shows the highest annual citation rate (118 citations/year), underscoring the urgency of climate-related synthesis. Notably, Scott, Daniel J. (H-index 69), hailing from Canada, stands out as the most influential contributor, although the network of authors is generally highly fragmented. The journal *Sustainability Switzerland* emerges as the most prolific publication outlet, while *Tourism Management* is the most prestigious. Furthermore, the Chinese Academy of Sciences (CAS) is identified as the most productive institution, and China is acknowledged as the leading country in terms of publication output, substantially contributing to the recent global expansion of research in this field. This topic holds considerable significance, as the sustainable management of mountain environments is regarded as essential within the broader context of global climate change and regional economic development in the twenty-first century.

6.1. Limitations

The limitation of this study is its exclusive reliance on Scopus documents. Although Scopus offers access to a substantial number of prominent, high-impact journals with comprehensive bibliographic information, relying exclusively on Scopus as the data source may not capture all publications related to mountain tourism, especially those appearing in local or regional journals or in book chapters. This limitation may lead to an incomplete representation of the full breadth of regional mountain studies. Future research could expand its coverage by integrating document data from specialized databases such as the Web of Science (WoS), which provides comprehensive impact metrics, alongside thematic resources like CAB Abstracts and DOAJ, to attain a more comprehensive and integrated understanding of the scholarly discourse, particularly with respect to rural development and ecological impacts.

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