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Scientific landscape of organic waste management in Asian countries (1999-2025): A comprehensive bibliometric analysis

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Abstract: Organic waste management is a significant challenge for Asian countries. Research on this issue has grown rapidly; however, a comprehensive study mapping the development of research on organic waste in this region has not been conducted. This bibliometric analysis examines research trends in Asian countries from 1999 to 2025. The analysis provides insights into international publication distribution, author and institutional output, collaboration patterns, citation metrics, and research topic development over the studied period. The findings indicate that India, China, and Indonesia are the primary contributors, supported by productive institutions such as Universitas Indonesia. Many scientific studies are published in Scopus Quartile 1 journals. Notable authors in this field include Lee, Dutt, Singh, and Tiwari. The use of Black Soldier Fly for bioconversion and microbial processes is extensively cited. The scientific community frequently researches composting, anaerobic digestion, and vermicomposting. Currently, research emphasizes an integrated approach rather than conventional methodologies. These findings establish a solid foundation for future investigations, enhance regional scientific capabilities, and facilitate the development of better organic waste management solutions for Asian countries.

Keywords: *Asian countries, Bibliometric analysis, Organic waste management.*

1. Introduction

Organic waste management is a crucial issue currently faced by many Asian countries. In East and Southeast Asia, the organic waste management issue is becoming increasingly important as 3R (Reduce, Reuse, Recycle) policies are developed, although implementation still focuses on sorting and processing rather than on reduction at the source [1]. China also faces challenges due to the high volume of food waste generated, but this is not accompanied by an increase in waste treatment capacity [2]. In Malaysia, the disposal dependency on organic waste in landfills has increased the environmental burden [3]. Japan is also still focusing on the complex issue of food waste management, although regulatory frameworks like the Food Waste Recycling Law have increased recycling rates [4]. Meanwhile, South Korea is still experiencing issues such as high operational costs, instability in raw material quality, and limited facility capacity, despite its highly advanced sorting rate [5].

In Asian countries, organic materials (45–50% of total waste generation) dominate municipal solid waste [6]. Food scraps, kitchen waste, garden waste, and other biodegradable materials from household and commercial activities are types of organic waste [7]. Some countries still rely on landfills and open dumping for waste disposal, leading to environmental contamination and harming public health [6]. Studies also show that the lack of a standardized waste sorting system further increases the difficulty of introducing organic waste treatment technologies, especially in densely populated urban areas [8, 9]. In

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some countries, the informal sector continues to be utilized. However, its activities are still uncontrolled, which contributes to unstable collection efficiency and inconsistent processing performance [10].

Some countries in Asia have implemented technologies, including composting, vermicomposting, anaerobic digestion (AD), and the utilization of Black Soldier Fly (*Hermetia illucens*) larvae, to handle organic waste. Composting is the simplest method. It can also be done on a large scale [11]. Vermicomposting is a promising method but requires further evaluation [12]. AD produces biogas and digestate fertilizer [13], while Black Soldier Fly larvae rapidly reduce waste mass and yield protein-rich feed [14]. Since no single method is universally optimal, strategies should be tailored to waste characteristics, infrastructure, and environmental goals [7]. Research on organic waste management in Asia is growing, but existing studies remain fragmented. There is a limited explanation of how Asian countries collaborate in this field [15]. While some studies use systematic literature reviews to track progress, only a few articles have applied bibliometric analysis to this area [16-19].

Bibliometric analysis is a quantitative method used to study patterns of scientific publication by counting publications, citations, collaborations, and keywords in academic articles. This method helps researchers see how a field is developing, which research groups are most active, and which themes are rising or declining [20]. This approach is also useful for identifying research gaps, measuring the scientific impact of a country or institution, and mapping the direction of knowledge development through network visualization and topic trend analysis [21]. Thus, bibliometric analysis becomes an important tool to understand the research position and provide a basis for future research planning and policy. Therefore, this research used bibliometric analysis to examine Scopus-indexed publications regarding organic waste management in Asian countries from 1999 to 2025. The aim of this research is to analyze research trends in Asian countries, encompassing the distribution of publications by country, author, and institution productivity, collaboration and citation patterns, and identifying the development of research topics.

2. Materials and Methods

2.1. Study Design

This study employed a descriptive bibliometric analysis method. Publications on organic waste management in Asian countries retrieved from the Scopus database were analyzed using descriptive bibliometric techniques. Data collection involved several stages: identification, screening, eligibility, and inclusion [22]. Identification was conducted by entering keywords related to the research theme. Specifically, the keyword "organic waste management in Asian countries" was used in the Scopus database. This search yielded 670 publications based on the specified criteria. The dataset was then checked for duplicate entries; since no duplicates were found, all 670 publications proceeded to the screening phase. During screening, documents were evaluated against predefined eligibility criteria, which included: 1) publication in the form of an article or conference paper; 2) publication originating from Asian countries. After this process, 410 articles were excluded, leaving 260 documents that met the initial criteria. These remaining publications advanced to the eligibility stage, which involved a feasibility test to ensure language consistency; only English-language articles were deemed eligible for further analysis. Following this stage, 258 publications satisfied all criteria and were included in the final analysis. The entire data collection process is illustrated in Figure 1.

