

Indigenous Knowledge in Disaster Management Research: A Science-Mapping Analysis

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INDIGENOUS KNOWLEDGE IN DISASTER MANAGEMENT RESEARCH: A SCIENCE-MAPPING ANALYSIS

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Abstract

Indigenous Knowledge has increasingly been recognised as a resource for disaster risk reduction, climate change adaptation and community resilience. However, the evolution and conceptual structure of research linking Indigenous Knowledge with Disaster Management remain insufficiently synthesised. This study maps the research landscape of Indigenous Knowledge in Disaster Management using bibliometric analysis. Publications were retrieved from Scopus and Web of Science for 2005–2025 using terms related to indigenous, traditional and local knowledge, disaster management, disaster risk reduction, climate adaptation and natural hazards. The datasets contained 926 Scopus and 513 Web of Science records. After removing 421 duplicates using the duplicate-removal function in R, 1,018 documents were retained for analysis. Biblioshiny was used to examine publication growth, sources, authors, keywords, trend topics, co-occurrence networks, thematic maps, thematic evolution, factorial structure and international collaboration. The results show rapid growth, with an annual growth rate of 22.3% and publication output reaching 168 documents in 2025. The thematic analysis identifies traditional knowledge–disasters–floods as a motor theme, while climate change–indigenous knowledge–resilience represents an important basic theme. Factorial analysis further distinguishes hazard-specific disaster management from climate adaptation and resilience, positioning Indigenous Knowledge close to community resilience and disaster risk reduction. International collaboration is concentrated around major research-producing countries. The study demonstrates the increasing integration of Indigenous Knowledge into Disaster Management and identifies its systematic incorporation into disaster risk reduction and climate adaptation.

Keywords; Indigenous knowledge, Disaster management, Disaster risk reduction, Thematic analysis, Bibliometrics.

1. Introduction

Disasters are increasingly frequent, intense, and complex, producing cascading human, economic, social, and environmental consequences (*Report for the Mid-Term Review of the Sendai Framework for Disaster Risk Reduction*, 2023). Disasters pose significant threats to human lives, livelihoods, ecosystems, and sustainable development, highlighting the need for effective and context-sensitive approaches to disaster risk reduction. In this context, Indigenous Knowledge has gained increasing recognition as an important resource for understanding and managing disaster risks at the community level (Berkes et al., 2021).

Developed through generations of interaction with local environments, Indigenous Knowledge encompasses locally embedded observations, practices, coping strategies, and adaptive responses that can support disaster preparedness, risk reduction, response, and recovery (Hadlos et al., 2022).

Recent research has emphasized the potential of Indigenous and local knowledge to complement scientific approaches and strengthen community resilience to natural hazards (UNDRR, 2023). However, despite the growing scholarly interest in this area, the global development and structure of research on Indigenous Knowledge and disaster management require further systematic examination.

1.1 Global disaster-management context: rising frequency and complexity

1) The evolving disaster landscape: frequency, intensity, and systemic risk

- The disaster landscape has become more dynamic due to climate change, urbanization, and human activities, leading to higher exposure and vulnerability. Global analyses emphasize that hazard intensity interacts with environmental and socioeconomic conditions to shape losses, underscoring the importance of considering hazard, environment, and exposure as a coupled system (Shi et al., 2020). This framing aligns with disaster risk science that views a disaster as arising from hazard, environment, and exposed units with regional interconnectedness and complexity (Shi et al., 2020).
- Empirical syntheses show a rising trend in disaster occurrences and economic losses, with natural disasters accounting for a growing share of global events relative to insured losses in some periods, highlighting gaps in risk transfer and the need for comprehensive risk financing (O'Connor et al., 2021; Pauch et al., 2024). Several reviews also document a surge in multi-hazard and cascading risk, where simultaneous or sequential events amplify overall impact (O'Connor et al., 2021; Tomaszewski et al., 2020).
- Longitudinal data indicate that reporting improvements and awareness contribute to apparent increases in recorded events since mid-20th century, while policy frameworks (e.g., Sendai) are associated with improvements in preparedness and resilience that can attenuate fatalities and losses over time (Cvetković et al., 2024; Surianto et al., 2019).

1.2 Indigenous Knowledge in Disaster Management

Indigenous knowledge (IK) in the context of disaster management refers to the understandings, practices, innovations, and worldviews that are developed and transmitted within Indigenous and local communities over generations (Berkes et al., 2021; Lee & Chen, 2021). It encompasses knowledge about hazards, environmental indicators, risk reduction, adaptation, and resilience that are place-based, culturally embedded, and often interwoven with social institutions, language, and customary governance (Nyahunda et al., 2025; Pimprikar et al., 2023). In disaster management, IK is recognized as a complementary knowledge system that can inform hazard identification, early warning, preparedness, response, recovery, and long-term resilience when integrated with scientific and technical approaches (Reyes et al., 2020; Syahputra, 2019). This synthesis draws on multiple sources to define IK, describe its functions in disaster risk reduction (DRR), and highlight common themes and tensions across cases (Motsumi & NemaKonde, 2024).

1.3 Limitations of Conventional/Top-Down Disaster Management Approaches

Disaster risk management (DRM) has long been dominated by top-down, hazard-centric, and technocratic logics that prioritize centralized planning, standardized measures, and centralized decision-making. A substantial body of work critiques these conventional approaches for failing to account for local contexts, social vulnerabilities, power asymmetries, and governance complexities.

1) It overlooks local context and diverse vulnerabilities

- A persistent critique is that resilience and DRM policies describe or prescribe communities in a way that abstracts away from local specificities, thereby reproducing or concealing structural inequalities within communities. Rushton et al. document that critiques of resilience as a top-down discourse and as a mechanism that shifts responsibility to communities have mixed salience but emphasize that central-government and international-aid approaches can neglect intra-community inequalities and broader vulnerability drivers (Rushton et al., 2022).

2) It often fails to address structural causes of vulnerability

- The vulnerability analysis literature, as reviewed by Rossignol et al., argues that traditional vulnerability assessments have been hampered by top-down, quantitatively oriented approaches that inadequately incorporate participatory and qualitative insights, limiting governance effectiveness in addressing social vulnerability (Rossignol et al., 2014). Donovan et al. further emphasize that interdisciplinary, participatory approaches are essential to avoid top-down biases and to strengthen risk governance that truly reduces vulnerability (Donovan et al., 2023).

3) It may misalign with local governance capacities and realities of hybrid governance

- In many contexts, state capacity is limited, yet disaster response relies on a mix of state and non-state actors, including communities, NGOs, and informal authorities. Clark-Ginsberg et al. describe hybrid governance as normative in many African cities, where non-state actors address risks due to weak state capacity; top-down attempts to reintegrate or constrain these hybrids can disrupt adaptive risk management and potentially heighten risk (Clark-Ginsberg et al., 2022).

4) Top-down approaches risk neglecting power, politics, and urban inequality

- Cheek et al. argue that disasters reveal how space is produced through power and planning, and that top-down urban planning often suppresses bottom-up agency, thereby reproducing inequalities in disaster risk and governance outcomes. The article calls for critical urban theory engagement to address how power asymmetries shape disaster risk creation and governance in cities (Cheek et al., 2023). This contention is echoed by Straub's analysis of media framing and risk in the Anthropocene, which shows how hazard risk narratives are political and how institutions respond with rhetoric and policy that must be scrutinized for equity and accountability (Straub, 2024).

5) The risk of instrumentalizing local communities without genuine inclusion

- Multiple works stress that top-down DRR often instrumentalizes communities as passive recipients instead of active co-researchers and co-creators of risk reduction strategies. Dé et al. highlight the need for co-researcher participation and locally led DRR to empower communities, challenging top-down dissemination and implementation of DRR measures (Dé et al., 2023). Baudoin et al. (top-down-to-community-centric pathways for early warning) similarly argue for shifting EWS design toward community participation to enhance effectiveness and equity (Baudoin et al., 2016).

1.4 Why IK is relevant for Disaster Management?

- Enhanced hazard identification and early warning

IK provides locally relevant indicators and signs of impending hazards (for example, animal behavior, plant and celestial cues, seasonal patterns) that can augment or validate scientific forecasts. The Sendai Framework and various DRR syntheses repeatedly acknowledge the value of local and indigenous indicators in improving preparedness and resilience (Mwanza et al., 2024; Pimprikar et al., 2023).

Local early warning practices rooted in IK have been shown to contribute to casualty reduction and timely evacuation in multiple case studies, including Simeulue (Aceh) and other coastal communities, where “smong” stories and similar knowledge supported disaster readiness (Plange & Hollis, 2026).

- Contextualized hazard mitigation and risk reduction

IK includes context-specific practices for reducing vulnerability, such as vernacular architecture, land use, traditional farming, water management, and ritualized risk awareness. These practices are often cost-effective, participatory, and aligned with local values, making them attractive for DRR planning in rural and marginalized communities (Abid et al., 2025; Lunga et al., 2025).

The integration of IK with scientific knowledge can yield complementary DRR strategies that are both effective and culturally appropriate, supporting more inclusive policy design and implementation (Pimprikar et al., 2023; Rahiem & Rahim, 2020).

- Community-embedded preparedness and recovery

IK-based processes emphasize mutual aid, social networks, and leadership structures that facilitate preparedness, response, and recovery. They support locally owned resilience pathways and can reduce external dependency by leveraging existing social-capital and institutions (Reyes et al., 2020).

Documentation and safeguarding of IK, when done respectfully and with community consent, can preserve cultural memory and inform longer-term adaptation to climate change while aligning with broader DRR goals and UN frameworks (Berkes et al., 2021; Lee & Chen, 2021).

1.5 Significance of Indigenous Knowledge in Disaster Management

Indigenous Knowledge (IK) and Indigenous Knowledge Systems (IKS) offer context-specific, place-based understandings of hazards, vulnerabilities, and capacities that complement formal science in disaster risk reduction and management (Karim, 2024). Across the literature, IK is repeatedly shown to shape preparedness, risk reduction, response, and recovery through culturally grounded practices, social networks, and intergenerational knowledge transfer. Below, I synthesize evidence from the provided sources to directly map IK to each phase of the disaster-management cycle, highlighting areas of convergence, nuance, and where evidence diverges (Yang & Rahman, 2025).

1.5.1 Preparedness

- Early warning and risk awareness: Indigenous knowledge (IK), including oral traditions, ecological cues, and traditional warning signs, supports early hazard detection, evacuation timing, and community preparedness. The Simeulue *Smong* tradition demonstrates its life-saving role during tsunamis (Benazir et al., 2025; Kikkert & Lackenbauer, 2021).
- Integration with formal systems: Combining IK with scientific knowledge through community-based disaster risk reduction (CBDRR) improves the cultural relevance, legitimacy, and effectiveness of preparedness measures (Ali et al., 2021; Kaiser et al., 2025).
- Seasonal forecasting and risk planning: Traditional calendars and ecological indicators guide seasonal preparedness, livelihood planning, crop selection, and resource management, highlighting the need to document and preserve IK (Kamara et al., 2018; Senimoli et al., 2020).

1.5.2 Risk Reduction

- Risk-sensitive settlement and construction: IK informs safer settlement patterns, traditional construction, and environmental management, reducing exposure to hazards such as floods, coastal hazards, and earthquakes (Talubo et al., 2022).
- Environmental conservation: Sustainable farming, watershed management, and traditional ecological practices help reduce the impacts of droughts, floods, and storms while strengthening resilience (Bahta & Lombard, 2023; Kamara et al., 2018).

