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Research Article

Mapping Anomalies in Desert Studies in India: A Scientometric Insight into Research Gaps and Emerging Themes (1892-2025)

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Abstract

Desert regions represent some of the most climatically fragile environments, yet their research landscape in India remains uneven and weakly mapped. This study provides a comprehensive scientometric analysis of a total of 4,439 documents on desert-related scholarship in India using two major global databases—Scopus (n = 2,653) and Web of Science (WoS) (n = 1,786). The objective is to identify publication trends, thematic concentrations, dominant contributors, and anomalies that reveal critical research gaps and emerging opportunities.

Analysis of WoS data shows that research output peaked as late as 2022, followed by a noticeable decline, indicating fluctuating long-term engagement with desert issues. Climate Action (SDG 13) emerged as the most strongly aligned Sustainable Development Goal, reflecting the increasing relevance of desert studies within climate-change discourse. Publications were most frequently classified under Geosciences Multidisciplinary, suggesting a broad but non-specialised engagement with desert environments. Scopus results similarly reveal oscillating publication activity, with a decline around 2019 and a sharp rise peaking in 2023. Environmental Sciences forms the dominant disciplinary cluster, while the Indian institutions appear as the most prolific institutional contributors.

Keyword co-occurrence networks from both databases highlight the overwhelming dominance of "India," "desert," "Thar Desert," "Rajasthan," "soil," "desert climate," and "dust," indicating a strong regional and thematic bias. The prominence of terms such as remote sensing, landforms, aerosol, climate change, and monsoon underscores growing attention to climate and desert interactions.

However, the scarcity of keywords related to socio-economic systems, groundwater dynamics, biodiversity, and cold-desert environments reveals notable research gaps. The study concludes that while India demonstrates strong output in arid-region research, thematic imbalance, regional concentration in the Thar Desert, and fluctuating long-term publication trends signify critical anomalies. Addressing these gaps is essential for strengthening India's desert resilience and aligning future research with broader environmental and developmental priorities. It is the first bibliometric attempt which tends to examine the research field on desert ecosystem in India.

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1. INTRODUCTION

Desert regions represent some of the most environmentally sensitive and climatically fragile landscapes on the planet, characterised by extreme aridity, high temperature variability and fragile ecosystems (Noy-Meir, 1973; Laity, 2009; Whitford and Doval, 2019) [27, 19, 44]. Extending from the extensive hot arid Thar Desert in western India (Tewari and Arya, 2004; Dhir and Singhvi, 2012; Koli and Arora, 2025) [41, 5, 14] to the cold deserts of the trans-Himalayan region (Negi, 2002; Varghese, 2023; Singh and Sharma, 2025) [26, 42, 36], these landscapes play a crucial role in climate regulation, food security, livelihoods, and long-term sustainability (Laity, 2009; Whitford and Doval, 2019) [19, 44].

Over the past century, desert research in India has expanded in response to growing concerns related to desert ecology, flora, fauna, land degradation, desert dust, desertification, water scarcity, climate change, and extreme climatic events. International environmental frameworks, including the United Nations Convention to Combat Desertification (UNCCD) and the Sustainable Development Goals, have further elevated the relevance of desert studies, particularly in relation to Climate Action (SDG 13) and sustainable land management (Ali, 1964; Purohit, 1967; Prakash, 1977; Sahai, 1993; Singh, 1998; Mishra and Tripathi, 2008; Mukhopadhyay, 2008; Kar *et al*., 2009; Krishnamurti *et al*., 2010; Singhvi *et al*. 2010; Shekhawat *et al*., 2012; Sharma, 2013; Kar, 2014; Kothiyal, 2016; Chalchula, 2021; Rajesh and Goswami, 2023; Varghese, 2023; Gaur, 2025; Kushwaha *et al*, 2024; Mishra *et al*., 2025; Mukherjee, 2025; Sahu *et al*., 2025) [1, 30, 29, 32, 37, 20, 25, 13, 16, 39, 35, 34, 12, 15, 3, 31, 42, 6, 18, 21, 24].

Despite their significance, desert-focused research in India has seen limited attempts to synthesise its long-term intellectual development as has been observed by the author. This is to highlight that the intellectual structure, thematic evolution, and institutional drivers of desert research in India remain weakly mapped. This lack of systematic assessment restricts the identification of research gaps, emerging themes, and structural imbalances within the field which have been addressed in the current study. For this, bibliometric and scientometric (Glanzel & Schoepflin, 1994; Kumar, 2025; Pereira *et al*., 2025) [8, 17, 28] approaches provide a robust framework for addressing this limitation (Xue, 2024) [45].

By quantitatively analysing large bodies of scholarly literature (Straub, 2006), these methods enable the examination of publication trends (Mooghali *et al*., 2011) [23], disciplinary orientations, institutional dominance, collaboration networks, and thematic concentrations over extended temporal scales (Haghani, 2023; Xue, 2024) [10, 45]. Importantly, scientometric analysis allows for the identification of anomalies areas of neglect, over-concentration, or temporal volatility. These are often overlooked in conventional narrative reviews and makes scientometric studies highly scientific (Ivancheva, 2008) [11]. In the context of desert studies, such an approach is particularly valuable for assessing whether research growth aligns with environmental urgency or remains episodic and reactive. India constitutes a compelling case for a comprehensive scientometric investigation (Gupta *et al*., 2013; Garg and Tripathi, 2017; Amanullah and Rajeswari, 2021) [9, 7, 2].

Although the country has produced a substantial volume of desert-related scholarship since the late nineteenth century, existing evidence suggests a strong regional bias towards the Thar Desert and a thematic emphasis on physical and climatic processes as is observed in preliminary investigations of this study. But the under-represented dimensions also require highlighting. Furthermore, the extent to which institutional dominance and funding structures shape research priorities has not been systematically examined yet.

Against this backdrop, the present study undertakes a comprehensive scientometric analysis of desert-related research in India spanning the period 1892–2025. Drawing upon two leading global bibliographic databases Scopus and WoS the study analyses 4,439 documents to examine publication trends, subject-area distributions, institutional and funding dominance, and keyword-based thematic structures. By identifying both concentrations and anomalies, this study seeks to provide an empirical foundation for reorienting desert research in India towards greater thematic balance, regional inclusivity, and long-term relevance in an era of accelerating climate change.

SIGNIFICANCE OF THE STUDY

The significance of this study lies in its integrated use of Scopus and WoS, the two most authoritative and widely utilised global bibliographic databases (Vieira and Gomes, 2009; Singh *et al*., 2021) [43, 38]. While both platforms are central to bibliometric research, they differ substantially in journal coverage, disciplinary emphasis, temporal depth, and citation indexing (Mongeon and Hus, 2016; Zhu and Liu, 2020; Singh *et al*., 2021) [22, 46, 38]. By combining insights from both databases, this study mitigates the limitations inherent in single-database analyses and enhances the reliability of its findings.

From a bibliometric perspective, the study contributes methodologically by comparing publication trajectories, subject classifications, and institutional dominance across databases. The observed oscillations in publication output such as the post-2022 decline in WoS and the dip around 2019 followed by a sharp rise in Scopus, demonstrate how database-specific coverage influences perceptions of research momentum. Such insights are critical for scholars, funding agencies, and policymakers who increasingly rely on bibliometric indicators to assess research performance and strategic priorities.

Scientometrically, the study extends beyond descriptive statistics to interrogate the intellectual structure of desert research in India. Keyword co-occurrence analysis reveals dominant research themes as well as conspicuous absences. The strong presence of themes such as climate and geoscience related terms contrasts sharply with the marginal representation of socio-economic systems, biodiversity, groundwater dynamics, and cold-desert environments. These findings highlight structural imbalances that limit the integrative and policy-relevant potential of existing research.

Importantly, this study represents the first comprehensive scientometric assessment of desert research focused explicitly

on India across more than a century of scholarly output. It establishes a baseline against which future research trajectories can be evaluated and provides a framework for aligning desert research with national sustainability goals and international environmental commitments. In doing so, it demonstrates the value of bibliometrics not merely as a performance-evaluation tool, but as a strategic instrument for diagnosing and reshaping research agendas.

2. METHODOLOGY

This study adopts a comprehensive scientometric and bibliometric approach to examine the evolution, structure, and thematic orientation of desert-related research in India over the period 1892–2025. Bibliographic data were sourced from WoS and Scopus, selected for their global recognition, rigorous indexing standards, and complementary coverage of scholarly literature. Together, these databases provide both historical depth and contemporary breadth, enabling a robust long-term analysis of research trends.

Both databases were utilised for their curated collection of high-impact journals and its strong historical coverage, which is particularly valuable for tracing the early development and intellectual foundations of desert research in India. Structured citation indexing allows for consistent classification of subject areas and reliable identification of long-term publication trajectories. Both databases offer broader disciplinary and geographical coverage, with extensive indexing of environmental sciences, applied research, and recent publications. The integration of both ensures comprehensive coverage, reduces database-specific bias, and strengthens the reliability of bibliometric indicators.

The specific search comprised of exact key word search as ‘desert’ and ‘India’. A systematic search strategy was followed by filtering keywords related to deserts and arid environments in India. Only peer-reviewed journal articles, conference papers, reviews, and book chapters were included to maintain academic rigour. After data retrieval, bibliographic records were exported and cleaned to remove duplicates, harmonise author and institutional names, and address incomplete metadata.

The final dataset comprised 4,439 documents**,** including 2,653 records from Scopus and 1,786 from WoS**.** Descriptive bibliometric techniques were first employed to analyse temporal publication trends**,** enabling assessment of long-term growth patterns, peaks, and declines in desert-related research output. Subject-area analysis was conducted to identify dominant disciplinary orientations and the extent of interdisciplinary engagement. Diagrams were generated from Python libraries and VoS Viewer software. Institutional analysis was performed using author affiliation data to determine leading research organisations and assess institutional concentration. Funding analysis was carried out based on acknowledged funding sponsors to evaluate the role of national research agencies and funding structures in shaping research priorities.

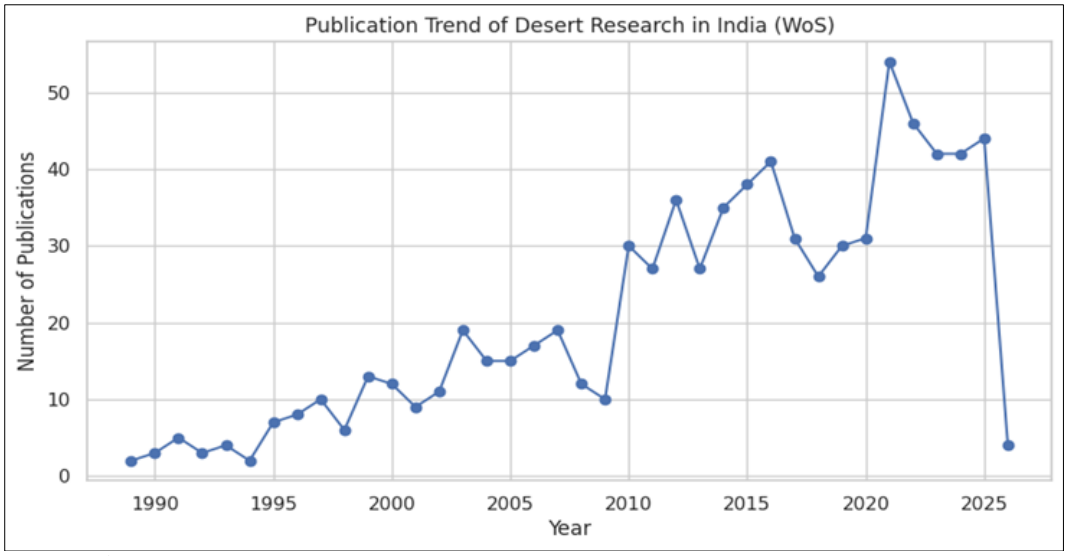
These outputs were visualised and presented in the accompanying figures. To examine the intellectual structure of the field, keyword co-occurrence analysis was conducted using author-provided and indexed keywords. This technique enabled the identification of dominant research themes, emerging topics, and under-represented areas. The resulting thematic networks highlight both research concentrations and anomalies within Indian desert studies. Overall, the methodology integrates descriptive and network-based varied bibliometric techniques to provide a systematic and empirically grounded assessment of desert research in India across more than a century of scholarly output.