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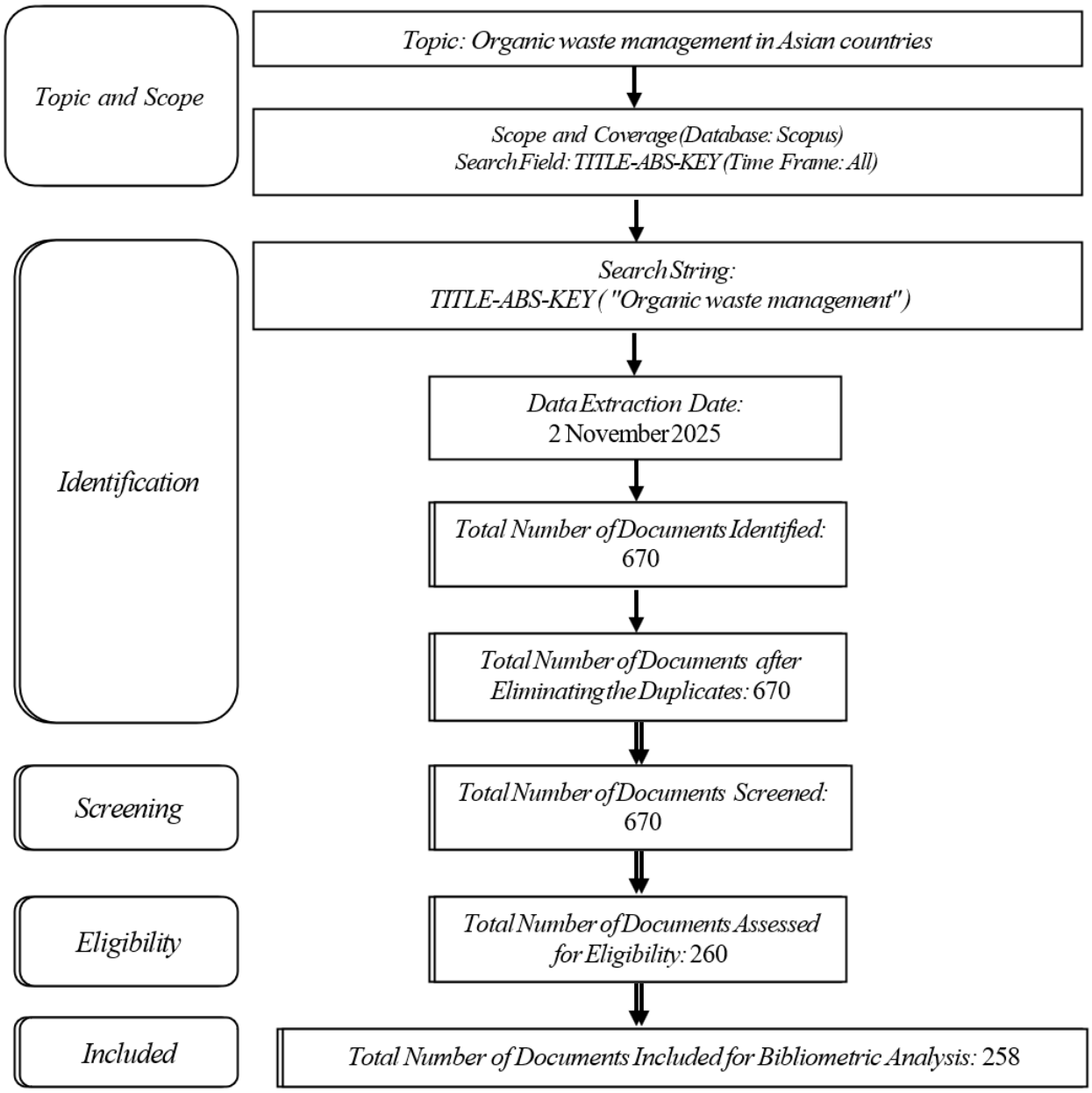

Figure 1.
Methodological process of search, retrieval, and selection of information for the analysis.

2.2. Data Analysis

The data retrieved from the Scopus database were exported in two different formats: CSV (Comma-Separated Values) and RIS (Research Information Systems). The CSV files were processed and analyzed using VOSviewer, while the RIS files were imported into Harzing's Publish or Perish software. Publication and citation trends related to Organic Waste Management in Asian countries were examined based on publication years and the geographical distribution of authors, which were further assessed for research novelty and thematic focus using VOSviewer. Additional analyses were supported by Microsoft Excel and Harzing's Publish or Perish, with the latter used to calculate the h-index, g-index, and various citation metrics, while Excel facilitated further data processing and interpretation.

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3. Results and Discussion

3.1. Research Trend from 1999 - 2025

The publication trend shows a very slow start, with only a single article on organic waste management in Asian countries appearing in 1999. The early 2000s period showed no significant expansion. The trend began to expand after 2010 before it entered a rapid growth phase, which spanned from 2018 to 2022, when sustainable waste technology became popular throughout Asia. The number of research studies about organic waste management in the region reached its highest point during 2024, with 56 published publications (Figure 2).

