West Science Interdisciplinary Studies
Vol. 03, No. 11, November and 2025: pp. 2005-2018

Soil Health and Fertility in Agriculture: A Bibliometric Mapping of Global Knowledge and Practices

Loso Judijanto[1], Elik Murni Ningtias Ningsih[2]
[1] IPOSS Jakarta, Indonesia and losojudijantobumn@gmail.com
[2] Fak. Pertanian, Univ. Widya Gama Malang and elikmurni@widyagama.ac.id

ABSTRACT

This study delineates the worldwide terrain of soil science research through bibliometric and network analysis to discern topic trends, conceptual frameworks, and patterns of international collaboration. Data obtained from Scopus and Web of Science were analyzed using VOSviewer to depict keyword co-occurrences, author networks, institutional connections, and international collaborations. The results indicate that soil fertility is the primary emphasis of the discipline, intricately associated with related topics including soil microbiology, nutrient dynamics, crop production, and sustainable agriculture. Emerging research domains—such as biochar, climate change effects, microplastics, biodiversity, and food security—indicate a transition towards sustainability-focused and ecologically integrated methodologies. Collaboration networks identify India, China, and European nations as prominent research centers, bolstered by robust institutional and transdisciplinary alliances. The study offers useful insights; yet, it is constrained by database coverage and dependence on quantitative measurements. The findings enhance comprehension of worldwide research trends and provide guidance for future investigations that incorporate ecological resilience, agricultural innovation, and climate-adaptive soil management.

Keywords: *Soil Fertility, Soil Science, Bibliometric Analysis, Sustainable Agriculture, Soil Microbiology, International Collaboration, Climate Change, Food Security.*

1. INTRODUCTION

Inclusive education has emerged as a fundamental component of global educational reform over the last thirty years, propelled by international agreements such as the Salamanca Statement [1], the United Nations Convention on the Rights of Persons with Disabilities [2], and the Sustainable Development Goals, specifically SDG 4 concerning quality education [3]. These global mandates underscore equitable access and participation for all learners, irrespective of disability, socioe conomic status, gender, or cultural identity. As nations implement these global standards, inclusive education transforms from a limited special-needs initiative into a broad reform movement grounded in equity and human rights [4]. As a result, scholarly interest and research output about inclusive education have markedly increased in recent decades.

In international scholarship, inclusive education is defined not simply as integrating students with disabilities into mainstream classrooms, but as a comprehensive transformation that reconfigures school cultures, pedagogical methodologies, and support systems to embrace learner diversity [5]. Research from Europe, the United States, Asia-Pacific, and Africa underscores the complex dimensions of inclusive education, encompassing teacher training, curriculum adaptation, assistive technologies, universal design for learning (UDL), assessment methodologies, and community engagement [6]. These studies demonstrate a transition towards rights-based and capability-oriented viewpoints that associate inclusion with social justice, educational equity, and lifelong learning [7].

International peer-reviewed journals have been crucial in promoting these discussions, acting as main venues for the dissemination of new empirical evidence, theoretical discourse, and

policy analysis. Data from Scopus and Web of Science reveal a notable increase in publications on inclusive education during the early 2000s, influenced by multidisciplinary viewpoints encompassing psychology, pedagogy, disability studies, sociology, and public policy [8]. Researc h subjects encompass inclusive pedagogy, educator attitudes, cross-cultural policy assessment, and technology-facilitated inclusion. The rising academic output indicates that inclusive education has emerged as a global research priority influenced by evolving societal expectations, technological advancements, and varied educational environments [9].

Notwithstanding this expansion, the vision and execution of inclusive education differ significantly between areas. Certain nations prioritize disability inclusion, whilst others concentrate on wider dimensions of marginalization, including language variety, indigenous lear ners, or refugee schooling [10]. Differences in regulatory frameworks, financial allocation, teacher training systems, and sociocultural values influence the trajectory and scope of research [11]. Consequently, global research exhibits diverse and disjointed patterns that hinder the synthesis of evidence, the recognition of new trends, and the identification of consistent theoretical foundations in the discourse on inclusion.

Due to the diversity and complexity of inclusive education literature, it is imperative to map research published in international journals to comprehend the evolution of the field, identify prevailing themes in global discourse, and recognize underexplored regions. Bibliometric and qualitative mapping methodologies offer systematic techniques for discerning publication trends, research clusters, prominent authors, methodological patterns, and geographical collaboration networks [12]. This mapping improves the integration of global knowledge, facilitates evidence-based policymaking, and assists future researchers in recognizing gaps and possibilities in inclusive education research globally [13].

Despite the significant international academic interest in inclusive education, thorough mapping studies that integrate publication trends, topic patterns, and methodological approaches across global journals are scarce. Current evaluations frequently concentrate on specific subth emes—such as disability inclusion, educator attitudes, or policy execution—failing to encompass the comprehensive framework of global inclusive education research [14]. This fragmentation hinders academics, practitioners, and policymakers from recognizing overarching patterns, enduring difficu lties, and new trends. Consequently, a systematic mapping study is essential to analyze the extent, evolution, and topic landscape of inclusive education research published in international peer-reviewed journals.

The primary aim of this study is to systematically delineate inclusive education research published in international publications. This study specifically aims to: (1) identify publication trends, prominent authors, and leading journals; (2) examine significant thematic clusters, conceptual frameworks, and methodological approaches employed in inclusive education research; (3) analyze geographic and institutional collaboration patterns; and (4) highlight research gaps and prospective areas for future inquiry. This mapping provides a thorough and evidence-based summary that promotes the progress of inclusive education research worldwide.