3. RESULTS

Temporal Evolution of Desert Research in India

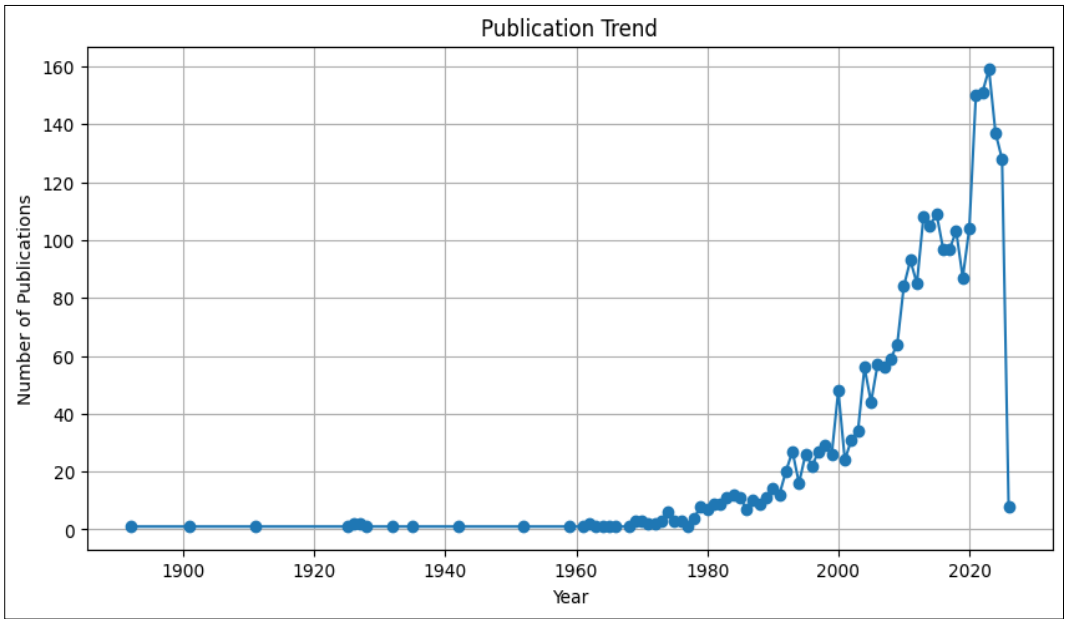
The temporal analysis of desert-related publications in India reveals a long but uneven research trajectory spanning more than a century. Early research output, particularly prior to the mid-twentieth century, was sparse and largely descriptive, reflecting exploratory geographical, geological, and climatological investigations. A gradual increase in publication activity is observed from the post-independence period onwards, coinciding with the institutionalisation of earth and environmental sciences in India. However, analysis of both WoS and Scopus datasets indicates that this growth has not been linear. Instead, desert research output exhibits pronounced temporal fluctuations.

WoS records show that publication activity peaked in 2022, followed by a noticeable decline, suggesting intermittent rather than sustained scholarly engagement. Scopus data display a similar oscillatory pattern, with a dip around 2019 and a sharp rise peaking in 2023. These patterns indicate that desert research in India has often been reactive, probably responding to funding cycles, policy initiatives, or climatic events, rather than driven by a stable long-term research agenda. The initial bibliometric findings can be seen in Fig.1., Fig.2., Fig.3. and Fig.4.



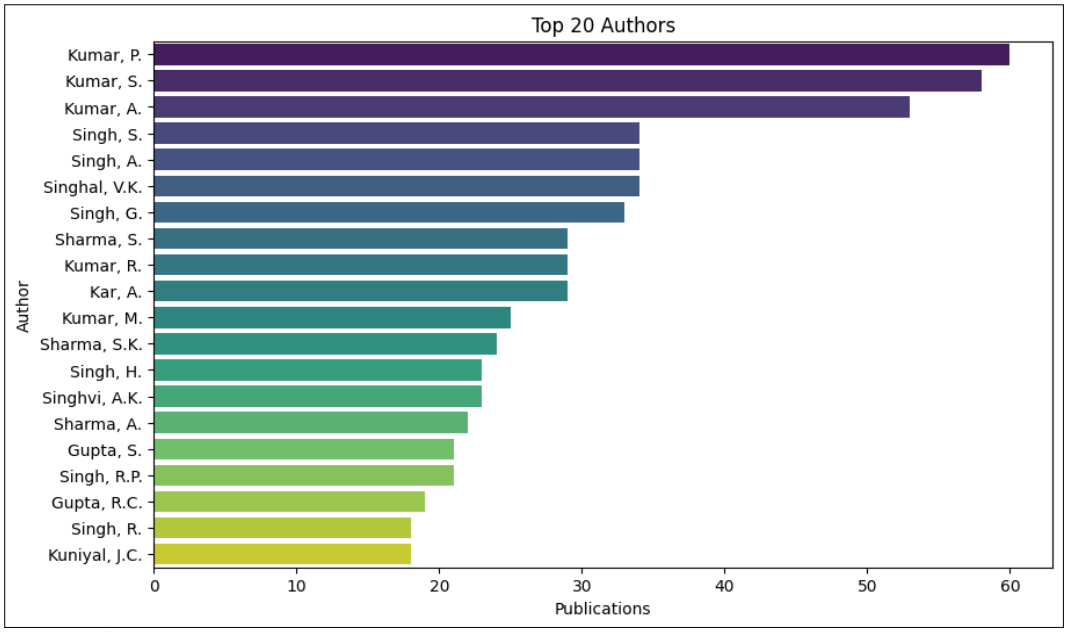
Source- Author, 2026

Fig 1: Publication Trend on 'Desert' and 'India'- WoS Database (1892-2026)



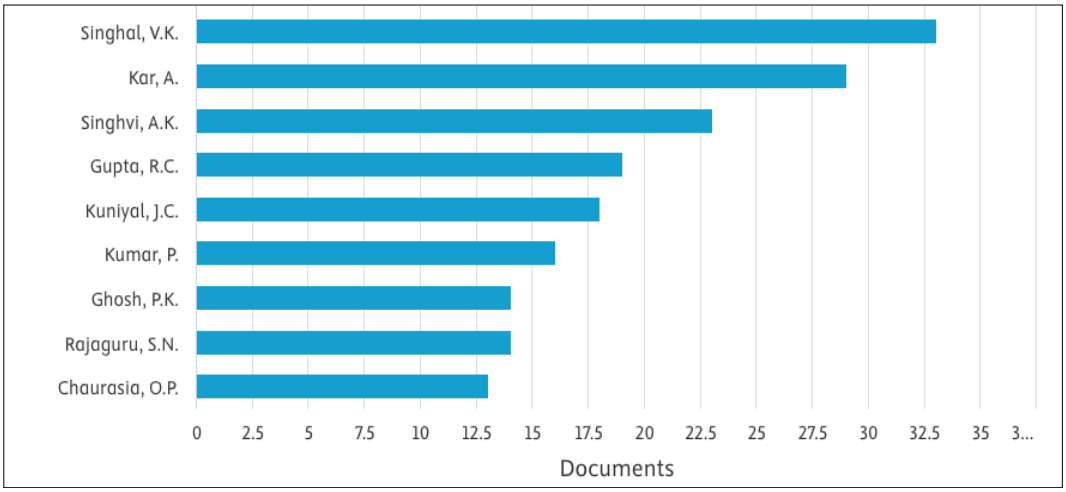
Source- Author, 2026

Fig 2: Publication Trend on 'Desert' and 'India'- Scopus Database (1892-2026)



Source- Author, 2026

Fig 3: Top Authors in Publications- WoS



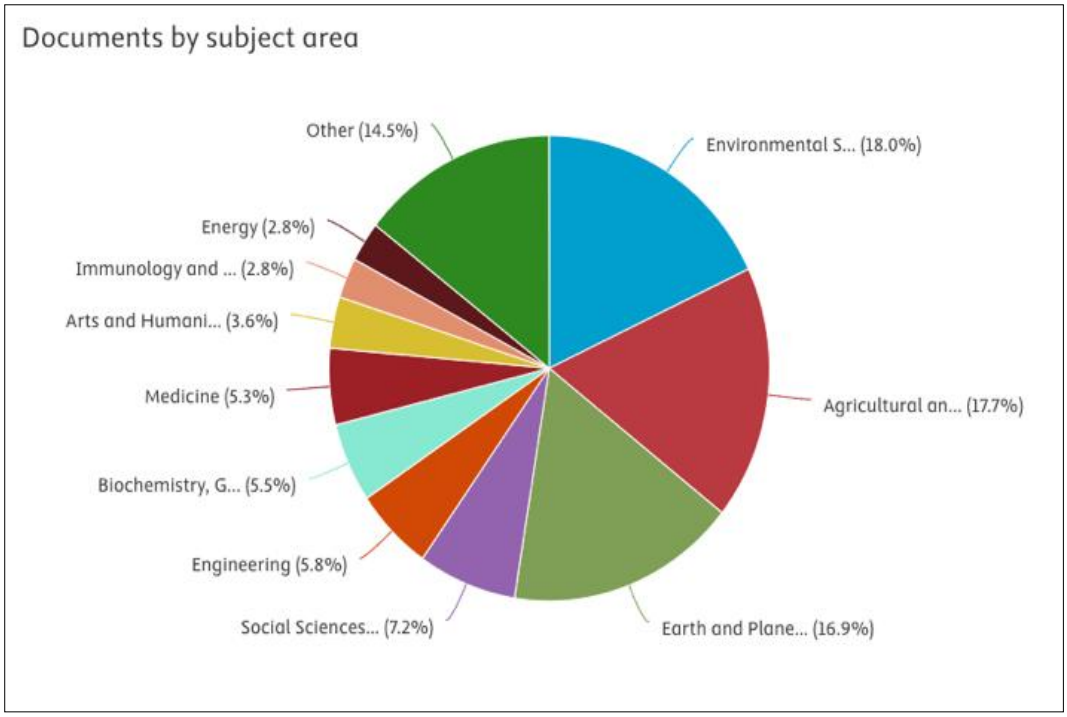
Source- Author, 2026

Fig 4: Top Authors in Publications- Scopus

Indian authors appear to be the main contributors to literature in both databases.

Subject Area Distribution

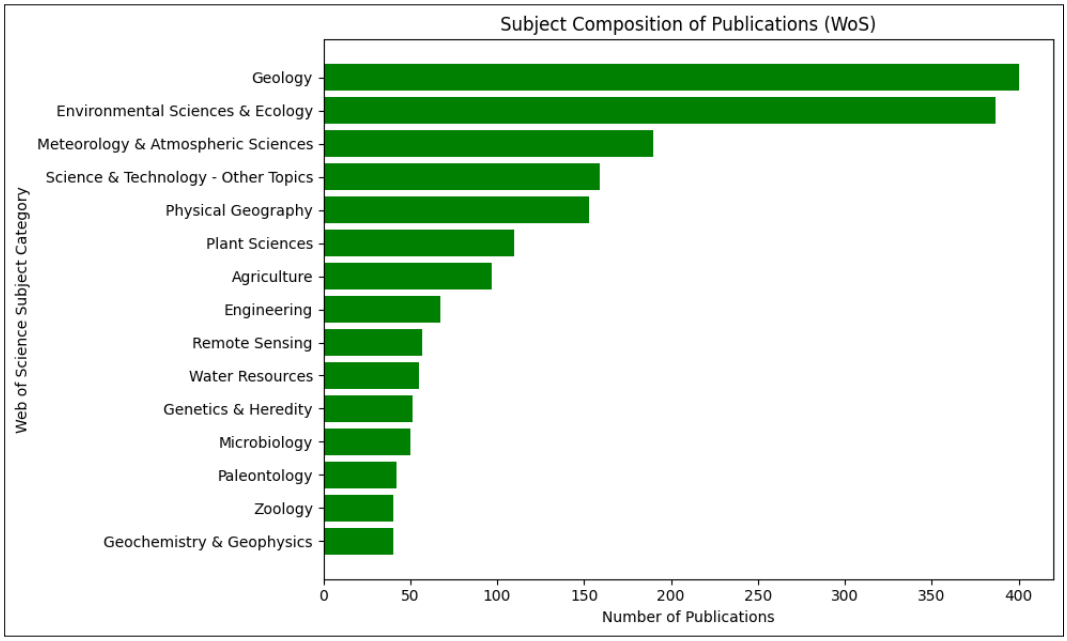
Subject-area classification reveals a strong disciplinary skew within Indian desert research. In the Scopus dataset, Environmental Sciences constitute the dominant subject category, followed by Earth and Planetary Sciences and Agricultural and Biological Sciences. This distribution reflects a strong emphasis on physical processes, land degradation, soil dynamics, and climate variability in arid environments.



Source- Author, 2026

Fig 5: Publications Composition by Subject Area- Scopus

WoS classifications similarly highlight Geosciences Multidisciplinary as the most prominent category, indicating broad engagement with desert systems through a physical science lens as can be seen in Fig. 5. and 6.



Source- Author, 2026

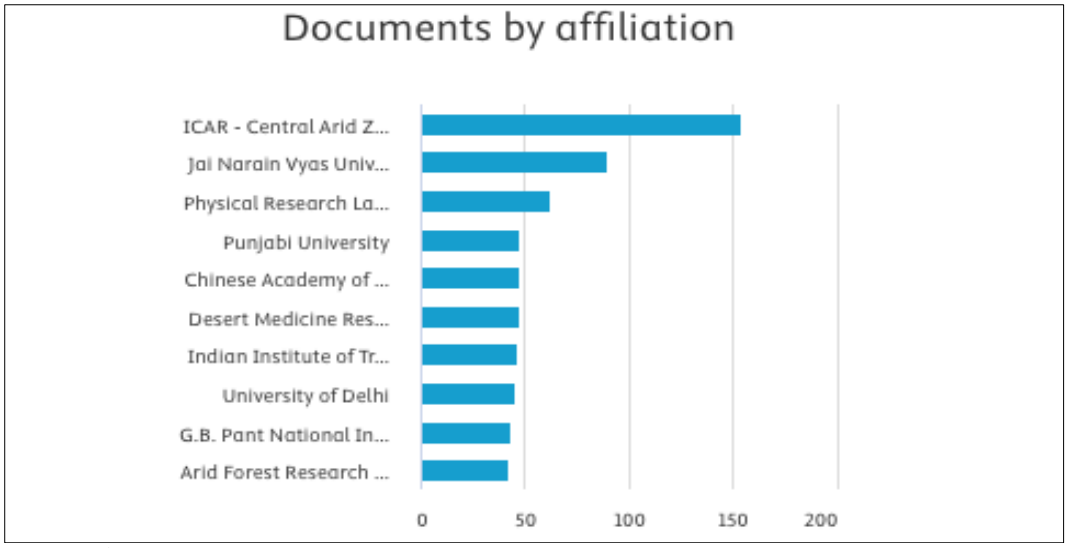
Fig 6: Publications Composition by Subject Area- WoS

Although these classifications suggest multi-disciplinarity, closer examination reveals limited integration of social sciences, economics, humanities, and health-related disciplines. These subject areas collectively represent a minor share of the

total research output. The marginal presence of biodiversity-focused and ecological studies further underscores the limited thematic breadth of desert research, despite the ecological sensitivity of arid and semi-arid environments.