- Hybrid risk governance: Integrating IK into formal DRR policies promotes inclusivity, local legitimacy, community participation, and sustainable risk reduction (Kaiser et al., 2025; Lunga et al., 2025).

1.5.3 Response

- Community-based coping: Kinship networks, elder leadership, customary mutual aid, and collective action facilitate rapid resource mobilization, shelter, care, and support for vulnerable groups during disasters (Senimoli et al., 2020).
- Traditional warning and timely action: Indigenous warning systems support timely evacuation, sheltering, and provisioning by linking hazard assessment with culturally appropriate response practices (Benazir et al., 2025).
- Integration with formal response: Co-producing disaster response strategies with Indigenous communities helps combine local capacities and knowledge with formal emergency-management systems (Ali et al., 2021; Kaiser et al., 2025).

1.5.4 Recovery

- Social and cultural capital: Social networks, cultural continuity, and intergenerational knowledge strengthen trust, cohesion, identity, and long-term recovery (Bogdan et al., 2024).
- Livelihood adaptation: IK supports traditional livelihoods, ecological practices, and community-led reconstruction, enabling locally appropriate and sustainable recovery (Kamara et al., 2018; Lunga et al., 2025).
- Locally led recovery governance: Embedding IK in recovery and DRR governance supports community ownership, reduces dependence on external assistance, and promotes culturally grounded resilience (Lunga et al., 2025; Reyes et al., 2020).

Despite the growing recognition of Indigenous Knowledge (IK) as an important resource for disaster preparedness, risk reduction, climate adaptation, and community resilience, the existing literature remains fragmented across geographical regions and academic disciplines. Previous studies have predominantly examined specific hazards, communities, or localized applications of Indigenous Knowledge, provided valuable contextual insights but offered limited understanding of the broader development of the research field (Bwambale et al., 2022). Consequently, the intellectual structure, thematic evolution, influential contributors, and patterns of scholarly collaboration within global research on indigenous knowledge and disaster management remain insufficiently understood (Hutagalung et al., 2025). A systematic mapping of the literature is therefore necessary to consolidate the dispersed body of knowledge and identify research trends and knowledge gaps.

The present study addresses this gap through a bibliometric analysis of global research on Indigenous Knowledge in disaster management. By examining publication trends, citation patterns, influential authors,

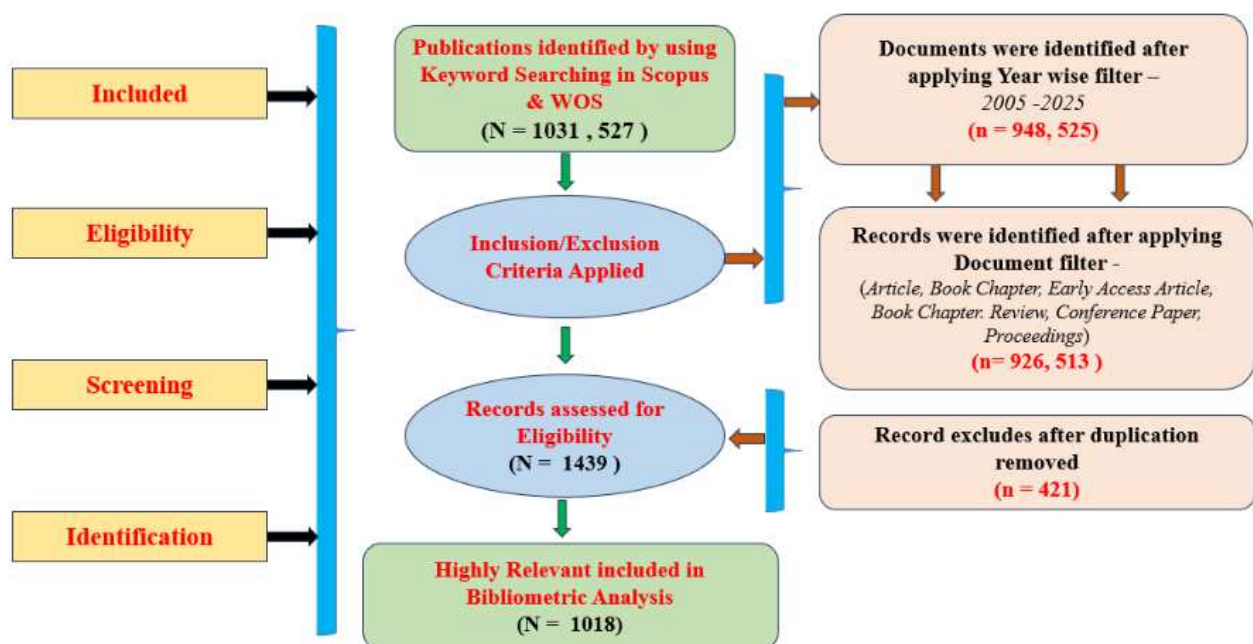
countries, institutions, journals, collaboration networks, keyword co-occurrence, and thematic development, the study provides a comprehensive overview of the intellectual and conceptual structure of the field (Mikaeili et al., 2025). The findings are significant for advancing academic understanding of the relationship between indigenous knowledge and disaster management while also identifying emerging research directions.

1.6 Objectives of the Study

- To Examine the temporal growth and development of research on Indigenous Knowledge and disaster management.
- To Identify major research themes and conceptual relationships through keyword co-occurrence and thematic analysis.
- To Explore the evolution of research themes and identify emerging areas of research in Indigenous Knowledge and disaster management.
- To Identify research gaps and potential future directions for integrating Indigenous Knowledge into disaster risk reduction, resilience, and sustainable disaster-management practices.

2. Method

This study employed a bibliometric approach to analyse the scientific literature on climate change and paddy cultivation in India. Bibliometric analysis is a widely used quantitative technique for evaluating research performance, identifying knowledge structures, and examining the evolution of scientific disciplines through publication and citation data (Adarsh and Sulthana, 2025). The methodological framework comprised four sequential stages: data collection, data integration, data cleaning, and bibliometric analysis. Bibliographic records were retrieved from the Scopus and Web of Science Core Collection databases, merged into a single dataset, screened for duplicate records, and subsequently analysed using performance indicators and science mapping techniques (Aria & Cuccurullo, 2017).



Fig; Methodology Chart

2.1 Data sources and search strategy

This study employed Scopus and Web of Science Core Collection (WoSCC) as the primary bibliographic databases for literature retrieval. These databases were selected because of their broad multidisciplinary coverage and established use in bibliometric and scientometric research. The search strategy was designed to capture variations in terminology associated with Indigenous Knowledge, disaster management, disaster risk reduction and major natural hazards.

The search in Scopus and Web of Science Core Collection (WoSCC) was conducted using the TITLE-ABS-KEY and TS (Topic) fields, respectively, to identify publications containing the predefined search terms in their titles, abstracts, and keywords. The search strategy combined three conceptual dimensions: Indigenous Knowledge, Disaster Management, and natural hazards. The Indigenous Knowledge component included terms such as “*indigenous knowledge*,” “*traditional knowledge*,” “*local knowledge*,” “*traditional ecological knowledge*,” “*folk knowledge*,” “*ancestral knowledge*,” and “*indigenous knowledge systems*.” The second component incorporated terms related to *disaster management*, *disaster risk reduction*, *disaster preparedness*, *disaster resilience*, *risk mitigation*, *hazard mitigation*, *emergency management*, and *coping mechanisms*. The third component included major hazard categories, including *floods*, *storm surges*, *tsunamis*, *earthquakes*, *landslides*, *volcanic hazards*, *droughts*, *wildfires*, *cyclones*, *hurricanes*, *typhoons*, *storms*, *extreme weather*, *heatwaves*, and *coastal erosion*.

2.2 Data screening and integration

The records retrieved from Scopus and WoS were subsequently integrated to construct a consolidated dataset. Duplicate records were identified and removed prior to bibliometric analysis, resulting in the removal of 421 duplicate publications. Following the deduplication and screening process, the final dataset consisted of 1,018 unique documents, which constituted the analytical corpus for the study.

The resulting dataset therefore represents research published between 2005 and 2025 and captures the development of scholarly literature concerning the relationship between Indigenous Knowledge, Disaster Management and natural hazard contexts. The use of two major multidisciplinary citation databases also reduces dependence on a single indexing system and provides broader coverage of the international research landscape.

2.3 Bibliometric analysis

The consolidated dataset comprising 1,018 unique publications was analysed using Biblioshiny, the web based interface of the *Bibliometrix* R package. Biblioshiny was used to perform both the descriptive and science mapping components of the bibliometric analysis. The analysis included annual scientific production, source performance, country contributions, keyword analysis, keyword co occurrence, trend topic analysis, thematic mapping, thematic evolution and conceptual structure analysis (Aria & Cuccurullo, 2017).

The descriptive analysis was used to assess the overall growth and development of research on Indigenous Knowledge in Disaster Management, while science mapping techniques were employed to examine the conceptual and thematic structure of the research field. Keyword co occurrence analysis was used to identify relationships among frequently occurring research concepts and to determine major thematic clusters. Trend topic analysis was employed to identify changes in research attention over time. Thematic mapping was used to classify research themes according to their degree of development and relevance to the broader research structure, whereas thematic evolution analysis was applied to examine changes in thematic orientations across different periods. In addition, conceptual structure analysis was conducted to identify the principal conceptual dimensions underlying the literature.

The use of Biblioshiny provided an integrated analytical framework for examining both the performance and intellectual structure of the research domain. Rather than limiting the analysis to publication and citation counts, the study combined descriptive indicators with relational and thematic techniques to identify the dominant research areas, conceptual linkages, evolving themes and emerging research directions within Indigenous Knowledge and Disaster Management research.

2.4 Descriptive analysis of a bibliographic data frame

The merged dataset covers 2005 to 2025 and comprises 1,018 documents published across 513 sources, demonstrating a broad and multidisciplinary publication landscape. Research articles constitute the largest document type with 738 publications, followed by 133 book chapters, 71 conference papers and 62 review articles. The dataset also contains 2,631 Keywords Plus and 2,532 Author Keywords, indicating substantial thematic diversity within the field.

The research domain demonstrates strong growth, with an annual growth rate of 22.3% and 3,525 authors contributing to the literature. The average of 3.93 co-authors per document indicates a strong collaborative research orientation, while 167 documents are single authored. International collaboration accounts for 22.79% of the publications, demonstrating considerable cross national research engagement.



Fig; Data Frame

The collection records an average of 19.14 citations per document, with an average document age of 6.04 years, indicating sustained scholarly attention to the research area. However, the absence of cited reference

data limits analyses based on co citation and bibliographic coupling. Overall, the dataset represents a rapidly growing, collaborative and multidisciplinary research domain, providing a strong basis for examining the thematic and conceptual development of Indigenous Knowledge in Disaster Management.

3. Result and Discussion

3.1 Annual Scientific Production and Temporal Development

Annual Scientific Production refers to the number of scientific publications produced or published in each year within a specific research field or dataset (Aria & Cuccurullo, 2017). The annual distribution of publications demonstrates a marked expansion of scholarly research on Indigenous Knowledge in Disaster Management between 2005 and 2025 (Fig. 2). During the initial years of the study period, scientific production remained relatively limited, with only 3 publications in 2005 and 2 in 2006. Publication output subsequently increased to 6 documents in 2007, 9 in 2008 and 11 in 2009, reaching 13 publications in 2010 and 17 in 2011. Although the absolute number of publications remained relatively modest during this initial phase, the progressive increase indicates the gradual emergence of Indigenous Knowledge as a subject within disaster related scholarship.

