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Research Article

Circular Economics In Organic Waste Management Based On Maggot BSF : Bibliometric Analysis.

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Abstract

This study aims to analyze and present the latest developments in managing larvae-based organic waste Hermetia illucens (Maggot BSF) within a circular economy framework. Using bibliometric analysis methods with data from Scopus for 2019- 2024 with 254 journal publications, this study details scientific publication trends, conceptual thinking, and innovations related to the use of Maggot BSF in managing organic waste. Three analyses were conducted to explore the most significant publications through citation analysis, map knowledge structures through co-citation analysis, and predict future trends through co-word analysis. The findings showed four clusters in the co-citation analysis and four clusters in the co-word analysis. The theoretical implications of these results could help stakeholders design more effective waste management policies and practices based on a circular economy approach.

Keywords : Circular Economy, Organic Waste, Maggot BSF, Sustainability in Waste Management.

INTRODUCTION

Organic waste management is a serious challenge faced by the global community in the 21st century (Cook et al., 2023; Pajura et al., 2023; Salman et al.,2023). With rapid population growth and continued urbanization, organic waste production is increasing, negatively impacting the environment and human health (Al-Hameedi et al., 2019; Banks et al., 2014; Cook et al., 2023; Sykes et al., 2007; Truzzi et al., 2020). In the face of this problem, the circular economy emerged as a promising solution. This concept carries the idea of reducing waste by reusing it in the economic cycle, creating a sustainable and environmentally friendly system (Taffuri et al., 2021; Tuni et al., 2023).

One of the latest innovations in Circular Economy- based organic waste management is using black soldier fly (BSF) larvae as organic waste decomposition agents (Broeckx et al., 2021; Bui et al., 2020; Kavals & Gusca, 2021; Klammsteiner et al., 2020; Pajura et al., 2023; Sayadi-Gmada et al., 2019). Black soldier flies are known to convert organic waste effectively into pupae and pupae into pupae that can be used as animal feed or other industrial raw materials. Recent studies try to combine the concept of Circular Economy with the biological benefits of BSF larvae to optimize organic waste management (Akram et al., 2019; Fernando□foncillas et al., 2021; Klammsteiner et al., 2020; Li et al., 2011; Pajura et al., 2023; Tanga et al., 2021).

This research focuses on bibliometric analysis using Scopus data from 2019 to 2024 to present a comprehensive picture of research trends related to the Circular Economy in BSF larva-based organic waste management. Bibliometrics is a quantitative approach used to analyze scientific publications in a field of research. By detailing and identifying research trends, most relevant topics, and key contributors in this field, bibliometric analysis can provide valuable insights for further development in Circular Economy-based organic waste management (Bui et al., 2020; Gitelman et al., 2019; Romero-Silva & de Leeuw, 2021; Shishehgarkhaneh et al., 2023).

Context Organic waste issues include various organic matter, such as food scraps, agricultural residues, and green waste (Abro et al., 2020; Cheng et al., 2017; DiGiacomo & Leury, 2019; Moruzzo et al., 2021; Stenberg et al., 2019; Tschirner & Simon, 2015). The main problem faced by modern society is the effective way to manage this organic waste without causing adverse environmental impacts. Decomposition of organic waste using BSF larvae has become a major focus in recent years, as these flies can convert organic waste into

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valuable resources (Banks et al., 2014; Liu et al., 2017).

Circular Eco Economy fers aholistic approach to addressing the problem of organic waste by shifting the paradigm from linear thinking to a closed cycle (Bava et al., 2019; Salomone et al., 2017; Zheng, Hou, et al., 2012). In this context, the concept of Circular Economy aims to maximize the reuse of organic waste as a reusable resource, reduce the waste generated, and create a more sustainable environment (Cheng et al., 2017; Liu et al., 2017; Miranda et al., 2019; Salomone et al., 2017; Tomberlin et al., 2009; Van Huis, 2013).

This research is significant in organic waste management and implementing the Circular Economy [15], [29]–[32]. Through bibliometric analysis, we can identify recent research trends, understand methodological developments, and assess the impact of scientific publications in this field. This helps researchers develop more effective research plans and guides stakeholders, government, and industry to take more targeted steps in implementing a circular economy in organic waste management (Bava et al., 2019; Salomone et al., 2017).