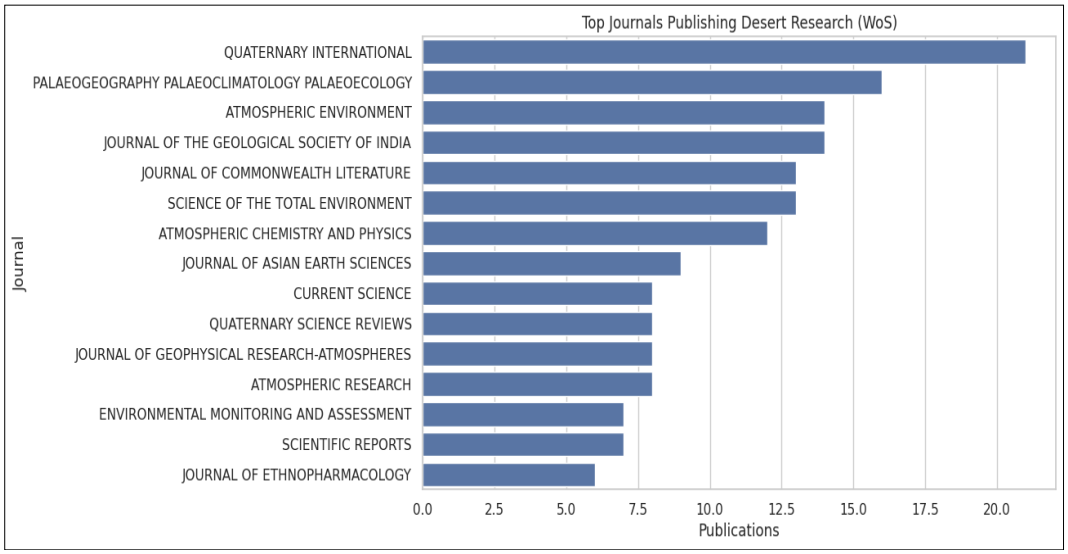
Institutional Contributions and Journals for Publication

Institutional affiliation analysis reveals a high degree of concentration among a relatively small number of organisations. The Indian Council of Agricultural Research (ICAR) emerges as the most prolific contributor to desert-related research, reflecting the centrality of agriculture, land-use management, and soil studies within the national desert research agenda. Other specialised arid-zone research institutes and physical research laboratories also feature prominently. Fig.7. gives an example of this.



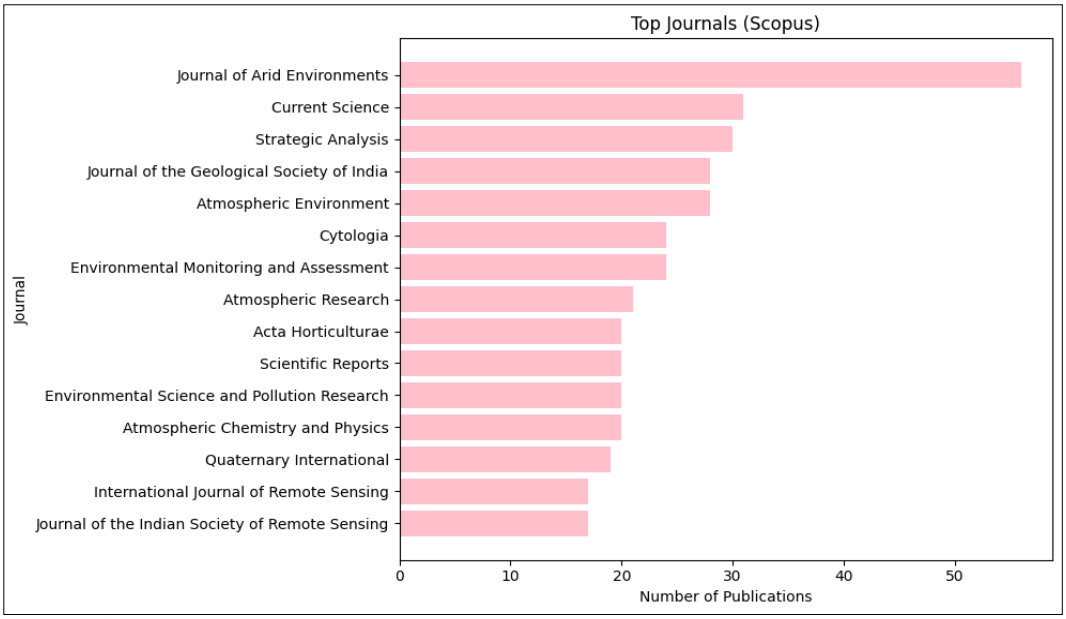
Source- Author, 2026

Fig 7: Affiliation of Documents- Scopus



Source- Author, 2026

Fig 8: Top Publishing Journals- WoS



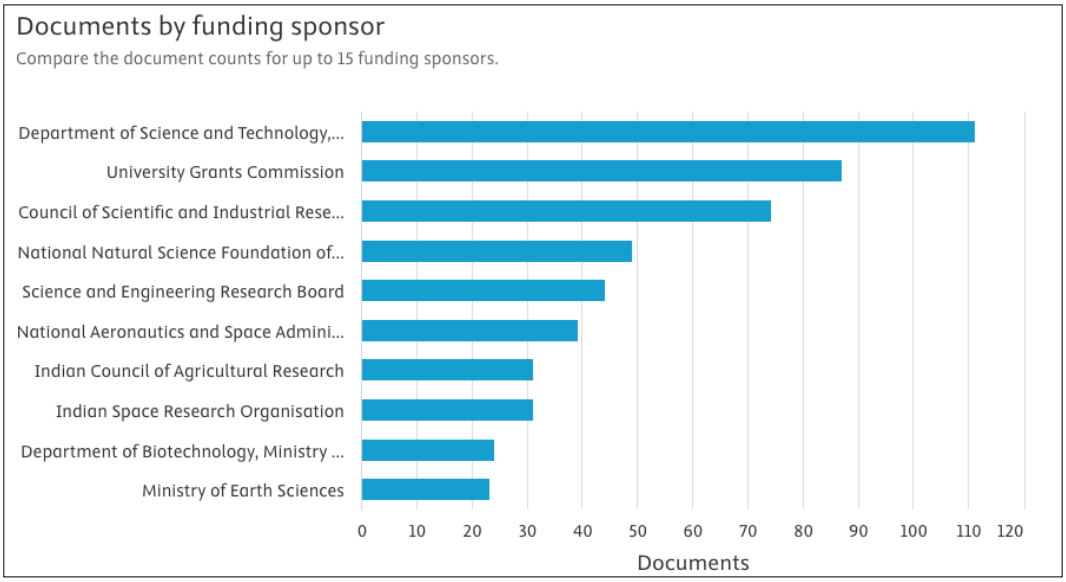
Source: Author, 2026

Fig 9: Top Publishing Journals- Scopus

The topmost journals publishing in the field can be seen in Fig.8 and 9.

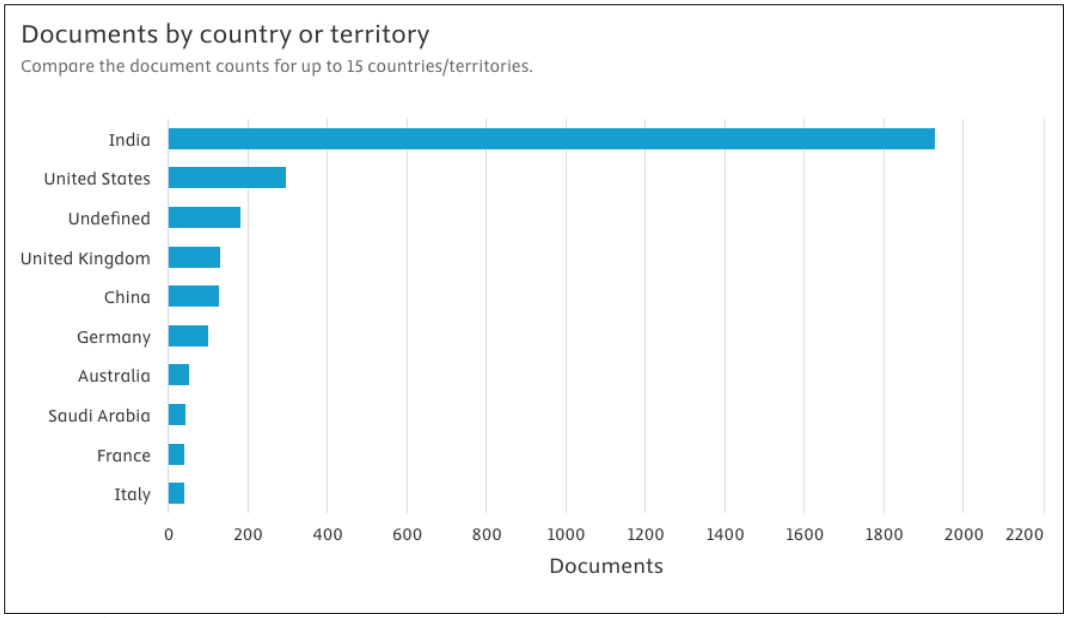
FUNDING LANDSCAPE AND CO-AUTHORSHIPS

Analysis of funding sponsors highlights the dominant role of national public-sector agencies in shaping desert research in India. In Scopus dominated publications, The Department of Science and Technology (DST) is the most frequently acknowledged funding body, followed by the University Grants Commission (UGC), the Council of Scientific and Industrial Research (CSIR), and sector-specific organisations such as ICAR. This funding pattern indicates strong governmental support for desert-related research, particularly in areas aligned with climate processes, land degradation, and agricultural resilience as can be seen in Fig.10.



