Organic waste for potential chicken feed: A systematic literature review and bibliometric analysis

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Abstract: One of the improvement efforts is to utilize local potential to improve food security and nutritional needs by maximizing environmental resources. In this paper, we aim to analyze the status of research on the utilization of organic wastes as local poultry feed ingredients through a systematic literature review and bibliometric approach. Current research focuses on processing as compost media material, which is very different from the development expectation that is closely related to the circular economy, while the deregulation trend is on organic waste processed as organic fertilizer. Then, we found that there were 210 papers based on the keywords we used, and we eliminated 30 papers according to the keywords "organic waste" and "chicken feed". Our findings show that there is a connection between the integration of organic waste treatment and larval cultivation. There are two clusters related to the keyword relationship with the development of organic waste as an alternative feed source, and there are two clusters of countries that match the keywords. These findings will provide reference information and resources for the development of integrated organic waste processing ranging from household scale, small business, medium business, to industry which is useful for improving the provision of feed.

1 Introduction

The issue of organic waste is becoming an increasingly urgent global concern as public consumption and industrial activity continue to rise [1]. Among the various types of waste generated, organic waste particularly from household consumption and industrial-scale food processing remains largely underutilized [2]. Based on the data presented by Gani et al., [3] explained that Malaysia produces about 16,688 tons of food waste every day. Organic waste

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such as banana peels have nutrients that can still be utilized. Proper utilization can reduce the risk of environmental pollution, odor, and greenhouse gas emissions [4, 5]. Organic waste can be utilized as an alternative feed ingredient for local poultry.

One option that is currently being widely developed is as a bioconversion agent for organic waste. This bioconversion technology is considered capable of converting organic waste into products of economic value, such as protein-rich biomass, biofertilizer, and biodiesel [6]. The use of organic waste also supports the implementation of circular economy principles, where waste is processed into new resources for the agricultural, livestock and industrial sectors [7]. In several studies, the combination of organic waste and larvae has been shown to be able to turn many types of organic waste, including kitchen waste, agricultural waste, and agro-industrial waste into valuable products [1]. Due to its high conversion rate, this technology is considered as an environmental friendly alternative to organic waste management for animal feed [8].

In particular, researched by Gunggot and Lardizabal [2] became one of the approaches to study the efficiency of combined utilization of larvae as a dual-functional agent, both as chicken feed and as a decomposer. It also highlights that the nutritional content of the feed affects the growth rate and biomass of the larvae produced. This finding supports the results of another study by Diener et al., [8, 9]; Schreven et al., [10] mentioned that larvae are highly adaptable in their ability to process various types of organic waste. According to the study conducted Ojumoola et al., [5]; Akwa et el., [11] emphasized the importance of developing an integrated system of organic waste processing as an alternative feed in supporting the provision of animal feed.

The bibliometric analysis was compiled to provide a more in-depth overview of research trends in the field. It allows mapping of the number of publications, annual trends, popular keywords, collaboration between researchers, and the contribution of countries or institutions in the development of this topic. The approach of this study will focus on the utilization of organic waste in the bioconversion of organic waste as alternative animal feed. This study is expected to serve as a foundation for further research development as well as support biotechnology-based waste management practices. In addition, the bibliometric analysis results can serve as a reference for policy makers in developing sustainable organic waste management strategies.

2 Material and methods

2.1 Data collection

The articles collected in this study from the Scopus, where it is one of the most comprehensive peer-reviewed journal databases providing good scientific academic information. The research was conducted by exploring an online search on June 6, 2025. The methodology of bibliometric research used VOSviewer software to analyze and visualize the data. The Publish and Perish (Windows GUI Edition) 8 software was further used to analyze citations from the Scopus Database using the keywords “organic AND waste AND chicken AND feed” according to the criteria of “title, keywords, and abstract (topic area)”.

The research was conducted with a systematic literature review approach following the format of Preferred Reporting Items for Systematic Reviews (PRISMA) [13]. Bibliometric performance analysis is based on literature database (e.g., authors, institutions, national cooperation analysis, literature citations, citation analysis, keyword cluster analysis and popular words). Furthermore, the transformation of the obtained information is visualized into a more intuitive and clear visual analysis network graph with the help of visual bibliometric analysis.