The main objective of this study is to provide a deep understanding of the development of research related to Circular Economy in BSF larva-based organic waste management (Abd El-Hack et al., 2020; Surendra et al., 2016; Zotte et al., 2019). The study will conduct a bibliometric analysis using Scopus data from 2019 to 2024 to achieve this goal. The analysis includes identifying this field's most influential research, trends, and major contributors. The implications of these findings could help governments, industry, and communities develop supportive policies, adopt these technologies more broadly, and raise awareness of the importance of sustainable organic waste management (Diener et al., 2009; Li et al., 2011; Surendra et al., 2016).

With global problems related to organic waste increasingly urgent, developing innovative approaches such as the Circular Economy in BSF larva- based organic waste management is becoming increasingly important (Berbel et al., 2023; Fassio & Minotti, 2019; Kuan et al., 2022; Kyriakopoulos et al., 2019). The research is expected to provide deep insight into research trends related to this topic, contribute significantly to further development in this field, and guide public policy and industry practitioners to adopt sustainable solutions. By involving bibliometric analysis, this research is expected to contribute to global efforts to achieve more sustainable and environmentally friendly organic waste management (Shishehgarkhaneh et al., 2023).

MATERIAL AND METHOD

Data collection techniques

The search string and related keywords and terminology expanded to include all studies currently used in this study are presented in **Table 1**. The search is not limited to journal publications but to conference proceedings, magazines, books, and book chapters to ensure quality and peer-reviewed publications are included. In addition, the review includes all overall publications. Scopus data notes that there will be related research until 2024.

Table 1: Search string in Scopus database.

No	Keywords	Justification
1	("Circular Economy" OR "Bioeconomic*" OR "Product Lifecycle" OR "Sustainable Products" OR "Ecodesign" OR "Eco innovation" OR "Waste Management" OR "Environmental Economic*" OR "Service Ecosystem*")	To identify literature related Circular Economy Organic Waste
2	("Maggot" OR "Hermetia illucens" OR "Entomotecnology" OR "Larva")	To identify literature related the Maggot
3	("Organic "Green Waste" OR Waste" OR "Biomass" OR "Biowaste," OR "Compostable Waste" OR "Food Scraps" OR "Plant Residue")	To identify literature related to Organic Waste

Data Analysis

This study used bibliometric analysis methods with data from Scopus in 2019-2024 with 254 journal publications. Scopus is a multidisciplinary scientific database providing information on research articles, conferences, and other scientific literature. This database includes leading and quality scientific data worldwide, allowing researchers to access relevant and up-to-date scientific literature and providing comprehensive indexation, including citations, indexing references, and information on the impact of a work. Scopus helps researchers monitor trends, track research progress, and increase visibility and recognition within the global scientific community. VOS viewer (V1.6.17) is a network analysis and data visualization software used to identify relationship patterns and clusters in complex datasets to help researchers understand the structure and relationships between elements in data. Through intuitive visualization techniques, VOS Viewer is related Circular Economyconsidered the best software for providing a scientific Organic Waste network of research literature based on a quantitative database approach (Raboaca et al., 2021), allowing users to effectively present and explore information, facilitating understanding and decision-making based on patterns found in their data.

Bibliometrics comprise several analyses suitable to its intended objective. This study adopts three bibliometric

analyses in tandem with the objectives outlined:

1. Citation analysis: This analysis evaluates cited articles by measuring the number of citations a publication receives. Citation analysis is crucial in mapping knowledge structures to identify quality contributions in specific areas (Sood et al., 2021). The analysis includes institutional co-authorship networks and country co-authorship networks to identify the influence of institutions and states in circular economic studies (Reyes-Gonzalez et al.,2016).
2. Co-citation: Co-citation facilitates the exploration of intellectual relationships between scientific disciplines based on influential documents (Hota et al., 2020). This method is based on the citation frequency that two documents from earlier works are cited together in a later work (Small, 1973). The assumption is that the more highly two documents are cited together, the more highly they are related and considered part of the same research field (McCain, 1990).
3. Co-word analysis: The network of co-word analysis extracts the keywords from the title, abstract, and keywords of a publication (van Eck & Waltman, 2014). It searches for the connection between concepts that co-occur within the keywords. The strength of the co-word analysis is that it can produce the meaning of a field structure, thus predicting future trends (Bernatovic et al., 2021). Among all the bibliometric approaches, co-word is the only analysis that applies the real content to produce measurement similarity (Zupic & Cater, 2015)

This study has five stages: keyword determination, data search, article selection, data validation, and data analysis.