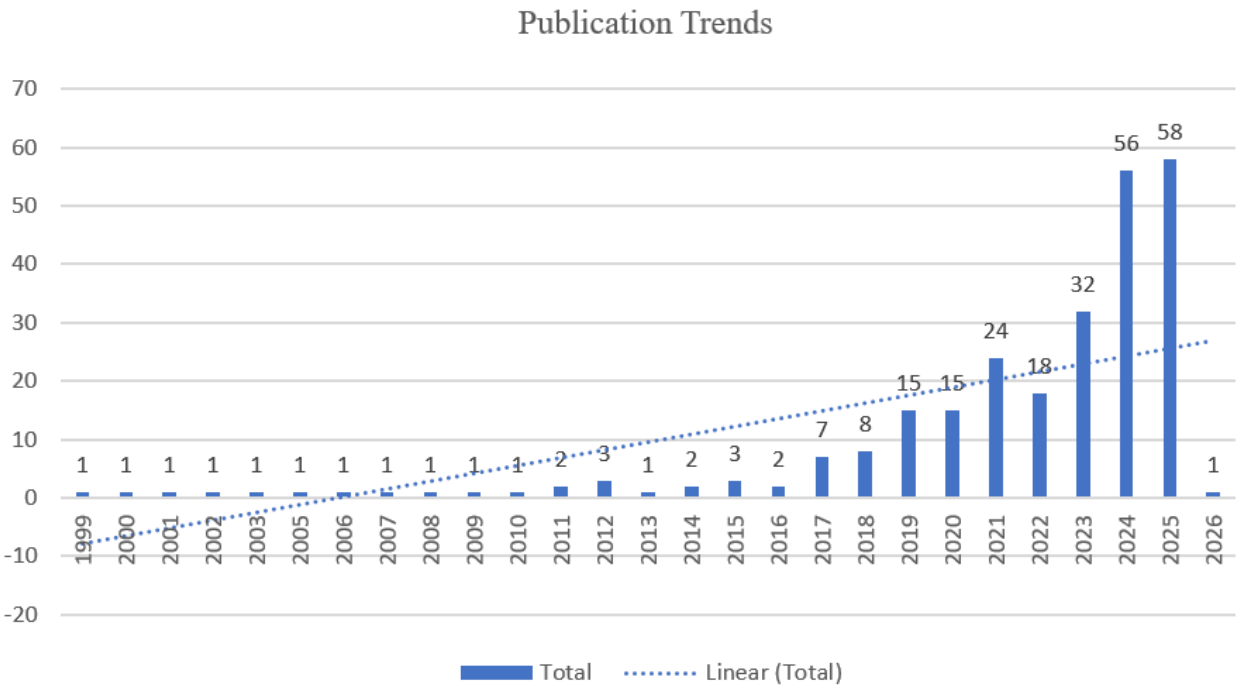

Figure 2.
Organic waste management publication trends in Asian countries

3.2. Country Distribution

Table 1 shows that Asia hosts multiple countries that have published scientific research about organic waste management. The three countries that published the most papers about organic waste management are India, China, and Indonesia. The scientific publications about organic waste management show India as the leading country with 68 papers, followed by China with 54 papers and Indonesia with 50 papers. This dominance can be attributed to several structural factors, such as large population and increasing economic development [23-25]. As the largest producers of organic waste in Asia, these countries face complex waste management challenges that require innovative and sustainable solutions [26, 27]. The high publication rate is also in line with the government's policy of encouraging implementation in waste valorization and bioconversion technology [28-30].

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Table 1.
Asian countries with scientific publications on organic waste management.

Country	Documents
India	68
China	54
Indonesia	50
Malaysia	18
Thailand	15
Japan	13
Pakistan	12
South Korea	11
Saudi Arabia	9
Turkey	8
Bangladesh	5
Nepal	4

Countries like Malaysia, Thailand, Japan, Pakistan, and South Korea also show contributions to scientific publications due to the continuous development of organic waste treatment technology in each country and efforts to implement a circular economy [3-5, 31]. Meanwhile, scientific publications from Saudi Arabia, Turkey, Nepal, and Bangladesh are considered low in number. The limited research activity on organic waste in these countries results from insufficient government investment in organic waste research and management, alongside a deficiency in multidisciplinary collaboration necessary for generating robust scientific publications [32-35].

3.3. Institution Role

The research publications on organic waste management from Asian institutions are presented in Table 2. The institutions that published the most research papers on organic waste management are based in Indonesia, Malaysia, China, and India. Universitas Indonesia leads the list with eight published research papers. Universiti Teknologi Malaysia and Northwest A&F University share second position with seven published papers each. The research results show that universities across Southeast Asia and East Asia have established themselves as the leading centers for the development of organic waste management studies.

Table 2.
Asian institutions are involved in research on organic waste management.