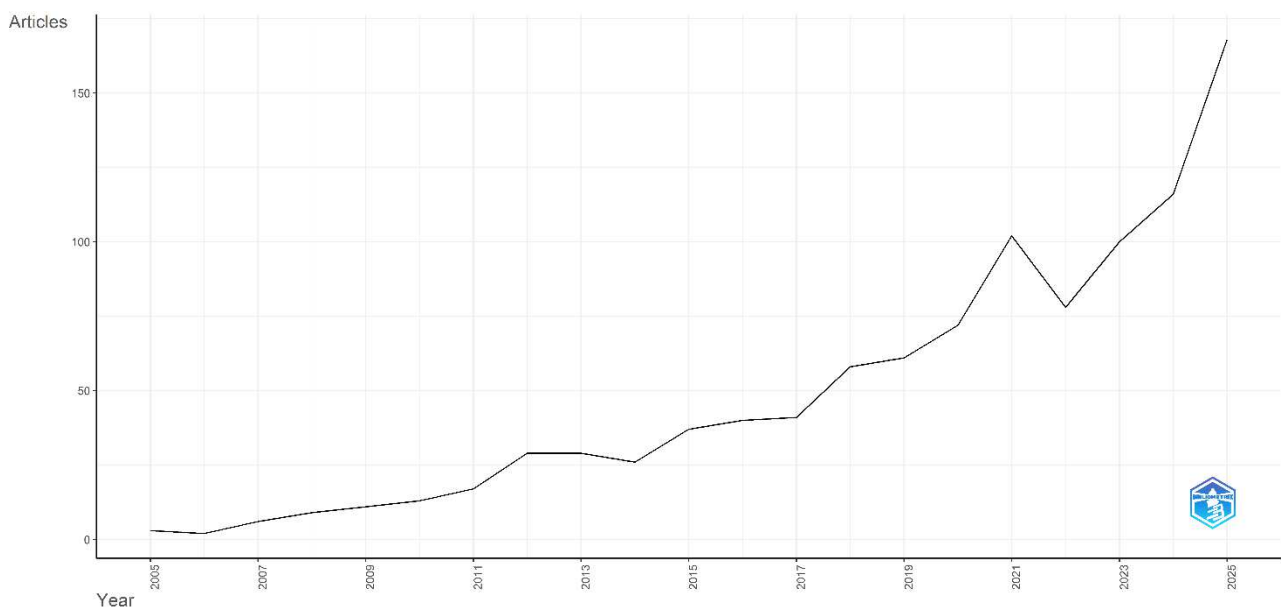


Fig.2 Annual scientific production (all figures in this paper, except Fig.6 has been prepared using Biblioshiny (Aria and Cuccurullo, 2017))

A more evident expansion occurred from 2012 onwards. Annual scientific production increased from 29 publications in 2012 and 2013 to 37 in 2015, 40 in 2016 and 41 in 2017. The number of publications then increased substantially to 58 in 2018 and 61 in 2019, followed by 72 publications in 2020. This period represents an important transition in the development of the research field, as annual output moved beyond the levels observed during the first decade and research on Indigenous Knowledge became increasingly visible within the wider Disaster Management literature.

The most pronounced expansion occurred after 2020. Scientific production increased from 72 publications in 2020 to 102 in 2021, representing an increase of approximately 42%. Although output declined to 78 publications in 2022, this reduction was temporary, with publication production recovering to 100 documents in 2023. The upward trajectory continued in 2024, when the number of publications reached 116, before increasing sharply to 168 publications in 2025. The 2025 output represents the highest annual production recorded during the study period and accounts for approximately 16.5% of the entire 2005–2025 corpus.

3.2 Life Cycle of the Research Field

The life cycle analysis of the bibliographic dataset reveals that the research domain follows a *logistic growth trajectory*, which is characteristic of evolving scientific fields (Aria et al., 2020). The cumulative publication pattern exhibits a clear *S shaped curve*, indicating that the field is currently in a phase of *accelerated expansion* with rapidly increasing scholarly output (Bettencour et al., 2009). The annual publication trend further supports this observation, showing a continuous increase in research productivity, with the field positioned on the *ascending phase prior to peak growth*. This suggests that the domain has not yet reached its maximum research output and continues to attract growing academic attention (Small & Upham., 2009).

The life cycle analysis indicates that research on Indigenous Knowledge in Disaster Management is undergoing rapid expansion (Fig. 3). The cumulative publication trajectory follows an approximately sigmoidal pattern, while annual production has increased substantially during the later years. The model estimates a carrying capacity of 10,180 publications and an inflection point at approximately 2038.37, suggesting a potential future peak in publication growth if historical trends continue. These values should be interpreted as model-based extrapolations rather than definitive forecasts.

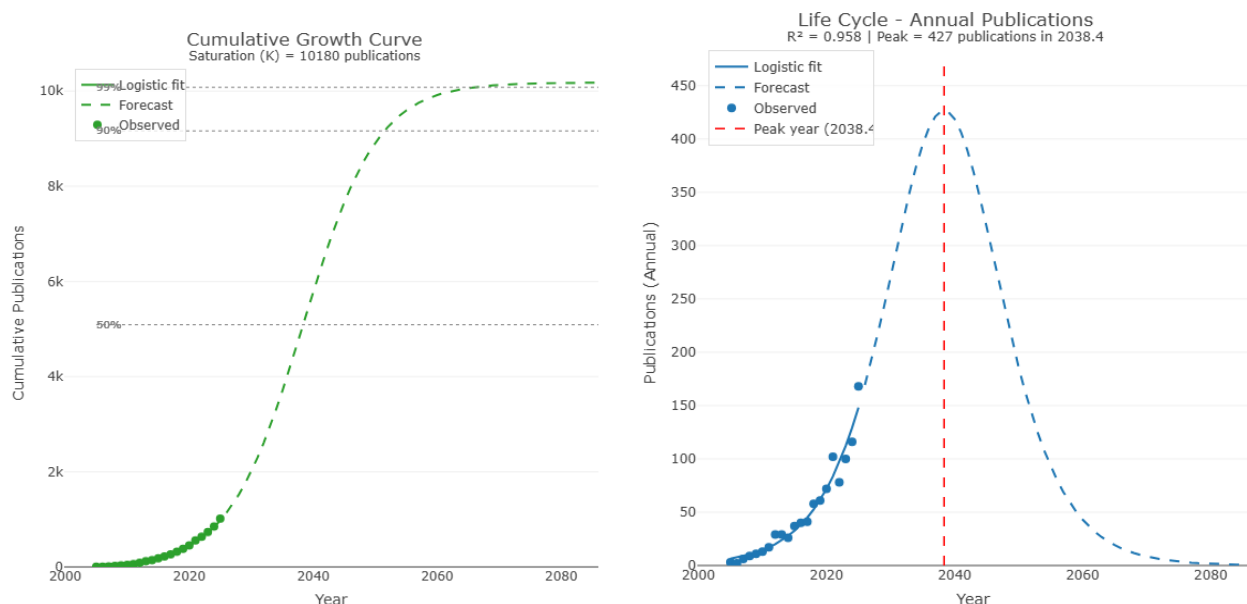


Fig.3 Logistic growth model and scientific life cycle of research on Indigenous Knowledge in Disaster Management, 2005–2025

The publication trajectory can be broadly divided into three phases (Wang, 2018): (i) emergence (2005–2011), with fewer than 20 publications annually; (ii) expansion (2012–2018), when output increased from 29 to 58 publications; and (iii) rapid expansion (2019–2025), with production increasing from 61 to 168 publications.

The substantial growth during the final phase indicates that the field remains in an active expansion stage rather than bibliometric maturity. The life cycle analysis confirms that Indigenous Knowledge in Disaster Management is a rapidly developing research domain with considerable growth potential. However, the projected inflection points and carrying capacity should be viewed as mathematical extrapolations. The subsequent thematic analyses are therefore important for understanding whether this quantitative growth is accompanied by substantive changes in the conceptual and thematic orientation of the field (Rogers, 2003).

3.3 Bradford's Law of Scattering

The Bradford's Law analysis of the structure of the publications shows a moderately dispersed structure in which a distinct set of very productive sources is linked to a significantly larger number of peripheral journals (Bradford, 1934). The Bradford multiplier, 5.53, suggests that if you increase the number of sources, you need then you are creating a corresponding proportion of the literature in the three Bradford zones (Brookes, 1969). The core zone contains 22 sources, the intermediate zone has 116 sources, and the peripheral zone has 671 sources, highlighting the increasing spread of research away from the core research venues (Fig. 4).

As can be seen the empirical distribution has a good fit with the theoretical Bradford distribution with an R^2 value of 0.9938 (Egghe, 1986). In addition, the Kolmogorov – Smirnov test ($p = 0.091$) shows that the observed distribution is not significantly different from the theoretical distribution at the level of significance (0.05). The results obtained support the applicability of Bradford's Law to the data set well (Aria & Cuccurullo, 2026).

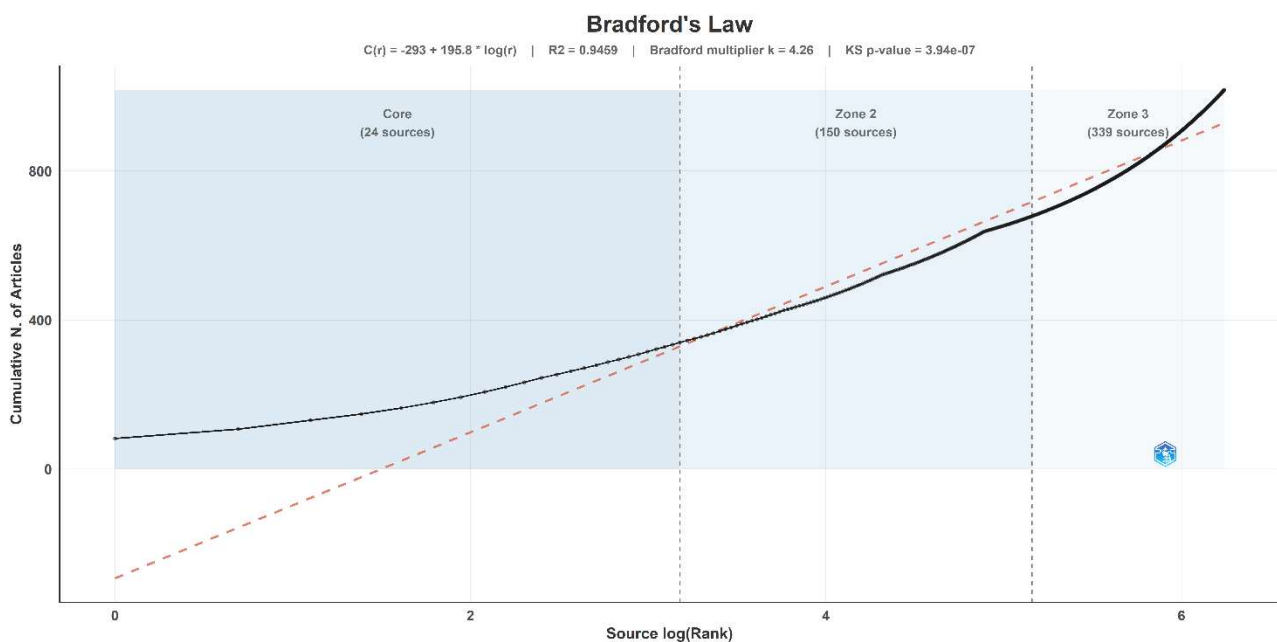


Fig. 4 Core sources identified by Bradford's Law. The shaded region highlights the "core zone" of journals contributing the majority of publications in the dataset.

