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Charting the Knowledge Landscape of Solid Waste Management: A Bibliometric Study

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ABSTRACT
The growing challenges of solid waste management (SWM) have attracted increasing scholarly attention, warranting a systematic evaluation of the research landscape. This study employs a comprehensive bibliometric analysis to map the intellectual structure, research trends, and scholarly collaborations in SWM research, from 2000 to 2024. Data were retrieved from the Scopus database and analyzed using VOS viewer and Biblioshiny, an R-based bibliometric tool. Key performance indicators, including publication growth, source productivity, author contributions, institutional output, and country-level scientific production, were examined alongside co-citation, co-authorship, and keyword co-occurrence networks. The analysis reveals a steady increase in publications over the study period, with *Waste Management*, *Waste Management & Research*, and *Science of the Total Environment* emerging as dominant sources. China and India lead in both research output and citation impact, while a concentrated group of prolific authors and institutions significantly shape the field's development. Thematic mapping indicates that recent research increasingly focuses on sustainable waste treatment technologies, circular economy, life cycle assessment, and climate change mitigation. This study provides valuable insights into the evolution, dynamics, and emerging directions of SWM research globally, offering guidance for researchers, practitioners, and policymakers to address existing gaps and advance sustainable waste management practices.

Keywords: Solid Waste Management, Bibliometric Analysis, Research Trends, Sustainability.

1. INTRODUCTION

Solid waste management (SWM) is a critical component of sustainable development and environmental governance, particularly in the context of rising urbanization, industrial expansion, and population growth. Globally, the generation of municipal solid waste is projected to increase from 2.24 billion tonnes in 2020 to 3.4 billion tonnes by 2050 (World Bank, 2018), placing immense pressure on existing waste infrastructure and regulatory frameworks. In response, research on SWM has evolved considerably, encompassing diverse themes such as waste minimization, circular economy practices, recycling technologies, and climate-responsive strategies. The scholarly discourse reflects an increasing recognition of the complex, interdisciplinary, and policy-relevant nature of SWM challenges across both developed and developing economies (Wilson et al., 2012; Guerrero et al., 2013). Despite this growing body of literature, there remains a lack of comprehensive synthesis regarding the evolution and structure

of SWM research. While numerous studies focus on technological solutions and case-specific management practices, fewer have examined the broader patterns of scientific production, collaboration, and thematic progression that shape this field. Bibliometric analysis offers a robust, quantitative methodology to fill this gap by systematically mapping research trends, author and institutional productivity, source impact, and intellectual structure over time (Pritchard, 1969; Zupic & Čater, 2015). It also enables the identification of influential contributors, conceptual hotspots, and emerging research directions through performance indicators and science mapping tools.

In recent years, bibliometric reviews have been increasingly applied in related fields such as sustainability science (Xie et al., 2021), climate change research (Haunschild & Bornmann, 2022), and waste management (Fu et al., 2021), providing strategic insights into scholarly development. However, a focused, large-scale bibliometric review of the global SWM literature remains underexplored. This study addresses this gap by conducting a comprehensive bibliometric analysis of scientific publications on solid waste management from 2000 to 2024. Using data retrieved from the Scopus database and analyzed via Bibliometrix and VOSviewer, this review aims to map the intellectual landscape of SWM research across geographies and disciplines. By offering an evidence-based synthesis of the global research landscape, this study contributes to a clearer understanding of knowledge development in SWM and provides a foundation for future research, policymaking, and international collaboration in pursuit of sustainable waste management systems.

2.THEORETICAL AND EMPIRICAL REVIEW OF RELATED LITERATURE

2.1. Theoretical Perspectives on Solid Waste Management

Solid waste management (SWM) has been widely studied through various theoretical lenses including sustainability theory, systems theory, and circular economy frameworks. According to Wilson (2007), effective SWM is not merely a technical issue but is deeply rooted in social, economic, and institutional structures that require comprehensive governance approaches. The circular economy model, as proposed by Kirchherr et al. (2017), emphasizes resource recovery and waste minimization, providing a transformative framework for managing solid waste sustainably. Additionally, the systems theory posits that SWM is influenced by the complex interplay of various subsystems such as policy, economics, technology, and public behavior (Zhang et al., 2010).

2.2. Global Empirical Studies on Solid Waste Management

Empirical studies globally have highlighted the pressing challenges and diverse approaches in managing solid waste. In developed countries, SWM has evolved towards advanced technologies like waste-to-energy and high-efficiency recycling systems (Hoornweg & Bhada-Tata, 2012). In contrast, developing countries often face significant infrastructural, financial, and institutional challenges in establishing effective SWM systems (Guerrero et al., 2013). Studies by Alam and Ahmade (2013) emphasize that informal sectors play a crucial role in waste collection and recycling, particularly in the context of developing countries, where waste pickers contribute significantly to resource recovery.

2.3. Bibliometric Studies in Solid Waste Management Research

Bibliometric analysis has emerged as a powerful tool for mapping the evolution of research trends in solid waste management. Studies by Zhang et al. (2019) and Das et al. (2020) have employed bibliometric techniques to identify prolific authors, influential institutions, and emerging research themes in SWM globally. However, a focused, large-scale bibliometric review of the global SWM literature remains underexplored. This gap underscores the significance of the present study in

providing a comprehensive mapping of solid waste management research around the globe, revealing key contributors, collaborations, and thematic directions.

2.5. Emerging Trends and Research Gaps

Recent bibliometric studies have begun to explore the intersection of solid waste management with themes such as circular economy, climate change, and resource efficiency (Mavropoulos & Newman, 2020). Nevertheless, there is still limited empirical evidence that systematically analyses SWM research output using bibliometric tools. As noted by Singh et al. (2021), future research should focus on integrating interdisciplinary approaches and fostering international collaboration to address the multifaceted nature of waste management challenges.

3. RESEARCH QUESTION

RQ1: Which countries have contributed the most to the scientific literature on solid waste management?
RQ2: Which institutions are the leading contributors to research on solid waste management ?
RQ3: What are the most frequently occurring keywords and thematic trends in solid waste management literature?
RQ4: Who are the most prolific and influential authors in the domain of solid waste management research worldwide?
RQ5: Which authors and publications are the most cited in the field of solid waste management, and what does this reveal about the intellectual structure of the field?

4.METHODOLOGY

4.1 Research Design

This study employs bibliometric analysis, a quantitative technique designed to systematically examine patterns, trends, and structures within the scientific literature on solid waste management (SWM) from 2000 to 2024. The bibliometric approach is particularly suitable for this study given the interdisciplinary and rapidly expanding nature of SWM research. It provides a robust methodological framework to quantitatively assess and map the evolution of scholarly output over time, identify research fronts, influential contributors, and collaborative networks (Pritchard, 1969; Zupic & Čater, 2014). In addition, bibliometric methods enable the examination of publication productivity, citation impact, co-authorship networks, keyword co-occurrences, and thematic development using statistical and visualization tools. This methodology has been successfully applied in related fields such as sustainability science (Xie et al., 2021), climate change research (Haunschild & Bornmann, 2022), and waste management (Fu et al., 2021). By analyzing bibliographic data retrieved from reputable databases (e.g., Scopus/Web of Science), the study generates insights into research productivity, intellectual structure, and thematic trends within global SWM research landscape (Ellegaard & Wallin, 2015).

4.2 Data Collection

The data for this bibliometric analysis were retrieved from the **Scopus** database, one of the largest multidisciplinary abstract and citation databases of peer-reviewed literature (Chadegani et al., 2013). Scopus was chosen over other databases such as Web of Science, IEEE Xplore, and PubMed due to its broader subject coverage, extensive indexing of journals across environmental sciences, engineering, policy studies, and its inclusion of a large volume research output (Harzing & Alakangas, 2016; Mongeon & Paul-Hus, 2016).The search query formulated to collect relevantpublications:TITLE-ABS-KEY **(“solid waste management” OR “municipal solid waste” OR “waste disposal” OR “waste**

treatment" OR "waste recycling")AND PUBYEAR > **1999** AND PUBYEAR < **2025** AND (LIMIT-TO (LANGUAGE, "English"))**.**

This search strategy was designed to capture articles addressing various aspects of solid waste management, covering publications from 2000 to 2024, written in English. The document types included journal articles, conference papers, reviews, and book chapters, while editorials, letters, notes, and errata were excluded. The search initially returned **7697**records, which were screened to remove duplicates and non-relevant documents, yielding a final dataset of **3244** publications for analysis. The search results were exported in CSV format from Scopus and imported into **Bibliometrix/Biblioshiny** package in R (Aria & Cuccurullo, 2017), an open-source bibliometric tool widely used for comprehensive performance analysis, science mapping, and network visualization. Biblioshiny offers integrated capabilities to analyze citation patterns, co-authorship networks, keyword co-occurrences, and thematic evolution within a user-friendly interface. Compared to other bibliometric tools such as CiteSpace (Chen, 2004), and SciMAT (Cobo et al., 2012), Biblioshiny and VOS viewer provides a balance between advanced statistical capabilities, rich visualization options, and flexibility for customization. The analysis involved multiple layers of bibliometric techniques:

Descriptive statistics: quantifying annual publication trends, most productive authors, institutions, and countries.

Performance analysis: identifying highly cited documents, authors' productivity (Lotka's Law), and source impact (Bradford's Law).

Science mapping: conducting co-citation analysis, keyword co-occurrence mapping, thematic evolution, and collaboration network analysis among authors, institutions, and countries.

These combined quantitative and visual analyses enabled the systematic mapping of the intellectual structure, influential contributors, collaboration patterns, and emerging thematic trends in solid waste management research over the past two decades.

5. RESLULT

This bibliometric analysis provides a comprehensive mapping of the global research landscape on solid waste management (SWM) based on publications retrieved from the Scopus database. The analysis examines various performance indicators, including annual scientific production, average citations per year, leading journals, core sources (Bradford's Law), productive authors and institutions, author productivity patterns (Lotka's Law), and the global distribution of research output and collaborations. Furthermore, keyword co-occurrence, co-word network analysis, thematic evolution, and factorial analysis reveal the intellectual structure and emerging themes within the field. Author and institutional collaboration networks, as well as country-level scientific production and citation impact, offer insights into global and national research dynamics. The following sections present detailed results, visualized through a series of tables, charts, and network maps generated using Biblioshiny.