Source- Author, 2026

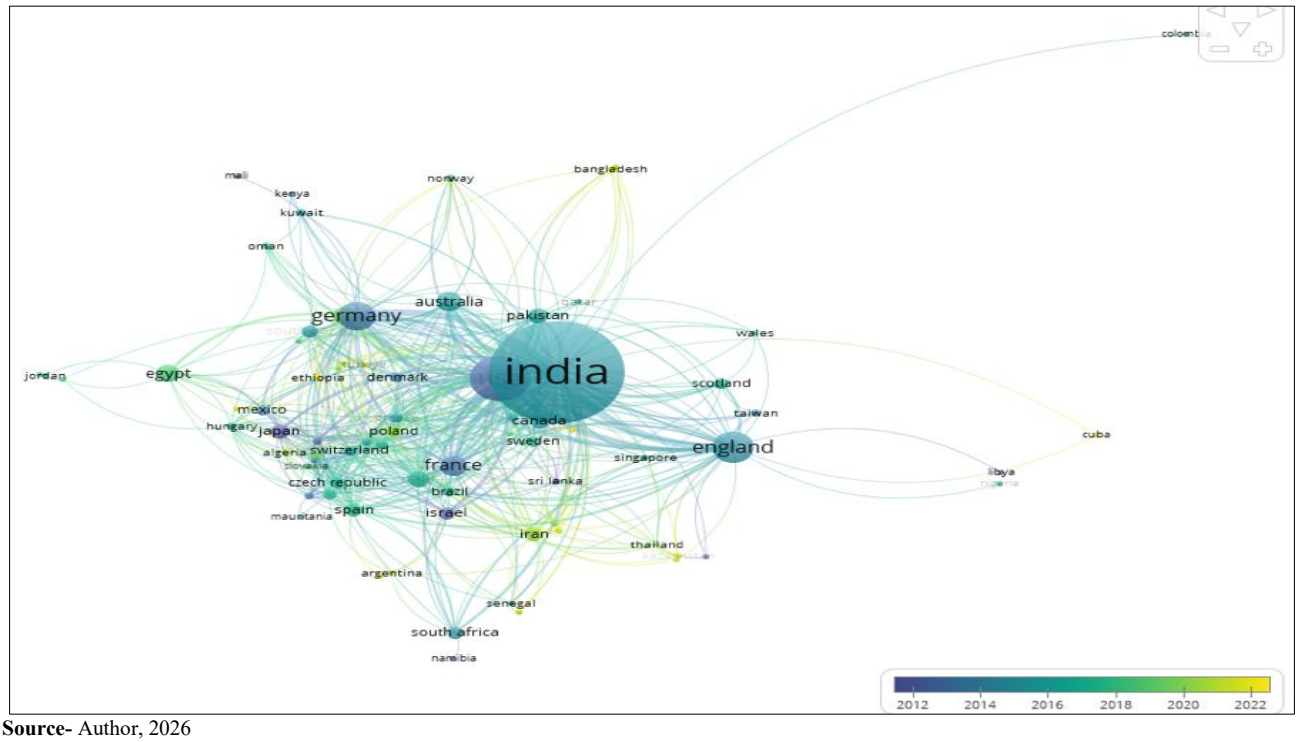
Fig 10: Publications by Funding- Scopus



Source- Author, 2026

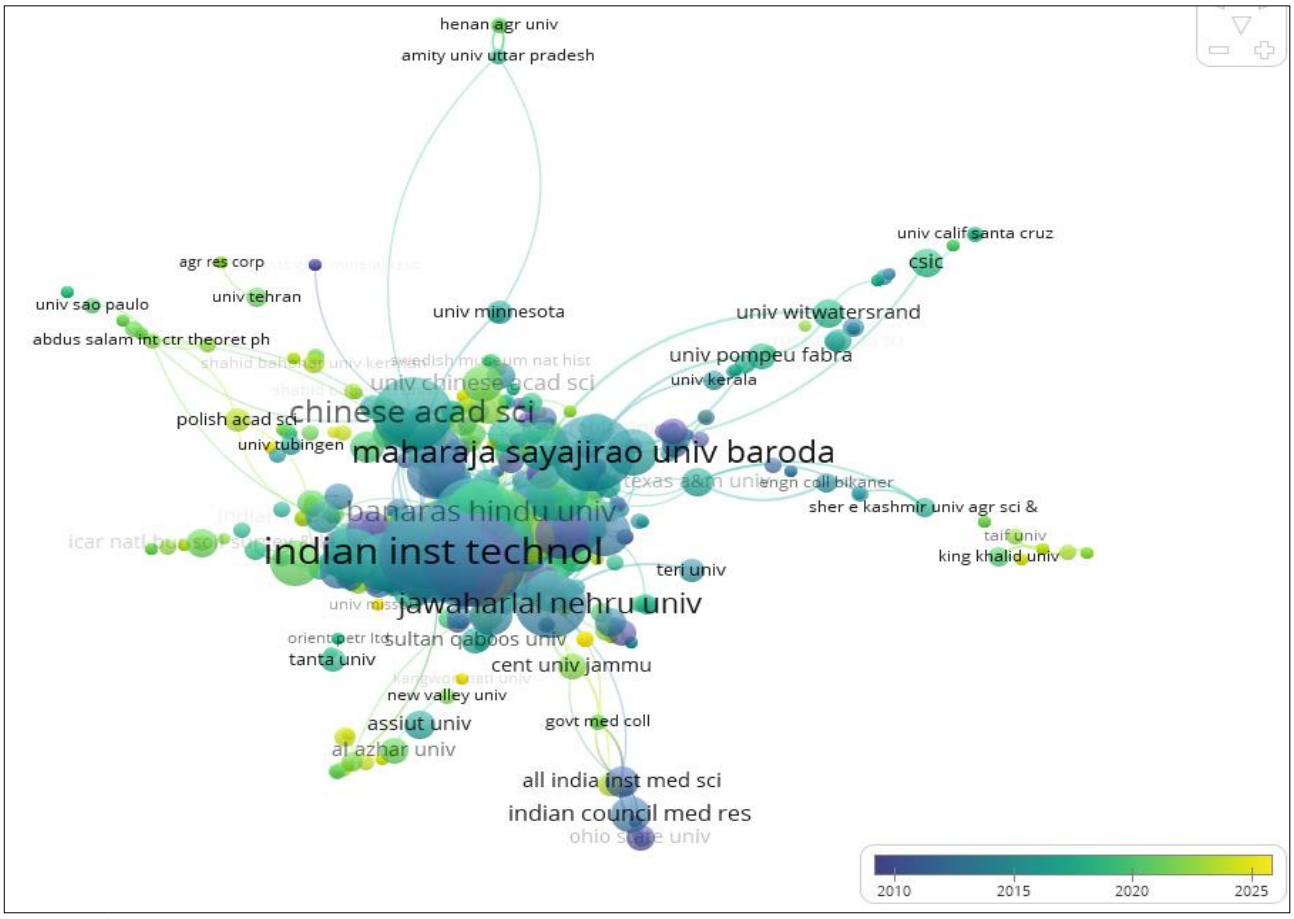
Fig 11: Documents by Country- Scopus

India dominates the publication scenario as can be seen in Fig.11. and 12. Germany, France, England and Pakistan also show clear clusters. Publication density decreases outwards towards the diagram and Columbia shows the farthest location as a cluster. However, India depicts publication network with almost every country in the domain.



Source- Author, 2026

Fig 12: Publication Details by Co-Authorship and Countries- WoS



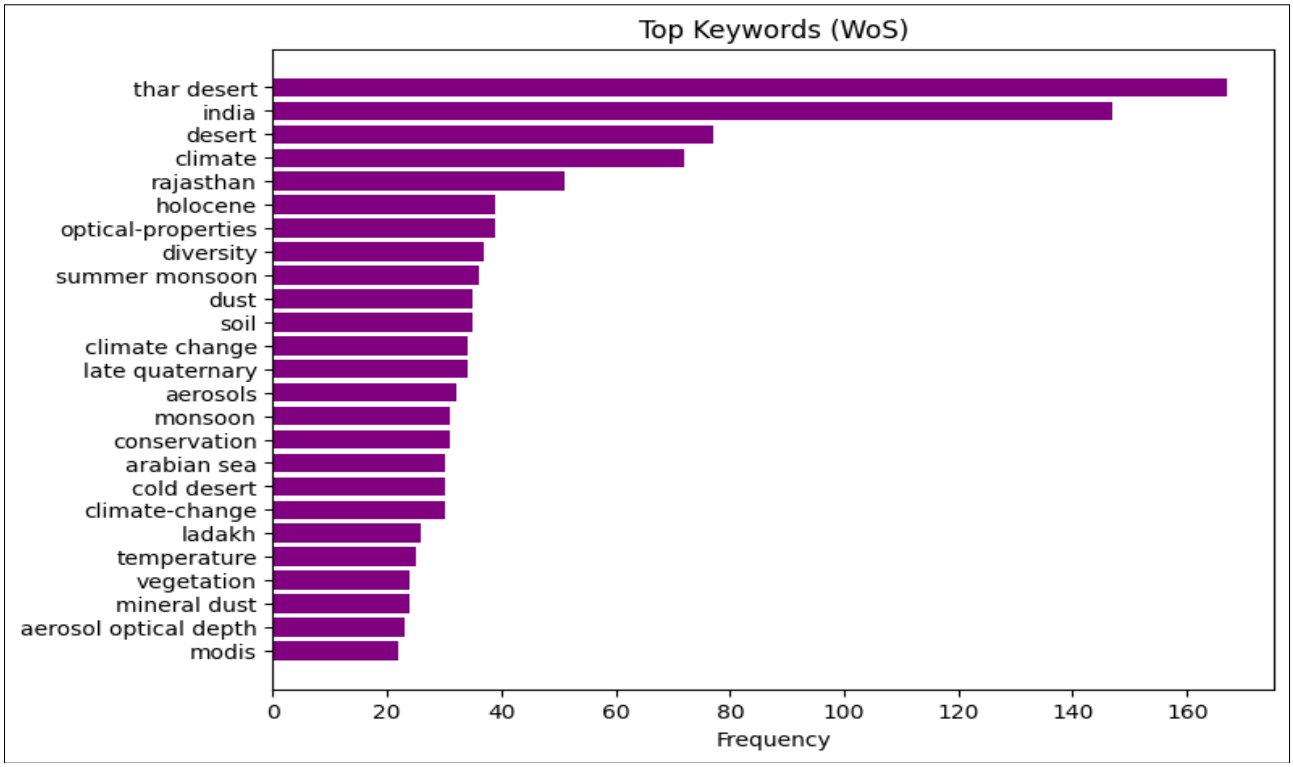
Source: Author, 2026

Fig 13: Publication Clusters by Co-Authorship and Organisations- WoS

International funding organisations, interdisciplinary research programmes, and development-focused agencies appear relatively infrequently in the funding data. This limited diversity in funding sources may contribute to the under-representation of socio-economic, governance, biodiversity, and community-based research themes. IIT's, BHU, JNU and Maharaja Sayajirao University dominate the publication scenario and show a very dense clustering as per co-authorship as is visible in Fig.13. They also contribute a smaller proportion of publications and are largely clustered within institutions located in or near arid regions. The comparatively limited participation of universities from non-arid regions suggests that desert research remains geographically localised rather than nationally diffused. Furthermore, institutions specialising in social sciences, policy research, and interdisciplinary environmental studies are under-represented, reinforcing the dominance of biophysical perspectives within the field.

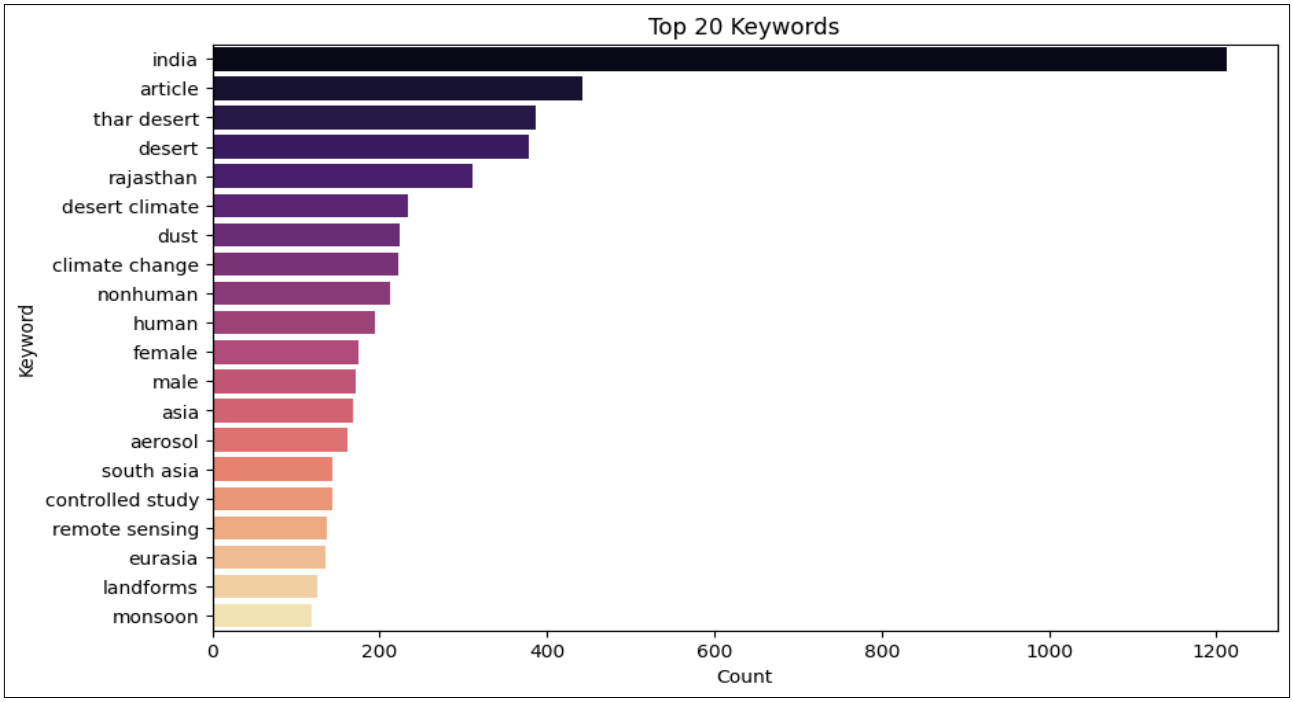
Keyword Co-occurrence and Thematic Structure

Keyword co-occurrence analysis provides insight into the intellectual structure and thematic orientation of desert research in India. Networks generated from both Scopus and WoS datasets reveal the overwhelming dominance of region- and climate-specific terms, including *India, desert, Thar Desert, Rajasthan, soil, dust, and desert climate*. These keywords form the core thematic cluster and highlight a strong regional and conceptual focus on the hot arid landscapes of western India. Fig.14.,15. and 16. exhibit the top most keywords and their relative strength in publication landscape.