It was applied to examine the concentration and dispersion of publications across sources. The literature was distributed across three zones, comprising 24 sources in Zone 1, 150 in Zone 2 and 339 in Zone 3, indicating a relatively small core of productive sources alongside a much larger peripheral literature. The 24 core sources in

Zone 1 represent the principal publication outlets, while the substantially larger number of sources in Zones 2 and 3 demonstrates increasing dispersion towards the periphery.

The identification of a relatively small core alongside a broad range of peripheral sources also reflects the multidisciplinary character of Indigenous Knowledge in Disaster Management. Research is distributed across Disaster Risk Reduction, climate adaptation, environmental change, sustainability and traditional knowledge related outlets. The findings therefore indicate a concentrated yet dispersed publication structure, in which a core group of sources provides the principal publication base while a wider range of interdisciplinary sources contributes to the development of the field.

3.4 Author Productivity through Lotka's

The analysis of author productivity based on Lotka's Law shows a highly skewed distribution of scientific contributions. He states that large proportion of authors contribute only a single publication, while a small fraction produces multiple outputs (Lotka, 1926). The observed pattern closely follows Lotka's Law, where the number of authors decreases exponentially with increasing publications. Most authors are concentrated at the lower end of the productivity spectrum, with only a few highly prolific contributors (Pao, 1985).

Author productivity in Indigenous Knowledge in Disaster Management research shows a highly skewed distribution. Of the 3,525 authors contributing to 1,018 publications, 3,174 authors (90.04%) produced only one publication, while only a small proportion contributed repeatedly (Fig. 5). Specifically, 269 authors produced two publications, 52 produced three, 19 produced four, seven produced five, three produced six, and one produced eight publications. This indicates that research output is dominated by occasional contributors, with sustained publication activity concentrated among a small group of researchers.

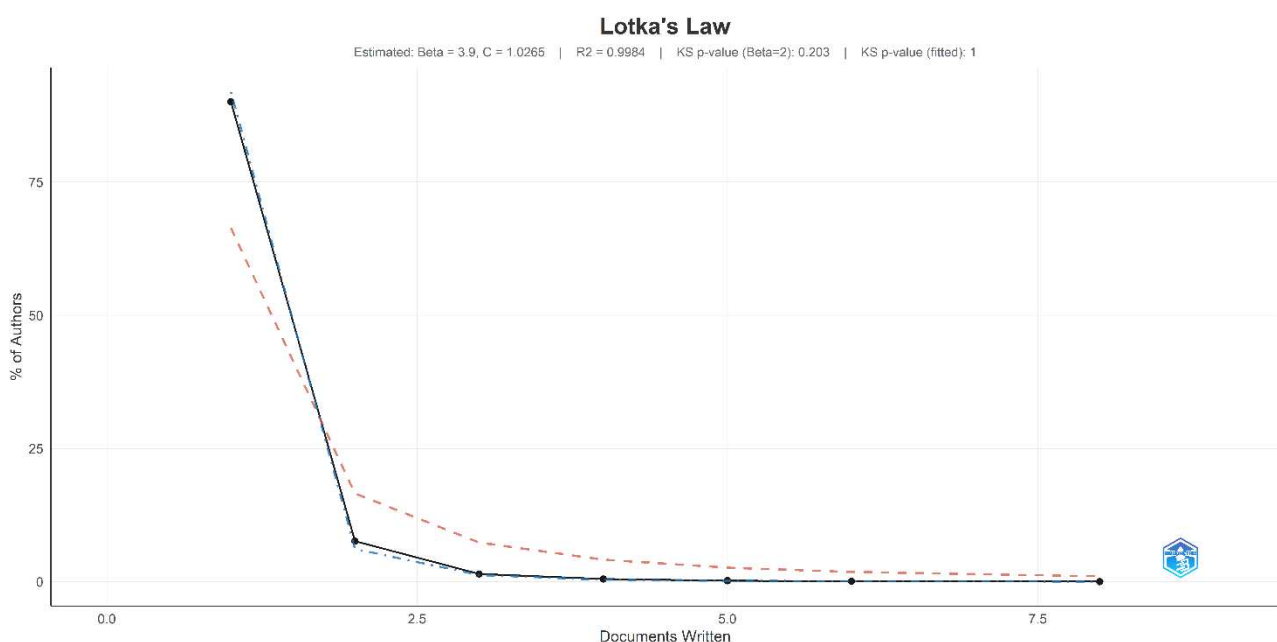


Fig. 5 Author productivity distribution following Lotka's Law

The results reveal a pronounced core–periphery structure in author productivity. While the large proportion of single-publication authors reflects broad participation, only 11 authors (0.31%) produced five or more publications, indicating that sustained research activity is concentrated within a very small core of researchers. This pattern is consistent with the interdisciplinary nature of the field and provides a basis for examining productive authors, collaboration networks, and their institutional and geographical affiliations.

3.5 Countries' Scientific Production

Countries' Scientific Production refers to the number of scientific publications contributed by each country within a specific research field or dataset. It indicates the research productivity and geographical distribution of scholarly contributions across countries (Aria & Cuccurullo, 2026).

The geographical distribution of scientific output shows that a wide-spread international collaboration for the production of scientific knowledge in the field of Indigenous Knowledge in Disaster Management. *The United States* was the most productive country with a total of 255 publications, followed by *the United Kingdom* (146) and *Australia* (138). Other leading contributors were *Indonesia* (112), *China* (105), *Japan* (103), *India* (99), *South Africa* (77), *Canada* (74), and *New Zealand* (60). About 25.0% of the documents were from *the United States*, 14.3% were from *the United Kingdom* and 13.6% were from *Australia*. This suggests a high level of research output in established research systems, with significant research output from *Asia*, *Africa* and *Oceania* (Fig. 6).

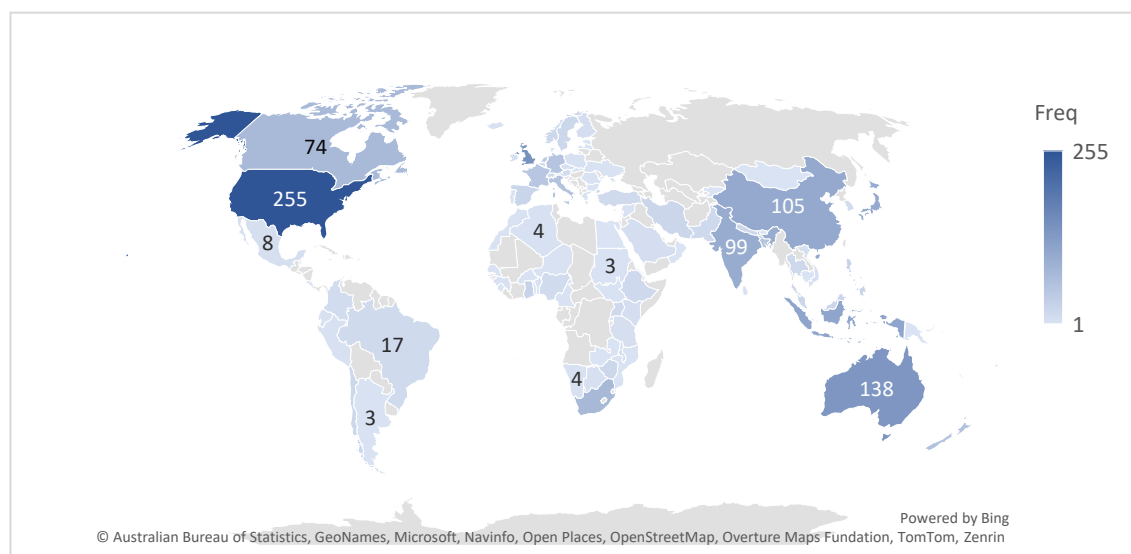


Fig.6 Leading countries in scientific production on Indigenous Knowledge and Disaster Management 2005–2025.

It is especially important to highlight the contributions of the countries of *Indonesia*, *China*, *Japan* and *India*, which in total produced 419 publications. Their strong representation delineates the significant contribution of *Asian research systems* to research on Indigenous Knowledge and Disaster Management. The field also expands beyond the major research centres as seen in *South Africa*, which has 77 publications. Notably, the country level results also indicate the presence of *Asia Pacific* institutions, with the *Indonesian*, *Japanese* and *New Zealand* institutions appearing among the top country affiliations. This indicates that scientific capacity of these countries plays a significant role in their scientific production.

The results show that the research field of IKDM has become an internationalised research field, albeit with uneven scientific production. The significant involvement of *the United States, the United Kingdom and Australia* is complemented by significant involvement of *Indonesia, China, Japan, India and South Africa*, suggesting increasing geographical diversity in the field. This distribution is a foundation for an analysis of whether there is good international research collaboration in the context of geographical diversity.

3.6 Most Cited Countries

Most Cited Countries refers to the countries whose scientific publications have received the highest number of citations within a specific research field or dataset. It indicates the research impact and influence of publications produced by different countries (Aria et al., 2025).

The results of the country level citation analysis show significant differences in the scholarly impact of Indigenous Knowledge in Disaster Management studies. *The United States* had the highest number of citations overall (2,285) followed by *the United Kingdom* (1,808) and *Australia* (1,618). *Canada, Germany, Bangladesh* and *South Africa* were next with 963, 882, 795 and 788 citations respectively, followed by *China, New Zealand* and *Japan* (Fig. 7).

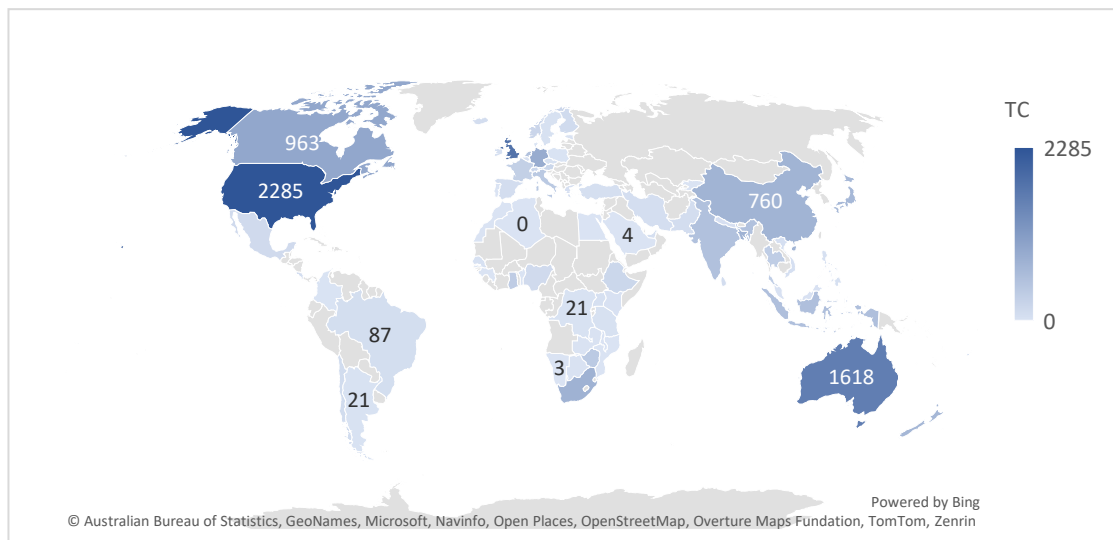


Fig.7 Most cited countries

The United States has the highest number of publications AND the highest number of citations, suggesting a strong overall contribution. But total citations and average article citations give different aspects of research impact. *The United Kingdom* had the highest average number of citations per article (31.7), followed by *Germany* (31.5), *Australia* (28.9), *Canada* (28.3) and *the United States* (26.9). This means that more publications do not necessarily lead to more citations per publication.