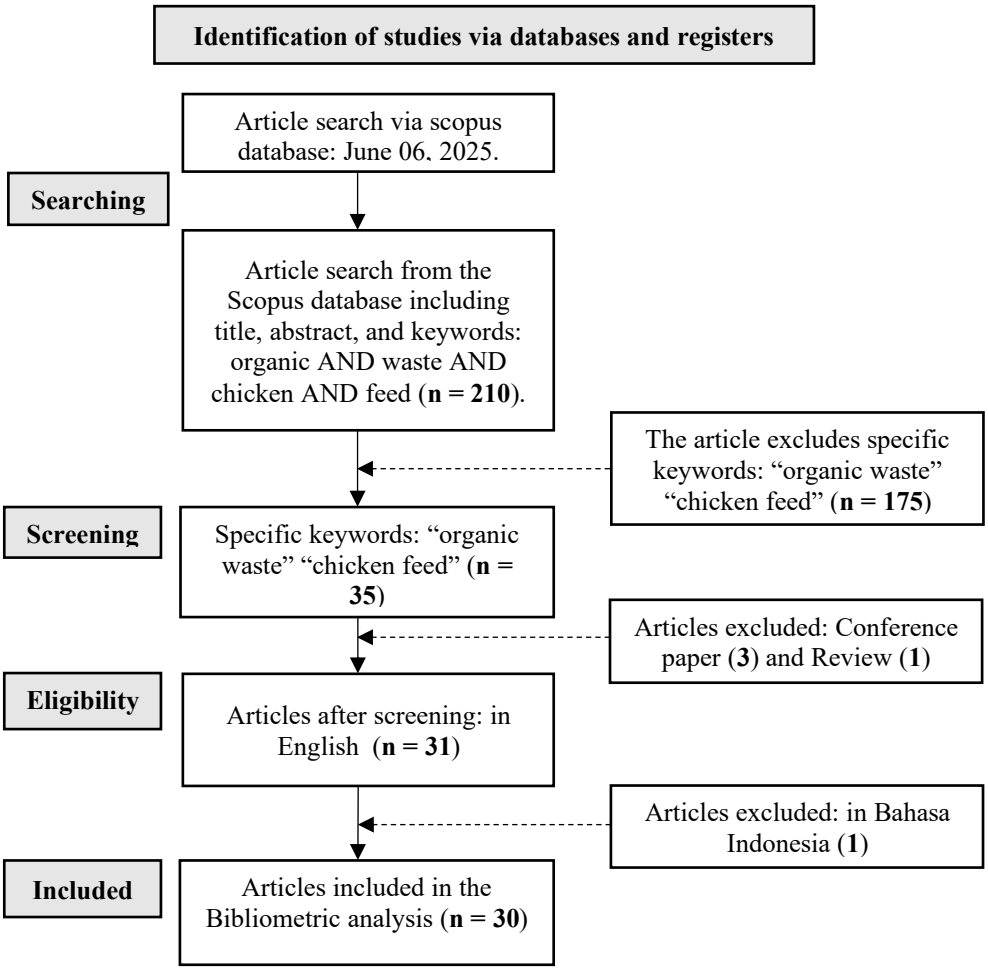

Fig. 1. Flowchart of the study selection process for the bibliometric analysis

2.2 Systematic literature review and bibliometric

The objective of the literature review using the PRISMA approach was to explore the potential of organic waste as an ingredient in poultry feed. A total of 210 English-language articles were initially screened, as illustrated in Fig. 1. The screening process involved filtering papers using the specific keywords "organic waste" and "chicken feed." Non-research document types, such as conference proceedings and review articles, were excluded. The selected articles were then analyzed based on several parameters, including publication year, source, authorship, institutional affiliation, country of origin, and subject area. These categories formed the basis for subsequent analysis and visualization [14].

2.3 Data analysis

The sample articles had been downloaded in *.csv format and processed using Microsoft excel to facilitate data analysis. Furthermore, the research uses VOSviewer 1.6.20 software used to visualize and analyze trends in the bibliometric maps form. VOSviewer creates

science mapping (e.g., co-authorship analysis, co-citation analysis, co-word analysis, co-occurence analysis, country analysis in the journal based on networks by keyword that are shared and found [15]. The keywords frequency could be adjusted as desired and removed in less relevant keywords. VOSviewer software is used to perform data mining, mapping, and clustering of articles retrieved from database sources.

3 Result and discussion

Searching scopus found articles to be processed with a publication period of 16 years, from 2009 to 2025. Biowaste and chicken feed were discussed as publication sources. A total of 30 articles were included in the bibliometric analysis. Figure 1 shows the search process and the number of articles retrieved from the Scopus database containing the keywords “organic waste” and “chicken feed”.