Table 5.1: Main Information About Data

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2000:2024
Sources (Journals, Books, etc)	458

Documents	3277
Annual Growth Rate %	5.59
Document Average Age	8.31
Average citations per doc	41.28
References	0
DOCUMENT CONTENTS	
Keywords Plus (ID)	21965
Author's Keywords (DE)	8025
AUTHORS	
Authors	9035
Authors of single-authored docs	131
AUTHORS COLLABORATION	
Single-authored docs	157
Co-Authors per Doc	4.56
International co-authorships %	34.91
DOCUMENT TYPES	
article	3244

Source*: Bibliometrix*

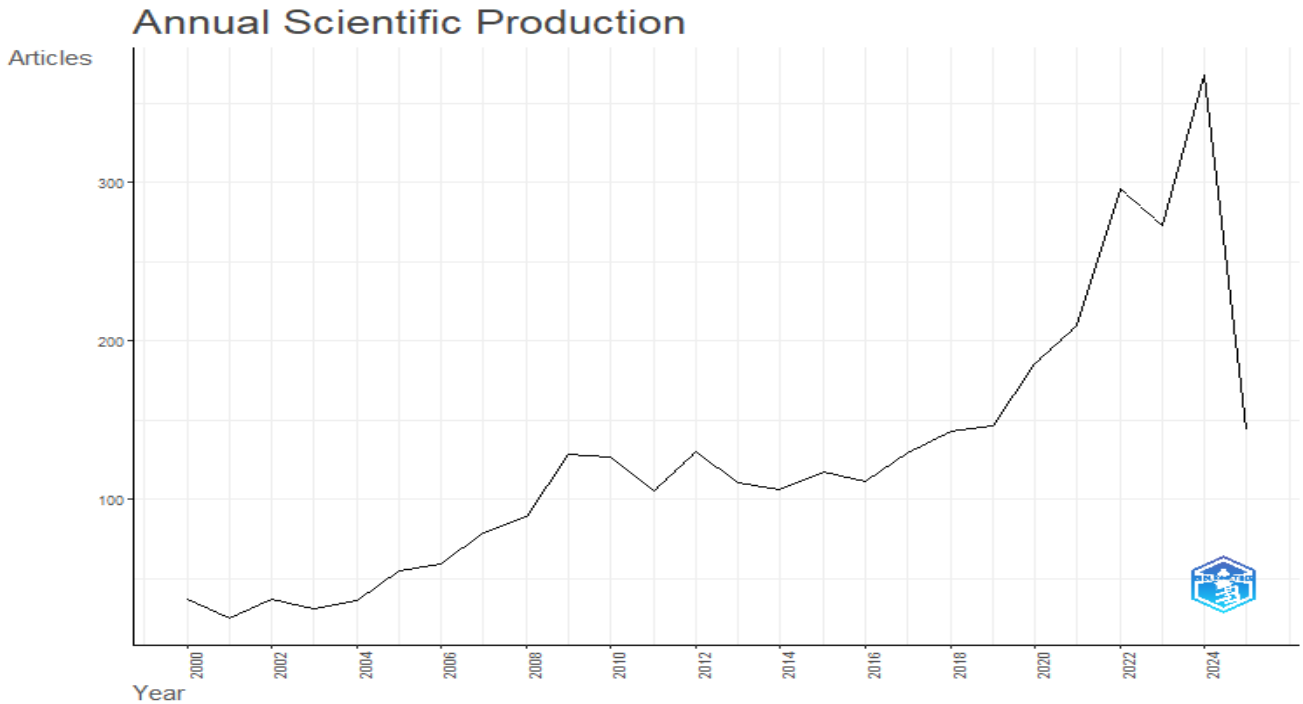

Figure5.1Annual Scientific Production

Source*: Bibliometrix*

Result and Discussion

The annual scientific production pertaining to global solid waste management (SWM) demonstrates a consistent and substantial upward trajectory over the past two decades. Initial publication volumes were relatively modest in the early 2000s, with incremental growth observed until 2008. Between 2010 and

2016, publication activity exhibited intermittent fluctuations, potentially reflecting variations in research funding, policy focus, or data availability. From 2017 onward, a pronounced escalation in scholarly output is evident, culminating in a peak around 2023. This sustained growth corresponds with increased national and international prioritization of sustainable waste management, heightened policy interventions such as the Solid Waste Management Rules (2016), and the broader global agenda of achieving the Sustainable Development Goals (SDGs). The surge in publications post-2020 may also reflect advancements in waste management technologies, rising public and governmental engagement, and intensified interdisciplinary research efforts. The apparent decline in 2024 is plausibly attributable to the partial nature of data collection for the ongoing year. Collectively, these trends underscore the growing academic and policy significance of SWM research, driven by the imperative to address complex environmental, socio-economic, and public health challenges associated with rapid urbanization and industrial growth.

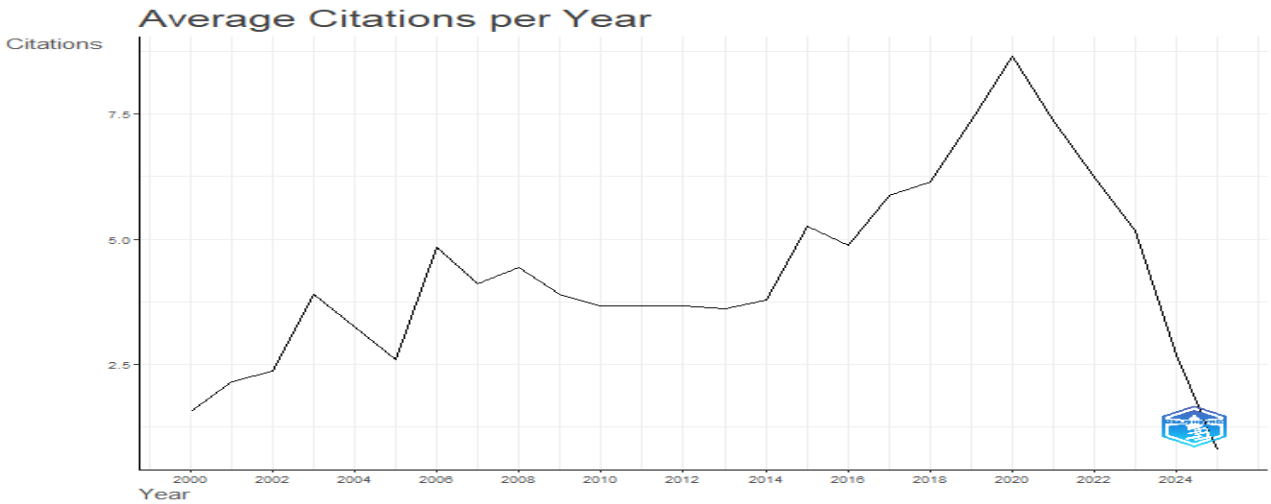

Figure5.2 Average citation per year

Source*: Bibliometrix*

Result and Discussion

The temporal analysis of average citations per year indicates a dynamic evolution in the scholarly impact of solid waste management around the globe. Early years exhibited modest citation rates, reflecting limited academic engagement. A gradual increase was observed from the mid-2000s, with notable peaks around 2007–2008, likely driven by foundational studies. A sustained rise post-2016 culminated in a peak around 2020–2021, highlighting the growing academic relevance and global visibility of SWM research, possibly influenced by policy reforms, international collaborations, and alignment with global sustainability priorities. The subsequent decline post-2022 is likely due to the inherent citation lag for recent publications. Overall, the pattern underscores the increasing maturity and influence of SWM research within global research landscape.

Sources

The analysis of publication sources offers insights into the most influential journals and the dissemination patterns of research on global solid waste management. Various metrics such as source productivity, local impact (H-index), and core journals (Bradford's Law) are examined to identify

leading publication outlets.

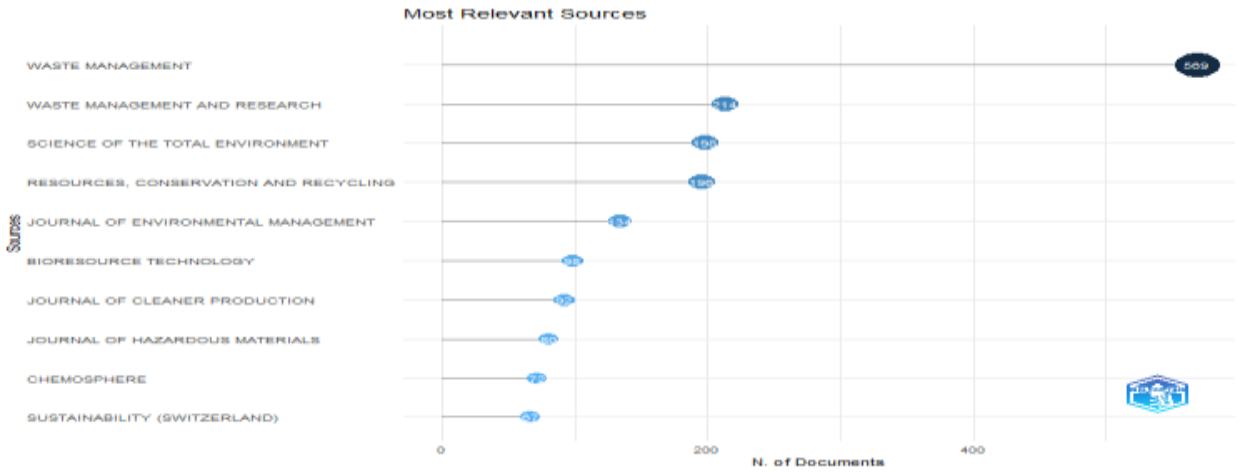

Figure 5.3 Most Relevant sources

Source*: Bibliometrix*

Result and Discussion

The analysis of the most relevant sources in solid waste management (SWM) research reveals that *Waste Management* leads substantially with 589 publications, indicating its dominant role in disseminating SWM scholarship. This is followed by *Waste Management & Research* (214 documents), *Science of the Total Environment* (198), and *Resources, Conservation and Recycling* (198), highlighting their significant contributions to the field. Other prominent journals include *Journal of Environmental Management*, *Renewable & Sustainable Energy Reviews*, and *Journal of Cleaner Production*, which collectively reflect the interdisciplinary nature of SWM research, encompassing environmental science, sustainability, energy recovery, and policy dimensions. The prominence of high-impact international journals underscores the global relevance of SWM research and reflects the growing engagement of I scholars with internationally recognized publication platforms.