China had 760 citations, an average of 15.8 citations per article, and *Japan* had 694 citations with 16.1 citations per article among the Asian countries. By comparison, *Bangladesh* had 795 citations and 25.6 citations per article and *South Africa* had 788 citations and 25.4 citations per article. These findings show that although the number of publications was lower, the influence of the citations was relatively high. *The United States*

publishes the most papers, and *Germany* and *the United Kingdom* have the highest average number of citations per paper. The results also point to the contribution of countries other than the main players, like *Bangladesh* and *South Africa*, as evidence of the influence of research is not strictly based on the number of publications.

3.7 Classification of Frequently Occurring Keywords

Thematic Classification of Keywords refers to the grouping of frequently occurring keywords into thematic clusters based on their conceptual relationships. It helps identify the major research themes, emerging topics, and conceptual structure of a research field (Aria & Cuccurullo, 2026).

The frequently occurring terms were classified into four broad thematic categories based on their conceptual relevance to Indigenous Knowledge and Disaster Management: Indigenous/Local Knowledge, Climate Change and Adaptation, Vulnerability and Resilience, and Disaster Risk and Hazards. This classification provides an initial conceptual overview of the research landscape before examining the relationships among keywords through co-occurrence and thematic analyses (Tab.1).

Theme	Keywords	Frequency	Interpretation
Indigenous/Local Knowledge	Indigenous knowledge (175); Local knowledge (134); Traditional knowledge (106)	175–106	Represents the core conceptual foundation of the research, focusing on community-based and place-specific knowledge systems.
Climate Change and Adaptation	Climate change (176); Adaptation (140); Climate-change (75); Climate change adaptation (64)	176–64	Highlights the growing focus on the role of Indigenous Knowledge in climate adaptation and changing environmental conditions.
Vulnerability and Resilience	Resilience (144); Vulnerability (141); Risk (58)	144–58	Emphasizes the relationship between Indigenous Knowledge, community vulnerability, coping capacity, and resilience.
Disaster Risk and Hazards	Disasters (92); Disaster risk reduction (72); Floods (68); Disaster (67); Disaster management (62); Drought (60); Hazards (52)	92–52	Reflects the application of Indigenous Knowledge to disaster risk reduction and specific hazards, particularly floods and droughts.

Tab 1. Frequency and interpretation of keywords

3.8 Trend Topics

The Trend Topics analysis identifies and visualises the temporal dynamics of key terms within a bibliometric collection (Cobo et al., 2011). By tracking the frequency of keywords (or other terms) across publication years, this tool reveals which topics are gaining momentum, which have reached maturity, and which are declining, providing a clear picture of the evolution of research interests over time (Noyons et al., 1999). Trend analysis in bibliometrics is based on the observation that the vocabulary used in scientific publications reflects the intellectual priorities of a research community at a given point in time (Aria & Cuccurullo, 2017).

The analysis illustrates a progressive transformation in the research focus of Indigenous Knowledge in Disaster Management between 2012 and 2024. The temporal distribution of the three most prominent terms per year indicates a gradual movement from hazard identification and vulnerability assessment towards risk perception, early warning, resilience, Indigenous and local knowledge, climate change, adaptation and sustainable development. This pattern indicates an expansion of the research agenda from event-oriented disaster assessment towards broader socio-environmental and knowledge-based approaches to disaster risk (Tab. 2).

Period	Prominent topics	Dominant research orientation
2012–2015	Housing; Solomon Islands; weather forecasting; risks; hazard management; vulnerability assessment	Hazard identification, forecasting and vulnerability
2016–2018	Climate variability; rain; storms; knowledge management; deforestation; early warning system; risk perception	Climatic hazards, environmental change and risk management
2019–2020	Vulnerability; adaptation; resilience; local knowledge; Indigenous knowledge; traditional knowledge	Community resilience, adaptation and knowledge systems
2021–2022	Climate change; natural disasters; disaster resilience; sustainable development; climate adaptation; mitigation	Climate change, resilience and sustainable development
2023–2024	Livelihood; flood control; cultural heritage; flood damage; economics; climate change and disaster-related themes	Socio-economic, cultural and applied dimensions of disaster risk

Tab. 2 Evolution of prominent research topics, 2005–2025

During the early period (2012–2015) was linked with particular geographical contexts, hazard assessment and identification of hazards. Certain words were used with great frequency, like *housing*, *Solomon Islands*, *weather forecasting*, *risks*, *hazard management* and *vulnerability assessment*. The use of geographically specific terminology implies that early in the development of the discipline, case-based investigations were important, whereas the increased presence of the terms '*weather forecasting*' and '*hazard management*' suggests that the understanding and management of hazard processes is significant. The development of *vulnerability assessment* also shows a shift in focus moving from hazard identification to analysis of differential vulnerability to disaster effects.

In 2016–2018, a more general environmental and risk management orientation was apparent. *Climate variability*, *rain*, *storms* and contexts of climatic processes and regional hazard contexts were reflected, with increased attention. In parallel, within the dominant topic structure, there was a knowledge management, deforestation, early warning system and risk perception. These terms reflect growing concerns regarding the social, cultural, environmental and human aspects of disaster risk—such as knowledge management and communication, social and environmental causes of risk, and hazard perception and early warning. The emergence of *early warning system* is of special interest to the study of Indigenous Knowledge, as it affords a possibility for a linkage between indigenous observations of environmental indicators and formalized disaster preparation processes.

A notable change occurred during 2019–2020, when terms related to vulnerability, adaptation, resilience and local knowledge systems became increasingly prominent. *Vulnerability* and *adaptation* gained visibility alongside *resilience*, while *local knowledge*, *indigenous knowledge* and *traditional knowledge* emerged as important research topics. This convergence represents an important development in the research trajectory because Indigenous and local knowledge increasingly appeared in association with concepts concerned with community capacity, adaptation and resilience, rather than only as descriptive accounts of traditional practices.

The prominence of these concepts suggests that the research agenda increasingly addressed the role of community-based knowledge in understanding and responding to environmental risks. In particular, the simultaneous emergence of *indigenous knowledge*, *local knowledge*, *traditional knowledge*, *resilience* and *adaptation* indicates an increasing conceptual connection between knowledge systems and community capacity to manage changing risks.

From 2021 to 2024, this was a time of rising significance of the more general issues of climate change, natural disaster, disaster resilience, sustainable development, climate adaptation and climate mitigation. The growing salience of these terms suggests that research increasingly placed the knowledge of the Indigenous peoples in broader frameworks of long-term environmental change and DRR. The latter research agenda turned more to systemic environmental change, adaptation and sustainability, rather than just individual hazard events.

The later period also demonstrates a diversification towards livelihood, flood control, cultural heritage, flood damage and economics. The terms reflect the growing awareness of social, cultural, and economic aspects of the disaster risk. The concept of livelihood has emerged, reflecting the growing focus on how the disaster risk might impact livelihood systems in the communities; cultural heritage has appeared, reflecting the cultural aspects of disaster impact and resilience. Likewise, the emergence of the economics and flood damage terms indicates that socioeconomic issues of hazards and the use of disaster knowledge for particular hazard risk management problems have increased in importance.

3.9 Keyword Co-occurrence Analysis

The Co-occurrence Network is a powerful tool for mapping the conceptual structure of a research field (Cobo et al., 2011). It builds a network where nodes represent terms (keywords, title words, or abstract terms) and edges connect terms that appear together in the same document (Aria & Cuccurullo, 2026). It reveals the

conceptual structure of the research domain, highlighting the major thematic clusters and their interrelationships (Callon et al., 1983). The network exhibits a well-connected structure, indicating a cohesive and interdisciplinary research field, with strong linkages between methodological approaches and ecological applications (Van Eck & Waltman, 2010).

It illustrates the conceptual structure of research on Indigenous Knowledge in Disaster Management and identifies three major thematic clusters (Fig. 8). The network demonstrates that Indigenous Knowledge is closely connected with disaster risk reduction, climate change, vulnerability, resilience and community-based disaster management. The three clusters represent strategic disaster risk reduction and governance, climate change vulnerability and adaptation, and local and traditional knowledge in practical disaster management, respectively.

3.9.1 Cluster 1: Strategic Disaster Risk Reduction and Governance

It is mainly concerned with strategic disaster risk reduction and governance. The network focuses on *indigenous knowledge*, *DRR (disaster risk reduction)* and *DRM (disaster management)*, and is well connected to *community resilience*, *governance*, *science*, *framework*, *mitigation* and *hazard*. The use of Indigenous Knowledge in various contexts of hazards and various risk-reduction strategies is also reflected by the presence of *tsunami*, *earthquake* and *climate change adaptation*. The architecture of this cluster indicates that Indigenous Knowledge is being studied not only as a traditional knowledge system but as part of formal disaster risk reduction frameworks, governance mechanisms and community resilience as well.

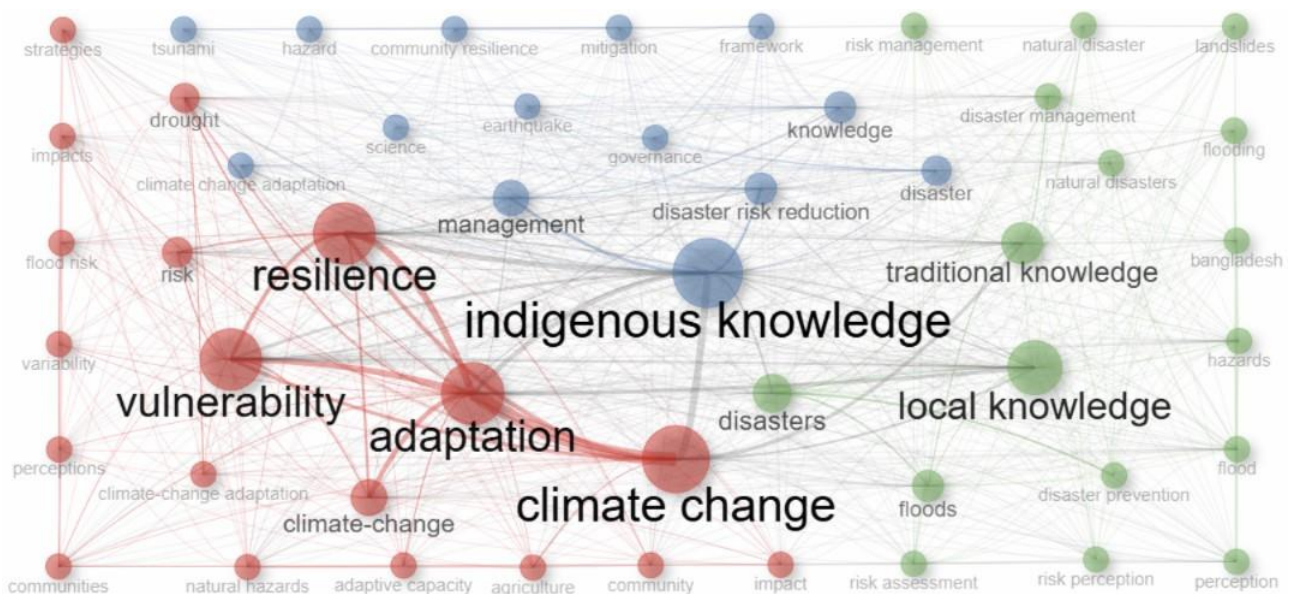


Fig.8 Keyword co-occurrence network of Indigenous Knowledge in Disaster Management research.