Institution	Country	n
Universitas Indonesia	Indonesia	8
Universiti Teknologi Malaysia	Malaysia	7
Northwest A&F University	China	7
Indian Veterinary Research Institute	India	5
China Agricultural University	China	5
Indian Council of Agricultural Research	India	5
Huazhong Agricultural University	China	5
Institut Teknologi Bandung	Indonesia	5
Badan Riset dan Inovasi Nasional (BRIN)	Indonesia	5
Ministry of Education of the People's Republic of China	China	4
Chinese Academy of Sciences	China	4
Chulalongkorn University	Thailand	4
Karnatak University Dharwad	India	4

Table 2 also demonstrates how institutions across China and India lead the field through their presence of China Agricultural University, Huazhong Agricultural University, the Indian Veterinary Research Institute, and the Indian Council of Agricultural Research. In Indonesia, Institut Teknologi

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Bandung and Badan Riset dan Inovasi Nasional (BRIN) also contribute to organic waste management research. Other institutions, such as Chulalongkorn University in Thailand and Karnatak University Dharwad in India have published four papers. The scientific publications from Asian institutions show their research work about organic waste management. The research about organic waste management in Asia stems from institutions which have strong research capabilities, secure funding, sustainability-focused strategies, and active collaborative research environments.

3.4. Productive Authors

Table 3 shows the authors who have contributed to the largest number of studies on organic waste management. The 1186 authors in the 258 documents were analyzed; researchers from countries with affiliations to institutions in Malaysia and India stood out. Productive authors in this field include Chew Tin Lee, Triveni Dutt, Amandeev Singh, and Rupasa Tiwari. The data reveals interesting patterns among the authors ranked second to fourth in the table. The researchers, namely Triveni Dutt, Amandeev Singh, and Rupasa Tiwari, collaborated on five scientific papers. The authors tend to publish their research collaboratively, linking up with other institutions [36-40]. They published several joint papers on various projects. Their repeated collaborations demonstrate sustained research efforts in a specific subfield.

Table 3.
Asian authors with the highest production of documents on organic waste management.

Author	Affiliation	H Index	Published articles
Lee, C.T.	Universiti Teknologi Malaysia	5	6
Dutt, T.	Indian Veterinary Research Institute	4	5
Singh, A	Veterinary and Animal Sciences University	4	5
Tiwari, R	Indian Veterinary Research Institute	4	5

The organic waste management research field unites scientists from various disciplines because it integrates environmental science with engineering, microbiology, agricultural knowledge, and sustainability expertise. The scientific community follows this pattern because environmental problems require researchers to work together across different fields [41-43]. The Chinese and Indian institutions participate in multiple collaborative projects because their governments back sustainable organic waste management through policy support [44, 45]. This emphasizes a highly integrated collaborative group that regularly engages in and disseminates joint research. Their repeated collaboration across multiple studies demonstrates a stable research partnership, shared expertise, and strong thematic alignment in organic waste management.

3.5. Productive Journal

Table 4 shows the list of the eight most productive journals, among which journals from the United Kingdom stand out, with publications of more than 20 documents.

Table 4.
Productive Journal with the highest production of documents on organic waste management.

Journal	Country	Quartile SJR 2022	Documents
IOP Conference Series: Earth and Environmental Science	United Kingdom	– (No SJR quartile, conference series)	22
Journal of Environmental Management	United States	Q1	7
Journal of Cleaner Production	Netherlands	Q1	7
Lecture Notes in Civil Engineering	Switzerland	– (No quartile/book series)	7
Waste Management	United Kingdom	Q1	6
Sustainability (Switzerland)	Switzerland	Q1	6
Chemical Engineering Transactions	Italy	Q2	5
Waste Management and Research	United Kingdom	Q2	5

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However, the first journal did not have an SJR quartile because it was included in the conference series. The IOP Conference Series: Earth and Environmental Science featured the most publications on organic waste management in Asia, with 22 papers, although without an SJR quartile. In reputable environmental journals in the first quarter (Q1), research topics on organic waste management in Asian countries also received considerable attention. The Journal of Environmental Management, Journal of Cleaner Production, Waste Management, and Sustainability each published 6-7 scientific articles, which demonstrate this trend. The second quarter (Q2) brought out significant research findings through Waste Management and Research and Chemical Engineering Transactions. Also, the Lecture Notes in Civil Engineering book series published several relevant studies, which Scopus indexes as conference papers, although it lacks an SJR quartile.

3.6. Number of Citations

Table 5 presents the most influential research papers that received more than 99 citations. The research community recognizes its significance through this citation pattern. The scientific community devotes most of its research to microbiological waste treatment methods and Black Soldier Fly (*Hermetia illucens*)-based technologies. The 310 citations represent the highest number, which indicates widespread researcher awareness of this topic. Research studies from 2011 to 2012 continue to influence current waste conversion sustainability research because new studies from 2020 to 2022 receive numerous citations.

Table 5.
Articles on organic waste management with the highest number of citations.