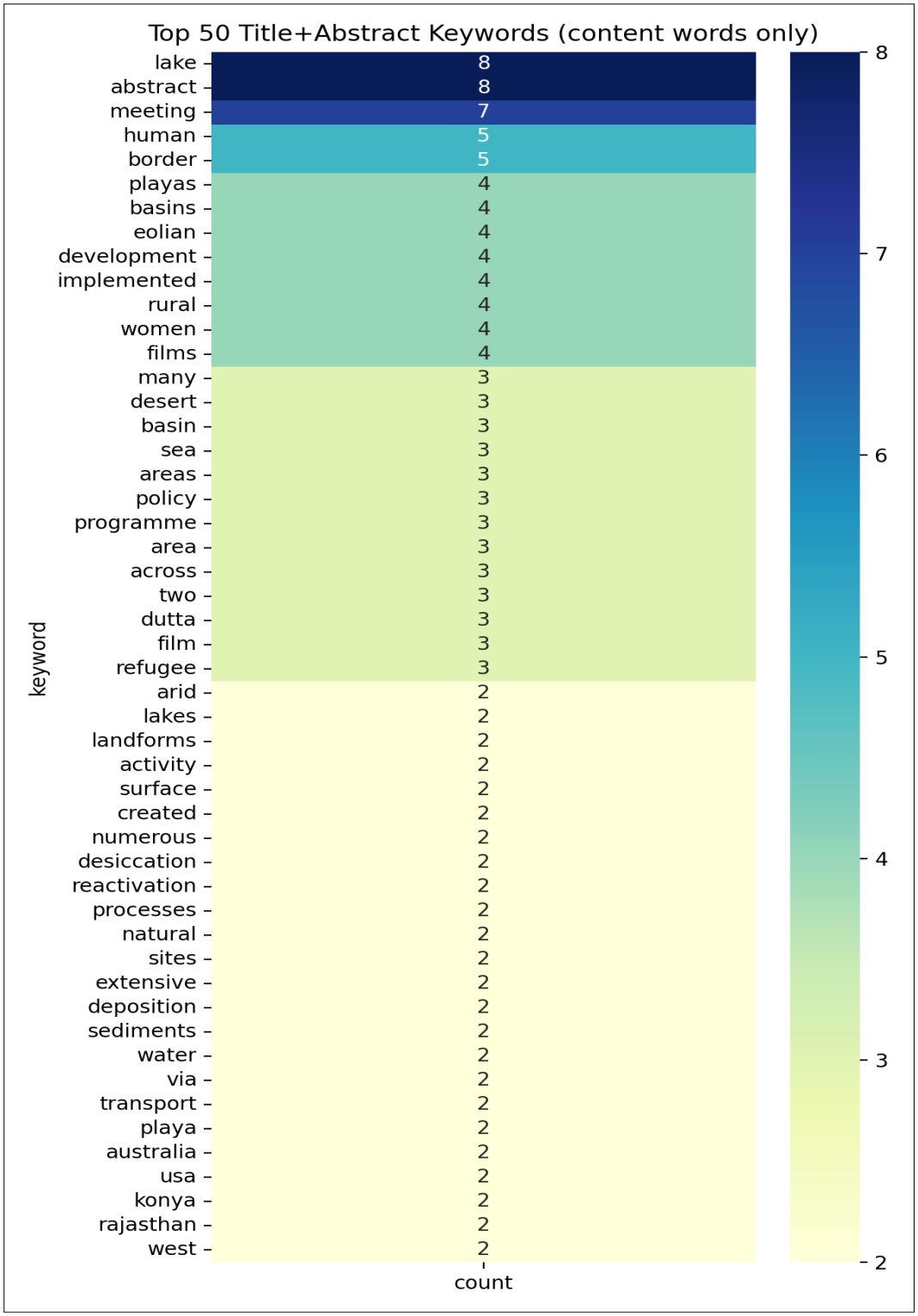
***Source*:** Author, 2026

Fig 14: Dominant Themes as Shown by Keywords- WoS



Source: Author, 2026

Fig 15: Dominant Themes as Shown by Keywords- Scopus



Source: Author, 2026

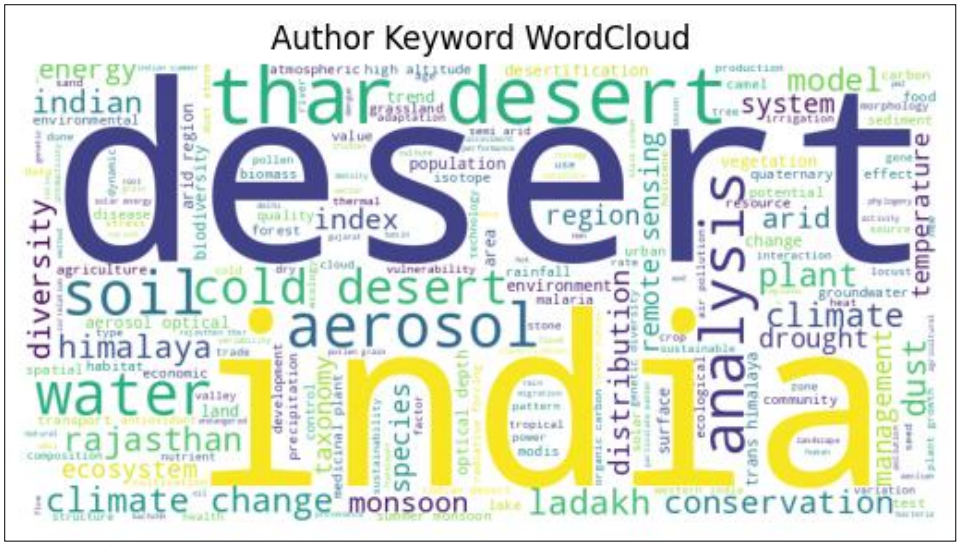
Fig 16: Dominant Themes as per Scopus and WoS Keywords

The bar charts show the most frequently occurring author keywords in the datasets. Dominance of terms such as *desert*, *Thar Desert*, *India*, and *climate change* highlights the thematic focus on arid environments, regional desert systems, and climate-driven processes shaping desert landscapes. Fig.14. and 15. show a high occurrence of terms related to deserts, climate

change, aerosols, dust, and monsoon processes reflects an interdisciplinary research emphasis combining climatology, geomorphology, and atmospheric sciences in dryland studies in Scopus. Keywords related to desert processes, human–environment interactions, climate variability, and regional studies dominate, indicating strong thematic convergence toward environmental change, desertification, and socio-environmental impacts in arid regions.

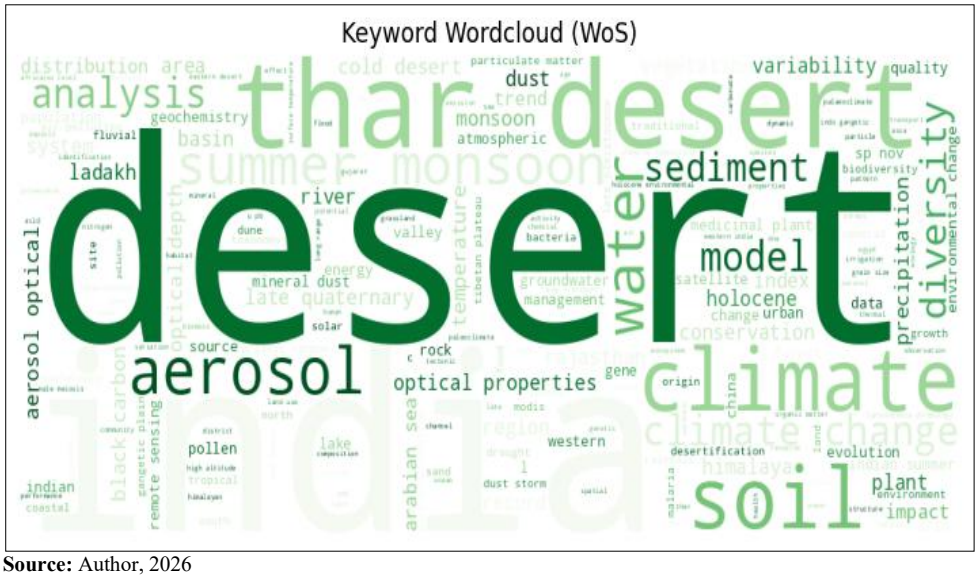
In Fig.16., secondary clusters reflect growing attention to climate–desert interactions and methodological advancements. Keywords such as *remote sensing*, *aerosol*, *landforms*, *monsoon*, and *climate change* feature prominently, indicating increasing use of geospatial techniques and climate-oriented frameworks as is visible in Fig.16. Keywords related to desert processes, human–environment interactions, climate variability, and regional studies dominate, indicating strong thematic convergence toward environmental change, desertification, and socio-environmental impacts in arid regions. The strong association of desert studies with Climate Action (SDG 13) further reinforces the centrality of climate discourse within the field.

The word clouds in Fig.17. and 18. show author-provided keywords, with font size proportional to frequency. Prominent emphasis on *desert*, *Thar Desert*, *aerosol*, *climate*, and *soil* underscores core research themes and reveals how authors conceptually frame desert-focused environmental and climatic investigations.



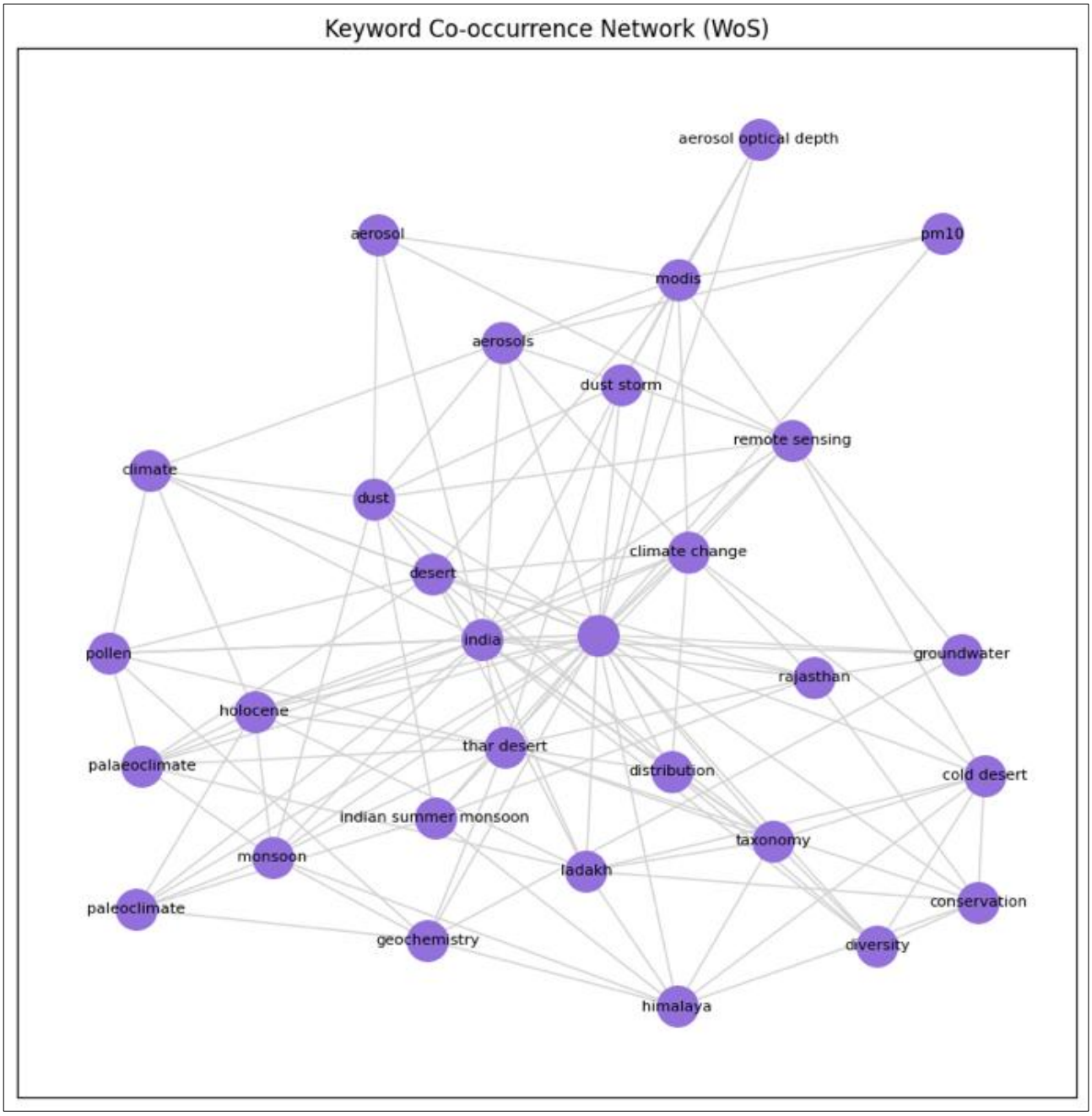
Source: Author, 2026

Fig 17: Word Cloud of Keyword Analysis-Scopus



Source: Author, 2026

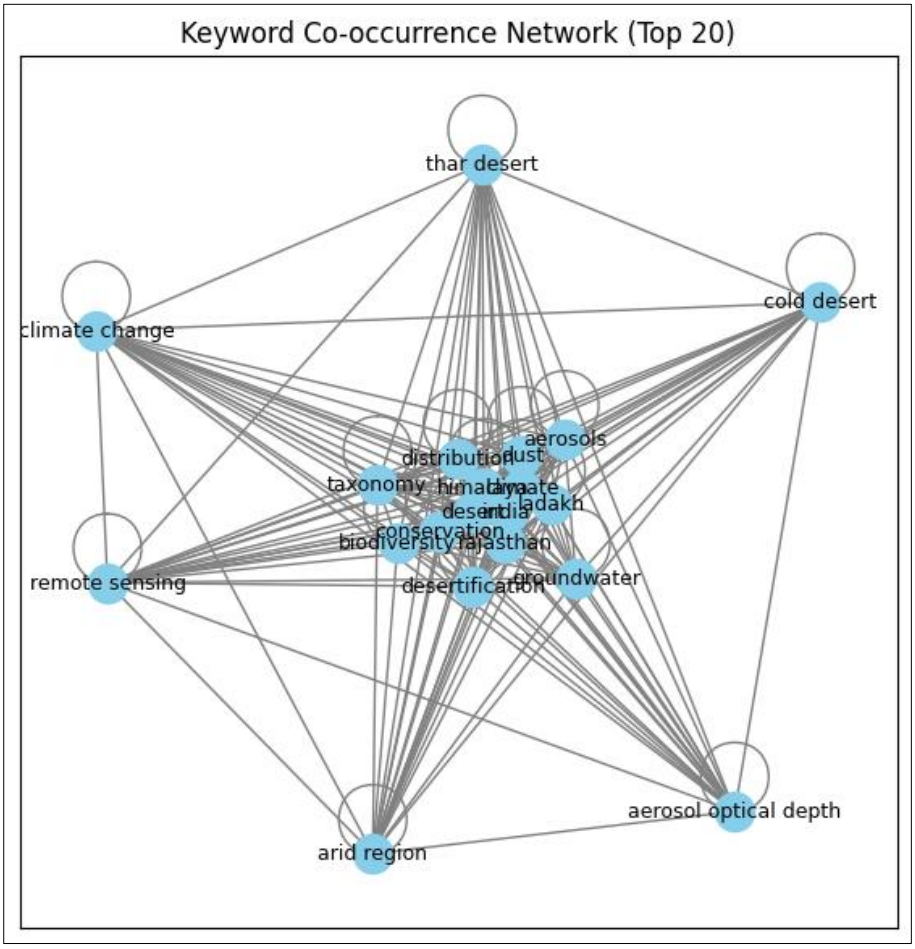
Fig 18: Word Cloud of Keyword Analysis-WoS



Source: Author, 2026

Fig 19: Keyword Co-Occurrence on the Topic- WoS

The network in Fig.19. represents co-occurrence relationships among keywords in the WoS dataset. Dense interconnections indicate strong thematic coupling between desert systems, climate change, aerosols, and land processes, revealing integrated research clusters and the multidimensional nature of desert and dryland studies.