3.9.2 Cluster 2: Climate Change, Vulnerability and Adaptation

It represents the climate change, vulnerability and adaptation dimension of the research landscape. The key terms in the cluster are *climate change*, *adaptation*, *vulnerability*, *resilience* and *risk*, with the sub-terms *adaptive capacity*, *perceptions*, *communities*, *natural hazards*, *flood risk*, *drought*, *agriculture*, *impacts* and

variability. The close clustering of these terms suggests that many of the texts focus on Indigenous and local knowledge in the context of climate change and climate risk. *Vulnerability and resilience*, and *adaptive capacity*, are further showing emphasis on community's response to environmental change, and the presence of *flood risk*, *drought* and *agriculture*, showing that vulnerability and resilience concepts are being applied to specific hazards and livelihood contexts.

3.9.3 Cluster 3: Local and Traditional Knowledge in Practical Disaster Management

It is characterised by local and traditional knowledge in practical disaster management. The principal terms include *local knowledge* and *traditional knowledge*, which are associated with *disasters*, *floods*, *disaster management*, *natural disasters*, *landslides*, *risk perception*, *hazards*, *flooding*, *risk management*, *risk assessment* and *disaster prevention*. This cluster is more community level and hazard specific than the other clusters as seen in Fig. 8. Local and traditional knowledge is often linked to floods and landslides, disaster risk perception and prevention suggests, which is manifested in the literature.

The relationships among the three clusters further demonstrate the interconnected nature of the research field. *Indigenous knowledge* occupies an important position within the network and is connected with both formal disaster risk reduction concepts and community-level knowledge approaches.

3.10 Thematic Map and Strategic Position of Research Themes

The thematic map (also known as the strategic diagram) is a two-dimensional visualization that classifies research themes according to their centrality (importance within the field) and density (internal coherence of the theme). Originally proposed by Callon et al. (1991) and further developed by Cobo et al. (2011), it provides a comprehensive snapshot of the thematic landscape of a scientific domain.

The map provides a strategic representation of the conceptual structure of research on Indigenous Knowledge in Disaster Management by positioning keyword clusters according to their centrality and density (Fig. 9). The analysis was conducted using the *KW_Merged* field, considering the 500 most relevant keywords with a minimum frequency of five occurrences. The Louvain clustering algorithm was used to identify thematic communities. The thematic map analysis provides insights into the conceptual structure of the research field by classifying themes based on their centrality and density. Based on this, the thematic map divided into four quadrants; motor, niche, basic, and emerging or declining themes (Aria et al., 2025).

The motor-theme quadrant was represented by the cluster “traditional knowledge–disasters–floods.” This theme was highly central and dense, suggesting it is very well embedded in the overall research field and also has high internal development. This is the location of this cluster and reflects the well-documented significance of TK in disaster settings, specifically on floods. The strategic location suggests it is a very mature research area, and that there are close links with other themes in the field.

The niche-theme quadrant contained the cluster “disaster–earthquake–community resilience.” relatively high density and lower centrality suggests a specialised research field with high internal development, but comparatively low linkage to other thematic fields. The cluster focuses on research for specific disaster

contexts (earthquake) and community resilience. The location indicates that these subjects are a rather specialized part of the research agenda, not a major cross-cutting theme.

The basic-theme quadrant contained the cluster “climate change–indigenous knowledge–resilience.” This cluster was highly concentrated and had relatively low density, making it an important building block for the research field. The high centrality shows high links with other research themes, whereas the lower density shows that the thematic structure is still relatively broad and not consolidated internally. Climate change and Indigenous Knowledge and resilience are especially relevant, as they provide a bridge to broader conversations about environmental change and community ability to adapt to climate threats.

The keyword analysis shows that the concepts of climate change, Indigenous Knowledge, resilience, vulnerability and adaptation are most common, which is aligned with the strategic position of this cluster. As a result of its classification as a basic theme, these concepts are considered to be an important conceptual base for the field, and due to their relative under-densification, scope remains in conceptual integration and development of these concepts.

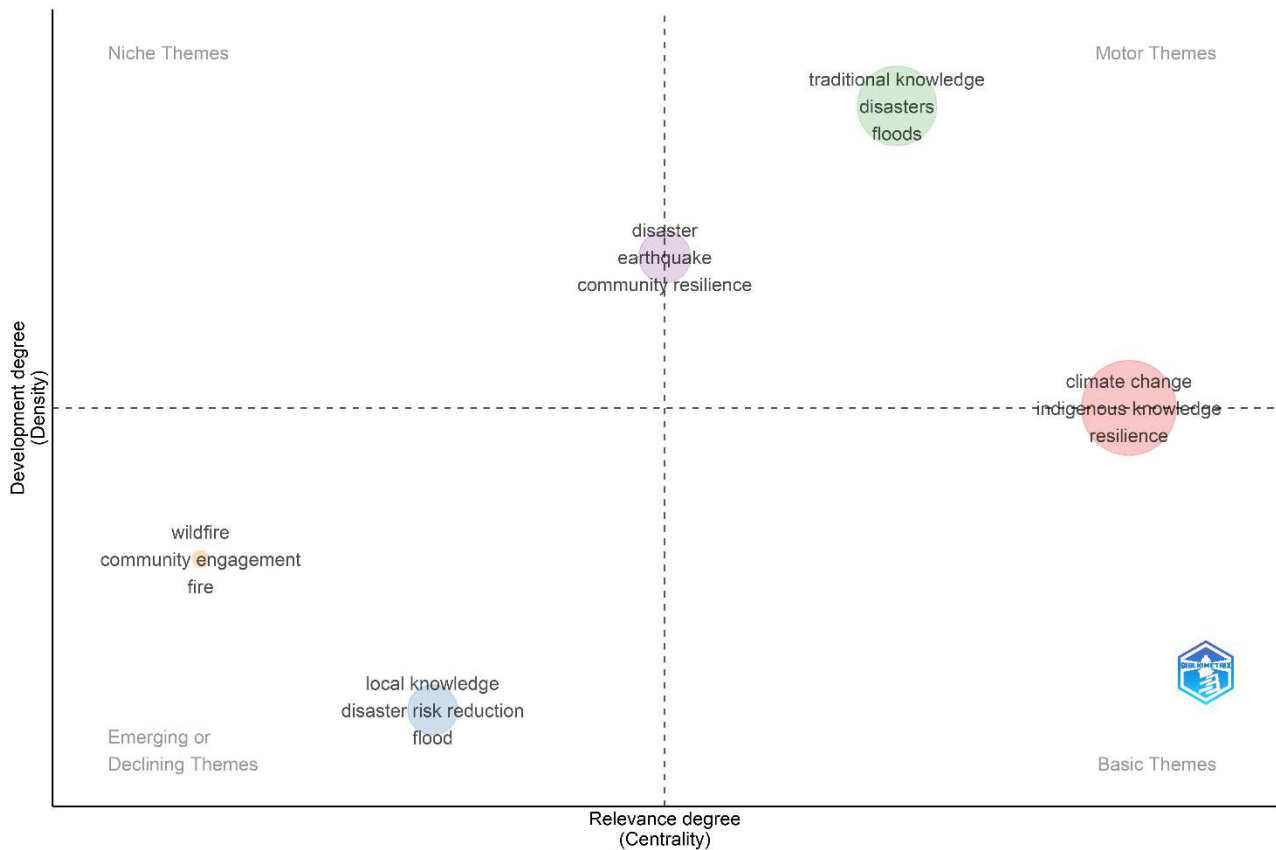


Fig. 9. Thematic map showing the strategic position of research themes in Indigenous Knowledge and Disaster Management research.

The Two clusters were located in the rising or falling square. The first was ‘wildfire–community engagement–fire’ which was low on both centrality and density. It is located in the middle of the thematic structure and is underdeveloped. The cluster however recognizes that there is a theme in the literature that could be labeled

wildfire and community engagement but it is not possible to clearly distinguish between an emerging and declining theme due to the strategic position of the cluster.

The second cluster in this quadrant, “local knowledge–disaster risk reduction–flood,” is particularly relevant to the focus of the present study. Its low centrality and density location put it in the quadrant of emerging/declining, and the recent finding of research related to local knowledge, disaster risk reduction and flood management indicates that there is an increasing focus on the practical application of locally embedded knowledge in disaster risk reduction. The strategic map does not, however, confirm that the cluster is developing or declining in its current stage; the map can be interpreted as a relatively immature and poorly connected thematic area.

There is an important difference in the maturity and strategic relevance of various themes related to knowledge in the strategic map. The motor quadrant of *traditional knowledge–disasters–floods* suggests a well-developed and inter-connected research space while the *climate change–Indigenous knowledge–resilience* space is a relatively underdeveloped but important theme with many linkages to the overall field. The relationship between *local knowledge and disaster risk reduction and flood* remains relatively underdeveloped and under-centralized although it is directly relevant to disaster risk reduction. The combination of the traditional knowledge research with established tradition and a wider strand of climate-resilience scholarship, and comparatively the local knowledge's application to disaster risk reduction, points to the fact that the research field is a blend of what is already known about traditional knowledge research and what is more recent in the field of climate-resilience.

The thematic map shows that traditional knowledge, Indigenous Knowledge, climate change and resilience are important aspects of the intellectual structure of the field, with more specific applications of local knowledge and disaster risk reduction being less well developed.

3.11 Thematic Evolution of Research

The thematic evolution analysis tracks how research themes emerge, grow, merge, split, and decline over time (Callon et al., 1991). By dividing the publication timeline into consecutive time slices and performing co-occurrence analysis within each slice, this method reveals the dynamic evolution of a field's conceptual structure (Morris & Martens, 2008). It provides insights into the transformation and continuity of research themes across different time periods, highlighting the shifting focus and maturation of the field (Cobo et al., 2011). The results demonstrate how core concepts related to mangrove ecosystems, land use change, and geospatial technologies have evolved over time.

The analysis reveals a progressive transformation in research on Indigenous Knowledge and disaster management between 2005 and 2025 (Fig. 10). The Sankey diagram demonstrates the persistence of major concepts such as *disasters* and *climate change*, alongside the increasing prominence of *local knowledge*, *traditional knowledge*, *Indigenous Knowledge*, *adaptation*, and *resilience*. Overall, the thematic trajectory suggests a transition from predominantly hazard-centred research toward broader knowledge-based approaches emphasizing adaptation, resilience, and disaster risk reduction.

3.11.1 Emergence of Local Knowledge and Hazard-Centred Research (2005–2009)

During 2005–2009, research was primarily oriented toward *local knowledge*, *natural disasters*, *hazards*, and *disaster management*. *Climate change* and *hazard assessment* represented broader and well-connected themes, while *adaptation* and *tsunami* remained comparatively less developed. Themes such as *community participation*, *vulnerability assessment*, *flood mapping*, and *environmental justice* reflected more specialized research directions. This period therefore represents an early stage in which locally embedded knowledge was mainly examined within conventional hazard and disaster-management contexts.