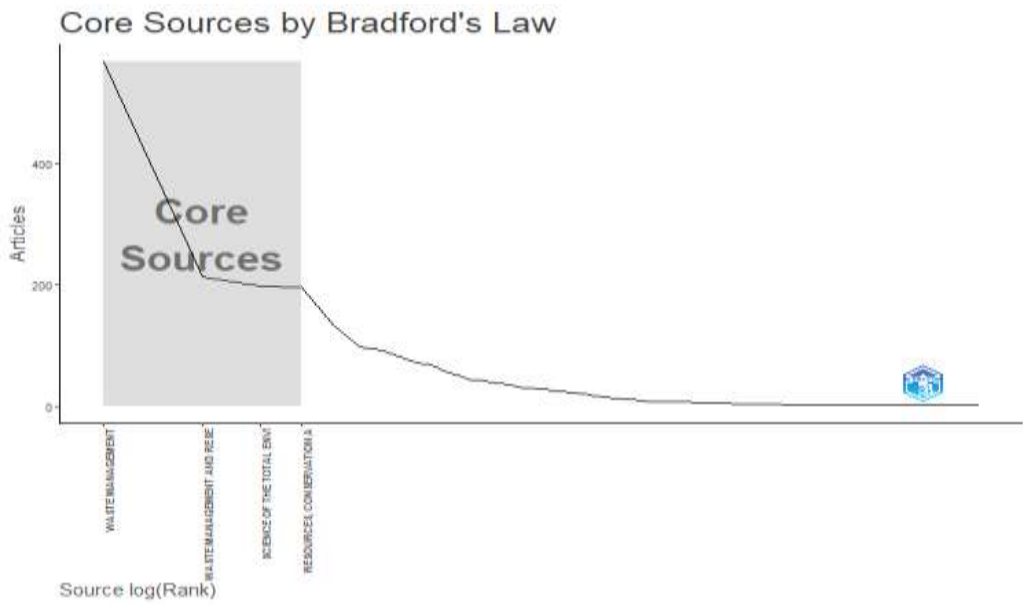

Figure 5.4 Core Sources by Bradford's Law

Source*: Bibliometrix*

Result and Discussion

The application of Bradford's Law identifies a distinct set of core journals that concentrate the majority of scholarly output on solid waste management (SWM) . The core zone is dominated by *Waste Management*, *Waste Management & Research*, *Science of the Total Environment*, and *Resources, Conservation and Recycling*, which collectively account for a substantial proportion of the total publications. This concentration of articles in a limited number of high-impact journals reflects the central role these sources play in disseminating pivotal SWM research. The distribution pattern aligns with Bradford's Law, highlighting a steep drop-off in article frequency beyond the core zone, thereby confirming the existence of a specialized core literature that serves as the primary knowledge base for SWM scholarship over the world.

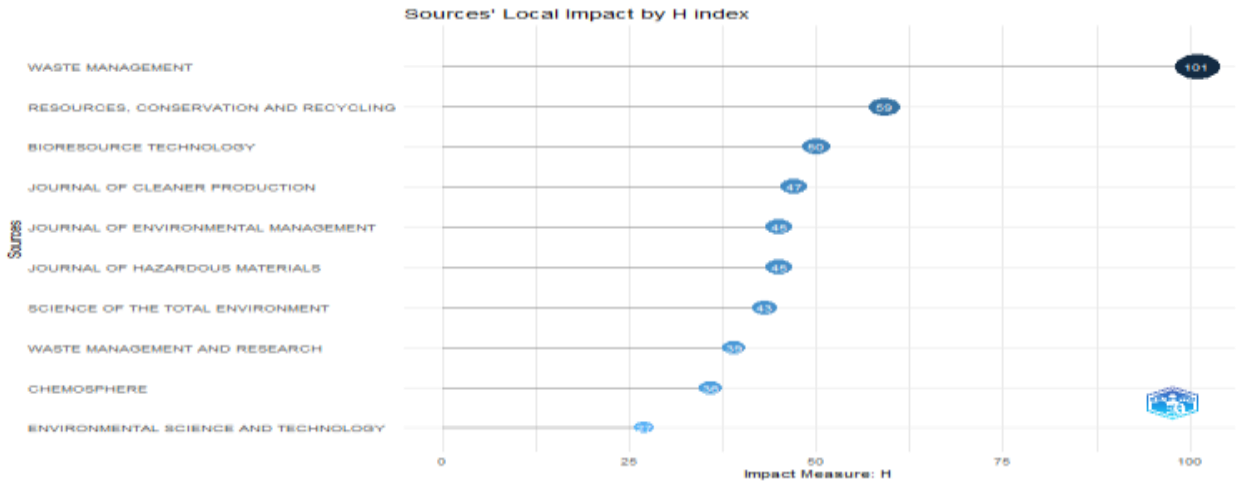

Figure 5.5 Sources'Impact Factor

Source*: Bibliometrix*

Result and Discussion

The analysis of sources based on their local impact using the H-index reveals distinct patterns of scholarly influence within the examined domain. *Waste Management* emerges as the most impactful source with an H-index of 101, indicating its significant and sustained contribution to the field. Following this, *Resources Conservation and Recycling* demonstrates a strong influence with an H-index of 59, while *Bioresource Technology* and *Journal of Cleaner Production* exhibit notable impacts with H-indices of 50 and 47, respectively. Other key journals such as *Journal of Environmental Management* (45), *Journal of Power Sources* (45), and *Science of the Total Environment* (43) also contribute substantially to the discourse. The presence of journals with lower H-indices, such as *Chemosphere* (38) and *Environmental Science and Technology* (27), underscores the diversity of publication outlets, reflecting both established and emerging research venues. This distribution suggests that while a few core journals dominate the dissemination of high-impact research, a wide range of sources collectively enrich the field by addressing various subtopics and methodological approaches.

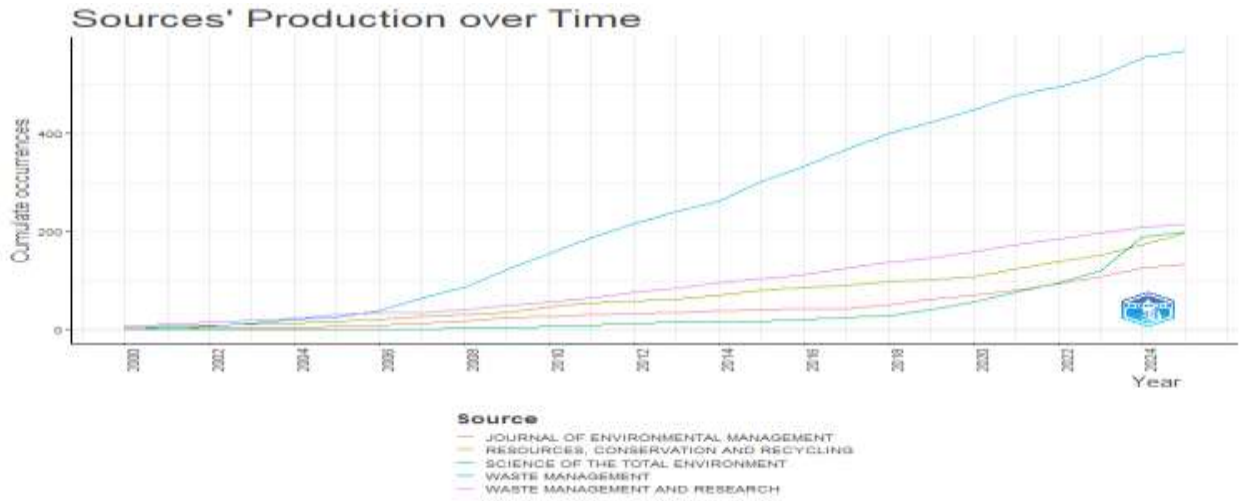

Figure 5.6 Source's Production over Time
Source*: Bibliometrix*

Result and Discussion

The cumulative production analysis illustrates distinct growth patterns across major journals in the field from 2000 to 2024. *Waste Management* demonstrates a pronounced and consistent increase, emerging as the most prolific source with a steep rise especially noticeable after 2008, indicating its central role in advancing research on waste-related topics. *Resources, Conservation and Recycling* and *Science of the Total Environment* also exhibit steady growth, reflecting the broadening scope of research in sustainability, resource efficiency, and integrated environmental management. The *Journal of Environmental Management* and *Waste Management and Research* show moderate but consistent contributions, highlighting their sustained relevance. The overall upward trend across all sources suggests an expanding scholarly interest and growing recognition of the importance of environmental management and waste-related research in addressing global sustainability challenges.

Authors

The authorship analysis identifies the most prolific and influential researchers contributing to solid waste management studies . Metrics such as author productivity, local impact (H-index), collaboration networks, and temporal publication trends are presented to map scholarly contributions and collaborations.