2. METHODS

This study utilized a comprehensive bibliometric method to delineate the terrain of inclusive education research published in international publications. Bibliometric analysis was chosen for its objective, reproducible, and comprehensive approach to evaluate scientific advancements,

publication trends, and knowledge frameworks within extensive datasets (Donthu et al., 2021). The analytical process adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards to guarantee transparency in data selection, screening, and reporting [15]. Keywords associated with inclusive education—namely inclusive education, special needs education, educational inclusion, inclusive pedagogy, and learning diversity—were employed to extract articles from Scopus and Web of Science, two premier academic databases for global research output [16]. The search encompassed papers from 2000 to 2024 to document recent advancements in inclusive education research.

The inclusion requirements mandated that articles be published in peer-reviewed international journals, composed in English, and specifically focus on inclusive education within school, higher education, or community learning environments. Conceptual articles, empirical investigations, systematic reviews, and policy analyses were incorporated to provide comprehensive coverage [17]. Publications exclusively addressing medical, therapeutic, or clinical interventions without an educational aspect were omitted to ensure conceptual coherence. Upon eliminating duplicates, irrelevant materials, book chapters, and conference papers, only research that fulfilled all qualifying criteria were preserved. Comprehensive bibliographic information—incl uding authorship, journal titles, publication years, institutional affiliations, and keyword descriptors—was exported in RIS and CSV formats for later quantitative and qualitative analysis.

Data analysis integrated performance assessment and scientific mapping to discern publishing patterns, prominent authors, research clusters, and collaboration networks. The performance analysis assessed growth trajectories, journal productivity, and national contributions to the literature on inclusive education [18]. Science mapping was performed with VOSviewer and Bibliometrix (R-Studio), facilitating the visualization of keyword co-occurrence, co-authorship networks, citation trends, and thematic progression over time [19], [20]. These instruments provide insights into the intellectual framework of the discipline, enabling the research to discern prevailing themes, nascent research trajectories, and enduring knowledge deficiencies. Qualitative analysis enhanced the quantitative results by situating patterns within wider social, educational, and policy contexts.

3. RESULTS AND DISCUSSION

3.1 Network Visualization

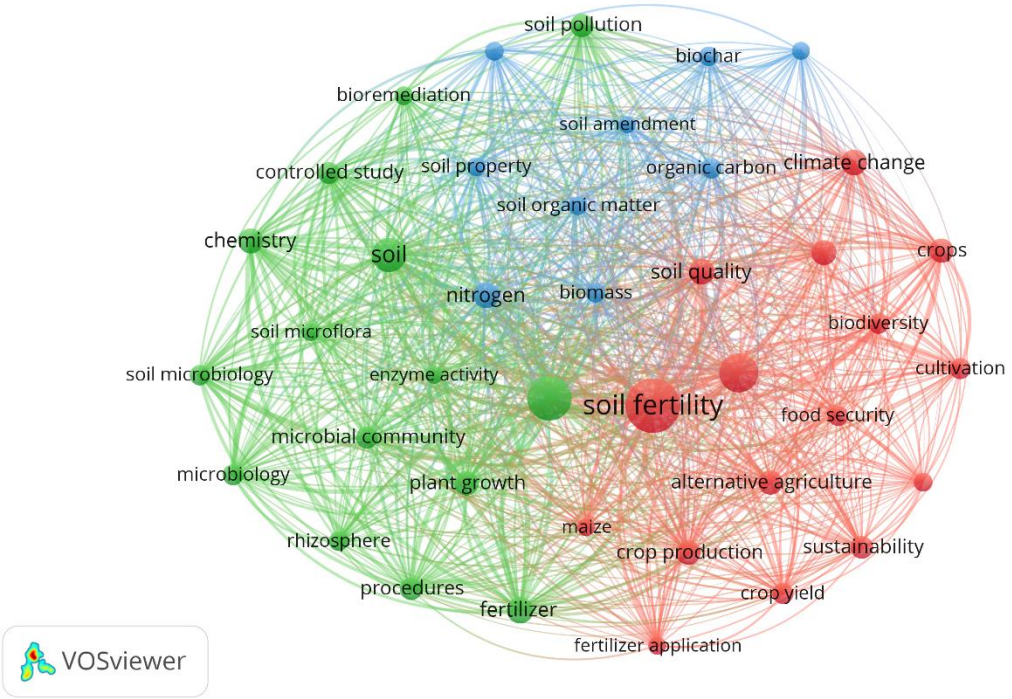

Figure 1. Network Visualization
Source: Data Analysis Result, 2025

The VOSviewer network visualization depicts the conceptual framework of soil science research, categorizing terms into separate clusters according to co-occurrence patterns. The network is extensively interconnected, suggesting that research in this domain frequently amalgamates several issues, including soil quality, soil microbiology, crop production, and environmental sustainability. The prominent position of the term soil fertility indicated by a big node demonstrates its status as the most frequently co-occurring and influential idea within this corp us of literature. Its magnitude and centrality signify its significance as a fundamental theme interconnecting biological, chemical, agricultural, and environmental aspects of soil study.

The green cluster signifies themes related to soil biology, microbiology, and biochemical processes. Terminology such as soil, microbial community, soil microflora, enzyme activity, soil microbiology, and rhizosphere underscores a significant focus on comprehending the biological mechanisms that affect soil health. The incorporation of chemistry and systematic study indicates that several investigations utilize experimental methodologies to examine nutrient cycling, microbial interactions, and biochemical reactions within soil ecosystems. This cluster emphasizes the essential function of microorganisms and biochemical processes in sustaining soil fertility, promoting plant growth, and ensuring nutrient availability.

The blue cluster emphasizes soil chemical characteristics, contamination, and carbon related phenomena. Terms such as soil pollution, biochar, organic carbon, soil organic matter, soil amendment, and nitrogen signify the cluster's focus on chemical restoration, nutrient enrichment, and environmental remediation. Biomass and bioremediation indicate that researchers are investigating biological approaches to alleviate soil deterioration and enhance soil quality via carbon sequestration and pollution reduction. This cluster signifies escalating international apprehensions about soil pollution, climate change, and the necessity for sustainable soil management strategies via chemical and carbon-based measures.