Title	Author	Source	Year	Quotes
Microbial diversity of vermicompost bacteria that exhibit useful agricultural traits and waste management potential [46].	Pathma and Sakthivel [46]	SpringerPlus, 1(1), pp. 1–19, 26	2012	310
From organic waste to biodiesel: Black soldier fly, Hermetia illucens, makes it feasible [47].	Li et al. [47]	Fuel, 90(4), pp. 1545–1548	2011	264
Food waste recycling for compost production and its economic and environmental assessment as circular economy indicators of solid waste management M. I [48].	Rashid and Shahzad [48]	Journal of Cleaner Production, 317, 128467	2021	113
A review of organic waste treatment using black soldier fly (Hermetia illucens) [49].	Amrul et al. [49]	Sustainability Switzerland, 14(8), 4565	2022	105
Physiochemical structure of chitin in the developing stages of the black soldier fly [50].	Wang et al. [50]	International Journal of Biological Macromolecules, 149, pp. 901–907	2020	100

Highly cited studies on microbial diversity of vermicompost bacteria and Black Soldier Fly-based biodiesel production underscore the increasing scientific interest in the valorization of biological waste, insect-based bioconversion, and microbial ecology [46, 47, 49]. The consistent citation performance of more recent articles (2020–2022) indicates that the direction of contemporary research, particularly involving the principles of circular economy and BSF larvae, is gaining significant academic traction within the global research community.

3.7. Keyword Co-Occurrence Analysis

The VOSviewer tool performed a keyword co-occurrence analysis to identify the main research concepts related to organic waste management. The 258 retrieved documents contained 798 registered

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keywords, which formed four major clusters through their 102 significant descriptors (Figure 3). In this map, the different colors simply indicate groups of keywords that tend to appear together in the literature. VOSviewer places keywords with strong connections in the same color cluster. As a result:

- The research field focuses on the red cluster, which contains its most common themes that serve as its core subjects.
- The blue cluster contains subjects that maintain their connection to the original topics but focus on detailed technical matters.
- The green cluster shows which sectors are gaining strength because Black Soldier Fly (BSF) bioconversion has emerged as a new interest during the last few years.
- The yellow cluster appears slightly more distant because the keywords are more specialized and do not co-occur as often with the larger themes, not because they are less important.

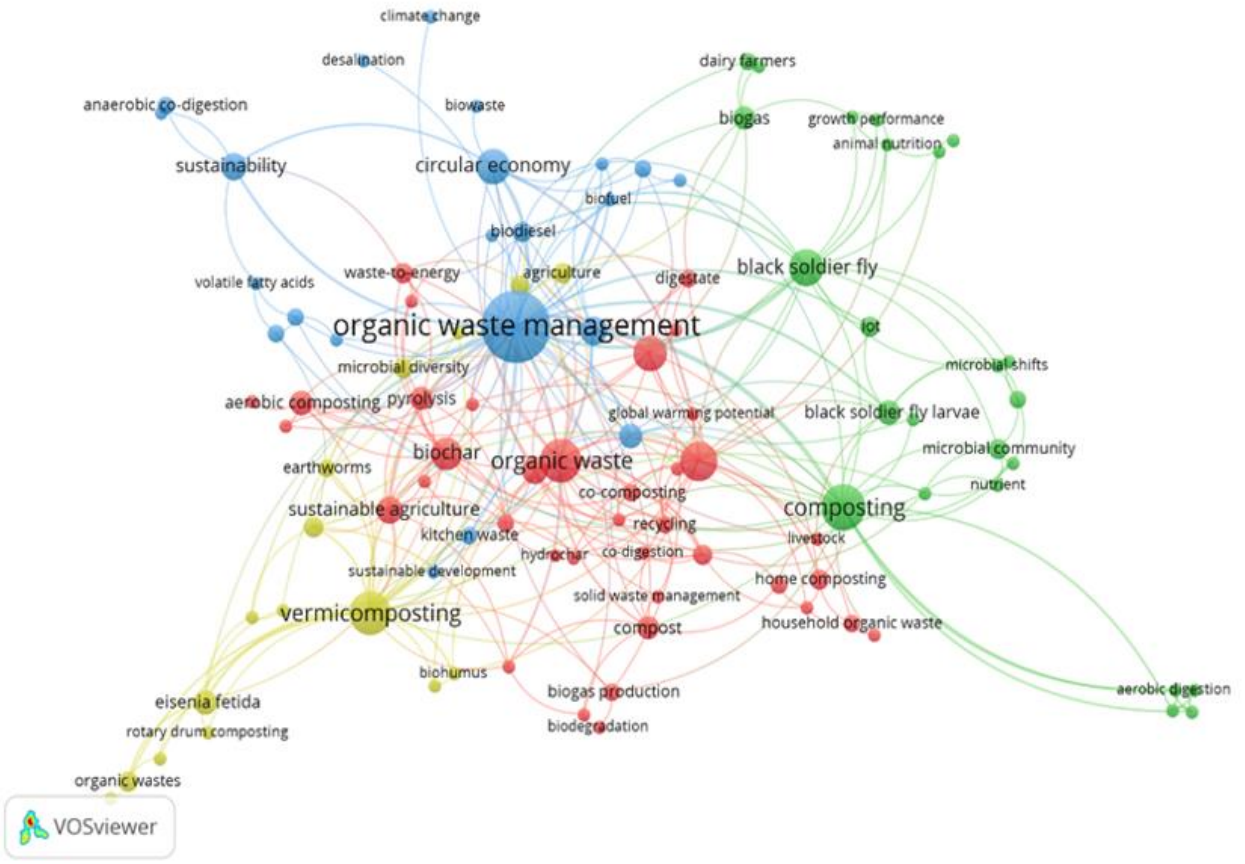

Figure 3.
Co-occurrence of keywords from network visualization to see the research focus.