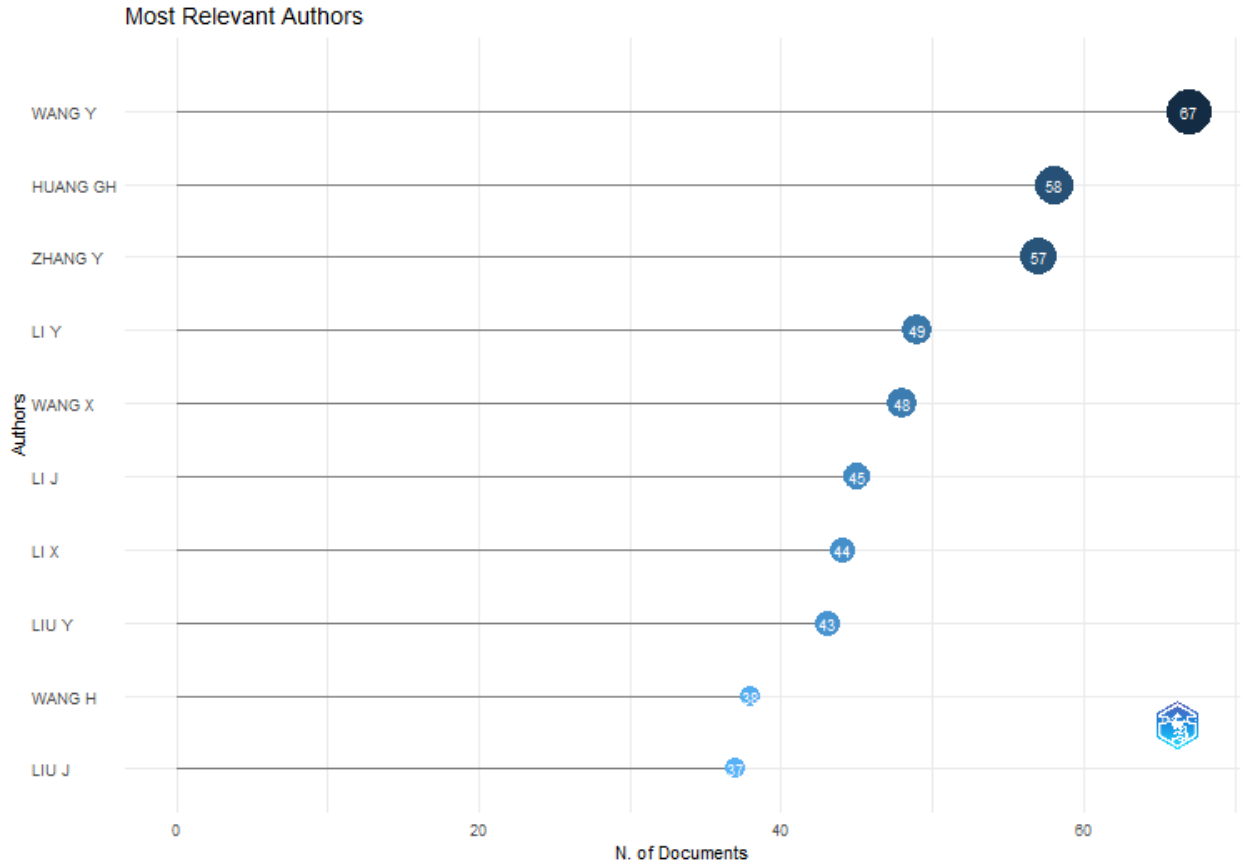

Figure 5.7 Most relevant authors

Source*: Bibliometrix*

Result and Discussion

The analysis of the most relevant authors reveals a core group of highly productive contributors to the field. Among them, **Wang Y** stands out prominently, leading with the highest number of publications (67 documents), followed by **Huang G H** (58 documents) and **Zhang Y** (57 documents). These authors have made substantial contributions, shaping the discourse and advancing knowledge within the domain. Other notable contributors include **Li Y** and **Zhang X**, with 49 and 48 publications respectively, indicating sustained research activity and influence. The remaining authors, such as **Liu J**, **Liu X**, **Zhou Y**, **Wang H**, and **Liu J**, have also consistently contributed valuable insights, collectively enriching the scholarly landscape. The concentration of prolific authors underscores the existence of an active and collaborative research community driving ongoing advancements in the field.

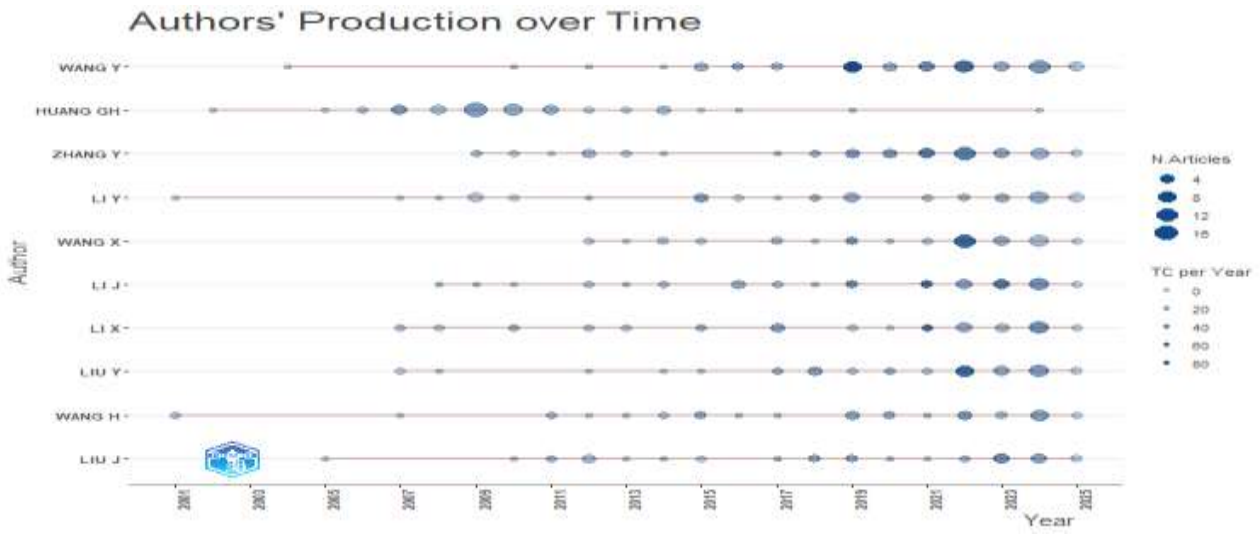

Figure 5. 8 Authors' Production Over Time

Source*: Bibliometrix*

Result and Discussion

The temporal analysis of authors' publication output highlights distinct patterns of productivity and scholarly influence over the years. **Wang Y** exhibits a consistently increasing publication trajectory, particularly after 2015, marking him as one of the most prolific contributors in recent years. Similarly, **Huang G H** shows a concentrated period of high publication activity between 2007 and 2014, reflecting substantial early contributions to the field. **Zhang Y** and **Li Y** demonstrate steady outputs across the timeline, indicating sustained engagement in the research domain. Authors such as **Wang X**, **Li J**, and **Li X** display notable increases in productivity from 2015 onward, suggesting growing research involvement and emerging prominence. Furthermore, the size and shading of the bubbles, representing the number of articles and total citations (TC) per year, respectively, reveal not only the quantity but also the scholarly impact of the authors' work, with several authors achieving high citation rates during peak productivity periods. Overall, the data underscores both the longevity and evolving dynamics of author contributions within the research area.

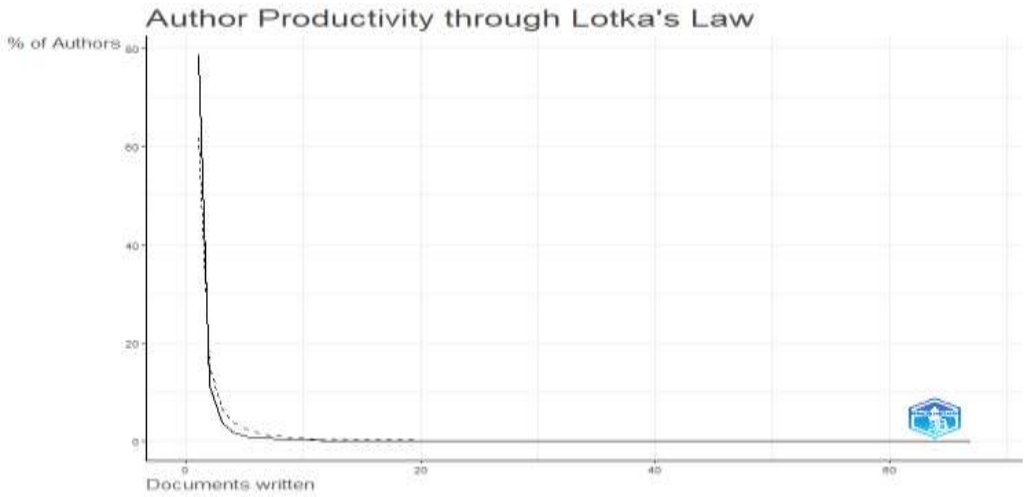

Figure 5. 9 Author Productivity through Lotka's Law

Source*: Bibliometrix*

Result and Discussion

The distribution of author productivity in this study adheres closely to Lotka's Law, which posits that a small proportion of authors contribute the majority of publications, while the vast majority produce only a few papers. As illustrated in the figure, a steep decline is observed, with approximately 80% of authors contributing only a single publication, while progressively fewer authors produce multiple documents. This highly skewed distribution underscores the presence of a core group of prolific authors who drive the majority of scholarly output, alongside a larger cohort of occasional contributors. The close fit between the observed data and Lotka's theoretical curve validates the typical pattern of scientific authorship within the field, reflecting both the concentration of expertise and the collaborative nature of research dissemination.