The red cluster pertains to agricultural systems, sustainability, and crop yield. Essential concepts such crops, cultivation, crop production, crop yield, fertilizer application, food security, sustainability, and biodiversity underscore the interrelation between soil management and

agricultural results. This cluster highlights the direct impact of soil fertility on food production and the sustainability of agriculture throughout time. The connection among alternative agriculture, maize, and soil quality indicates an emphasis on innovative or sustainable agricultural practices that diminish reliance on synthetic inputs and enhance biodiversity. This cluster illustrates the worldwide transition to sustainable agriculture and the necessity of reconciling productivity with environmental conservation.

The image illustrates that soil-related research is both diverse and highly cohesive. The three clusters—soil biology (green), soil chemistry and pollution (blue), and agriculture and sustainability (red)—exhibit a thick interconnection, signifying that progress in one domain is intricately linked to advancements in the others. Microbial activity (green) impacts nitrogen cycling (blue), therefore influencing crop output and food security (red). The robust intercluster connection s surrounding concepts like soil quality, organic carbon, and fertilizer indicate that enhancing soil fertility necessitates a comprehensive strategy integrating biological, chemical, and agricultural knowledge. This interconnected network framework underscores that sustainable soil management is fundamental to environmental health, climatic resilience, and global food security.

3.2 Overlay Visualization

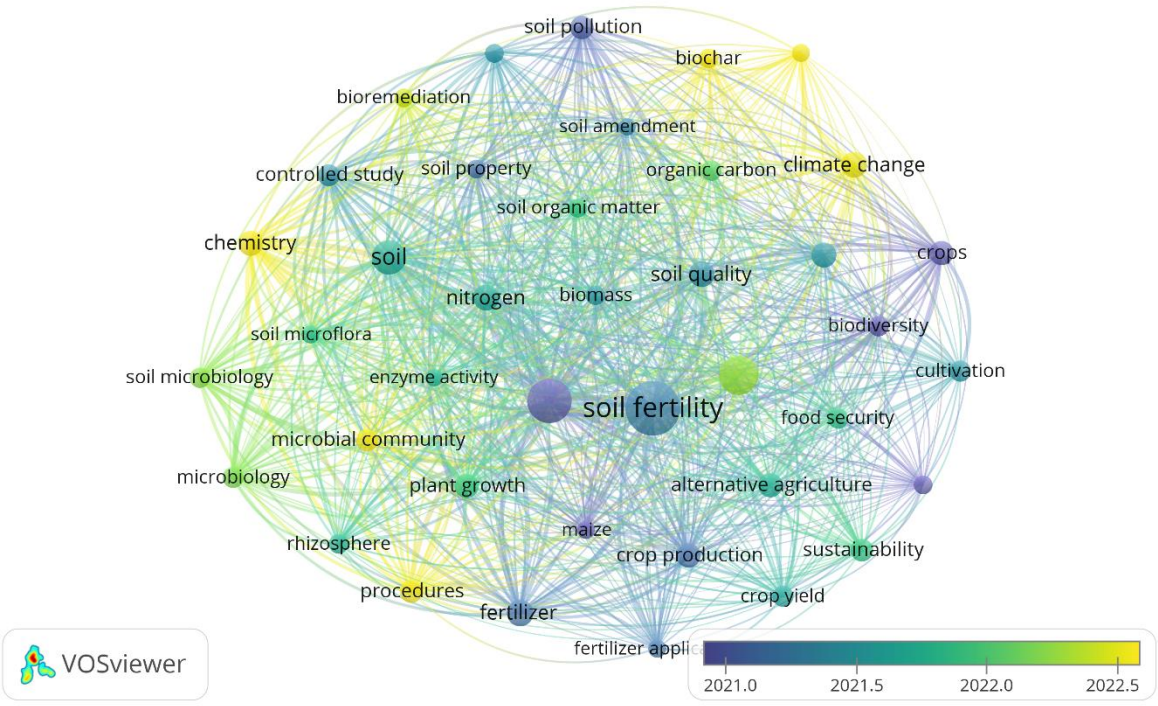

Figure 2. Overlay Visualization
Source: Data Analysis Result, 2025

The overlay visualization illustrates the temporal evolution of research themes in soil science, with colors indicating the average publication year for each keyword. Dark blue and green hues denote prior focal points from 2021, and yellow signifies more current attention from 2022 to 2023. Central topics like soil fertility, soil quality, nitrogen, and soil organic matter are represented in greenish-blue, indicating their constant examination throughout the entire temporal span. These fundamental themes function as reliable anchors within the discipline. Concurrently, topics such as biochar, climate change, chemistry, and food security are highlighted in yellow, indicating they have acquired more prominence in the latest timeframe. This transition exemplifies a tendency of amalgamating soil research with overarching environmental and sustainability concerns.

Current focus is on themes linking soil science to global environmental issues. The yellow nodes—biochar, climate change, chemistry, and bioremediation—represent rapidly evolving study domains that underscore the significance of soil in carbon sequestration, pollution mitigation, and ecosystem restoration. Biodiversity, cultivation, and food security are increasingly evident in contemporary discourse, indicating that soil research is progressively integrated with sustainable agriculture and climate-resilient food systems. The emergence of these phrases indicates an increasing focus in scientific and policy circles on soil as an essential element of climate plans, agricultural transformations, and sustainable land management.