RESULTS AND DISCUSSION

Trends in publication and descriptive analysis

Based on the Scopus database, this study (N = 254) was cited 5,768 times, with the average number of citations per item being 198.9. These 254 papers show growing interest among academics in higher education institutions. The first publication appeared in 2019, and since then, it has grown exponentially, with a total of 254 publications in 2024. The quantity of scientific work addressed will increase in the coming years.

Based on Vosviewer's analysis, it is known that the most cited publication material is in **Table 3**. Three publications have the most citations Čičková H.; Newton G.L.; Lacy R.C.; Kozánek M., "Čičková, Helena (347 Citation), Surendra K.C.; Olivier R.; Tomberlin J.K.; Jha R.; Khanal S.K., "Surendra, K.C. (273 Citation), dan Gold M.; Tomberlin J.K.; Diener S.; Zurbrügg C.; Mathys A., "Gold, Moritz (241 Citation).

Table 3.

No	Author	Topic	Citation
1	(C. H. Lalander et al., 2015)	The use of fly larvae for organic wastetreatment	347
2	(Surendra et al., 2016)	Bioconversion of organic wastes into biodiesel and animal feed viainsect farming	273
3	(Gold et al., 2018)	Decomposition of biowaste macronutrients, microbes, and chemicals in black soldier fly larval treatment: A review	241
4	Rehman K.U.; Rehman A.; Cai M.; Zheng L.; Xiao X.; Somroo A.A.; Wang H.; Li W.; Yu Z.;Zhang J.,"Rehman, Kashif ur(2017)	Conversion of mixtures of dairy manure and soybean curd residue by black soldier fly larvae (Hermetia illucens L.)	176
5	Shumo M.; Osuga I.M.; Khamis F.M.; Tanga C.M.; Fiaboe K.K.M.; Subramanian S.; Ekesi S.; van Huis A.;Borgemeister C.,"Shumo, Marwa (2019)	The nutritive value of black soldier fly larvae reared on common organic waste streams in Kenya	173
6	Surendra K.C.; Tomberlin J.K.; van Huis A.; Cammack J.A.; Heckmann L.- H.L.; Khanal S.K.,"Surendra,K.C. (2020)	Rethinking organic wastes bioconversion: Evaluating the potential of the black soldier fly (Hermetia illucens (L.)) (Diptera: Stratiomyidae) (BSF)	145
7	Rehman K.U.; Cai M.; Xiao X.; Zheng L.; Wang H.; Soomro A.A.; Zhou Y.; Li W.; Yu Z.; Zhang J.,"Rehman, Kashif ur (2017)	Cellulose decomposition and larval biomass production from the co-digestion of dairy manure and chicken manure by mini- livestock (Hermetia illucens L.)	139
8	Gold M.; Cassar C.M.; Zurbrügg C.; Kreuzer M.; Boulos S.; Diener S.; Mathys A.,"Gold, Moritz (56675245900)	Biowaste treatment with black soldier fly larvae: Increasing performance through the formulation of biowastes based on protein and carbohydrates	138

9	Gao Z.; Wang W.; Lu X.; Zhu F.; Liu W.; Wang X.; Lei C.,"Gao, Zhenghui (2019)	Bioconversion performance and life table of black soldier fly (Hermetia illucens) on fermented maize straw	104
10	Scala A.; Cammack J.A.; Salvia R.; Scieuzo C.; Franco A.; Bufo S.A.; Tomberlin J.K.; Falabella P.,"Scala, Andrea (2021)	Hermetia illucens (L.) (diptera: Stratiomyidae) odorant binding proteins and their interactions with selected volatile organic compounds: An in silico approach	91

Citation and Co-citation Analysis

The citation and co-citation threshold is set at 45, bringing the total number of cited references to 60. The following describes each cluster and its labels based on a shared citation analysis, showing four clusters in a co-citation analysis. A cluster represents a collection of items (**Table 2**)

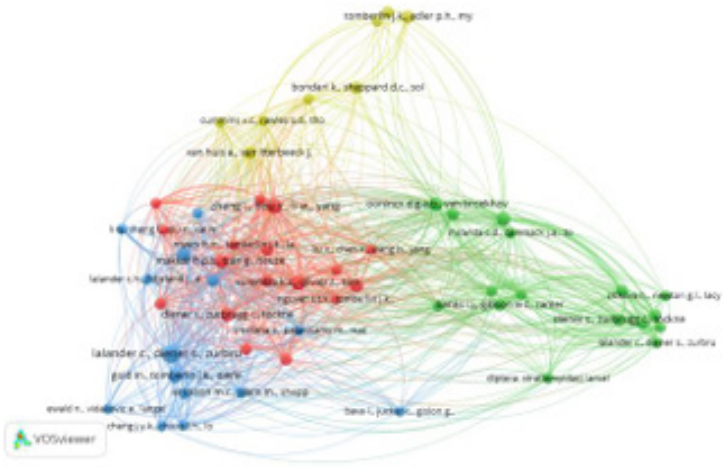
Table 2: Top 10 documents with the highest co-citation and total link strength.