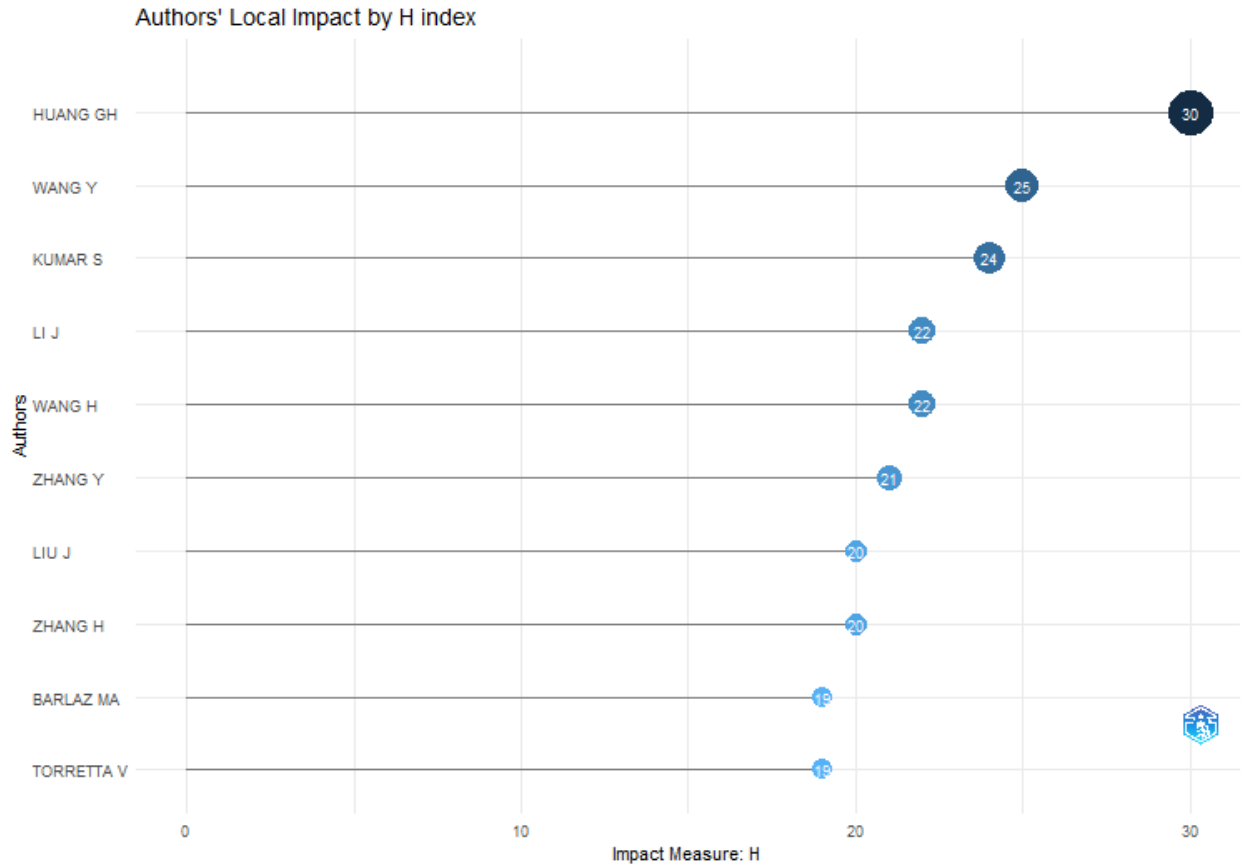

Figure 5.10 Author's local Impact by H index

Source*: Bibliometrix*

Result and Discussion

The analysis of authors' local impact, as measured by the H-index, reveals a concentration of influence among a select group of researchers. HUANG GH stands out prominently with the highest H-index of 30, indicating both high productivity and sustained citation impact within the dataset. WANG Y and HUANG Q follow with H-indices of 25 and 24, respectively, highlighting their significant contribution to the field. Several other authors, including LI J, WANG H, and ZHANG Y, also demonstrate considerable influence, with H-indices ranging from 22 to 20. This distribution reflects a core group of highly impactful authors who consistently produce widely cited research, thereby shaping the scholarly

discourse in this domain.

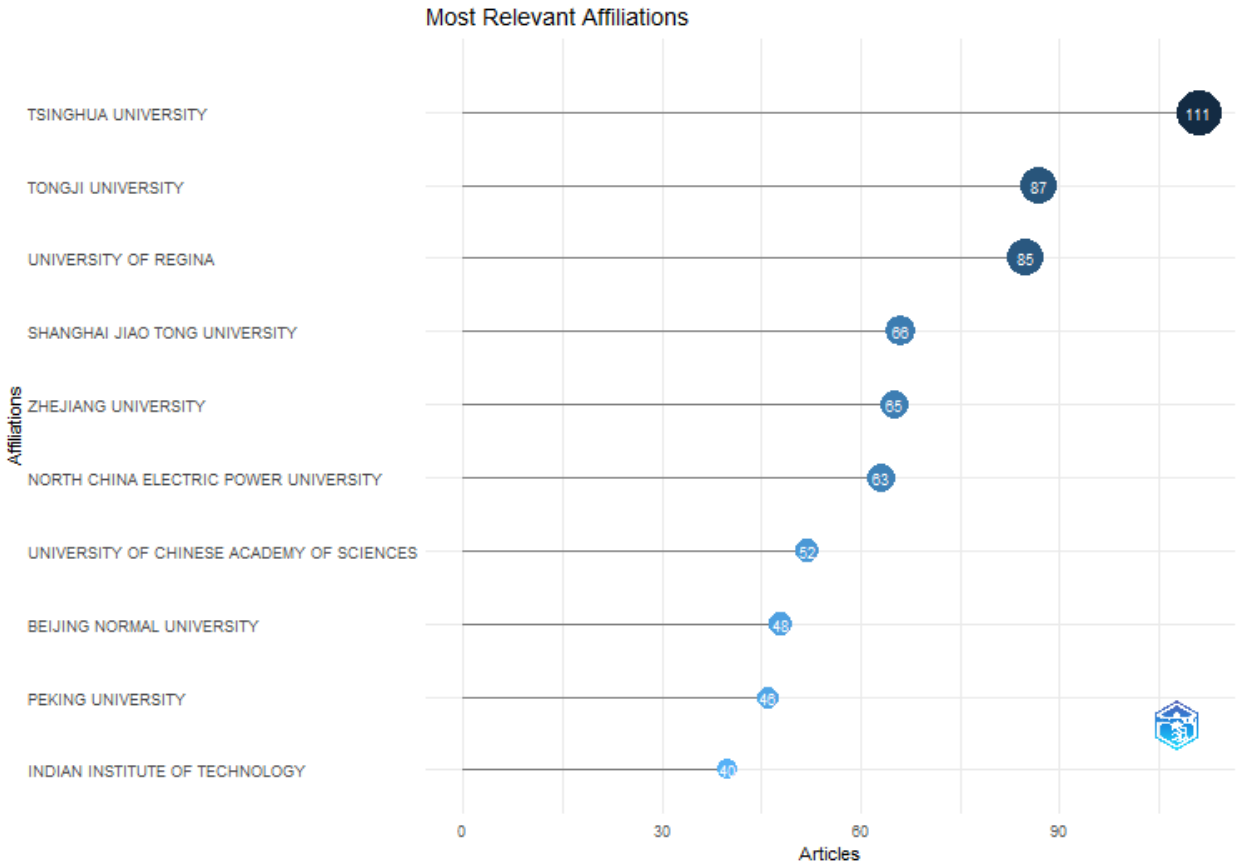

Figure5. 11 Most Relevant Affiliations

Source*: Bibliometrix*

Result and Discussion

The analysis of institutional affiliations highlights the key research centers contributing significantly to the field. Tsinghua University emerges as the leading institution with 111 articles, demonstrating its dominant role in advancing research output. Tongji University and University of Regina follow with 87 and 85 articles respectively, reflecting their substantial scholarly contributions. Other notable institutions include Sun Yat-sen University (68 articles), Zhejiang University (65 articles), and North China Electric Power University (63 articles). The strong representation of Chinese universities suggests a concentrated regional expertise, while the presence of international institutions such as University of Regina and Indian Institute of Technology (40 articles) underscores the global interest and collaborative efforts within this research domain.

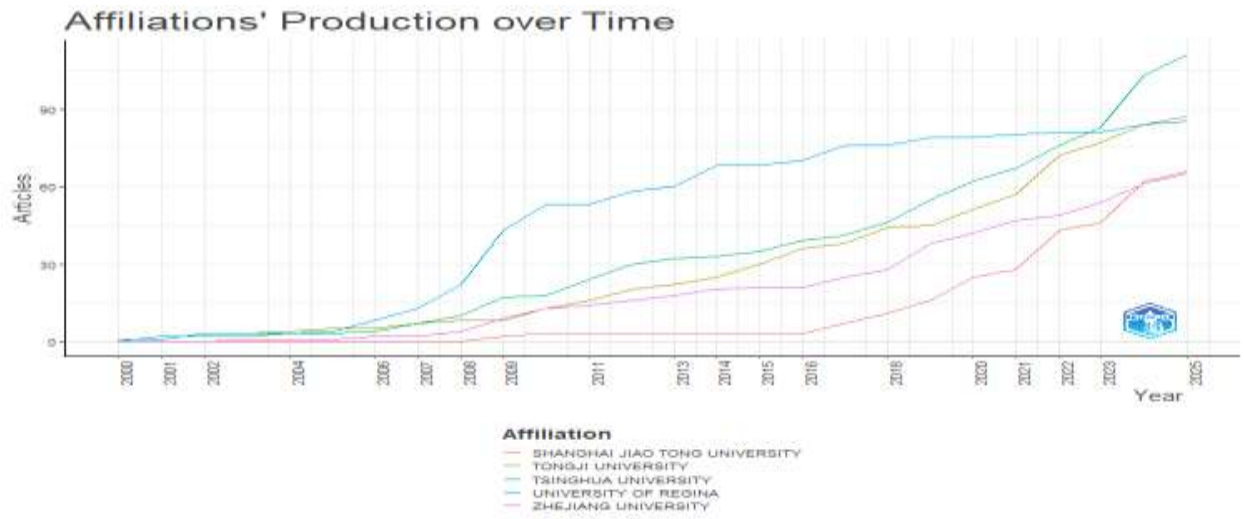

Figure 5.12 Affiliations Production Over time

Source*: Bibliometrix*

Result and Discussion

The temporal analysis of institutional research output reveals dynamic growth patterns among leading affiliations. Tsinghua University demonstrates a consistent and sustained increase, ultimately surpassing 90 articles by 2025, indicating its expanding influence and continuous research engagement in the field. Tongji University exhibits a steady upward trajectory, closely following Tsinghua University, reflecting its significant and growing contribution. The University of Regina also displays a marked increase, particularly after 2020, suggesting rising research activity and international collaboration. Zhejiang University shows a gradual but steady growth pattern, while Shanghai Jiao Tong University, though starting with minimal output, experiences a notable rise post-2018, indicating an emergent research focus in recent years. Collectively, these trends underscore the increasing global academic interest and institutional commitment towards advancing research in this domain.