Notwithstanding the appearance of novel subjects, the network remains profoundly interwoven, demonstrating that contemporary topics are predicated on enduring underpinnings. Previously investigated areas, including microbial communities, soil microbiology, and enzyme activity (greenish-blue), persist in supporting contemporary research on soil restoration, biochar application, and ecosystem resilience. This signifies that researchers are integrating conventional soil biology and chemistry with modern environmental objectives. The robust cross-cluster connections highlight an increasing multidisciplinary approach that integrates soil research with sustainability, climate change, agricultural innovation, and ecological health. The overlay map illustrates a shift from traditional soil fertility research to integrated, forward-looking studies focused on environmental resilience and global food security.

3.3 Citation Analysis

To comprehend the philosophical underpinnings and shifting goals in soil science research, it is crucial to emphasize the most impactful publications that have influenced the discipline in the last twenty years. Frequently referenced papers typically indicate foundational concepts, methodological advancements, or transformations in scientific paradigms concerning soil fertility, nutrient cycle, environmental stresses, and sustainable agriculture. The table below displays the most-cited articles in this field, highlighting a range of subjects, including nitrogen losses, microbial activities, biochar applications, nanofertilizers, and the contribution of legumes to food security. These seminal works collectively provide significant insight into the advancement of soil science and the potential directions for future research.

Table 1. The Most Impactful Literatures

Citations	Authors and year	Title
1111	Cameron, K.C., Di, H.J., Moir, J.L. (2013)	Nitrogen losses from the soil/plant system: A review
1050	Costa, O.Y.A., Raaijmakers, J.M., Kuramae, E.E. (2018)	Microbial extracellular polymeric substances: Ecological function and impact on soil aggregation
977	Zörb, C., Senbayram, M., Peiter, E. (2014)	Potassium in agriculture - Status and perspectives
896	Bhardwaj, D., Ansari, M.W., Sahoo, R.K., Tuteja, N. (2014)	Biofertilizers function as key player in sustainable agriculture by improving soil fertility, plant tolerance and crop productivity
810	Sanchez, P.A. (2002)	Soil fertility and hunger in Africa
798	Smith, S.R. (2009)	A critical review of the bioavailability and impacts of heavy metals in municipal solid waste composts compared to sewage sludge

Citations	Authors and year	Title
690	Wang, F., Wang, Q., Adams, C.A., Sun, Y., Zhang, S. (2022)	Effects of microplastics on soil properties: Current knowledge and future perspectives
690	Zulfiqar, F., Navarro, M., Ashraf, M., Akram, N.A., Munné-Bosch, S. (2019)	Nanofertilizer use for sustainable agriculture: Advantages and limitations
662	Qambrani, N.A., Rahman, M.M., Won, S., Shim, S., Ra, C. (2017)	Biochar properties and eco-friendly applications for climate change mitigation, waste management, and wastewater treatment: A review
644	Foyer, C.H., Lam, H.-M., Nguyen, H.T., ... Valliyodan, B., Considine, M.J. (2016)	Neglecting legumes has compromised human health and sustainable food production

Source: Scopus, 2025

The extensively referenced books displayed in the table underscore fundamental ideas that have directed soil science research. Preliminary fundamental research, exemplified by [21], underscores the correlation between soil fertility and worldwide food insecurity, especially in emerging areas. Subsequent research has broadened this discourse by incorporating biochemical and microbiological viewpoints, as seen in [22], [23], which emphasize the essential roles of microbial activities and biofertilizers in improving soil structure and plant productivity. Recent papers address rising environmental issues, including microplastic contamination [24] and climate-focused remedies such as biochar application [25]. The incorporation of research on nanofertilizers and the nutritional significance of legumes exemplifies a transition towards technical advancement and comprehensive sustainability in agricultural systems. These key works collectively illustrate the evolution of soil science from a traditional concentration on nutrients to a more integrated, interdisciplinary domain that addresses ecological resilience, food system sustainability, and global environmental change.