No	Document	Citation	Total link strength
1	Gold M.; Tomberlin J.K.; Diener S.; Zurbrügg C.; Mathys A.,"Gold, Moritz (56675245900)	241	57
2	Rehman K.U.; Rehman A.; Cai M.; Zheng L.; Xiao X.; Somroo A.A.; Wang H.; Li W.; Yu Z.; Zhang J.,"Rehman, Kashif ur (57193688359)	176	43
3	Rehman K.U.; Cai M.; Xiao X.; Zheng L.; Wang H.; Soomro A.A.; Zhou Y.; Li W.; Yu Z.; Zhang J.,"Rehman, Kashif ur (57193688359)	139	30
4	Gold M.; Cassar C.M.; Zurbrügg C.; Kreuzer M.; Boulos S.; Diener S.; Mathys A.,"Gold, Moritz (56675245900)	138	29
5	Čičková H.; Newton G.L.; Lacy R.C.; Kozánek M.,"Čičková, Helena (54974002500)	347	28
6	Scala A.; Cammack J.A.; Salvia R.; Scieuzo C.; Franco A.; Bufo S.A.; Tomberlin J.K.; Falabella P.,"Scala, Andrea (56681838400)	91	26
7	Gao Z.; Wang W.; Lu X.; Zhu F.; Liu W.; Wang X.; Lei C.,"Gao, Zhenghui (57208737963)	104	25
8	Surendra K.C.; Tomberlin J.K.; van Huis A.; Cammack J.A.; Heckmann L.-H.L.; Khanal S.K.,"Surendra, K.C. (54682303700) (Surendra et al., 2016)	145	21
9	Shumo M.; Osuga I.M.; Khamis F.M.; Tanga C.M.; Fiaboe K.K.M.; Subramanian S.; Ekesi S.; van Huis A.; Borgemeister C.,"Shumo, Marwa (57194228954) (Chineme et al., 2022)	173	21
10	Surendra K.C.; Olivier R.; Tomberlin J.K.; Jha R.; Khanal S.K.,"Surendra, K.C. (54682303700) (Surendra et al., 2016)	273	21

Source: Author interpretation based on VOS viewer analysis

Meanwhile, the results of network visualization (**Figure 1**) explain that there are four different clusters. Each cluster has its characteristics and interpretations.

Figure 1



Cluster 1 (red) consists of 17 publications labelled as "Entomfeed: Insect-Based Bioconversion". Recent research has shown significant advancements in using insects as animal feed and in converting organic wastes into biodiesel and animal feed through insect farming. Insects have become a primary focus in related research due to their potential to address global agriculture and waste management challenges. As animal feed, insects offer a sustainable alternative and have the potential to alleviate pressure on limited natural resources. In recent years, research has highlighted various insect species that can be developed as animal feed, including black soldier fly larvae, which can convert organic waste into nutritious feed sources.

Additionally, through bioconversion, insects can convert organic waste into biodiesel, which can serve as an environmentally friendly alternative fuel. The significance of this research lies in the ability of insects to convert organic waste into valuable products in terms of nutrition and energy. The insect-based approach to converting organic waste into useful resources is a tangible example of efforts to apply circular and sustainable economic principles in agricultural practices and waste management. However, despite progress made in this field, there are still challenges to overcome, including technical, economic, and regulatory aspects. Therefore, further research is needed to expand our understanding of the potential of using insects as animal feed and alternative energy sources through organic waste conversion. By continuing to drive innovation and interdisciplinary collaboration, this research is hoped to help advance the agricultural industry and waste management in a more sustainable and environmentally friendly direction.

Cluster 2 (green) consists of 16 publications labelled as "Insect Diet". The research delves into various aspects of utilizing insect species, particularly the black soldier fly (Hermetia illucens), to convert food by-products and human waste into valuable biomass. The study examines the effects of diet composition, specifically protein and carbohydrate content, on the growth, survival, and development of four insect species, including the black soldier fly. Firstly, the investigation focuses on feed conversion efficiency, survival rates, and developmental progress of the insect species when fed diets comprising food by-products. It evaluates how protein and carbohydrate content variations impact these life-history traits, shedding light on the optimal nutritional requirements for efficient biomass production.