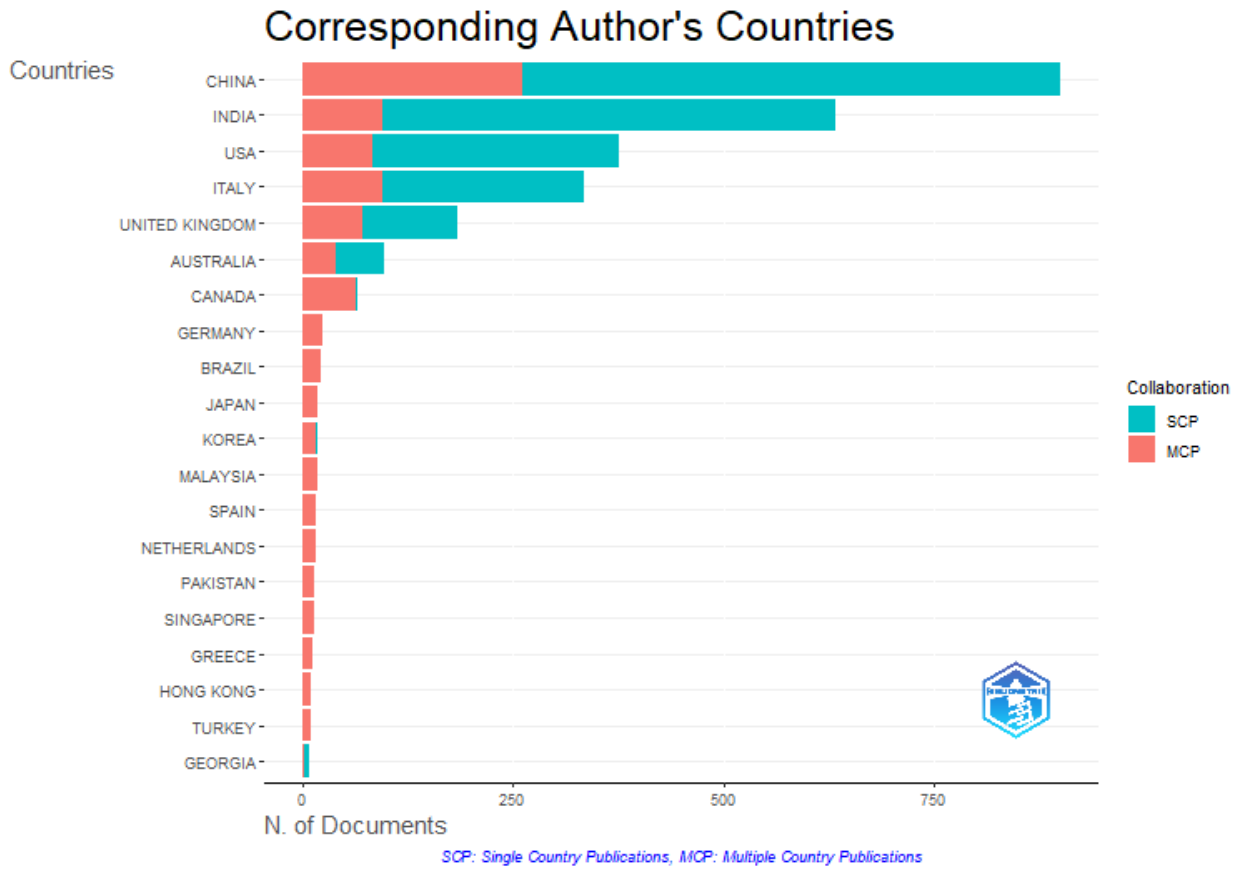

Figure 5. 13 Corresponding Authors' Countries

Source*: Bibliometrix*

Result and Discussion

The analysis of corresponding authors' countries highlights the global distribution and collaboration patterns within the research domain. China emerges as the most dominant contributor, accounting for the highest number of publications, with a substantial proportion of both single country publications (SCP) and multiple country publications (MCP), indicating both strong domestic research capacity and active international collaboration. India and the USA follow, each demonstrating significant contributions, with India showing a higher proportion of SCP, reflecting robust national research activity, while the USA exhibits a balanced mix of domestic and international collaborations. European countries such as Italy, the United Kingdom, and Germany, along with Australia and Canada, also present considerable research outputs, emphasizing their active participation in the field. The data further reveals a broader geographical spread with emerging contributions from countries like Brazil, Japan, Korea, Malaysia, and others, underlining the growing global interest and diversification of research efforts across continents.

Table 4. 2 Country Scientific production

region	Freq
CHINA	2502
INDIA	1557
USA	1127
ITALY	757

UK	573
AUSTRALIA	259
CANADA	174
BRAZIL	86
GERMANY	86
MALAYSIA	84

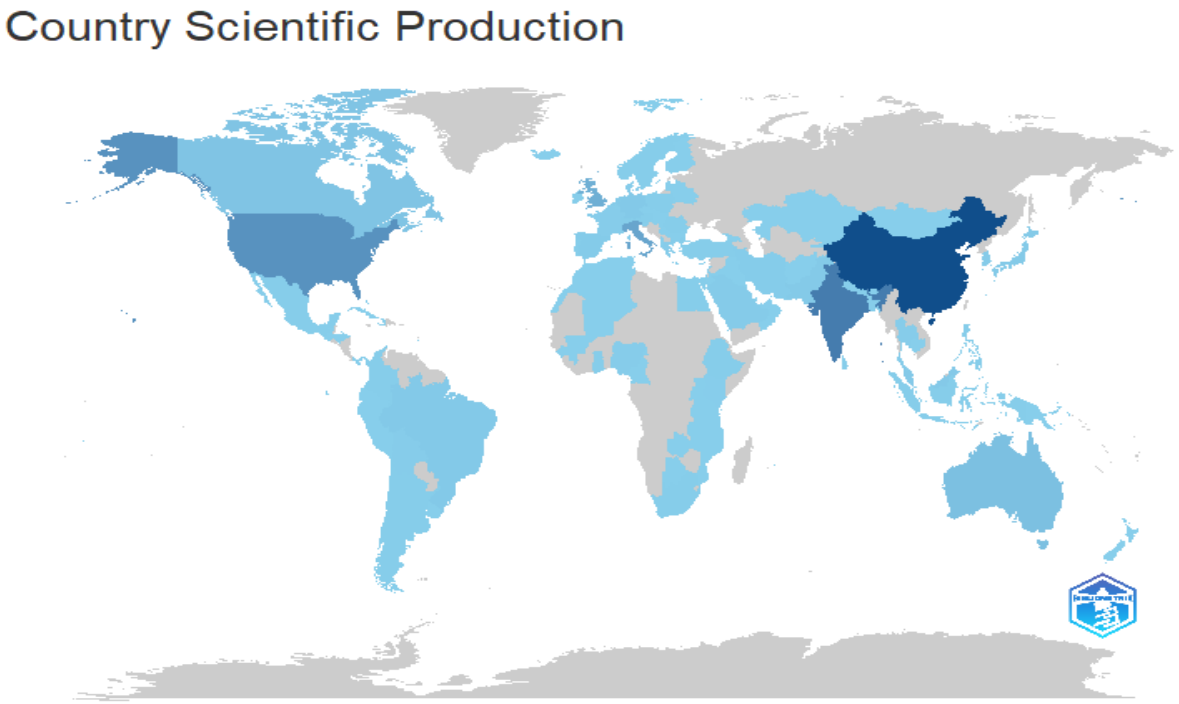

Figure 5.14 Country Scientific production
Source*: Bibliometrix*

Result and Discussion

The analysis of country-level scientific production reveals a significant geographical concentration of research output. China emerges as the most prolific contributor with 2,502 publications, followed by India (1,557) and the United States (1,127), highlighting their dominant roles in the field. European countries such as Italy (757), the United Kingdom (573), and Germany (86) also demonstrate considerable research activity, while Australia (259) and Canada (174) reflect strong engagement from the global South and North America, respectively. Countries like Brazil, Malaysia, Japan, Pakistan, and South Korea contribute moderately, whereas a diverse group of nations from Africa, South America, and smaller economies also participate, albeit with lower publication frequencies. This distribution underscores the global relevance of the research domain, while simultaneously indicating the existence of regional research hubs and disparities in scientific productivity across different countries.

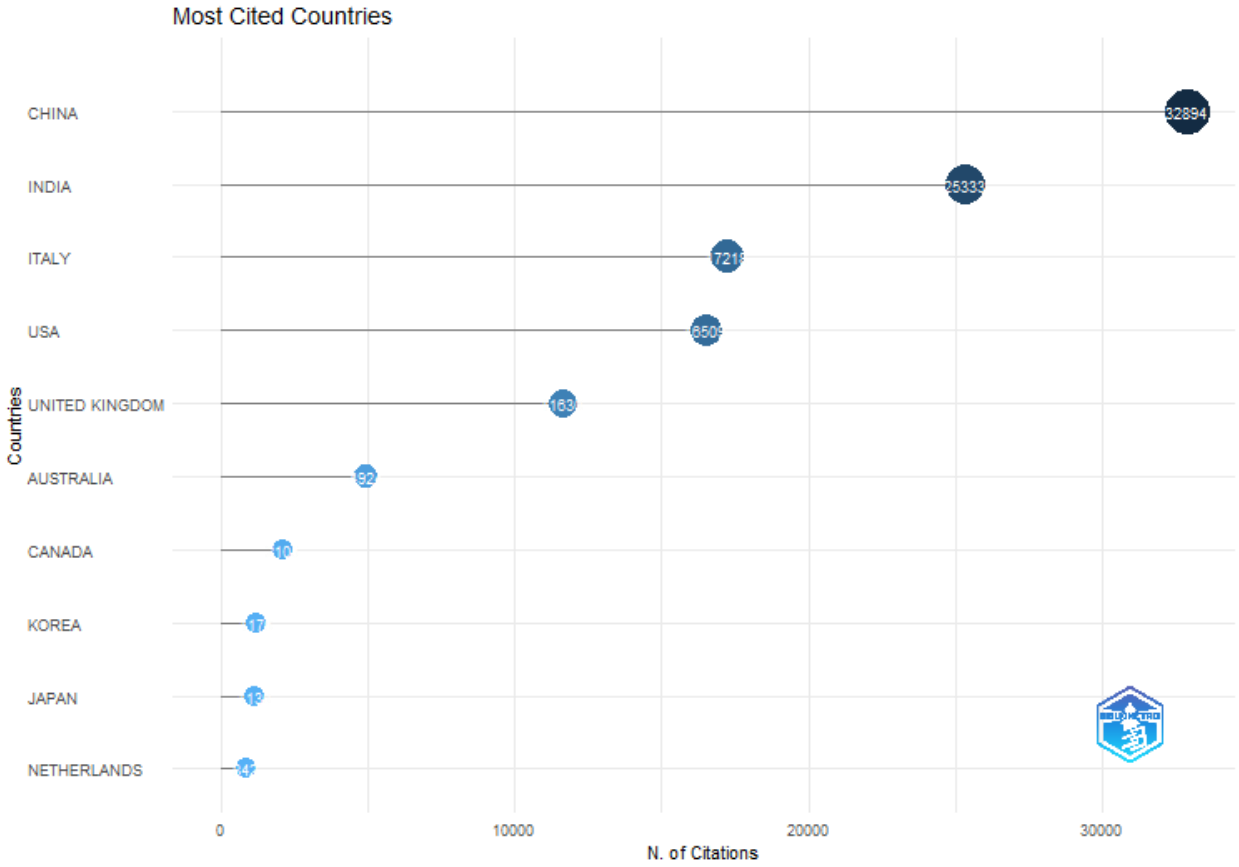

Figure 5.15 Most Cited Countries

Source*: Bibliometrix*

Result and Discussion

The citation analysis across countries demonstrates that China leads globally, having accumulated 32,894 citations, reflecting its extensive influence and scholarly impact in the field. India follows with 25,333 citations, indicating a strong and growing research presence. Italy (17,218 citations) and the USA (16,509 citations) also exhibit substantial citation records, underscoring their significant contributions. The United Kingdom (11,633 citations) and Australia (4,924 citations) display moderate but impactful scholarly outputs. Other countries, including Canada, Korea, Japan, and the Netherlands, contribute with varying but notable citation counts, ranging from 842 to 2,105 citations. These findings highlight a concentration of highly cited research in a few leading nations while also illustrating the broad international engagement in the domain.