3.11.2 Integration of Traditional and Indigenous Knowledge (2010–2019)

The period 2010–2019 marked a significant expansion and integration of knowledge-oriented themes. *Traditional knowledge* emerged as a motor theme alongside *disasters* and *floods*, indicating increasing relevance and internal development. *Indigenous Knowledge* appeared as a niche theme, suggesting that the concept was gaining scholarly recognition while remaining relatively specialized. At the same time, *climate change adaptation* emerged as a distinct research direction, while *vulnerability* and *resilience* became increasingly important basic themes. The growing association between *local knowledge* and *adaptation* indicates a shift toward examining how community-based knowledge contributes to changing environmental and disaster conditions.

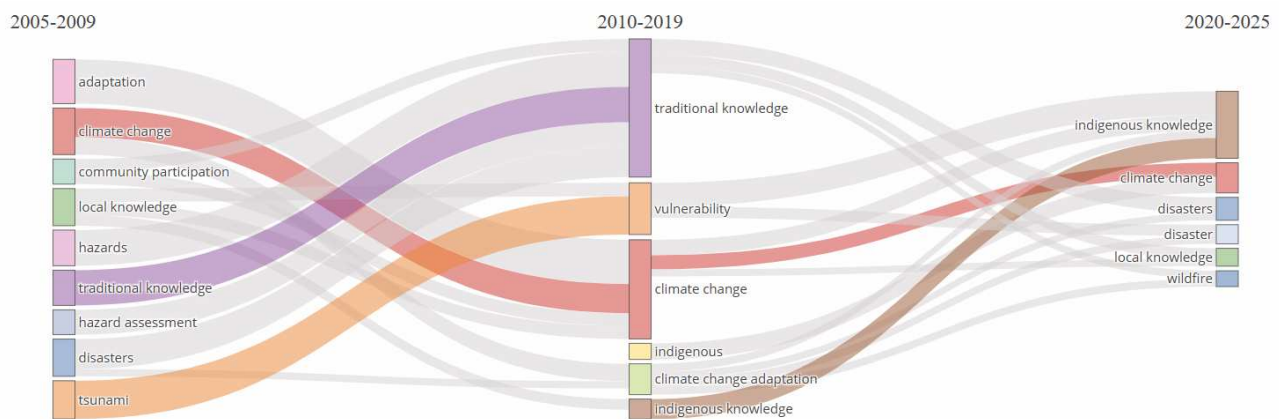


Fig. 10. The thematic evolution analysis provides a longitudinal view of research themes in have evolved over time

3.11.3 Consolidation of Indigenous Knowledge and Resilience (2020–2025)

A further thematic transformation occurred during 2020–2025. *Disasters*, *floods*, and *natural disasters* remained prominent motor themes, confirming the continued importance of hazard-oriented research. However, *local knowledge*, *traditional knowledge*, and *disaster risk reduction* also gained greater thematic centrality. Most notably, *Indigenous Knowledge* moved from the niche-theme quadrant during 2010–2019 to the basic-theme quadrant in 2020–2025. This movement indicates the increasing integration of Indigenous Knowledge into the broader conceptual structure of disaster management. *Resilience* and *adaptation* also

remained important basic themes, reinforcing the growing emphasis on adaptive capacity and community resilience

3.12 Factorial Analysis of Keywords

The conceptual structure of the research field, derived using Multiple Correspondence Analysis (MCA) on author keywords, reveals the underlying thematic relationships and intellectual organization of the domain (Greenacre, 2007). The first two dimensions explain a substantial proportion of the variance, indicating a reliable representation of the conceptual framework of mangrove ecosystem research (Benzecri, 1973).

The factorial analysis of the merged keyword field (*KW_Merged*) provides a two-dimensional representation of the conceptual structure of research on Indigenous Knowledge in Disaster Management (Fig. 11). The factorial map provides a useful representation of the principal associations and distinctions among the major research concepts in the dataset (Cuccurullo et al., 2016).

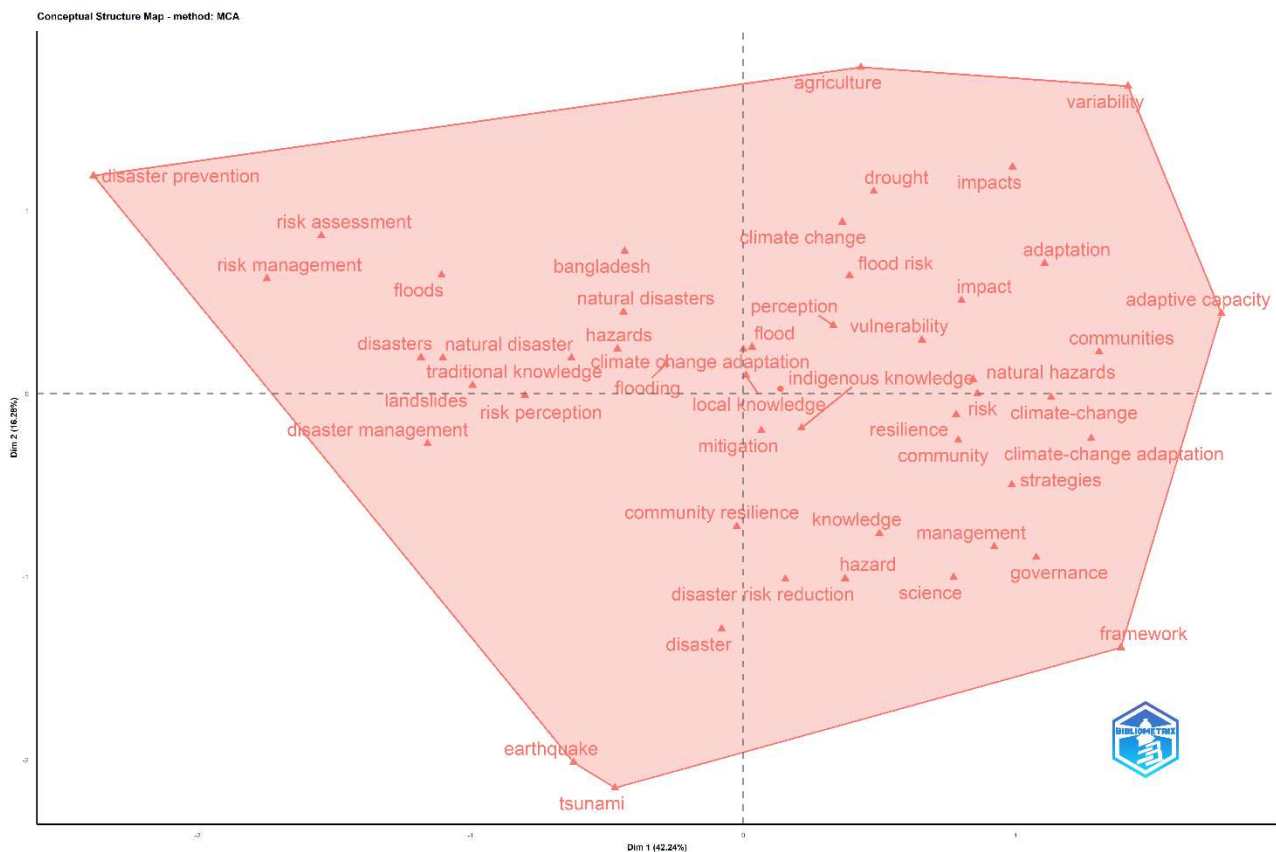


Fig. 11 Factorial map of the conceptual structure of Indigenous Knowledge in Disaster Management research based on Multiple Correspondence Analysis (MCA).

The horizontal axis (Dim 1) primarily differentiates between hazard-specific disaster risk management and climate change adaptation and resilience-oriented research. *Disaster prevention, risk assessment, risk management, floods, landslides, earthquake and tsunami* are on the negative side of the axis. These terms refer to a research focus that is based on the identification, assessment and management of specific disaster risks. On the other hand, the positive aspects are associated with *climate change, adaptation, impacts, vulnerability,*

adaptive capacity, resilience and framework. This is a more comprehensive approach to climate risks, adaptation and community resilience.

The vertical axis (Dim 2) further differentiates between broader environmental and contextual dimensions and specific hazards and community-level disaster responses. Positive values on the axis are linked to concepts like *agriculture, variability, climate change and disaster prevention*, reflecting an increased focus on the environmental variability and both sectoral impacts and prevention measures. The negative side features *earthquake, tsunami, disaster risk reduction, community resilience and Indigenous Knowledge*, which feature more specific hazard contexts and community-oriented approaches to *disaster risk reduction*.

The upper-left quadrant is characterised by a cluster of terms related to disaster risk assessment and management, including *disaster prevention, risk assessment, risk management, floods, landslides, risk perception and disaster*. The high occurrence of the terms reflects a research orientation towards the identification and management of disaster risk through assessment, prevention and risk-management strategies. However, the presence of *floods* and *landslides* indicates the presence of a strong emphasis on particular hazards, and *risk perception* adds a social element to the traditional perspective of disaster risk assessment.

The upper-right quadrant represents a distinct climate change, vulnerability and adaptation orientation. Terms including *climate change, adaptation, impacts, vulnerability, adaptive capacity, perception, communities, agriculture* and *variability* are positioned within this conceptual space. The linkage suggests that vulnerability and capacity in the context of *climate change* are now a central part of *climate change* research, especially with respect to *communities* and climate-sensitive sectors like *agriculture*. This is another example of the significance of climate oriented approaches in the context of Disaster Management literature, with *adaptation* and *climate change* occupying this side of the map.

The lower-right quadrant is primarily associated with resilience and knowledge-based disaster risk reduction. The terms *community resilience, knowledge, management, resilience, framework*, is where the terms *community resilience, knowledge, management, resilience, framework* and *Indigenous Knowledge* and *disaster risk reduction* are focused. This configuration is especially important for the present study as it reflects the conceptual linkage between *Indigenous Knowledge* and *community resilience* in the context of *disaster risk reduction* (DRR). The placement of *Indigenous Knowledge* in the category of *community resilience* and *disaster risk reduction* indicates that research on disaster management from knowledge has significant role in community oriented disaster management research.

The lower-left quadrant contains a comparatively smaller group of terms, particularly *earthquake* and *tsunami*. The relatively distinct position suggests a greater geophysical research orientation to hazards. *Earthquake* and *tsunami* research occupy a more differentiated conceptual position, while the other disasters (*floods* and *landslides*) are closer to the cluster of broader disaster risk management. This indicates that the area of geophysical hazards might be a comparatively independent literature stream under the umbrella of *Indigenous Knowledge* and Disaster Management.

The factorial map also identifies some terms that make a significant difference in conceptual space differences. *Disaster prevention* is placed in the negative quadrant of Dim 1 and thus helps to differentiate between conventional disaster risk management and the research domain aimed at adaptation to *climate change*. Contrary to this, *climate change* and *adaptation* are very linked to the positive side of Dim 1. The top part of the map is dedicated to *Agriculture* and *variability*, from which one can see a link with the environmental/livelihood context where climate-related research is conducted. The lower part of Dim 2 is due to the *earthquake* and *tsunami* activity and allows for differentiation of geophysical hazard research from the domain of climate adaptation.

