Mapping The Knowledge Landscape of Local And Traditional Ecological Knowledge (Lek/Tek) In Mangrove Ecosystems: A Bibliometric Analysis In The Past Decade

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Abstract.

Local Ecological Knowledge (LEK) and Traditional Ecological Knowledge (TEK) play a crucial role in mangrove ecosystem management, restoration, and community livelihoods. Over the past decade, scholarly interest in this topic has grown, yet research remains scattered across regions and disciplines. This study employed a bibliometric analysis of Scopus-indexed publications from 2014–2024, focusing on LEK/TEK in mangrove ecosystems. A total of 93 open-access articles and conference papers were identified. Results show two major research clusters: (i) ecosystem restoration, conservation, and ecosystem services, and (ii) ethnobotany and medicinal applications of mangrove species. Global publication patterns highlight Indonesia, India, and Bangladesh as leading contributors, while citation impact is distributed across both ecological and ethnobotanical studies. Despite growing attention, gaps remain in cross-regional comparisons, integration of LEK/TEK into policy, and interdisciplinary approaches bridging ecological, cultural, and governance perspectives. The findings provide a comprehensive overview of global scholarship and highlight future directions to strengthen the role of LEK/TEK in sustaining mangrove ecosystems.

Keywords: *Bibliometric analysis;Community-based management; Ethnobiology; Local ecological knowledge (LEK); Mangrove ecosystems and Traditional ecological knowledge (TEK).*

I. INTRODUCTION

Local Ecological Knowledge (LEK) and Traditional Ecological Knowledge (TEK) are knowledge systems developed and maintained by indigenous and coastal communities worldwide [1]. Rooted in cultural practices and long-term ecological observations, they play a critical role in biodiversity conservation, sustainable resource use, and adaptation to environmental change. In mangrove ecosystems, LEK and TEK have received growing attention over the past decade for their relevance and a wide coverage of themes, including ecosystem restoration, sustainable resource use, ecosystem services, biodiversity, governance, and cultural values [2]. For example, LEK has been shown to support mangrove rehabilitation in Madagascar [3], inform seahorse conservation in Brazil [4], and guide fishery management in the Pacific Islands [5].

Likewise, community-based practices have enhanced our understanding of ecosystem services, such as carbon storage and fisheries support, while also offering practical strategies for climate adaptation [6]. In addition, research highlights the importance of customary tenure, cultural capital, and local institutions in sustaining mangrove-dependent livelihoods and conservation initiatives [7,8]. Despite these contributions, the field remains fragmented across disciplines and geographic regions, with limited synthesis of research progress, dominant themes, and gaps. While a scoping review can provide insight into the breadth of topics and approaches, a bibliometric analysis offers a complementary perspective by mapping publication trends, thematic clusters, and global patterns of scholarship. The aim of this study is to analyze the scientific literature on LEK/TEK in mangrove ecosystems over the past decade (2014–2024) through a bibliometric approach, with a focus on publication trends, citation patterns, thematic structures, and research gaps.

II. METHODS

A comprehensive literature search was conducted in Scopus, chosen for its broad coverage of peer-reviewed journals across environmental sciences, social sciences, and interdisciplinary studies. The search was performed in July 2025. The Boolean string applied was: ("traditional ecological knowledge" OR "indigenous knowledge" OR "local knowledge" OR "folk knowledge" OR "ethno*" OR "customary

knowledge") AND (mangrove* OR "coastal forest*" OR "tidal forest*"). To ensure the relevance and quality of the included literature, a set of eligibility criteria was applied during the screening process. Publications were considered eligible if they explicitly examined traditional ecological knowledge (TEK), local ecological knowledge (LEK), indigenous knowledge, or closely related concepts such as customary knowledge or folk knowledge in the context of mangrove ecosystems. The publication window was set between 2014 and 2024, with the inclusion of three early 2025 articles, in order to capture the most recent and contemporary developments in the field.

Additional limits were applied to include only studies published in English and accessible through open access, ensuring transparency and reproducibility of the review process. Publications were excluded if they referred to "ethno-" concepts (e.g., ethnobotany, ethnobiology) without clear linkage to ecological knowledge or mangrove systems. Similarly, papers where traditional knowledge was only mentioned peripherally, without contextual analysis of its role in ecological practices or management, were omitted. Non-English documents, grey literature, book chapters, editorials, and other non-peer-reviewed outputs were also excluded. Descriptive analyses were conducted to explore annual publication trends and citation performance. Geographic distributions were mapped using Datawrapper (https://www.datawrapper.de/maps/choropleth-map), where shading intensity indicated publication counts and numeric labels represented citation totals per country. Keyword co-occurrence analysis was performed in VOSviewer (version 1.6.20), applying fractional counting to visualize research themes and clusters. Co-occurrence maps highlighted the relational structure among key concepts, allowing identification of dominant thematic foci (e.g., ecosystem services, conservation, ethnobotany, and medicinal applications).