Furthermore, the study explores the potential of black soldier fly larvae in waste management by analyzing their growth rates when fed fresh human faces. This aspect highlights the insect's capability to convert organic waste, potentially contributing to sanitation improvement efforts. By assessing the growth performance of larvae on human waste, the research underscores the practical implications of utilizing black soldier flies in waste treatment systems, offering a sustainable solution for sanitation challenges.

Cluster 3 (blue) consists of 14 publications labeled "Feedstock influence on black soldier fly larvae and waste treatment efficiency." This study aimed to evaluate the effects of feedstock on larval development and process efficiency in waste treatment using black soldier fly (Hermetia illucens). The use of fly larvae for organic waste treatment has been an intriguing research topic due to their potential to convert waste into a source of energy and organic fertilizer. In this study, the growth rates of black soldier fly larvae were analyzed when fed with fresh human faces to improve sanitation. The study's results indicated that the feedstock type significantly influenced larval development and process efficiency. Larvae fed various types of organic waste exhibited different growth patterns, with some feedstocks producing larger and faster-developing larvae.

Additionally, using black soldier fly larvae to process fresh human faces showed potential for improving sanitation. The rapid larval growth and effective consumption of organic waste indicated that these larvae could be used as efficient waste treatment and sanitation improvement tools. These findings provide valuable insights for developing more efficient and sustainable organic waste treatment methods using black soldier fly larvae. By understanding the effects of feedstock on larval development and processing, researchers can optimize the use of these larvae in practical applications such as household waste treatment, agriculture, and industry. Furthermore, the study highlights the importance of considering the natural resources used in waste treatment processes to ensure environmental sustainability.

Cluster 4 (yellow) consists of 4 publications labeled "Insects as Feed and Food Security." This research explores the potential use of soldier fly larvae (Diptera: Stratiomyidae) as feed in commercial fish production and their temperature-dependent development. Food security is a pressing global issue that requires urgent attention, and using insects as a food and feed source has garnered interest as a sustainable alternative. The black soldier fly has been identified as one of the insects suitable for this purpose. The study aims to understand how temperature affects the development of black soldier fly larvae and their nutritional suitability as fish feed. The research identifies the relationship between temperature and larval development through empirical data and experimental methods, crucial for optimizing larval production as fish feed. Findings indicate that temperature influences larvae growth rate and development, which must be considered in mass cultivation practices.

Additionally, nutritional analysis of soldier fly larvae demonstrates their potential as a high-quality feed source for commercial fish. Implications of this research include practical

applications in agriculture, fisheries, and overall food security. By harnessing insects as feed and food, sustainable food and feed sources can diversify, contributing to global efforts to achieve enhanced food security.

Discussion

The concept of circular economics in organic waste management, particularly focusing on the Black Soldier Fly (BSF) larvae, presents a promising avenue for sustainable resource utilization and environmental conservation. This bibliometric analysis delves into the existing literature surrounding this innovative approach, shedding light on its evolution, current state, and prospects.

Organic waste management is a pressing global challenge exacerbated by rapid urbanization and population growth. Traditional waste management practices, such as landfilling and incineration, contribute to pollution, greenhouse gas emissions, and resource depletion. In contrast, circular economics principles advocate for a regenerative approach where waste is viewed as a valuable resource.

The Black Soldier Fly, scientifically known as Hermetia illucens, has emerged as a key player in organic waste management due to its remarkable ability to convert organic matter into high-quality protein and fat-rich biomass. This process, known as bioconversion, reduces waste volume and generates valuable by-products suitable for various applications, including animal feed, biofuels, and fertilizer.

The bibliometric analysis reveals a growing interest in the potential of BSF-based organic waste management solutions over the past decade. Researchers from diverse disciplines, including environmental science, biology, engineering, and economics, have contributed to this topic's body of knowledge. Key themes identified in the literature include optimizing BSF-rearing techniques, valorizing BSF-derived products, and the environmental and economic implications of BSF-based waste management systems.

Studies highlight the efficiency of BSF larvae in degrading a wide range of organic substrates, including food waste, manure, and sewage sludge. Moreover, researchers have explored various factors influencing BSF growth and development, such as temperature, moisture content, and substrate composition, to enhance bioconversion efficiency. Additionally, advancements in biotechnology have facilitated the genetic modification of BSF strains to improve desired traits, such as faster growth rates and higher nutrient content.