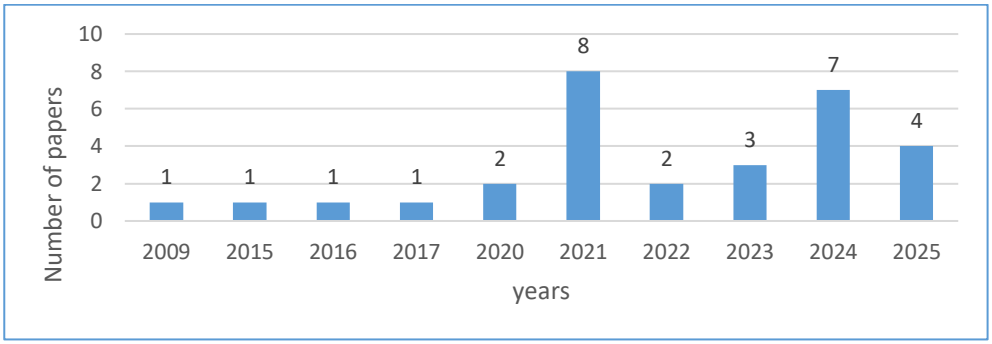

Fig. 2. The number of documents published each year

Based on Figure 2, it is known that the highest number of publications occurred in 2021 (8 papers), 2024 (7 papers), and 2025 (4 papers). This shows that there is a trend of publications in the last five years experiencing an increase and interest in developing innovations in the utilization of organic waste utilized as poultry feed. Utilization of organic materials plays a role in reducing the risk of environmental damage. Factors contributing to the publication trend may include new technologies, agricultural practices, and recognition of the nutritional benefits of organic waste processing in providing alternative livestock feed [16].

3.1 Citation analysis

Citation analysis is a fundamental technique for science mapping that operates on the assumption that citations reflect the intellectual relationships between publications that are formed during one publication cites another.

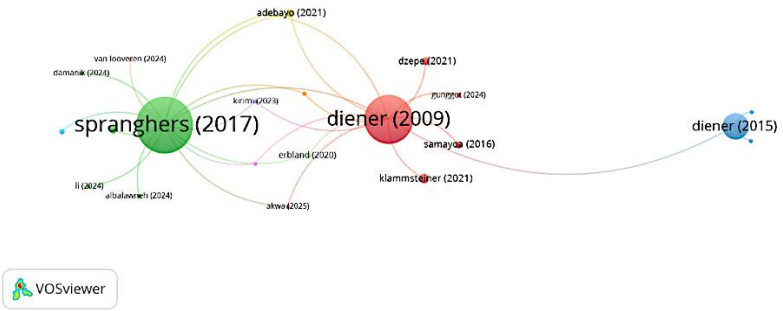

Fig. 3. Citation analysis in network visualization represents an entity

Based on Figure 3, it is known that the visualization of citations from several studies found there is a strong relationship or correlation between the authors in research related to the study of organic waste treatment. This shows that there is a development trend by Diener et al., [9] and Spranghers et al., [16] who was widely cited by several subsequent studies. This collaborative approach is expected to produce broader and more comprehensive research results. International collaboration in research offers several advantages.

Table 1. Some authors with the highest citation

Authors	Title	Citations	Link	Per year	Reference
Spranghers *et al.,* 2017	Nutritional composition of black soldier fly	760	14	95.13	[16]
Diener *et al.*, 2009	Conversion of organic material by black soldier fly larvae: Establishing optimal feeding rates	613	13	38.38	[9]
Adebayo *et al.*, 2021	Comparative assessment of developmental parameters, proximate analysis and mineral compositions of black soldier fly (Hermetia illucens) prepupae reared on organic waste substrates	235	3	23.50	[17]
Diener *et al.*, 2015	Bioaccumulation of heavy metals in the black soldier fly, Hermetia illucens and effects on its life cycle	90	3	18.00	[10]
Ojumoola *et al.*, 2025	Unlocking the potentials of the discarded: suitability of common food and fruit wastes in Ilorin metropolis for rearing black soldier fly, Hermetia illucens L. larvae	51	3	12.75	[5]

Based on Table 1, the findings in the bibliometric approach exposes that this collaboration allows researchers to utilize diverse expertise, methodologies, and resources available in different regions and institutions. Therefore, it is imperative for future research on organic waste treatment as potential poultry feed to encourage greater international collaboration among authors from different countries and institutions.

3.2 Co-occurence analysis

The visualized co-occurrence analysis, in Figure 4, resulted in two groups, revealing different research focuses. It is clear that the application of organic waste utilization as potential poultry feed still has the opportunity to be developed further [2].