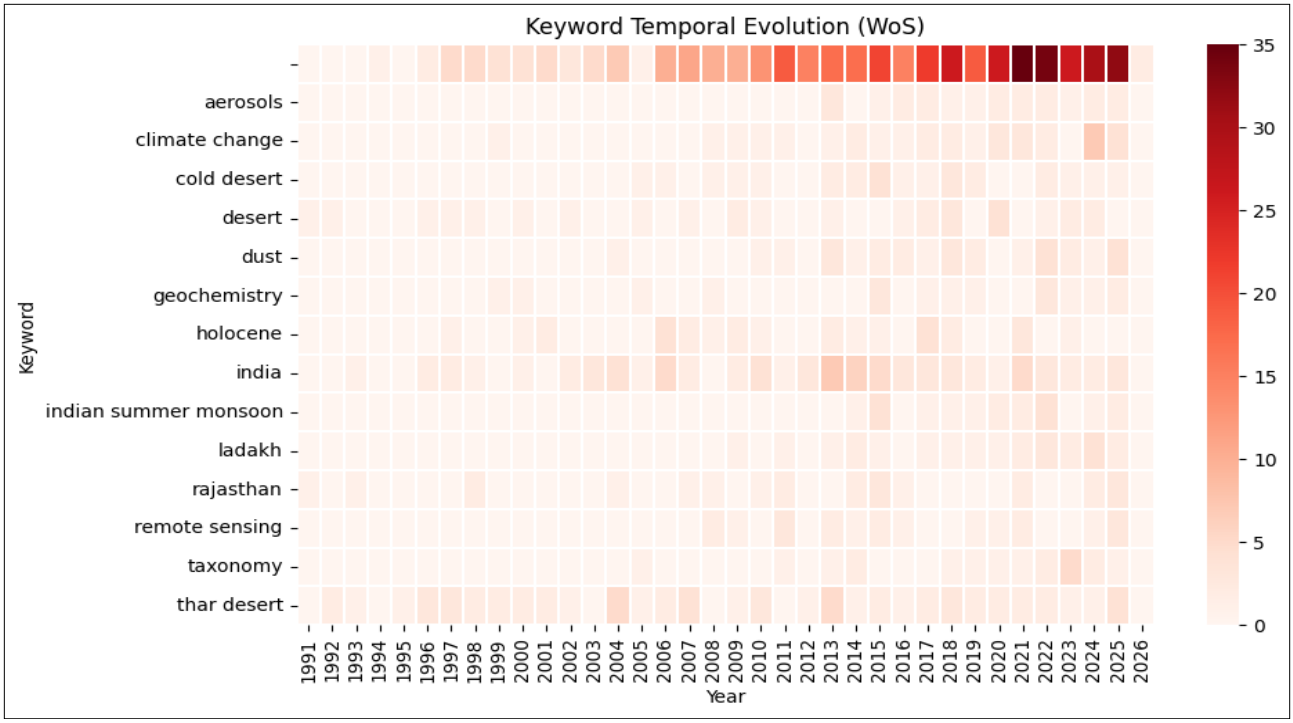
Source: Author, 2026

Fig 20: Keyword Co-Occurrence on the Topic- Scopus

The keyword co-occurrence network in Fig.20. highlights the strongest conceptual linkages in the literature. Central nodes such as *desert*, *climate change*, and *aerosols* act as hubs, reflecting their integrative role in structuring dominant research themes and interdisciplinary connections. It also reveals the conceptual structure of the field. Highly connected nodes such as *Thar Desert*, *India*, *aerosol*, and *dust* act as central hubs, indicating their integrative role across multiple studies. Dense interconnections reflect thematic overlap between climatology, atmospheric processes, and regional geography. Peripheral nodes represent specialised subtopics, while the overall network density suggests interdisciplinary linkages rather than isolated research strands. This structure demonstrates that desert studies in India are not fragmented but embedded within broader climate and environmental research frameworks.

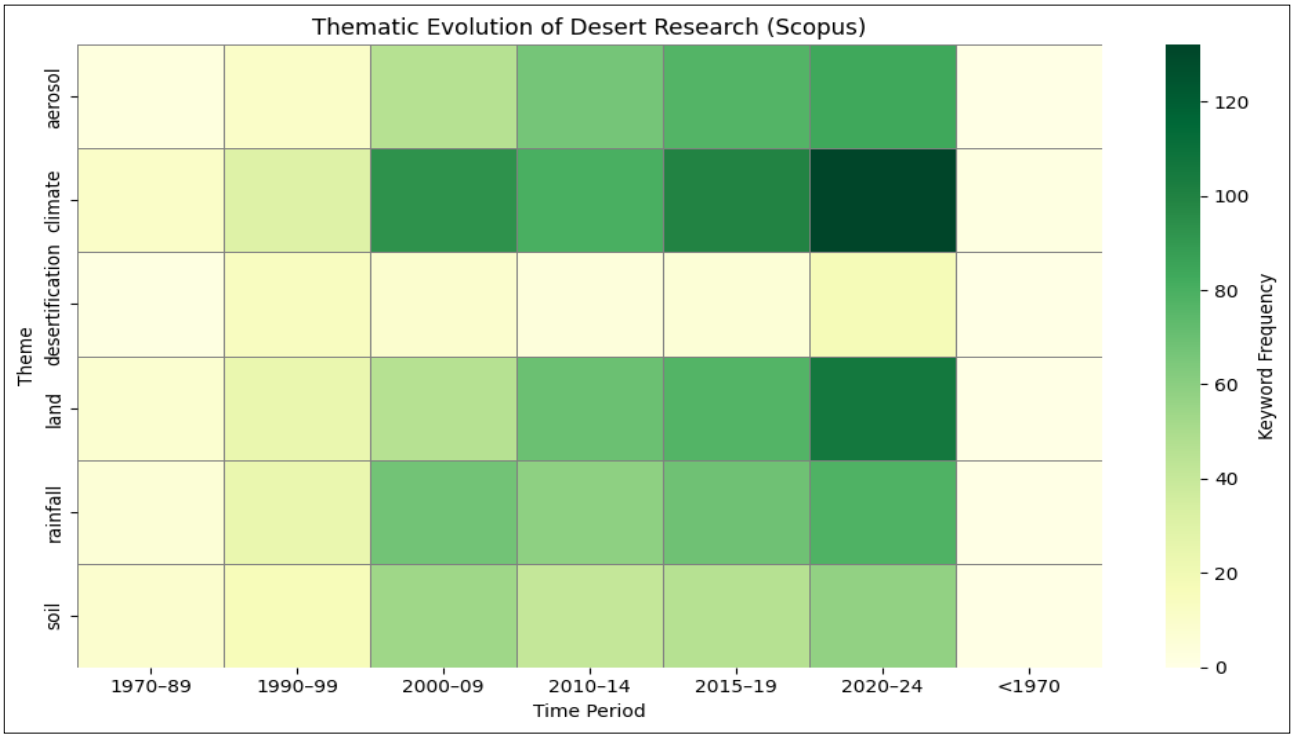
Keyword Temporal Evolution

The temporal heatmap illustrates how research priorities have evolved over time. Early years show limited keyword intensity, whereas recent decades exhibit a sharp increase in climate-related and aerosol-focused terms. This trend indicates growing scientific attention driven by climate change concerns, improved satellite data availability, and increased policy relevance.



Source: Author, 2026

Fig 21: Heat Map of Keywords- WoS



Source: Author, 2026

Fig 22: Heat Map of Keywords- Scopus

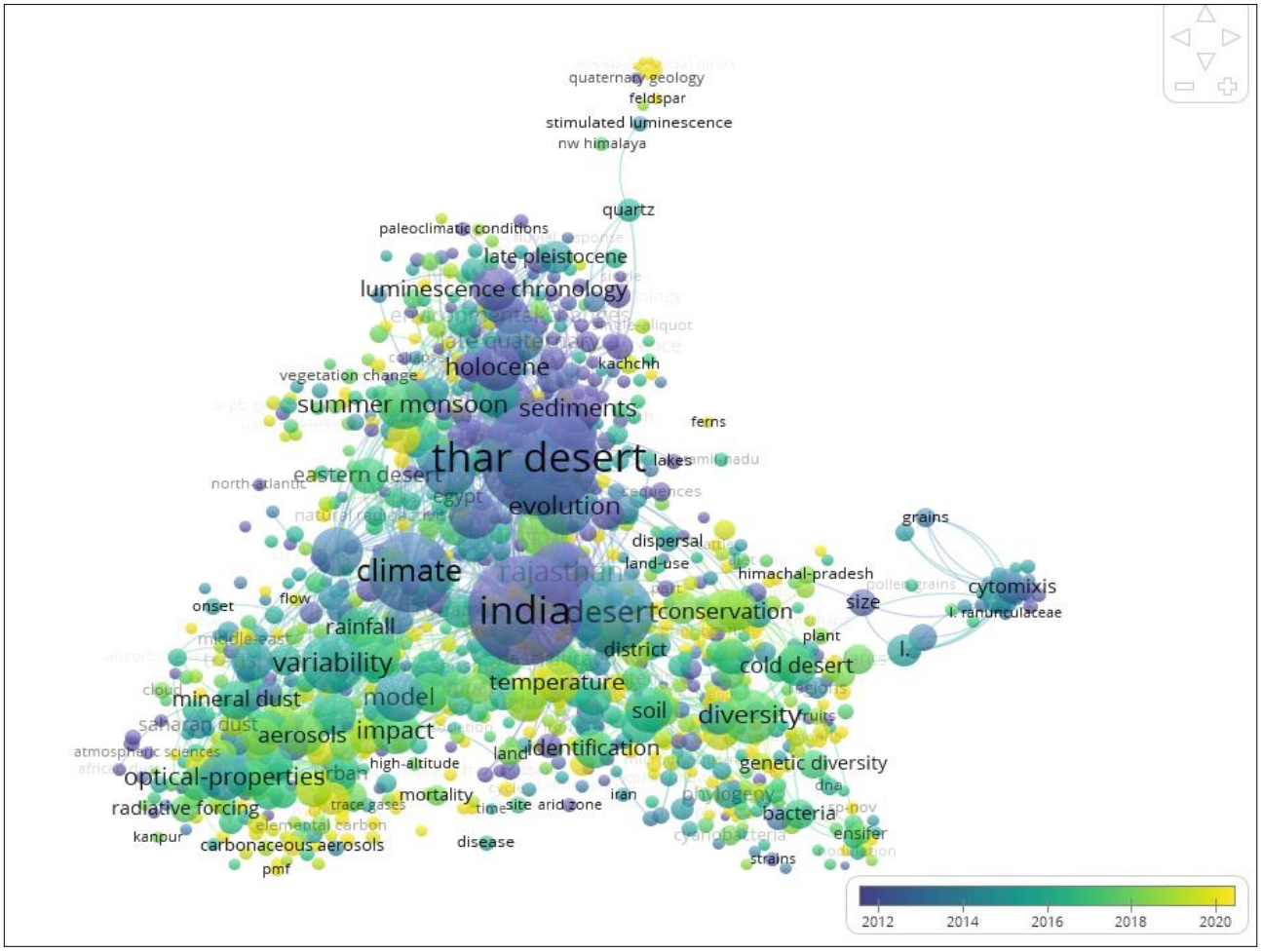
The Scopus-based thematic evolution heatmap in Fig. 22. shows a clear intensification of desert research after 2000, with climate, land, rainfall, soil, and aerosol themes exhibiting strong growth. Climate emerges as the dominant theme, peaking

during 2015–2019 and 2020–2024, reflecting heightened concern over climate variability and change. Land and rainfall themes show steady expansion, indicating increasing integration of hydrological and land-surface processes in desert and arid-region research.

The sustained presence of desert-specific keywords across years reflects continuity, while emerging keywords highlight methodological and thematic diversification. Overall, Fig.21. and Fig. 22., demonstrate a clear temporal intensification and thematic expansion of desert and climate research. Compared to WoS, the Scopus thematic evolution displays smoother, more continuous growth across themes, particularly after 2000, due to broader journal coverage and stronger representation of interdisciplinary and regional studies. WoS shows sharper peaks and greater sparsity in earlier periods, reflecting its more selective indexing. Consequently, Scopus better captures recent thematic diversification, while WoS emphasises core, high-impact research trajectories within desert and climate studies.