III. RESULT AND DISCUSSION

The annual distribution of publications (93 documents) on traditional and local ecological knowledge in mangrove ecosystems from 2014 to 2025 shows a clear upward trajectory with fluctuations (Figure 1). In the early period (2014–2018), publication output remained relatively modest, ranging from two to five documents per year. A small surge was observed in 2019 with nine publications, followed by a decline to four in 2020. A noticeable increase occurred in 2021, when the number of documents quadrupled to 16, representing the highest annual output across the decade. Although a slight decrease followed in 2022 (14 documents) and 2023 (13 documents), publication activity remained consistently high compared with the pre-2020 period. Another peak was recorded in 2024 with 15 documents, underscoring sustained scholarly interest in the subject. The count for 2025 is notably lower (three documents); however, this decline is likely attributable to incomplete indexing for the current year rather than an actual reduction in research activity. The temporal pattern demonstrates that LEK/TEK research in mangrove ecosystems has gained great momentum since 2020, coinciding with increasing global attention to nature-based solutions, indigenous knowledge systems, and community-based conservation frameworks.

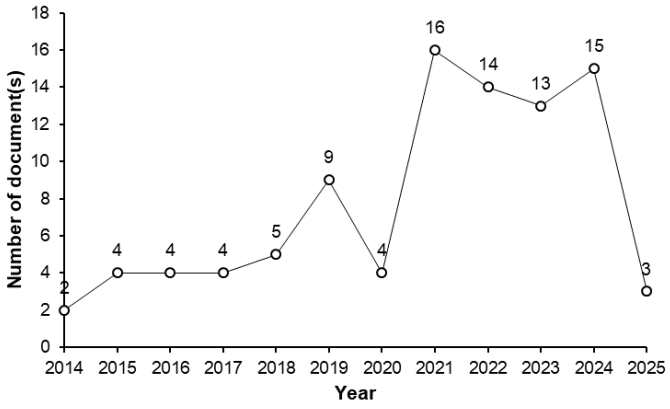

Fig 1. Number of documents mentioning the LEK/TEK in mangrove studies.

Between 2014 and 2024, publications on LEK/TEK in mangrove ecosystems were unevenly distributed across countries (Figure 2). India (15 documents, 249 citations), the United States (13 documents, 237 citations), and Indonesia (22 documents, 141 citations) stood out as the main contributors, both in

volume and impact. Australia (6 documents, 117 citations), the United Kingdom (9 documents, 90 citations), France (6 documents, 80 citations), Germany (4 documents, 73 citations), and the Netherlands (4 documents, 84 citations) also played a strong role, especially within Europe and Oceania. In the Global South, Kenya (3 documents, 93 citations), Bangladesh (3 documents, 69 citations), and Brazil (6 documents, 69 citations) showed important outputs despite smaller volumes. Southeast Asian countries such as Thailand (5 documents, 54 citations), Malaysia (3 documents, 27 citations), and the Philippines (3 documents, 10 citations) contributed regionally relevant research, while Spain (3 documents, 57 citations), Panama (3 documents, 31 citations), Canada (3 documents, 64 citations), and Japan (4 documents, 17 citations) added to the diversity of perspectives. Portugal had a minimal presence (3 documents, 1 citation). A comparison between document output and citation impact reveals notable differences. Indonesia produced the largest number of documents (22) but received fewer citations than India (141 vs. 249), indicating broad activity but more modest citation reach. Conversely, India, with 15 documents, achieved the highest citation count, reflecting strong influence per publication. The United States showed a similar pattern, with 13 documents yielding 237 citations. Countries such as Kenya (3 documents, 93 citations) and Australia (6 documents, 117 citations) also stand out for high citation rates relative to their publication volume, suggesting that their contributions have been particularly impactful.

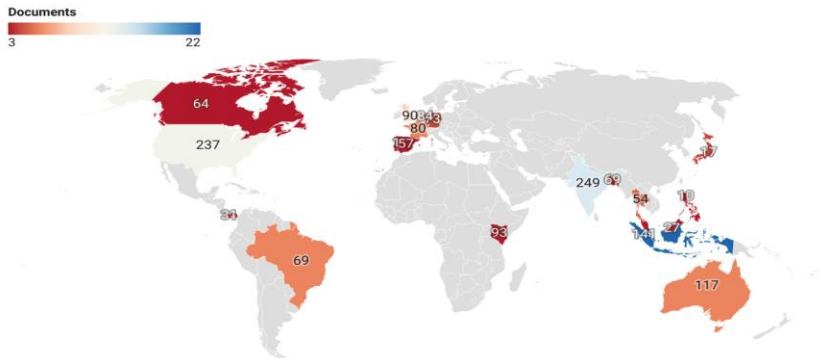

Fig 2. Global publications on local and traditional ecological knowledge (LEK/TEK) in mangrove ecosystems over the past decade (2014–2024). Only countries with at least three documents are displayed. Shading intensity represents the number of publications, while numeric labels indicate the total citations associated with those documents. Visualization generated using Datawrapper.