Figure 3 shows the co-occurrence mapping of keywords forming four main clusters in the study of organic waste management in Asia. Each color reflects the thematic relationships between keywords. The size of the nodes indicates the frequency of term occurrence in the publication. Overall, this network illustrates the evolving knowledge structure from conventional processing approaches, insect bioconversion innovation, circular economy integration, to community-based ecological practices.

Cluster 1 (Red): Conventional Organic Waste Treatment and Material Recovery Approaches

The red cluster contains keywords related to organic waste treatment based on biological and thermo-chemical processes that have been used for a long time. Dominant nodes such as "organic

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waste," "biochar," and "co-composting" are present. Additional keywords include compost, recycling, biogas production, co-digestion, solid waste management, pyrolysis, home composting, and household. This cluster indicates that research on organic waste management still focuses on classic methodologies for handling organic waste. The research emphasizes improving recycling and composting performance, both at the community and household levels, including optimizing aeration, nutrient stability, and the final quality of the product [26, 48, 51, 52]. The integration of biochar and hydrochar shows increasing interest in utilizing pyrolysis and hydrothermal carbonization technologies to improve compost quality, enhance nitrogen retention, and reduce emissions during the decomposition process [26, 53-56]. The keywords "home composting" and "household organic waste" indicate that the research is moving toward a decentralized approach that emphasizes waste reduction at its source [48, 57]. This cluster confirms that the conventional biological approach remains an important foundation in organic waste management, but it is now evolving through the integration of more advanced material recovery technologies such as biochar and hydrochar, thereby expanding the effectiveness and added value of the treatment process.

Cluster 2 (Green): Black Soldier Fly Bioconversion Innovation and Microbial Dynamics

The green cluster is dominated by the keywords "black soldier fly," "black soldier fly larvae," and "composting." Other additional keywords include nutrient, microbial community, microbial shifts, animal nutrition, growth performance, biogas, dairy farmers, and IoT. Insect-based bioconversion technology is a rapidly developing research area in Asia. The connection to microbial community, microbial shifts, and nutrients indicates that the research not only emphasizes waste volume reduction but also explores aspects of frass stabilization, improved nutritional quality, and microbial dynamics during the bioconversion process [28, 49, 50, 58-61]. It's also important to note that the keyword "composting" in the green cluster is different from "compost" and "home composting" in the red cluster. In the green cluster, this term refers more to composting BSF frass, which is the process that follows bioconversion to produce biologically stable fertilizer. Research in this cluster extensively discusses microbial shifts and the enhancement of frass's agronomic value during the advanced composting process [62, 63]. The relationship among BSF with dairy farmers, animal nutrition, and growth performance shows that BSF serves as a sustainable protein and nutrient source for livestock in circular agricultural systems [64, 65]. The term "biogas" is categorized within the green cluster. This subject has been integrated with studies on black soldier flies because of the prospective utilization of digestate from anaerobic digestion as a nutritional medium for cultivating black soldier fly larvae, which are then converted into biodiesel [47]. The green cluster shows progress toward insect-based bioconversion technologies, which apply biological methods for executing complex and unified operations.

Cluster 3 (Blue): Circular Economy, Sustainability, and Waste-to-Energy Transformation

The blue cluster features keywords representing a systemic approach to organic waste management within the framework of a circular economy and sustainability. Major nodes such as organic waste management, circular economy, and sustainability are the focal point of a broad keyword relationship, supported by nodes like biowaste, waste-to-energy, biodiesel, biofuel, volatile fatty acids, anaerobic co-digestion, and climate change. Studies in this cluster view organic waste management as part of energy transition and climate change mitigation strategies [66, 67]. The research in this cluster shows that organic waste can be a recoverable resource converted into energy carriers through biogas, biodiesel, and biofuel production [68-70]. The combination of volatile fatty acids with anaerobic co-digestion demonstrates how biochemical conversion methods boost energy production while making the system more efficient [71, 72]. Asian countries are now focusing on resource recovery and valorization methods for biowaste management as they adopt circular-economy principles [73, 74].

Cluster 4 (Yellow): Vermicomposting and Its Role in Agriculture

The yellow cluster represents vermicomposting as the dominant keyword. Other keywords, such as *Eisenia fetida*, earthworms, biohumus, sustainable agriculture, sustainable development, and rotary drum composting, indicate that research in this cluster assesses the effectiveness of vermicomposting as an environmentally friendly and easily adopted decomposition method [46, 75]. Studies in this cluster

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evaluate the quality of vermicompost, nutrient stability, and the role of biohumus in improving soil productivity. Some studies also compare vermicomposting with mechanical composting systems, such as rotary drum composting, to examine differences in degradation rates and scalability potential in the context of sustainable agriculture. The presence of the keywords "sustainable agriculture" and "sustainable development" indicates that the approach in this cluster is not only technical but also closely related to community empowerment [76, 77].