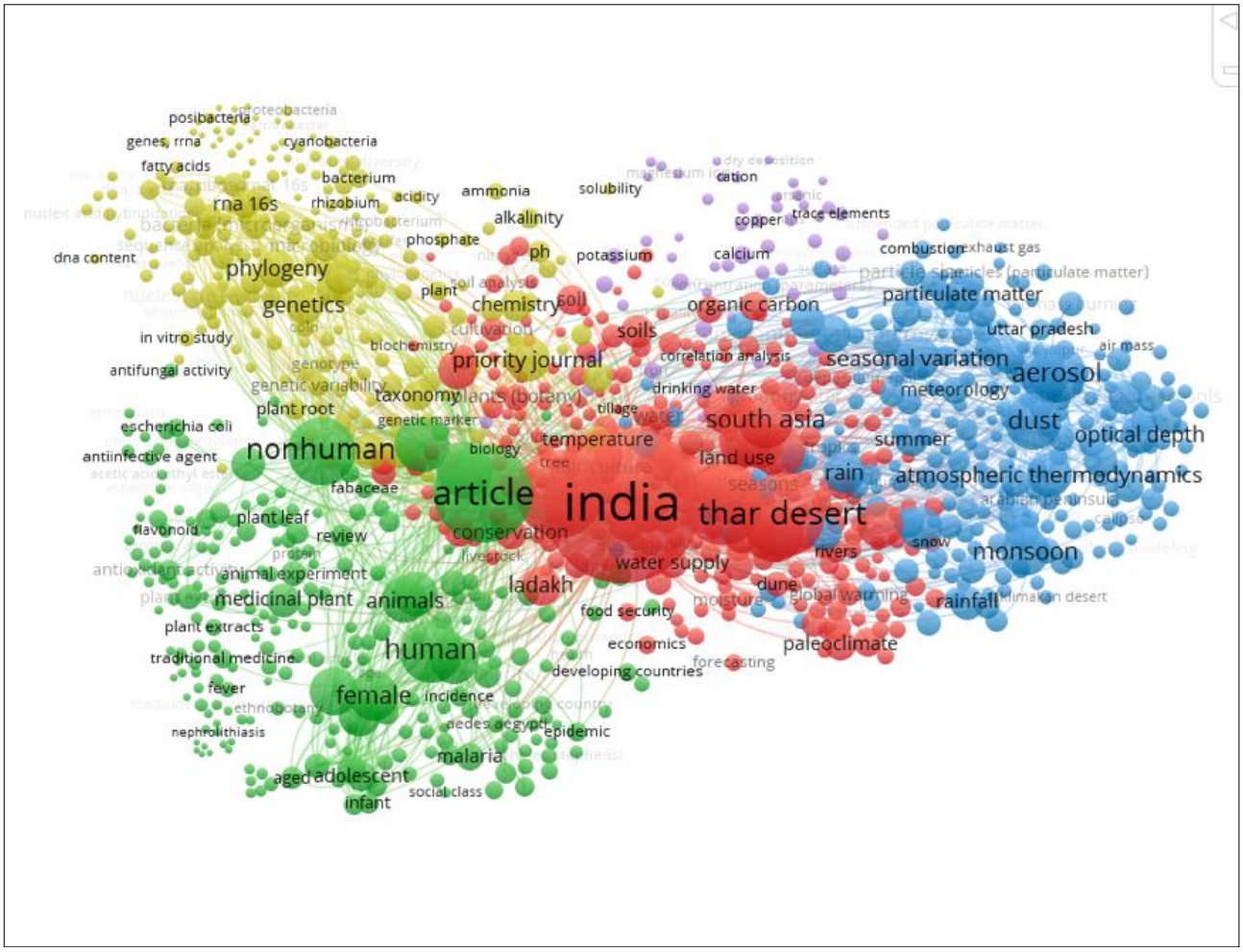
Top Keywords Distribution

The top-keyword bar chart highlights the dominant thematic focus of the research corpus. Terms such as *Thar Desert*, *India*, *aerosols*, *dust*, and *climate* appear with the highest frequencies, indicating a strong emphasis on arid-region environmental processes and regional climate interactions. The prominence of location-specific keywords reflects geographically grounded research, while process-based terms such as aerosols and optical properties suggest intensive use of remote sensing and atmospheric analysis. Overall, the distribution reveals a mature and well-defined research domain centered on desert climatology and environmental change in the Indian subcontinent. The results are visible in Fig.23. and 24.



Source: Author, 2026

Fig 23: Top 1000 Keywords and Clusters- WoS



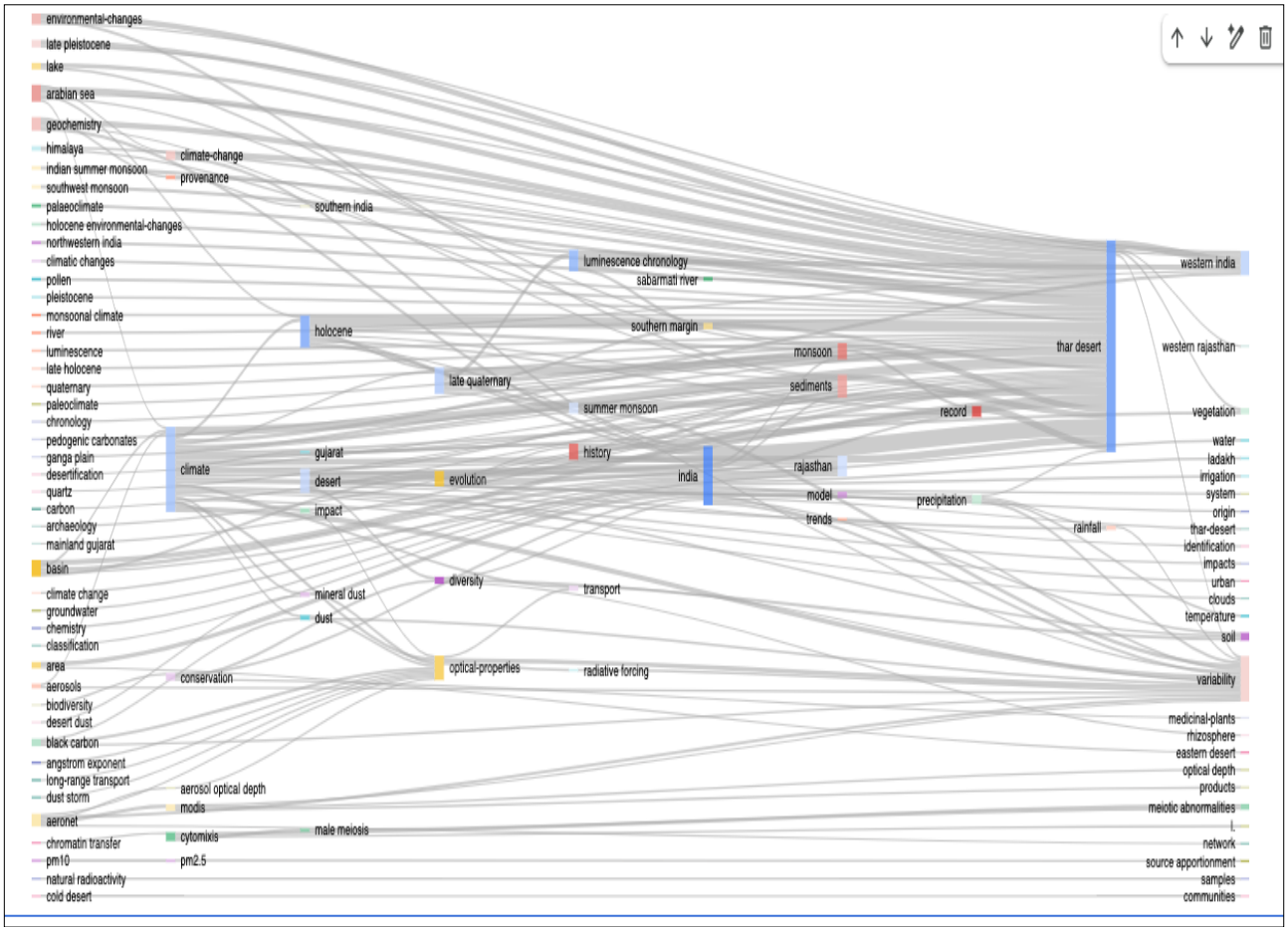
Source: Author, 2026

Fig 24: Top 1000 Keywords and Clusters- Scopus

In contrast, keywords related to socio-economic systems, groundwater dynamics, biodiversity, pastoral livelihoods, public health, and cold-desert environments appear infrequently and occupy peripheral positions within the network. Their limited visibility represents a significant thematic anomaly, pointing to neglected dimensions of desert sustainability and resilience.

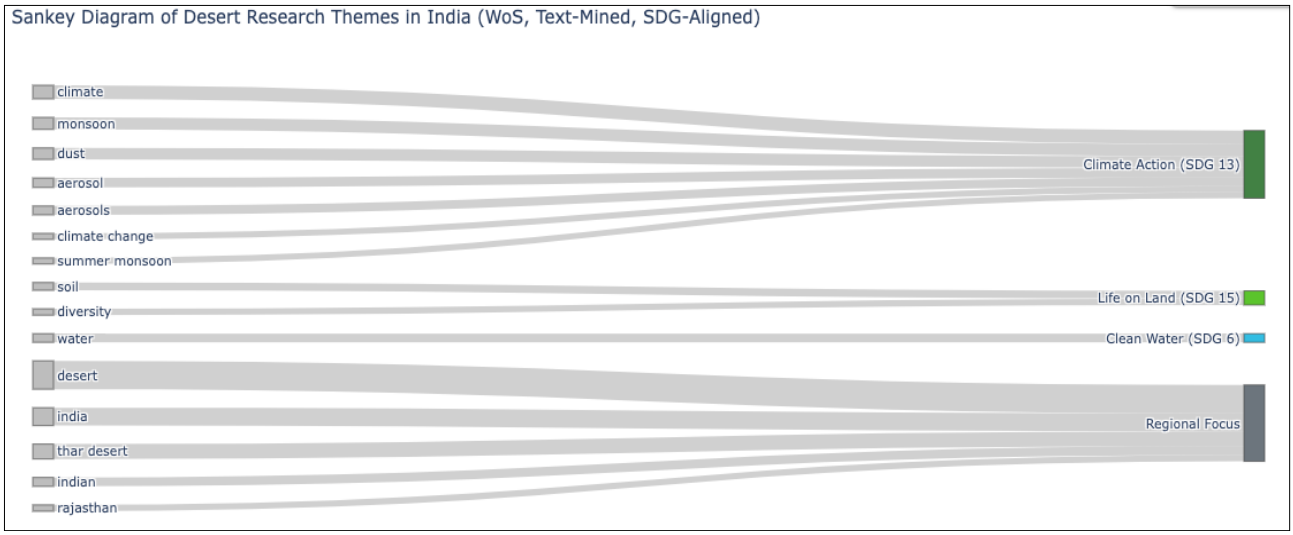
Integrated Patterns and Anomalies

Taken together, the temporal, disciplinary, institutional, funding, and thematic analyses reveal a research landscape characterised by both strength and imbalance. India demonstrates substantial scholarly capacity and output in desert research, particularly in relation to physical processes, climate interactions, and land management. However, this output is marked by regional concentration in the Thar Desert, institutional dominance by specialised agencies, and thematic selectivity favouring biophysical approaches. The details can be interpreted from Fig. 25., 26., 27., 28., and 29. The Sankey diagrams illustrate the thematic structure and Sustainable Development Goal (SDG) alignment of desert research in India, based on text-mined bibliometric data.



Source: Author, 2026

Fig 25: Integrated Sankey Diagram for Scopus and WoS

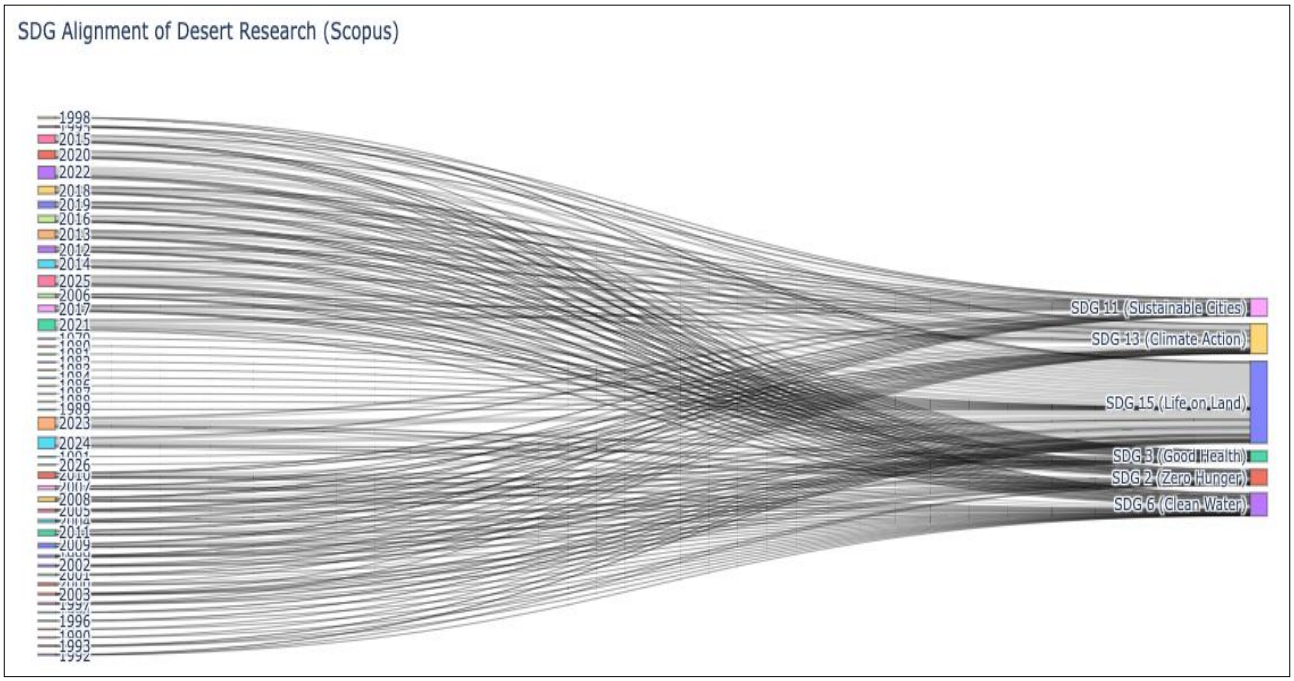


Source: Author, 2026

Fig 26: SDGs Alignment Sankey Linkages - WoS

The Sankey diagrams illustrate the thematic structure and Sustainable Development Goal (SDG) alignment of desert research in India, based on text-mined bibliometric data. The combined Sankey captures the internal knowledge structure of desert research, linking core drivers such as climate change, monsoon variability, precipitation, soil moisture, and land degradation to intermediate processes (e.g., vegetation dynamics, water stress, evapotranspiration) and finally to regional foci such as the Thar Desert, western India, Rajasthan, and arid–semi-arid zones. The dense flows indicate that desert research is highly interdisciplinary, with strong coupling between climatic processes and ecological or land-surface responses.