Figure 5.16 Most frequent keyword

Source*: Bibliometrix*

Result and Discussion

The keyword analysis reveals the thematic core and primary focus areas within the research domain. The most frequently occurring terms include "solid waste management," "waste management," "municipal solid waste," "waste disposal," and "solid waste," underscoring the centrality of waste handling and disposal practices in the literature. Additional prominent keywords such as "recycling," "landfill," "incineration," "anaerobic digestion," "composting," and "life cycle assessment" reflect the diverse strategies explored for sustainable waste treatment and resource recovery. Keywords like "environmental impact," "greenhouse gas," and "biodegradation" highlight growing concerns regarding the environmental consequences of waste management practices. Moreover, the recurrence of geographical identifiers like "China" and "India" suggests significant regional contributions and interest. Collectively, this keyword distribution illustrates a research landscape strongly centered on optimizing waste management systems while addressing environmental sustainability.

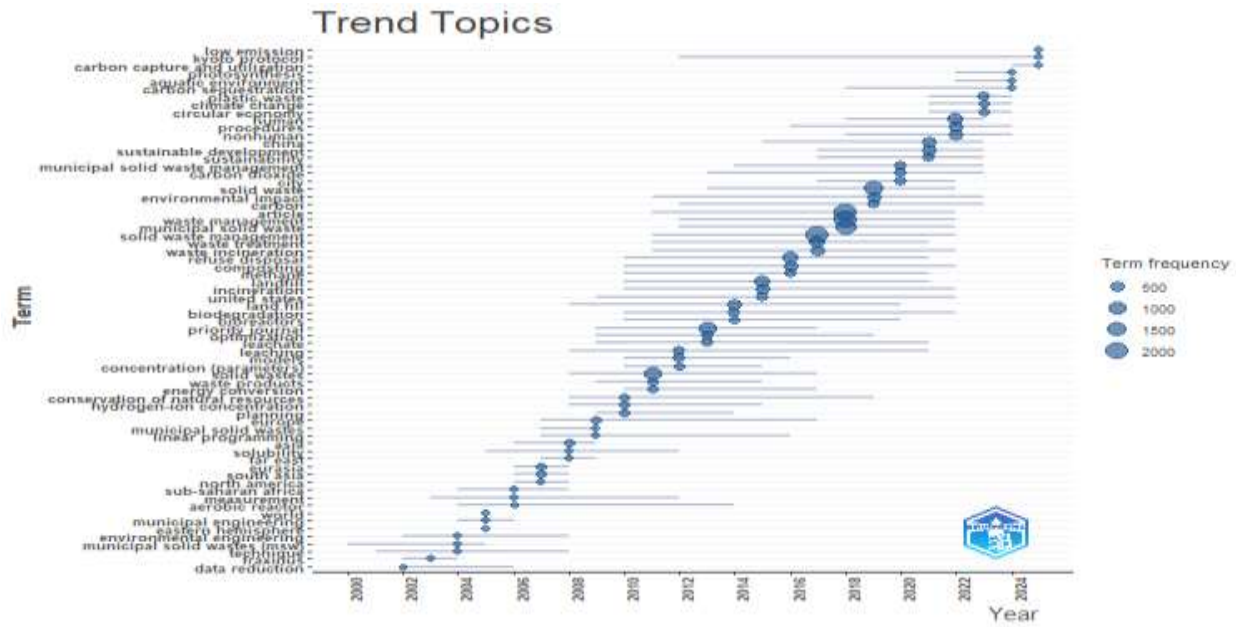

Figure 5.17 Trend topics - keywords

Source*: Bibliometri*

Result and Discussion

The analysis of trend topics provides valuable insights into the evolving focus of research within the domain over time. In the early 2000s, studies primarily addressed foundational themes such as "municipal solid waste," "waste management," "refuse disposal," and "solid waste treatment." Over the years, emerging concerns such as "landfill," "composting," "incineration," and "recycling" gained prominence, reflecting increasing interest in sustainable waste handling techniques. From approximately 2010 onward, there has been a clear shift toward more environmentally integrative and policy-relevant themes including "environmental impact," "sustainable development," "life cycle assessment," and "carbon dioxide." In recent years, frontier topics such as "circular economy," "climate change," "carbon sequestration," and "carbon capture and utilization" have emerged, indicating a growing alignment of waste management research with global climate change mitigation efforts and resource optimization strategies. This temporal progression underscores the dynamic nature of the field and its responsiveness to global sustainability agendas.

Co-occurrence analysis

In bibliometrics, cooccurrence analysis is a potent technique for identifying the conceptual framework of academic literature, finding relationships between terms and concepts, and revealing patterns that can guide future research and investigation.

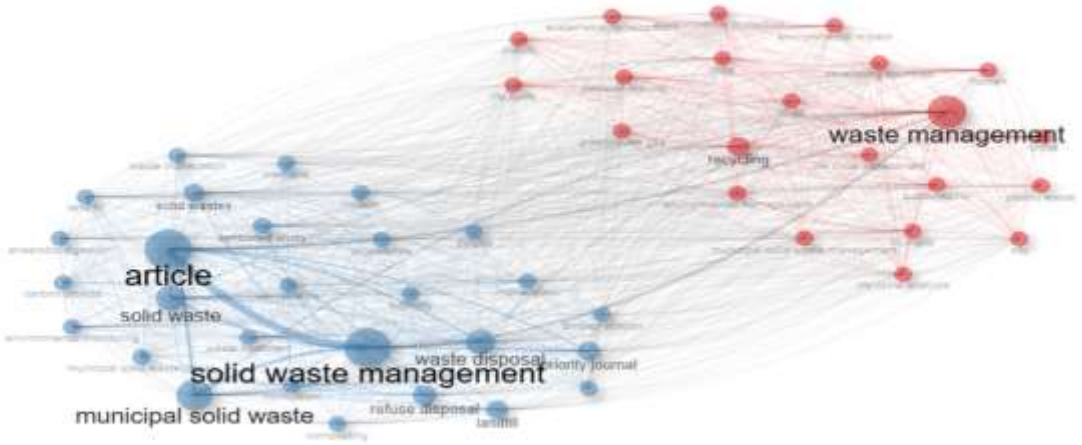

Figure 5.18Keyword Co-occurrence Network
Source*: Bibliometrix*

Result and Discussion

The co-word network analysis illustrates the conceptual structure and thematic interrelationships within the literature on solid waste management. The network reveals two prominent clusters, indicating distinct but interconnected research domains. The blue cluster primarily revolves around technical and operational aspects of waste handling, with core terms such as "solid waste management," "municipal solid waste," "waste disposal," "landfill," "refuse disposal," and "anaerobic digestion." This suggests a strong research focus on waste treatment technologies and process optimization. In contrast, the red cluster highlights broader systemic and policy-oriented themes, anchored around "waste management," "recycling," "sustainable development," "environmental protection," and "life cycle assessment." These terms reflect the increasing scholarly attention on environmental sustainability, policy implications, and the socioeconomic dimensions of waste management practices. The interconnections between the two clusters signify an integrative approach that combines technical efficiency with sustainability goals, underlining the multidimensional nature of the research field.