These four clusters form a complementary research landscape. The red cluster confirms the foundations of conventional biological processing; the green cluster highlights increasingly prominent insect-based bioconversion innovations; the blue cluster broadens perspectives toward a circular economy and energy recovery; and the yellow cluster emphasizes vermicomposting as a practical, inexpensive, and readily adopted approach to organic waste management. The relationships among major nodes such as organic waste management, biochar, compost, black soldier fly, and the circular economy indicate that research in Asia is increasingly moving toward an integrative, multidisciplinary, and resource-recovery-oriented model of organic waste management. This reflects a scientific and policy commitment to developing processing systems that are not only effective but also support long-term economic and environmental sustainability.

3.8. Keyword Occurrence Network Analysis

The VOSviewer visualization overlay in Figure 4 demonstrates the development of research themes across different time periods. The map contains author keywords as nodes, with their average publication year displayed by color. The research themes from previous periods appear in blue and green nodes, but yellow nodes show both new and recently popular scientific topics. The research field has recently focused on microbial shift and microbial community.

The overlay visualization in Figure 4 illustrates the dynamics of the development of the research theme of organic waste management in Asia in recent years, indicated by the color change from blue to green to yellow. In the initial phase (2018–2019), blue nodes marked the dominance of classic topics such as composting, vermicomposting, anaerobic digestion, biogas production, and digestate. This topic has long been a cornerstone of organic waste processing research, indicating that it was a well-established field of study long before new bioconversion technologies emerged [78-80]. Aerobic decomposition-based methods utilizing microbes and soil organisms, namely composting and vermicomposting, have emerged as a primary area of study in the early period due to their ease of application across household and community contexts [78, 81].

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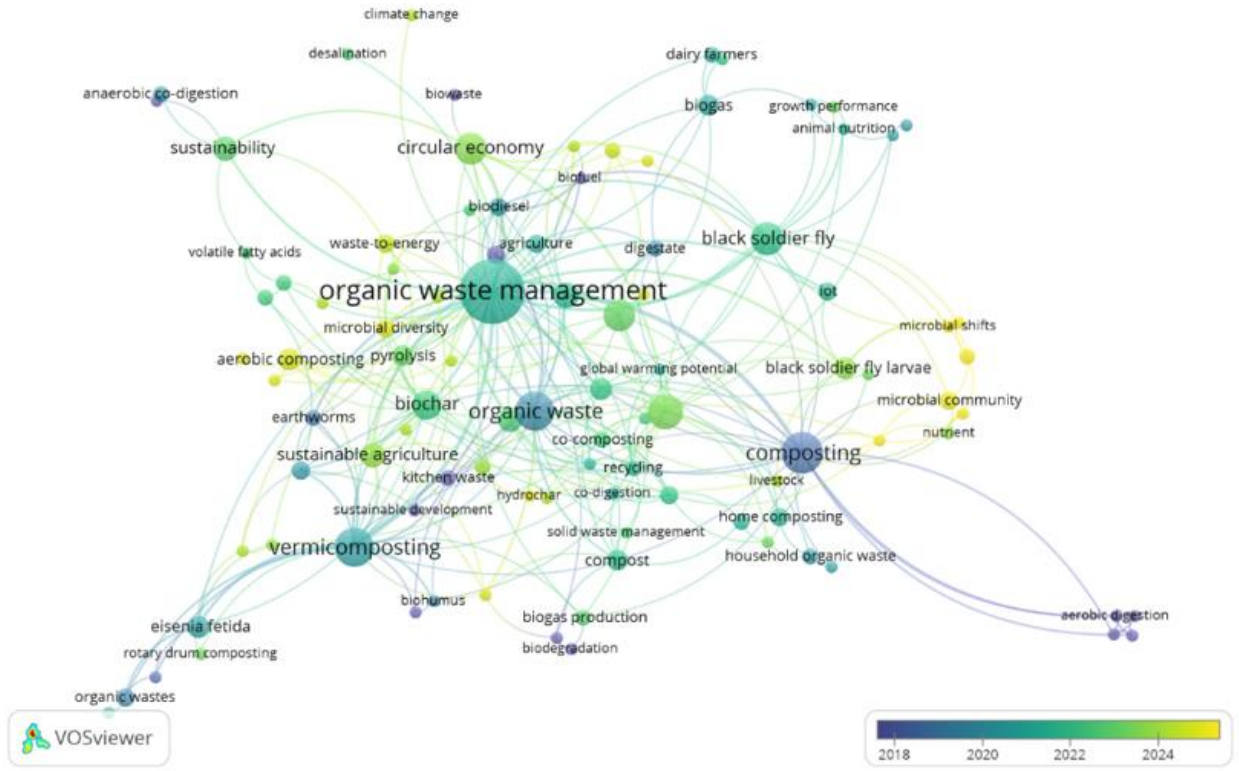

Figure 4.
Visualization of the keyword occurrence network.