Table 1 presents the leading publication outlets for studies on local and traditional ecological knowledge in mangrove ecosystems over the past decade. The Scopus-indexed proceeding, *IOP Conference Series: Earth and Environmental Science* accounted for the highest number of contributions (seven documents), reflecting the role of conference proceedings in disseminating case-based research. Among peer-reviewed journals, *Sustainability* (*Switzerland*) ranked second with five publications, supported by its strong indexing status (SJR 0.69, Q1). Other sources included the recent discontinued journal, *Evidence-based Complementary and Alternative Medicine* (four documents) and *Biodiversitas* (three documents, Q2), indicating the interdisciplinary reach of the topic across ecological, cultural, and health-related perspectives. Other high-impact journals also involved in publishing these studies.

Table 1. Top five publication sources on LEK/TEK in mangrove ecosystems for the past decade

No.	Publication(s)	Number of document(s)	SJR 2024	Quartile(s)
1.	IOP Conference Series: Earth and Enviromental Science	7	0.21	-
2.	Sustainability (Switzerland)	5	0.69	Q1
3.	Evidence-based Complementary and Alternative Medicine	4	-	-
4.	Biodiversitas	3	0.37	Q2
5.	Frontiers in Marine Science	2	0.93	Q1
	International Archives of the Photogrammetry Remote Sensing and Spatial Information Sciences (ISPRS)	2	0.31	-
	Journal of Ethnobiology and Ethnomedicine	2	0.73	Q1
	Journal of Marine and Island Cultures	2	0.20	Q2

The most cited articles on LEK/TEK in mangrove ecosystems illustrate three dominant themes: ethnobotany, ecosystem services, and livelihood adaptation (Table 2). The top-ranked study by Tounekti *et al.* [9] on medicinal plant use in Saudi Arabia (72 citations) and works from Mahomoodally *et al.* [10] in Mauritius and Arbiastutie et al. [11] in Indonesia highlight the strong presence of ethnobotanical research. Damastuti and de Groot [12] (61 citations) and Singh *et al.* [13] emphasized ecosystem service mapping and climate adaptation in Indonesia and the Sundarbans. Livelihood- and socio-ecological studies, such as Hossain *et al.* [14] on health and livelihoods during COVID-19 and Jamal et al. [15] on conflict and tourism, reflect the human dimensions of mangrove systems. Additional contributions include de Echeverria and Thornton [16] on TEK in climate adaptation in North America, Beitl [17] on fisheries commons in Ecuador, and Ternes *et al.* [18] on LEK of seahorses in Brazil.

Table 2. Top ten articles on LEK/TEK in mangrove ecosystems for the past decade ranked from the highest citations

No.	References	Title	Number of citation(s)
1.	Tounekti *et al.* (2019)	Ethnobotanical study of indigenous medicinal plants of Jazan region, Saudi Arabia	72
2.	Damastuti & de Groot (2019)	Participatory ecosystem service mapping to enhance community-based mangrove rehabilitation and management in Demak, Indonesia	61
3.	de Echeverria & Thornton (2019)	Using traditional ecological knowledge to understand and adapt to climate and biodiversity change on the Pacific coast of North America	46
4.	Hossain *et al.* (2021)	Livelihood challenges and healthcare-seeking behavior of fishermen amidst the COVID-19 pandemic in the Sundarbans mangrove forest of Bangladesh	36
5.	Singh *et al.* (2019)	Evaluating the effectiveness of climate change adaptations in the world's largest mangrove ecosystem	34
6.	Mahomoodally *et al.* (2016)	Traditional therapies used to manage diabetes and related complications in Mauritius: A comparative ethnoreligious study	33
7.	Ternes *et al.* (2016)	Seahorses in focus: Local ecological knowledge of seahorse-watching operators in a tropical estuary	27
8.	Beitl (2014)	Adding environment to the collective action problem: individuals, civil society, and the mangrove-fishery commons in Ecuador	26
9.	Jamal *et al.* (2022)	Livelihood, conflict and tourism: An assessment of livelihood impact in Sundarbans, West Bengal	25
10.	Arbiastutie *et al.* (2021)	Ethnobotanical and ecological studies of medicinal plants in a mangrove forest in mempawah district, west kalimantan, indonesia	24