3.13 Collaboration Network of Countries

The country collaboration network analysis provides insights into the global distribution of scientific production and the structure of international research partnerships within the field (Aria & Cuccurullo, 2017). The results reveal a highly interconnected global network, with clear disparities in research output and collaboration intensity across regions. The analysis identifies several major hubs of scientific production, characterized by high research output and extensive collaborative linkages (Aria & Cuccurullo, 2026).

The countries' collaboration map illustrates the international co-authorship structure of research on Indigenous Knowledge in Disaster Management (Fig. 12). The United States is the principal international research centre and is well connected with countries across Europe, Asia and Oceania, particularly the United Kingdom, Germany, China, Japan and Australia. A strong cooperation network is evident within Europe, especially among Western European countries, along with substantial intra-regional and intercontinental connections. China and Japan serve as key nodes in the Asian network, while India demonstrates an increasing role in the international collaboration structure. Australia and New Zealand are important contributors to the Asia-Pacific collaboration network, maintaining strong links with North America, Europe and Asia.

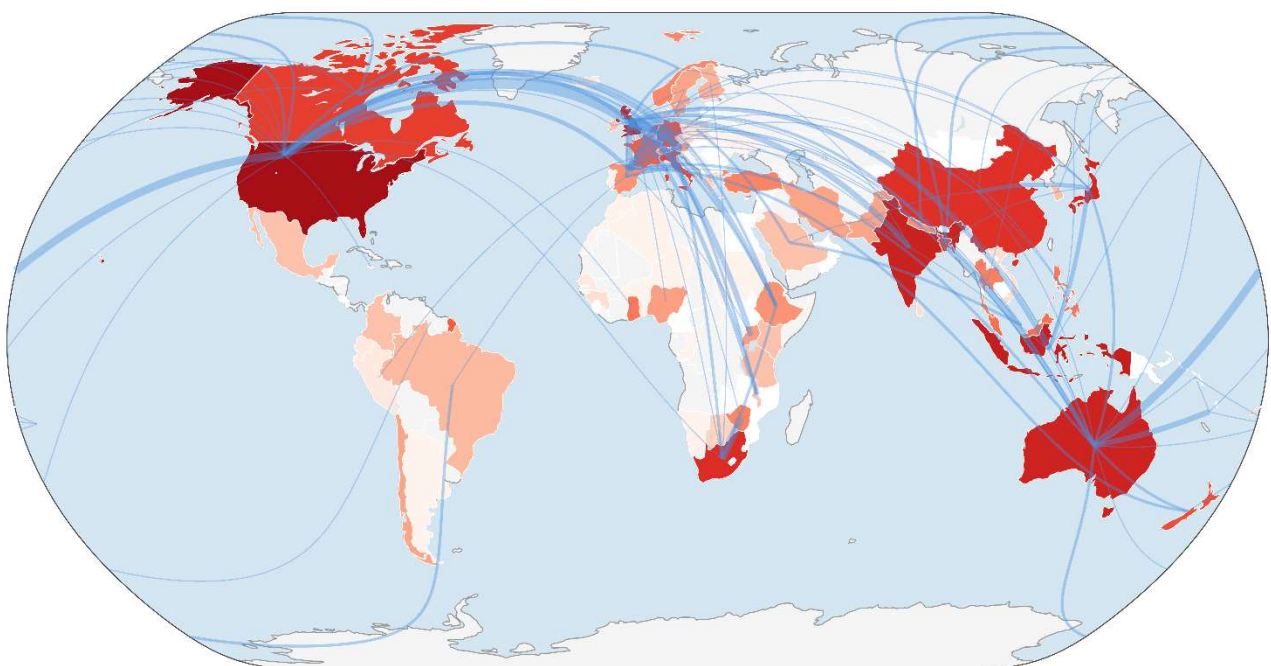


Fig. 12 International collaboration network among countries in Indigenous Knowledge and Disaster Management research.

The network also demonstrates the involvement of Global South research systems, including South Africa and Brazil, indicating that research on Indigenous Knowledge and Disaster Management extends beyond the major research-producing centres. However, collaboration remains more concentrated among established research-producing countries. Overall, the map reveals a tightly connected international research network, with major collaborative centres in the United States, Western Europe, East Asia and Australia. This broad geographical distribution reflects increasing international knowledge exchange, the sharing of disaster experiences and the integration of diverse geographical contexts. The participation of countries from Africa, Asia and South America further demonstrates the expanding global reach of the field. The collaboration pattern is generally consistent with country-level scientific productivity but also highlights two distinct dimensions of the research landscape: research productivity and collaboration intensity.

4. Major Discussion

This study demonstrates a clear conceptual evolution in research on *Indigenous Knowledge in Disaster Management* during 2005 to 2025. The findings from trend topics, keyword co-occurrence, thematic map, thematic evolution, factorial analysis and international collaboration collectively indicate a transition from hazard centred research towards an integrated knowledge, adaptation and resilience-oriented research framework (Vitale, 2017).

The Trend Topics analysis identifies four broad stages in the development of research priorities: (i) hazard and vulnerability assessment (2012 to 2015), (ii) climatic variability, risk perception and early warning (2016 to 2018), (iii) vulnerability, adaptation, resilience and local knowledge (2019 to 2020), and (iv) climate change, sustainable development and socio-economic dimensions of disaster risk (2021 to 2024). This progression indicates that the research agenda has expanded from understanding hazards and vulnerability towards examining *adaptation, resilience, local knowledge* and *Indigenous Knowledge* within broader disaster and climate risk contexts (Orsetti et al., 2022).

The keyword co-occurrence network identifies three interconnected dimensions: (i) strategic disaster risk reduction and governance, (ii) climate change, vulnerability and adaptation, and (iii) local and traditional knowledge in practical disaster management. The relationships among these themes demonstrate that *Indigenous Knowledge* is increasingly connected with *disaster risk reduction, adaptation* and *resilience*, while retaining strong associations with community level experiences and hazard specific research, particularly *floods* and *landslides* (Reyes et al., 2020).

The thematic map further demonstrates differences in the strategic development of these themes. These findings suggest that although *Indigenous Knowledge, traditional knowledge, climate change* and *resilience* have become important components of the intellectual structure, the direct integration of local knowledge into formal disaster risk reduction remains comparatively underdeveloped (Berkes et al., 2021).

The thematic evolution demonstrates a progressive transformation in the role of knowledge systems: (i) local knowledge, hazards and disaster management (2005 to 2009), (ii) traditional knowledge, vulnerability, resilience and climate change adaptation (2010 to 2019), and (iii) Indigenous Knowledge, local knowledge, traditional knowledge, disaster risk reduction, adaptation and resilience (2020 to 2025). This evolution indicates that research has gradually moved from documenting local and traditional knowledge towards examining its relationship with adaptation, resilience and disaster risk reduction (Siregar et al., 2026).

The factorial analysis identifies a dual conceptual orientation: (i) hazard specific disaster prevention, risk assessment and risk management, and (ii) climate change, adaptation, vulnerability and resilience. Within this structure, *Indigenous Knowledge* is positioned closer to *community resilience* and *disaster risk reduction*, indicating its relevance to community centred and knowledge-based approaches. The factorial structure therefore demonstrates the coexistence of conventional hazard management approaches with increasingly integrated climate and resilience-oriented perspectives (Stringer et al., 2018).



Fig; 13 Major Findings

The international collaboration network demonstrates that research on Indigenous Knowledge in Disaster Management has developed as an internationally connected research domain (Muis et al., 2025). The United States, United Kingdom, Australia, China and Japan occupy prominent positions within the collaboration structure, while countries such as India, Indonesia and South Africa demonstrate the broader geographical participation of the field.

The combined findings demonstrate a progression from hazard centred Disaster Management towards knowledge-based adaptation and resilience. The increasing integration of *Indigenous Knowledge, local knowledge, traditional knowledge, disaster risk reduction, climate change adaptation and resilience* indicates the growing importance of community knowledge within contemporary disaster research. The comparatively weaker position of local knowledge, disaster risk reduction and flood indicates that the field has progressed further in establishing the relevance of Indigenous Knowledge than in demonstrating its systematic integration into formal Disaster Risk Reduction frameworks. This gap provides an important direction for future research on early warning, preparedness, risk assessment, adaptation and community resilience.

5. Conclusion

This bibliometric analysis study aims to give a comprehensive picture of the development of research on Indigenous Knowledge in Disaster Management from 2005 – 2025 and the intellectual structure. Findings show that the field has matured to a more cohesive research field that has become more integrated between hazard and vulnerability related research and between indigenous and local knowledge and DRR and community resilience in the face of climate change.

The study showcases the three complementary approaches of strategic disaster risk reduction and governance, climate change and adaptive resilience, and community-level implementation of local and traditional knowledge that are guiding contemporary research. Meanwhile, the continuity of flooding and droughts and other hazard-specific studies demonstrate that disaster-related contexts will continue to play a key role in the field.

The study makes a significant contribution in identifying a wider transition in thinking, where the knowledge of Indigenous people is becoming integrated into broader modes of thinking about adaptation and resilience, and not just as a tool for traditional or cultural knowledge resource. The results also show that this integration is still imbalanced. While traditional knowledge and disaster-related research have already been integrated into disaster risk reduction, systematic integration of local and Indigenous Knowledge into formal disaster risk reduction frameworks is still comparatively underdeveloped.

The study thus identifies an important research need: future research should go beyond the descriptive documentation of Indigenous practices to evidence-based assessment of the potential of integrating Indigenous Knowledge into risk assessment, early warning, preparedness, adaptation and mitigation and resilience planning efforts. This work should also place more focus on the variety of Indigenous knowledge systems in geographical and hazard contexts, and meaningful involvement of the holders of the local knowledge in research and disaster governance.

This study highlights the significance of Indigenous Knowledge in the Disaster Management research agenda in the global context in spite of these limitations. The overall trend seems to be towards more integrated knowledge systems, adaptation and resilience to climate change, and clearly this is a good foundation for future interdisciplinary research and for creating locally based and context-specific approaches to DRR.

6. Limitations of the Study

The study is subject to several limitations. The analysis is restricted to publications indexed in Scopus and Web of Science and therefore may not capture relevant literature from other databases or grey literature. The merging of the two databases resulted in the absence of some metadata fields, particularly cited-reference information, limiting citation-network analyses such as co-citation and bibliographic coupling. The keyword-based bibliometric methods reflect the terminology used in the indexed literature and may not fully capture the contextual or culturally specific dimensions of Indigenous Knowledge.

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Declaration of Generative AI Use

During the preparation of this manuscript, the authors used AI-assisted tools, including ChatGPT (OpenAI), for language editing, grammar checking, improving clarity, and assisting in the design and visual representation of the major findings diagram based on the authors' analyses. AI tools were used solely as an assistive resource and did not replace the authors' responsibility for the methodology, data collection, analysis, interpretation, and conclusions. All AI-assisted outputs were critically reviewed and verified by the authors. The authors take full responsibility for the accuracy, originality, integrity, and final content of the manuscript and its visual materials.

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Conflict of Interest

The authors declare that there are no conflicts of interest associated with this study.

Informed Consent

Not applicable. This study is based exclusively on secondary data derived from published literature and publicly available bibliographic databases and does not involve human participants.

Authors' Contributions

All authors contributed equally to the conceptualization, data collection, analysis, interpretation, and writing of the manuscript and approved the final version.

Data Availability Statement

This study is based on bibliometric data retrieved from the Scopus and Web of Science databases. Due to licensing restrictions of the databases, the full datasets cannot be shared publicly; however, processed data and analytical outputs used in the study are available from the corresponding author upon reasonable request.

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