The network color transitioned to light green during 2019–2021 because scientists began working on circular economy and energy recovery research. Researchers started exploring circular economy, biochar, hydrochar, pyrolysis, and waste-to-energy technologies to reduce landfill use and establish a circular economy [53, 82, 83]. This shift led the scientific community to view waste as a valuable resource.

The bright green color in the graph indicates the development of a new cluster from 2021 through 2023, driven by the Black Soldier Fly (BSF) bioconversion theme. The research emphasizes Black Soldier Fly, Black Soldier Fly larvae, their growth performance, and nutritional value for animals, while exploring concepts related to nutrient recovery, feed production, and agricultural system integration. The increasing popularity of BSF results from its unique advantages, which surpass conventional waste reduction methods through efficient waste mass reduction, flexible waste processing, and dual product generation of protein-rich larvae and organic fertilizer from frass. This rise is also attributed to several advantages of BSF that are difficult to match by conventional methods, including high efficiency in waste mass reduction, the ability to process various types of organic waste, and the potential to produce two economically valuable products: larvae as a protein source and frass as organic fertilizer. Some studies demonstrate that BSF can convert organic waste into useful biomass more efficiently than traditional biological methods such as composting and anaerobic digestion [36, 49].

This time marks a significant change from the "waste treatment" model to the "waste valorization" model, which uses insects to turn waste into something useful. The shift from the "waste treatment" paradigm toward "waste valorization" through insect-based bioconversion is evident. Overall, the dominance of BSF keywords in the overlay in Figure 4 confirms that insect bioconversion has become a key pillar of organic waste management research. Several studies have shown that BSF is not only capable of rapidly reducing waste volume but also produces economically valuable biomass through the

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production of larvae and frass [84, 85]. In various countries, BSF is increasingly regarded as a key technology that can bridge the needs for waste reduction, nutrient recovery, and the development of value-added products, making it highly relevant for implementation within a circular economy framework [14, 49]. The latest publication trends also show an increase in research intensity on microbiological aspects, their potential as biofuels, and the development of their production for a circular bioeconomy. This indicates that this cluster is developing most rapidly and is expected to remain a major research focus in the coming years [86-89].

The 2023–2024 research map shows its most recent phase through the numerous bright yellow nodes. The nodes contain microbial shifts and microbial communities. Recent studies increasingly integrate microbial process analysis with insect-based bioconversion and compost biochemistry, including work on lignocellulose-degrading inocula that enhance the breakdown of complex plant materials during composting [90]. This integrated approach reflects a broader shift toward developing waste treatment systems that operate more efficiently, remain microbiologically stable, and produce higher-quality end products [55, 90].

The evolution of themes in Figure 4 shows a consistent shift: starting from classic topics based on aerobic composition and decomposition (2018–2019), then moving toward waste utilization within a circular economy framework (2019–2021), followed by a surge in research interest in BSF-based bioconversion (2021–2023), and finally entering a more modern and mechanistic microbiological research phase (2023–2024). This pattern indicates that the field of organic waste management is evolving from an orthodox approach toward a more integrated, resource recovery-oriented, and increasingly aligned scientific approach, in line with long-term sustainability agendas [41-43].

4. Conclusions

The analysis of 258 Scopus-indexed publications on organic waste management in Asia from 1999 to 2025 shows how rapidly this research area has grown and how diverse it has become. Most studies come from India, China, and Indonesia, as countries that face major waste challenges and therefore invest heavily in research and innovation. The production of knowledge and research collaborations between nations depends on their leading universities and research institutes, which operate across these countries. The authors continue their research partnership through their shared projects, which advance the field of study.

Multiple research studies published in Q1 journals demonstrate a rising worldwide academic interest in this subject area. The keyword mapping indicates that researchers have focused their studies on four distinct scientific domains. The first section examines traditional methods, including composting and co-composting, biogas production, and the increasing adoption of biochar and hydrochar to enhance decomposition outcomes. The second cluster highlights how Black Soldier Fly (BSF) technology has developed through scientific studies of microbial communities present in bioconversion systems. The third cluster investigates organic waste by analyzing its relationship to circular-economy principles, waste-to-energy conversion, and strategies for climate-change mitigation. The fourth approach integrates vermicomposting with community-based practices, establishing ecological knowledge connections to meet the needs of local community members.

The overlay visualization shows the historical development of these themes throughout time. Earlier research focused on three waste management methods: conventional composting, vermicomposting, and anaerobic digestion. The research applied circular economy principles to study biochar, hydrochar, and waste-to-energy conversion methods. The BSF bioconversion process began to grow rapidly in 2021, leading to a shift in waste management from basic treatment to productive product generation. Scientists studied organic waste treatment systems from 2023 to 2024 to understand microbial behavior, while now they focus on biological processes to develop efficient, sustainable waste management systems. The research findings from this study will help researchers, policymakers, and practitioners identify new research directions and establish partnerships that will lead to sustainable waste management systems across Asia.

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The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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