The keyword co-occurrence network reveals two major thematic clusters in LEK/TEK research on mangrove ecosystems over the past decade (Figure 3). The first cluster (red) centers on traditional knowledge, conservation, ecosystem services, and climate change, often linked with indigenous and local perspectives in management contexts, with frequent geographic reference to Indonesia. The second cluster (green) highlights ethnobotany and medicinal applications, connecting terms such as herbal medicine, plant extracts, antioxidant activity, and experimental studies. The bridging role of "mangrove" underscores its position as the core subject linking ecological knowledge with both conservation and pharmacological research.

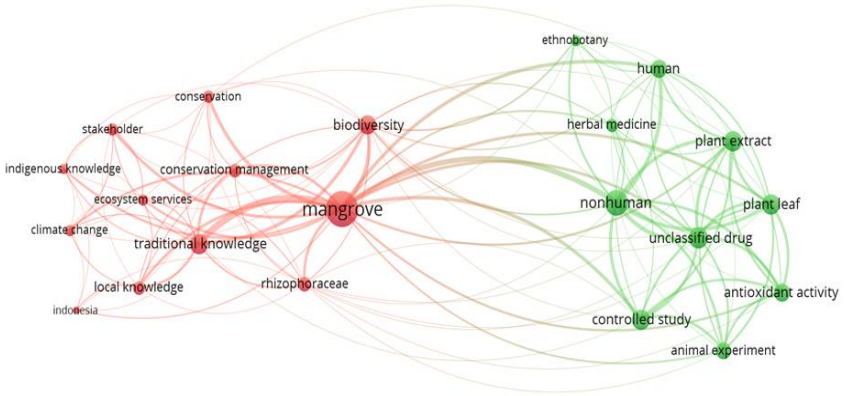

Fig 3. Keyword co-occurrence network of publications on traditional and local ecological (LEK/TEK) knowledge in mangrove ecosystems (2014–2024). Visualization generated using VOSviewer.

TEK informs environmental and health-related behaviors, such as dietary practices, medicinal use of mangrove plants, and strategies for reducing exposure to hazards in coastal settings. At the same time, studies also focus on fauna closely associated with mangroves, including fish species of commercial value, seahorses, and bats, as well as mangrove tree species such as *Rhizophora*, *Bruguiera*, and *Ceriops*, which are central to restoration and resource use. Broader ecosystem services, including carbon storage, coastal protection, and fisheries productivity, are frequently assessed through the lens of LEK. Governance actors, from customary tenure institutions to government-led conservation initiatives, appear less consistently, though they form an important bridge between community practices and policy. Despite these advances, several limitations remain evident. Validation challenges also arise when reconciling oral histories with empirical ecological data, as knowledge is often highly localized and context-dependent.

Conceptually, the literature has yet to fully address conflicts, trade-offs, and power dynamics in mangrove resource use. For example, while mangrove rehabilitation is often presented as a shared goal, communities may have divergent perspectives when livelihood needs compete with conservation priorities. Similarly, gendered dimensions of TEK remain underexplored, even though women often contribute distinct forms of knowledge related to resource use, medicine, and cultural practices. The role of governance structures, particularly how different management regimes shape conservation outcomes when informed by LEK, is also insufficiently documented. Future research would benefit from broadening both geographic and taxonomic coverage, while applying more rigorous mixed-methods designs that link TEK to empirical ecological datasets. A stronger focus on gender and intra-community differences would enrich the understanding of how knowledge is generated, transmitted, and applied. Importantly, institutionalizing TEK within education systems, policy frameworks, and formal governance could strengthen its role in sustaining mangrove ecosystems. More attention may be given to conflicts, trade-offs, and adaptive strategies under climate stress would help advance socially inclusive and ecologically effective conservation approaches.

IV. CONCLUSION

This bibliometric analysis demonstrates that LEK/TEK in mangrove ecosystems is an emerging but fragmented field, characterized by diverse disciplinary approaches and regional emphases. Research has advanced understanding of restoration practices, community-based management, and ecosystem services, while also documenting the ethnobotanical value of mangroves. However, the literature remains uneven, with limited integration of knowledge across ecological, cultural, and governance dimensions. Greater collaboration across regions, as well as stronger incorporation of LEK/TEK into policy frameworks, is needed to ensure that community knowledge informs sustainable mangrove management under changing environmental and social conditions. By mapping existing trends and identifying gaps, this study provides a foundation for future interdisciplinary research that strengthens the interface between traditional knowledge and scientific practice.

V. ACKNOWLEDGMENTS

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