3.4 Density Visualization

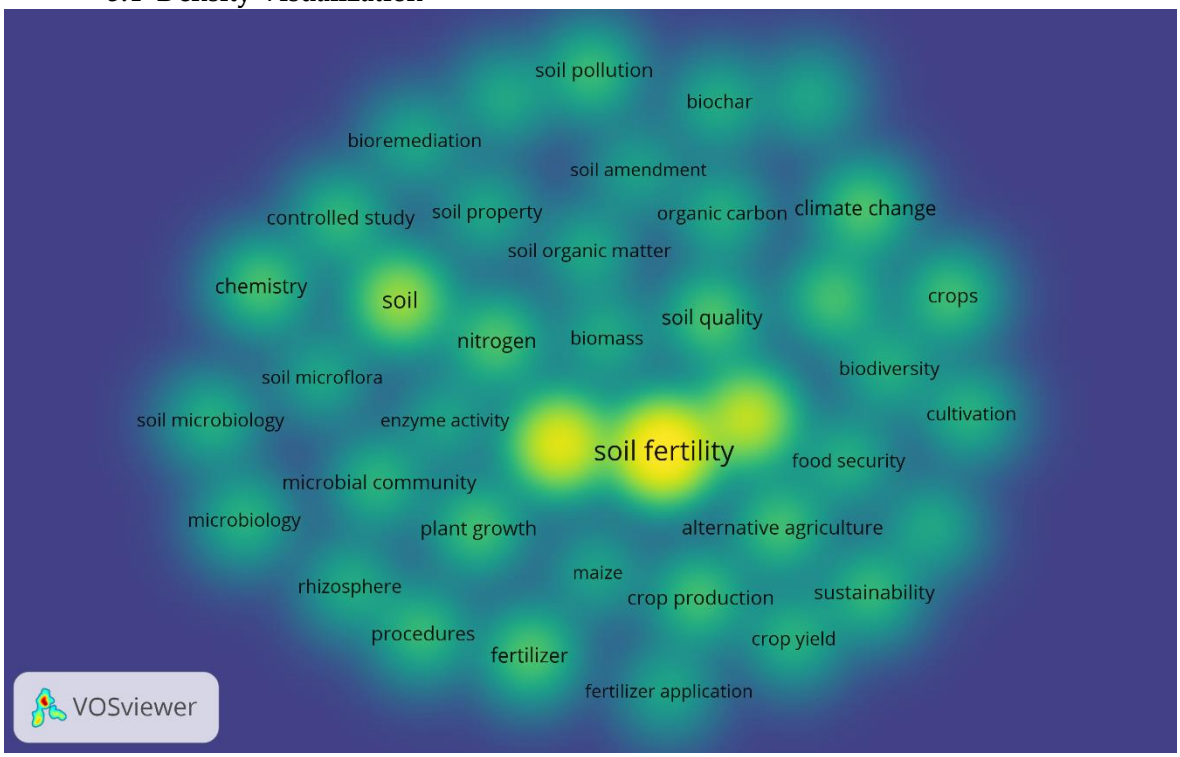

Figure 3. Density Visualization

Source: Data Analysis Result, 2025

The density graphic illustrates the concentration of research activity in the soil science field, with brighter yellow regions signifying keywords that occur most frequently or exhibit the strongest connections. Soil fertility emerges as the most prominent and pivotal focal point, illustrating its preeminence in the literature and its essential function in connecting biological, chemical, and agricultural topics. Adjacent to this core are additional high-density phrases including soil, soil quality, plant development, nitrogen, and fertilizer, all of which signify essential elements of study pertaining to nutrient cycles, soil health, and agricultural productivity. This concentrated cluster signifies that the preservation and enhancement of soil fertility is a highly scrutinized and interdisciplinary subject, encompassing elements of microbiology, environmental chemistry, and agricultural science.

As one moves away from the core, the density progressively transitions to green and blue areas, signifying terms with moderate to low levels of research intensity. Concepts such as biodiversity, climate change, biochar, food security, and alternative agriculture emerge in these middensity zones, indicating that, although they are becoming more pertinent, they have not yet attained the same prevalence as conventional soil fertility research. However, their existence in warmer tones signifies an increasing interest in comprehending how soil management affects wider environmental and sustainability issues. Peripheral concepts such as soil pollution, methodologies, and microplastics indicate burgeoning research domains that are increasingly relevant as global priorities evolve towards climate resilience, contamination, and ecological restoration. The density map depicts a study landscape rooted in traditional soil fertility themes while progressively incorporating multidisciplinary subjects related to environmental change, sustainable agriculture, and ecosystem health.

3.5 Co-Authorship Network

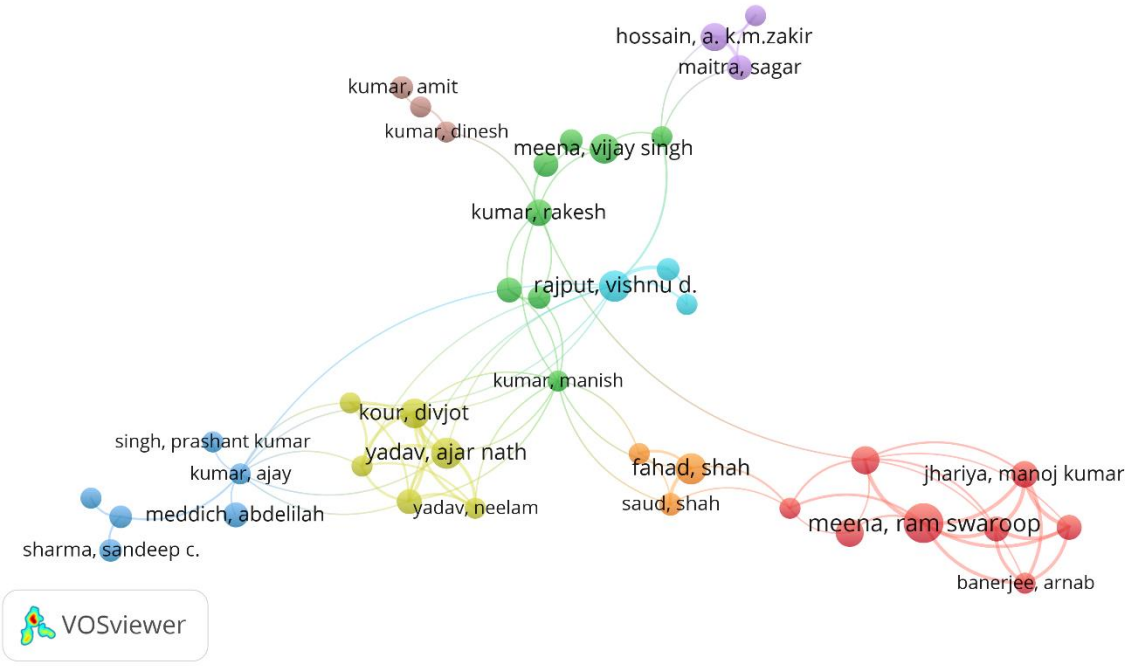

Figure 4. Author Visualization
Source: Data Analysis Result, 2025

The VOSviewer co-authorship cooperation network identifies multiple unique clusters of researchers who regularly co-author publications in the field of soil science. At the core of the network, Rajput, Vishnu D. serves as a crucial connector, interlinking various author groups across clusters, suggesting a significant collaborative role and potentially greater research productivity or engagement in interdisciplinary projects. Encircling this center node are clusters of closely linked co-authors, including Meena, Vijay Singh, Kumar, Rakesh, and Kumar, Manish, indicative of cohesive research teams presumably engaged in common subjects such as soil fertility, crop productivity, or nutrient management. Other clusters, including those led by Meena, Ram Swaroop, Fahad, Shah, Meddich, and Abdelilah, exhibit dense internal linkages but weaker ties to external groups, indicating specialized subfields or regionally concentrated research collaborations. The existence of smaller, isolated clusters—such as Kumar, Amit and Kumar, Dinesh—suggests the emergence of more distinct research trajectories. The network exhibits a combination of robust collaborative centers and marginal contributors, underscoring both established alliances and emerging research trajectories within the soil science community.