Furthermore, the bibliometric analysis underscores the importance of assessing BSF-based waste management systems' environmental sustainability and economic viability. Life cycle assessments and techno-economic analyses have been conducted to evaluate the environmental impacts, energy requirements, and cost-effectiveness of implementing BSF larvae in waste treatment facilities. Findings suggest that BSF bioconversion can significantly reduce greenhouse gas emissions, energy consumption, and waste disposal costs compared to conventional methods.

However, challenges still need to be solved in scaling up BSF-based waste management practices to meet the demands of large-scale urban environments. Regulatory barriers, public perception, and infrastructure limitations hinder widespread adoption. Additionally, further research is needed to address concerns regarding the potential spread of pathogens and contaminants through BSF-derived products intended for human or animal consumption.

Implication

Circular economics in organic waste management, particularly focusing on using maggots from the Black Soldier Fly (BSF), represents a burgeoning field of research with promising implications for sustainable resource utilization. This bibliometric analysis delves into the scholarly landscape surrounding this topic to discern trends, identify key research areas, and highlight future directions.

The concept of circular economics revolves around closing the loop of resource consumption, waste generation, and resource regeneration. Organic waste, a significant component of global waste streams, presents challenges and opportunities in this context. Traditional waste management practices often involve landfilling or incineration, which are environmentally detrimental and fail to harness the potential value inherent in organic waste.

Enter the Black Soldier Fly (BSF), a remarkable insect capable of efficiently converting organic waste into high-quality protein and fat through its larvae, called grubs. Using BSF larvae in organic waste management aligns with the principles of circular economics by transforming waste into valuable resources while minimizing environmental impact.

A bibliometric analysis provides valuable insights into this field's evolution and current state of research. By systematically analyzing scholarly publications, citation patterns, and collaboration networks, we can discern the trajectory of research, identify influential studies and authors, and uncover emerging themes and gaps in knowledge.

Our analysis reveals a growing interest in applying BSF larvae in organic waste management, reflected in an increasing number of publications over the past decade. Research on this topic spans various disciplines, including environmental science, agriculture, entomology, and waste management, underscoring its interdisciplinary nature.

CONCLUSIONS

In recent years, circular economics, particularly in organic waste management utilizing the Black Soldier Fly (BSF), has emerged as a critical study area. This bibliometric analysis

aims to provide a comprehensive overview of the existing literature on this topic, highlighting key trends, influential authors, and major research themes.

Organic waste management presents a significant challenge today, with growing concerns about environmental sustainability and resource scarcity. The concept of circular economics offers a promising framework for addressing these challenges by emphasizing the importance of closing the loop in material flows and minimizing waste through recycling and reuse. In this context, using the Black Soldier Fly (BSF) as a biological agent for organic waste decomposition has garnered increasing attention due to its efficiency and environmental benefits.

The bibliometric analysis conducted for this study involved the systematic review of relevant literature from various academic databases, including PubMed, Scopus, and Web of Science. Keywords such as "circular economics," "organic waste management," and "Black Soldier Fly" were used to identify relevant articles, which were then analyzed based on citation counts, publication trends, and authorship patterns. The results of the analysis reveal a growing interest in applying circular economics principles to organic waste management, particularly in the context of BSF-based systems. The number of publications on this topic has steadily increased over the past decade, indicating its rising importance in academic research and practical applications.

Several key themes emerge from the literature, including optimizing BSF-rearing techniques, evaluating its environmental impacts, and developing integrated waste management strategies. Researchers have explored various aspects of BSF biology and behavior to improve rearing efficiency and maximize waste conversion rates. Additionally, studies have assessed the environmental benefits of BSF-based systems, such as reduced greenhouse gas emissions and nutrient recycling.

Regarding authorship, certain individuals and institutions stand out as influential contributors. Collaborative research networks have formed around key research groups, facilitating knowledge exchange and interdisciplinary collaboration. This trend reflects the complex nature of circular economics and organic waste management, which require expertise from diverse fields such as biology, engineering, and economics.

Despite progress in this area, several challenges and opportunities for future research still need to be addressed. One notable concern is BSF-based waste management systems' scalability and commercial viability. While laboratory-scale studies have demonstrated the effectiveness of this approach, more research is needed to assess its feasibility at larger scales and in real-world settings.

Furthermore, the socio-economic implications of adopting circular economics principles in organic waste management warrant further investigation. Understanding the potential impacts on livelihoods, employment, and equity will be essential for ensuring these strategies' equitable and sustainable implementation.

Conflict of Interest

The authors declare that there is no conflict of interest.

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