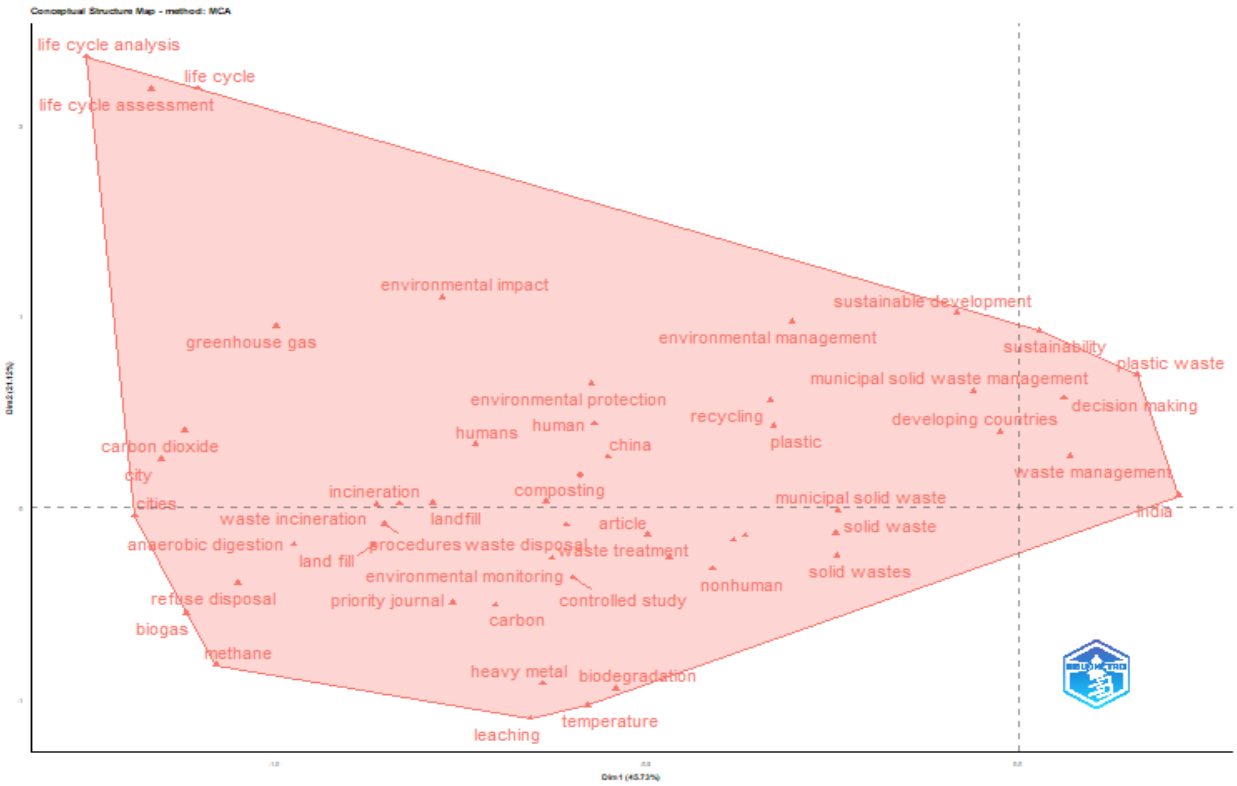

Figure5.19 Factorial Analysis

Source*: Bibliometrix*

Result and Discussion

The factorial analysis map provides a visual representation of the conceptual structure of the research domain, highlighting the underlying dimensions and thematic organization of keywords. The horizontal axis (Dimension 1) differentiates studies with a strong focus on operational and technical aspects such as "landfill," "waste disposal," "anaerobic digestion," "incineration," and "biodegradation," indicating emphasis on treatment technologies and waste processing. The vertical axis (Dimension 2) captures the more systemic and policy-oriented discourse, where terms like "life cycle assessment," "life cycle analysis," "sustainable development," "environmental management," and "decision making" dominate, reflecting strategic considerations in sustainability and environmental governance. The spatial proximity of terms like "waste management," "municipal solid waste management," "recycling," and "environmental impact" suggests an integrative research orientation that blends both technological innovation and sustainability-driven policies. This mapping underscores the multifaceted nature of solid waste management research, where technical, environmental, and policy dimensions are deeply interconnected.

Figure 5.20Author Collaboration Network
Source*: Bibliometrix*

Result and Discussion
The author collaboration network shows a highly centralized cluster led by *Wang Y*, *Wang X*, and *Wang H*, indicating strong intra-group collaboration. Smaller, distinct clusters, such as the partnership between *Huang GH* and *Li Y*, and the group involving *Torretta V*, suggest active but more localized collaborative efforts within the field.

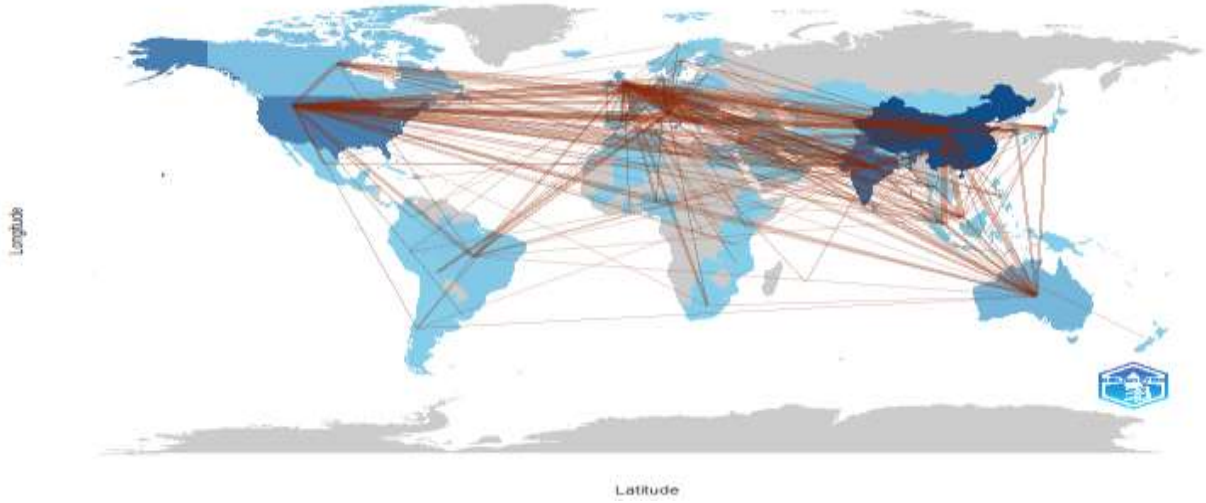

Figure 5.21 Author Collaboration World map
Source*: Bibliometrix*

Result and Discussion
The author collaboration world map illustrates extensive international research partnerships, with China, the United States, India, and European countries serving as major hubs of collaboration. The dense intercontinental linkages underscore the global and multidisciplinary nature of research on solid waste management, reflecting strong cross-border scientific exchanges and cooperative efforts to address global environmental challenges.

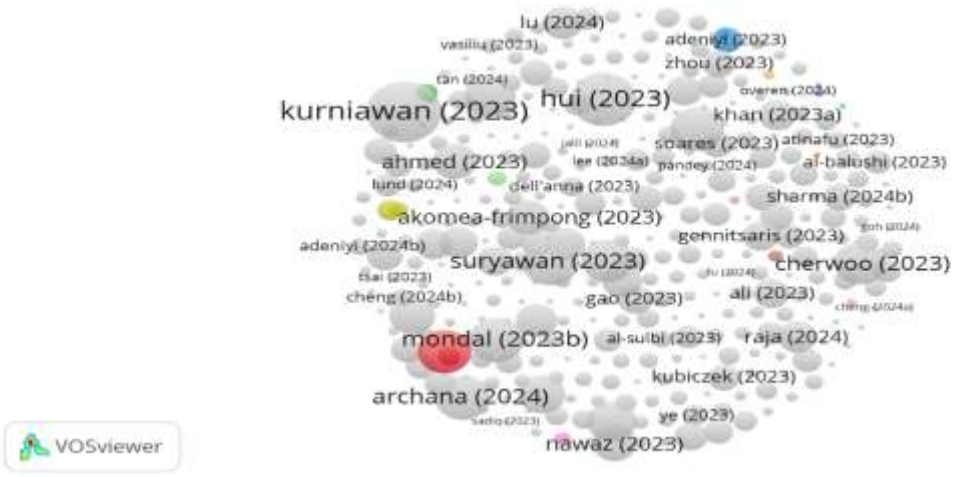

Figure 5.22 Citation analysis
Source:VOSviewer

Result and Discussion

Figure 5.22 presents the citation analysis of authors in the field, highlighting those with significant scholarly influence. Authors such as Kurniawan (2023), Hui (2023), and Mondal (2023b) appear prominently, indicating their higher citation counts and substantial contributions to recent research. The dense network structure suggests active and growing scholarly engagement in the domain, with emerging authors also contributing to the expanding body of literature.

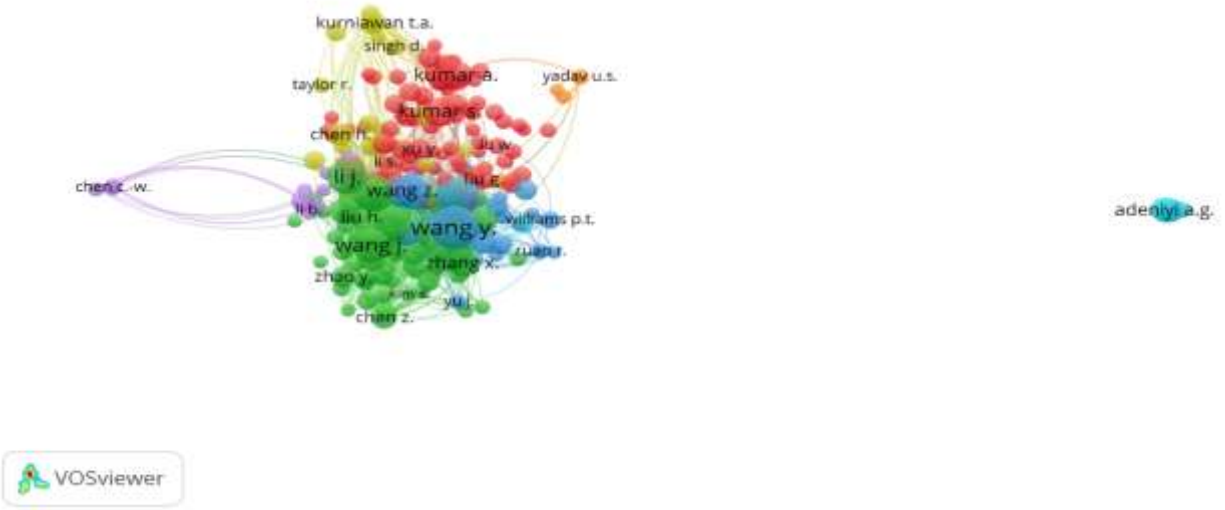

Figure 5.23 Authors co citation network
Source:VOSviewer

Result and Discussion

Figure 5.23 illustrates the co-citation network of authors, identifying key clusters based on their citation

patterns. Distinct groups are observed, with authors like Wang Y., Wang J., Kumar S., and Li J. positioned centrally, indicating their significant co-citation frequency and influence across multiple studies. The presence of isolated nodes, such as Adeniyi A.G., suggests emerging or specialized research contributions that are less interconnected with the main research clusters.

6. CONCLUSION

This bibliometric analysis provides a comprehensive mapping of the global research landscape on solid waste management (SWM) , revealing significant growth in scholarly output over the past two decades. The findings highlight a concentration of research productivity among a limited number of prolific authors, institutions, and journals, with *Waste Management*, *Waste Management & Research*, and *Science of the Total Environment* emerging as the most influential publication outlets. China, India, and the United States lead in both publication volume and citation impact, reflecting active global engagement and collaboration. The thematic analysis underscores a strong focus on municipal solid waste, recycling, landfill management, and environmental sustainability, while recent trends point toward the growing importance of circular economy principles, life cycle assessment, and climate change mitigation in SWM research. Author collaboration networks reveal a mixture of well-established research clusters and emerging partnerships, indicating an increasingly interconnected research community. Overall, this study offers valuable insights into the intellectual structure, evolving trends, and research dynamics shaping the field of solid waste management. These findings can inform policymakers, practitioners, and researchers in identifying research gaps, fostering interdisciplinary collaborations, and guiding future research directions aligned with sustainable development goals.

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