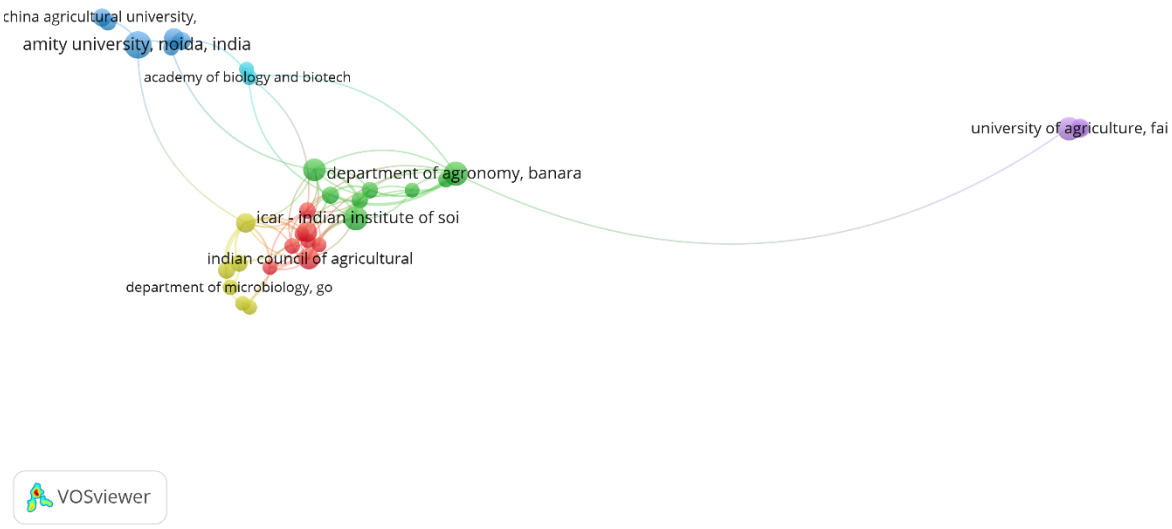

Figure 5. Affiliation Visualization
Source: Data Analysis Result, 2025

The institutional collaboration network emphasizes many significant research centers and their cooperative dynamics in soil science. At the map's center, entities like the Indian Council of Agricultural Research (ICAR), the Indian Institute of Soil Science, and other Department of Agronomy units constitute the most networked and productive cluster. Their intricate internal connections indicate robust national collaboration networks in India, where agricultural research institutes often participate in cooperative initiatives, exchange data, and co-author articles on soil fertility, agronomy, and sustainable agriculture methods. Adjacent to these primary institutions are subordinate nodes—such as microbiology and biotechnology departments—that link to the center cluster and provide knowledge in soil microbiology, plant–soil interactions, and environmental biotechnology. Minor yet discernible foreign affiliations are seen with institutions such as Amity University (India) and China Agricultural University, indicating selective transnational interactions. Conversely, the University of Agriculture, Faisalabad, seems more isolated with restricted linkages, indicating either nascent involvement in the dataset or specialized, less collaborative research avenues. The network exhibits a research landscape characterized by robust national collaboration clusters, complemented by minor international partnerships that expand the subject and geographic dimensions of soil science research.