The WoS Sankey explicitly aligns dominant research themes with SDGs. Climate-related keywords (climate change, monsoon, aerosols, dust) overwhelmingly connect to SDG 13 (Climate Action), highlighting climate resilience as the primary policy relevance of Indian desert research. Secondary but consistent links to SDG 15 (Life on Land) reflect attention to land degradation, biodiversity, and desert ecosystems, while SDG 6 (Clean Water and Sanitation) emerges through studies on soil moisture, groundwater, and water availability in arid environments. A distinct regional stream emphasises the spatial specificity of Indian desert studies.

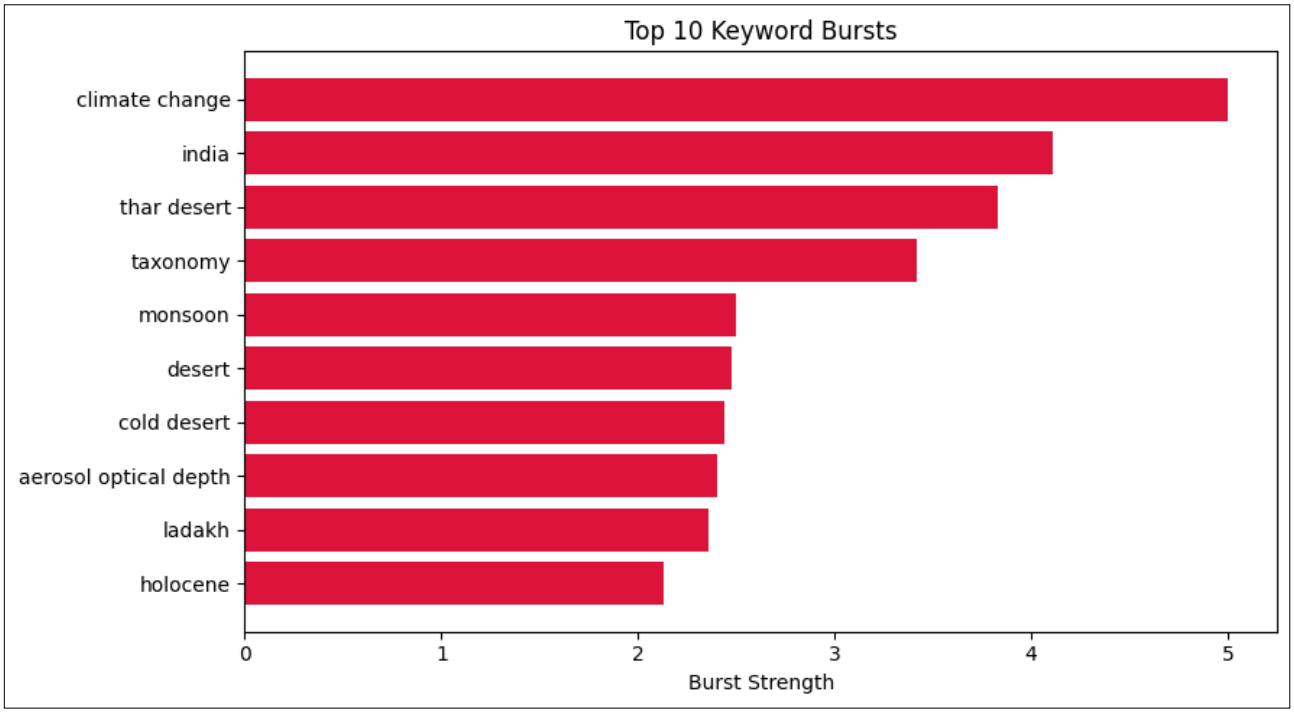


Source: Author, 2026

Fig 27: SDGs Alignment Sankey Linkages – Scopus

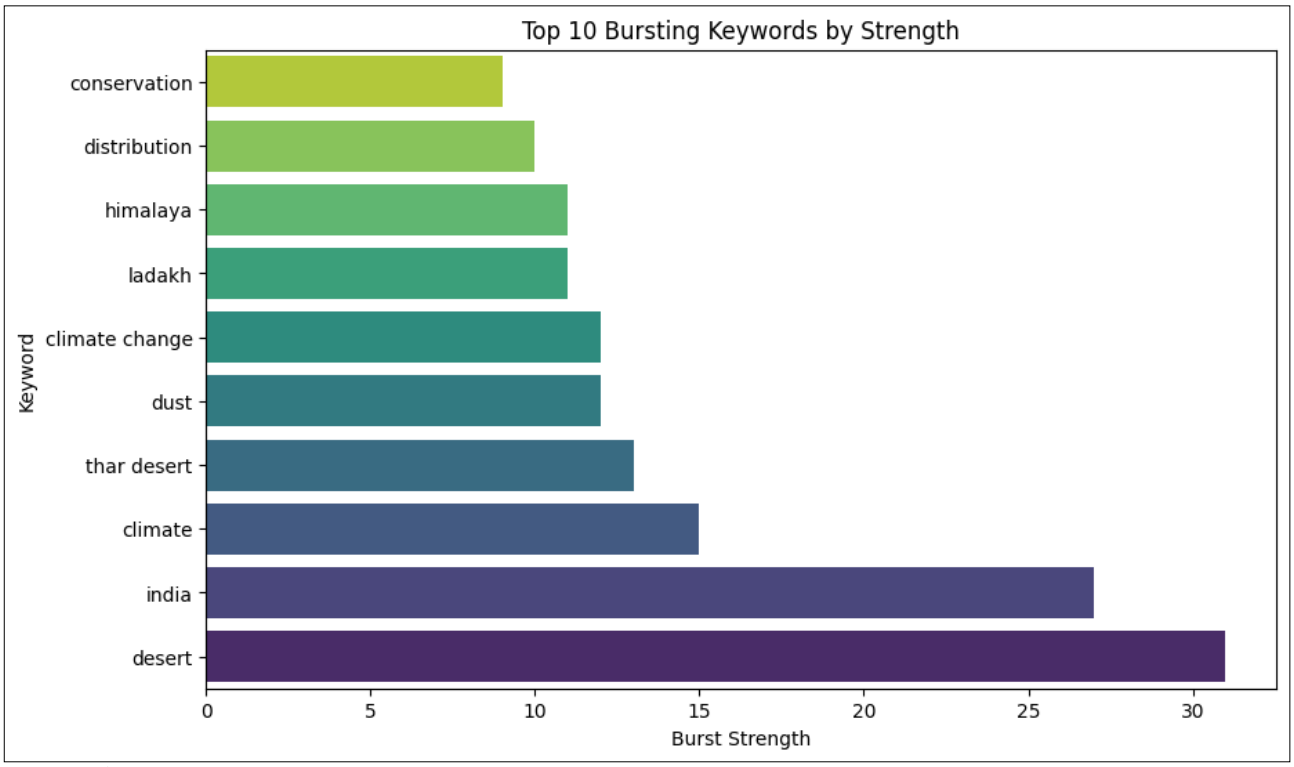
The Scopus Sankey shows the temporal–SDG linkage, indicating that SDG alignment has strengthened over time, with recent publications increasingly converging on SDG 13 and SDG 15.

Overall, the Sankeys demonstrate a clear evolution toward climate and sustainability oriented desert research, firmly embedded within national and global development agendas. The combined results indicate that desert research in India remains unevenly structured, with limited integration of human, ecological, and socio-economic dimensions. These patterns highlight critical anomalies within the research landscape and provide a strong empirical basis for reorienting future desert research towards greater interdisciplinarity, regional inclusivity, and long-term strategic coherence. The prevalence of dominating keywords indicate the strength of emerging topics in publications.



Source: Author, 2026

Fig 28: Topmost Keywords Emerging by Strength- WoS



Source: Author, 2026

Fig 29: Topmost Keywords by Strength- Scopus

The bursts in Fig.28. and 29. highlight "desert," "India," and "climate" as the strongest and most sustained research surges, indicating a major shift toward region-specific and climate-driven desert studies. Keywords like climate change, dust, Thar Desert, Himalaya, and Ladakh show moderate bursts, reflecting growing interdisciplinary attention to environmental change, geomorphology, and regional vulnerability in recent decades; and also a focus on cold deserts as well.

4. CONCLUSIONS–DISCUSSING TRANSITION:

Interpreting Patterns, Concentrations, and Anomalies

The results presented in the preceding section collectively reveal a research landscape that is simultaneously productive and uneven, robust in volume yet selective in scope. While Indian desert research demonstrates considerable scholarly engagement over more than a century, the patterns emerging from temporal trends, subject-area distributions, institutional dominance, funding structures, and keyword networks suggest that this engagement has been shaped by specific structural and thematic priorities. Interpreting these patterns provides critical insight into the underlying drivers of desert scholarship in India and forms the basis for a deeper discussion of research gaps and future directions.

The temporal volatility observed across both WoS and Scopus datasets represents more than simple fluctuation in publication numbers. Rather, it reflects the episodic nature of research attention towards desert environments. Peaks in publication output appear closely aligned with periods of heightened policy focus, climatic extremes, or funding availability, whereas subsequent declines suggest limited continuity in long-term research agendas. This pattern raises important questions about the sustainability of desert research in India, particularly in the context of accelerating climate change and increasing socio-environmental vulnerability. The absence of steady growth indicates that desert studies have not yet achieved the institutional variance observed in other environmental research domains.

Disciplinary distributions further reinforce this interpretation. The dominance of Environmental Sciences, Earth and Planetary Sciences, and Geosciences Multidisciplinary categories demonstrates a strong orientation towards physical processes, climate variability, and land-surface dynamics. While such focus is scientifically justified given the environmental sensitivity of desert regions, it also reveals a narrow framing of desert systems.

Deserts are not merely physical landscapes. They are lived environments shaped by complex interactions between climate, ecology, livelihoods, governance, and cultural practices. The limited presence of social sciences, economics, health studies, and biodiversity research suggests that these human and ecological dimensions remain peripheral within the dominant research paradigm.

Institutional patterns provide further explanatory context. The concentration of publications within specialised research organisations, particularly those focused on agriculture and arid-zone management, indicates that desert research in India has been driven largely by mission-oriented mandates. Institutions such as the Indian Council of Agricultural Research have played a central role in advancing applied research related to productivity, land degradation, and resource management. While this has generated valuable knowledge, it has also shaped the thematic boundaries of the field. Universities and interdisciplinary research centres appear less prominent, limiting the diversity of theoretical perspectives and methodological approaches applied to desert studies.

Funding structures reinforce these institutional dynamics. The predominance of national public-sector funding agencies reflects strong governmental investment in desert research, particularly in areas aligned with climate resilience and agricultural sustainability. However, the relatively limited involvement of international funding bodies and interdisciplinary programmes suggests constrained exposure to global research frameworks and comparative perspectives. Funding priorities, in turn, influence research questions, methodologies, and thematic focus, contributing to the observed concentration on biophysical processes and applied environmental management.

The keyword co-occurrence analysis offers a direct window into the intellectual core of Indian desert research. The overwhelming prominence of terms such as *Thar Desert, Rajasthan, soil, dust,* and *desert climate* confirms a strong regional and conceptual anchoring of the field. While emerging clusters related to remote sensing, aerosols, monsoon dynamics, and climate change indicate methodological advancement and growing engagement with climate discourse, they remain largely embedded within a physical science framework. The association of desert studies with Climate Action (SDG 13) further underscores the alignment of research with global climate narratives.

Equally revealing, however, are the absences within the keyword networks. The marginal visibility of terms related to groundwater, biodiversity, socio-economic systems, health, and cold-desert environments constitutes a critical anomaly. These omissions suggest that key dimensions of desert sustainability—particularly those related to human vulnerability, ecological resilience, and water security—are insufficiently integrated into mainstream research. This imbalance limits the capacity of desert research to inform holistic adaptation strategies and policy interventions.

Taken together, these patterns indicate that desert research in India has evolved within a structurally bounded intellectual space. The field exhibits strong national capacity, methodological sophistication in geospatial and climate-related studies, and clear alignment with environmental policy priorities. At the same time, it remains characterised by thematic selectivity, regional concentration, and episodic engagement. These characteristics point to the need for a conceptual reorientation that treats deserts not solely as physical systems under climatic stress, but as coupled socio-ecological landscapes requiring interdisciplinary inquiry. he identified

bursting keywords likely represent emerging or rapidly growing topics within the dataset, warranting deeper qualitative and quantitative analysis to understand the reasons behind their sudden increase in prominence.

Further investigation should focus on the specific time periods associated with the high burst strength of these keywords to contextualise their emergence and potential implications. This transition from results to discussion thus highlights the central tension within Indian desert research- the coexistence of scientific strength and structural imbalance. The findings invite a broader discussion on how research agendas are shaped, whose perspectives are prioritised, and which dimensions of desert environments remain under-explored. Addressing these issues is essential for enhancing the relevance, resilience, and societal impact of desert research in India, particularly in the context of long-term environmental change and sustainable development goals.

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