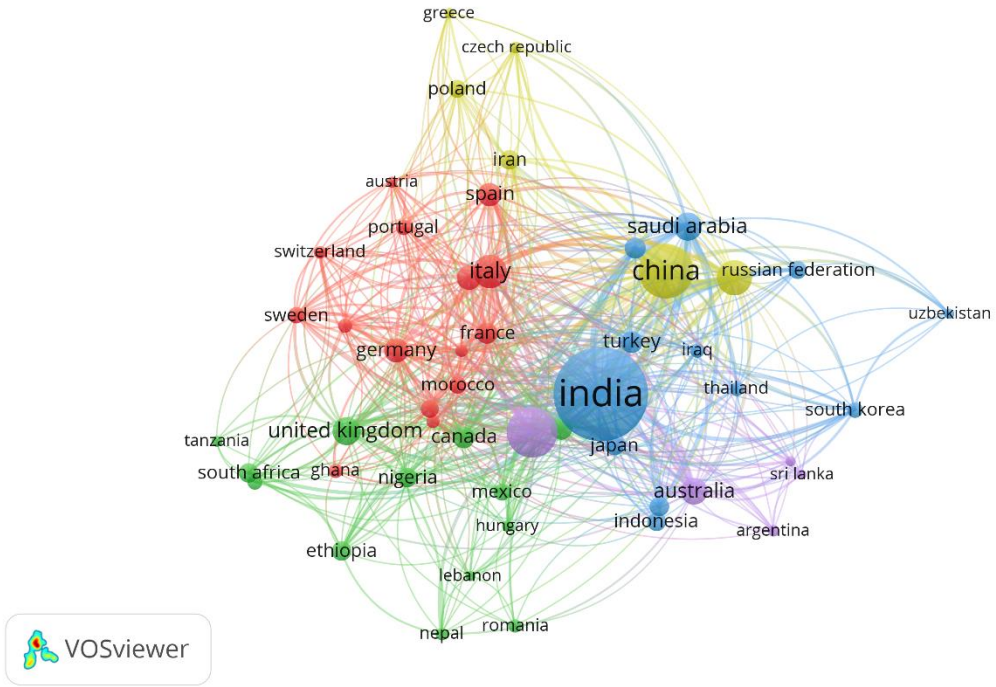

Figure 6. Country Visualization
Source: Data Analysis Result, 2025

The VOSviewer co-country collaboration map country cooperation network illustrates a highly integrated worldwide research landscape in soil science, with India appearing as the most influential and productive nation, as evidenced by its prominent node size and extensive connections. India's robust relationships with countries such China, Saudi Arabia, Australia, the United Kingdom, Germany, and Japan illustrate its pivotal role in cultivating international collaborations, presumably motivated by common research interests in agriculture, soil fertility, and climate resilience. China emerges as a significant nexus, closely connecting with the Russian Federation, Saudi Arabia, and many Asian and European nations, indicative of its expanding influence in environmental and agricultural research. European nations, such as Italy, Spain, Germany, France, Switzerland, and Poland, constitute a tightly-knit collaborative cluster, indicating well-established scientific networks and robust cross-border research integration. African nations, including South Africa, Ethiopia, Ghana, and Nigeria, form an interconnected southern cluster tightly linked to the UK and European partners, emphasizing persistent North–South research interactions. The map illustrates a worldwide research ecosystem in which India and China serveas central nodes for extensive collaboration networks, Europe exhibits robust internal cooperation, and emerging regions progressively participate through partnerships that broaden the geographic and thematic scope of soil science research.

Practical Implications

This study offers numerous practical insights pertinent to policymakers, agricultural practitioners, environmental authorities, and international research institutes. The findings show global collaboration hotspots, particularly robust networks in India, China, and Europe, emphasizing areas of heightened scientific capacity and knowledge flow. These insights can assist governments and funding agencies in establishing strategic relationships with nations or institutions exhibiting high productivity and competence in soil fertility, sustainable agriculture, and climate-related soil research. The keyword and density maps indicate growing themes, like biochar utilization, microplastic pollution, and climate resilience, which can guide national agricultural exte

nsion programs, soil management policies, and sustainability initiatives. Practitioners must comp rehend the interconnections between soil fertility, microbial activity, nutrient management, and crop output to develop more efficient and environmentally sustainable agricultural operations. The pronounced focus on multidisciplinary collaboration indicates that effective solutions to soil degradation and food security necessitates integrated methodologies encompassing agronomy, microbiology, environmental chemistry, and policy innovation.

Theoretical Contributions

This paper advances soil science theory by delineating the conceptual framework of the discipline and pinpointing the intellectual underpinnings that influence contemporary research directions. This study employs bibliometric and network analyses to illustrate that classical theories of soil fertility and nutrient dynamics remain foundational in current research, while emerging theoretical frameworks—such as sustainable intensification, climate-soil interactions, and soil-m icrobe symbiosis—are increasingly gaining significance. The visualization of co-occurrence networks indicates that theoretical discourse is transitioning from discrete disciplinary frameworks to more comprehensive, systems-based approaches that incorporate ecological, biochemical, and socio-environmental phenomena. Furthermore, international collaboration patterns enhance models of scientific knowledge dissemination by demonstrating how research influence traverses geographic and institutional borders. These findings enhance theoretical discourse on global research disparity, scientific aggregation, and collaborative innovation within environmental sciences.

Limitations

Notwithstanding its thorough approach, this investigation possesses many shortcomings that warrant acknowledgment. The dataset is restricted to papers indexed in Scopus and Web of Sc ience, potentially omitting pertinent studies published in regional journals, non-English publications, or databases with more extensive disciplinary scope. Secondly, bibliometric analyses are significantly dependent on keyword indexing and citation methodologies, which may vary inconsistently among authors, journals, and nations, thus compromising the precision of cluster formation and thematic interpretation. Third, collaboration networks are affected by publication counting methodologies and may not adequately reflect informal or unpublished scientific interactions. The study emphasizes quantitative mapping and does not do comprehensive qual itative evaluations of the substantive substance, quality, or methodological rigor of the included studies. Future research may mitigate these constraints by integrating mixed-method reviews, broadening data sources, or employing longitudinal methodologies to monitor the progression of research themes over an extended period.

CONCLUSION

This study offers a thorough analysis of global research trends, thematic frameworks, and collaborative networks in soil science, emphasizing the field's evolution in response to rising environmental issues, technology advancements, and global food security requirements. Keyword co-occurrence, density visualization, and overlay maps collectively demonstrate that soil fertility constitutes the intellectual nucleus of the discipline, serving as the basis for the proliferation of interconnected themes, including soil microbiology, nutrient management, crop productivity, and sustainable agriculture. The prominent presence of themes such as biochar, climate change, bio diversity, and microplastic contamination indicates a modern transition towards sustainability-focused research that combines ecological resilience with agricultural productivity. The author and institutional collaboration networks indicate that soil science is supported by a combination of closely connected research communities and developing clusters. India, China, and several European countries hold crucial roles in the global collaboration framework, showcasing their ability

to generate impactful research and cultivate varied relationships. These global networks are augmented by regionally focused cooperation across African, Middle Eastern, and Southeast Asian nations, reflecting an increasing inclusivity in environmental research and an acknowledgment of soil-related issues as worldwide concerns. The institutional analysis indicates that agricultural councils, soil research institutes, and microbiology departments function as key innovation centers, facilitating multidisciplinary research initiatives that connect agronomy, environmental science, and biotechnology. The results highlight the necessity of ongoing international cooperation and interdisciplinary integration to tackle soil degradation, climatic effects, and food insecurity. The information derived from this mapping can assist policymakers in choosing strategic collaborators for research funding, agricultural innovation programs, and sustainability activities. Researchers can utilize the discovered theme clusters to connect their work with global discourse and explore potential in developing areas such as alternative agriculture, soil remediation technology, and climate-adaptive soil management. Nonetheless, the study recognizes difficulties pertaining to database selection, inconsistencies in keywords, and dependence on quantitative indicators. Future study may rectify these deficiencies by integrating qualitative content analysis, broadening data sources, and performing longitudinal studies on the evolution of soil science across time. This study provides a fundamental reference for comprehending the structure, dynamics, and future trajectories of soil science, highlighting the necessity for integrated, collaborative, and sustainability-focused strategies to address global ecological and agricultural concerns.

REFERENCES

[1] Unesco, *The Salamanca Statement and Framework for action on special needs education: adopted by the World Conference on Special Needs Education; Access and Quality. Salamanca, Spain, 7-10 June 1994*. Unesco, 1994.

[2] U. Nations, "Convention on the Rights of Persons with Disabilities (CRPD), U," *New York Div. Soc. Policy Dev. Disabil.*, pp. 1–31, 2006.

[3] E. UNESCO, "2030–Incheon Declaration and Framework for Action," *Pars UNESCO*, 2015.

[4] M. Ainscow and M. Viola, "Developing inclusive and equitable education systems: some lessons from Uruguay," *Int. J. Incl. Educ.*, vol. 28, no. 14, pp. 3568–3584, 2024.

[5] L. Florian and K. Black-Hawkins, "Exploring inclusive pedagogy," *Br. Educ. Res. J.*, vol. 37, no. 5, pp. 813–828, 2011.

[6] W. Yan, *Preparing Teachers for Inclusive Education in China*. Routledge, 2023.

[7] R. Slee, "Belonging in an age of exclusion," 2019, *Taylor & Francis*.

[8] A. de Boer and S. J. Pijl, "The acceptance and rejection of peers with ADHD and ASD in general secondary education," *J. Educ. Res.*, vol. 109, no. 3, pp. 325–332, 2016.

[9] K. Göransson and C. Nilholm, "Conceptual diversities and empirical shortcomings–a critical analysis of research on inclusive education," *Eur. J. Spec. Needs Educ.*, vol. 29, no. 3, pp. 265–280, 2014.

[10] R. Opertti, Z. Walker, and Y. Zhang, "Inclusive education: From targeting groups and schools to achieving quality education as the core of EFA," *SAGE Handb. Spec. Educ.*, vol. 2, pp. 149–169, 2014.

[11] S. J. Peters, "Inclusive education: Achieving education for all by including those with disabilities and special education needs," *Washingt. DC World Bank*, pp. 1–133, 2003.

[12] N. Donthu, S. Kumar, D. Mukherjee, N. Pandey, and W. M. Lim, "How to conduct a bibliometric analysis: An overview and guidelines," *J. Bus. Res.*, vol. 133, pp. 285–296, 2021.

[13] A. Ramos-Rodríguez and J. Ruíz-Navarro, "Changes in the intellectual structure of strategic management research: A bibliometric study of the Strategic Management Journal, 1980–2000," *Strateg. Manag. J.*, vol. 25, no. 10, pp. 981–1004, 2004.

[14] V. Teixeira, A. Correia, E. Monteiro, A. C. H. Kuok, and C. Forlin, "Placement, inclusion, law and teachers' perceptions in Macao's schools," *Int. J. Incl. Educ.*, vol. 22, no. 9, pp. 1014–1032, 2018.

[15] M. J. Page *et al.*, "The PRISMA 2020 statement: an updated guideline for reporting systematic reviews," *bmj*, vol. 372, 2021.

[16] M. E. Falagas, E. I. Pitsouni, G. A. Malietzis, and G. Pappas, "Comparison of PubMed, Scopus, web of science, and Google scholar: strengths and weaknesses," *FASEB J.*, vol. 22, no. 2, pp. 338–342, 2008.

[17] D. Papaioannou, A. Sutton, and A. Booth, "Systematic approaches to a successful literature review," *Syst. approaches to a Success. Lit. Rev.*, pp. 1–336, 2016.

[18] H. F. Moed, *Citation analysis in research evaluation*. Springer, 2005.

[19] N. Van Eck and L. Waltman, "Software survey: VOSviewer, a computer program for bibliometric mapping," *Scientometrics*, vol. 84, no. 2, pp. 523–538, 2010.

[20] M. Aria and C. Cuccurullo, "bibliometrix: An R-tool for comprehensive science mapping analysis," *J. Informetr.*, vol. 11, no. 4, pp. 959–975, 2017.

[21] P. A. Sanchez, "Soil fertility and hunger in Africa," *Science (80-.).*, vol. 295, no. 5562, pp. 2019–2020, 2002.
[22] O. Y. A. Costa, J. M. Raaijmakers, and E. E. Kuramae, "Microbial extracellular polymeric substances: ecological function and impact on soil aggregation," *Front. Microbiol.*, vol. 9, p. 1636, 2018.
[23] D. Bhardwaj, M. W. Ansari, R. K. Sahoo, and N. Tuteja, "Biofertilizers function as key player in sustainable agriculture by improving soil fertility, plant tolerance and crop productivity," *Microb. Cell Fact.*, vol. 13, no. 1, p. 66, 2014.
[24] F. Wang, Q. Wang, C. A. Adams, Y. Sun, and S. Zhang, "Effects of microplastics on soil properties: current knowledge and future perspectives," *J. Hazard. Mater.*, vol. 424, p. 127531, 2022.
[25] N. A. Qambrani, M. M. Rahman, S. Won, S. Shim, and C. Ra, "Biochar properties and eco-friendly applications for climate change mitigation, waste management, and wastewater treatment: A review," *Renew. Sustain. Energy Rev.*, vol. 79, pp. 255–273, 2017.