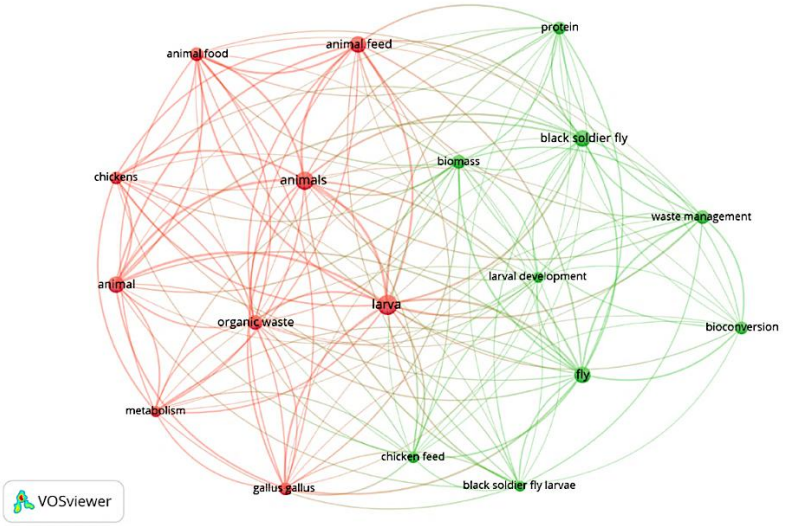

Fig. 4. Co-occurrence analysis in network visualization representation of the key terms

The Table 2 shows the nine keywords that appear most in the strength of the relationship between keywords. The keywords larva and animal are the most co-occurring.

Table 2. Cluster analysis of entities based on keyword relevance

Cluster	Keyword	Link	Total link strength	Co-occurence	Avg. pub years
1	Larva	17	92	15	2020
	Animals	17	89	13	2020
	Animal	15	68	10	2021
	Animal feed	17	68	10	2020
	Animal food	15	53	7	2019
	Chickens	15	46	6	2022
	Organic waste	16	46	8	2021
	Gallus gallus	16	48	6	2022
	Metabolism	15	39	5	2022
2	Fly	17	38	10	2021
	Balack soldier fly	17	38	10	2021
	Biomass	17	37	7	2021
	Waste management	14	37	7	2020
	Chicken feed	17	34	5	2023
	Protein	16	33	6	2018
	Balack soldier fly larvae	16	32	5	2022
	Larval development	17	25	5	2021
	Bioconversion	12	21	6	2023

The findings suggest that future research should address unexplored areas: organic waste treatment research, nutrient content profiling, integrated farming system and organic waste availability profiling. Furthermore, it is important to conduct side-effect evaluation research, both on livestock and the environment. This focused approach will help address environmental degradation and optimization of organic waste [18].

3.3 Country analysis

Furthermore, figure 3 shows a visualization of the collaboration network between keywords in publications related to organic waste and chicken feed research topics. Based on the

visualization, there are two large clusters that dominate the collaboration map, namely the European cluster (marked in red) and the South American-African cluster (marked in green). The European cluster consists of countries such as the Netherlands, Belgium and Germany, which show close collaborative relationships with each other.

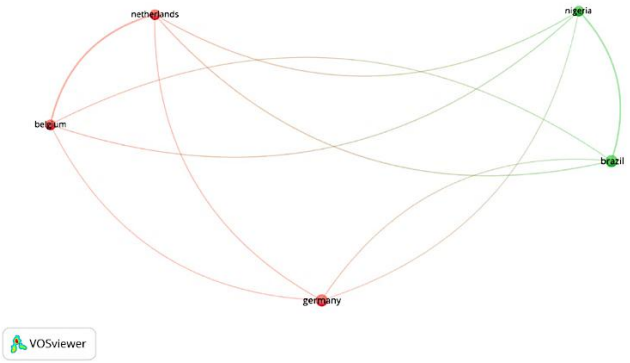

Fig. 5. Country analysis collaboration patterns in interconnected visualizations

This indicates that these countries have a similar research focus and work together on scientific publications in this area. The second cluster involves Nigeria and Brazil, which shows a strong collaborative relationship between them. Connections between the European cluster and the South American-African cluster can be seen in cross-cluster relationships, such as between the Netherlands and Nigeria and Brazil.

Table 3. Cluster analysis of entities based on country network

Cluster	Country	Link	Citation	Total link strength	Documents
1	Netherlands	4	802	127	3
	Belgium	4	787	117	3
	Brazil	4	35	113	4
2	Nigeria	4	51	112	3
	Germany	4	866	61	4

Based on Table 3 Cluster 1 consists of Netherlands, Belgium, and Brazil, which have high total link strength. Although Brazil has low citations (35), it still belongs to the same cluster because its link strength is quite large (113). Cluster 2 contains Nigeria and Germany. Interestingly, Germany has the highest citations (866), but the lowest link strength (61), which could indicate that its contribution is large but the linkages between countries (collaboration) are relatively limited compared to cluster 1.

3.4 The most relevant subject area

Based on Figure 6, it shows the distribution of documents related to Organic waste as potential poultry feed through larvae combination as bioconversion based on scientific fields. The majority of the documents are in the Agricultural and Biological Sciences field at 31.5%, indicating the main focus of the research on agricultural aspects and insect biology.

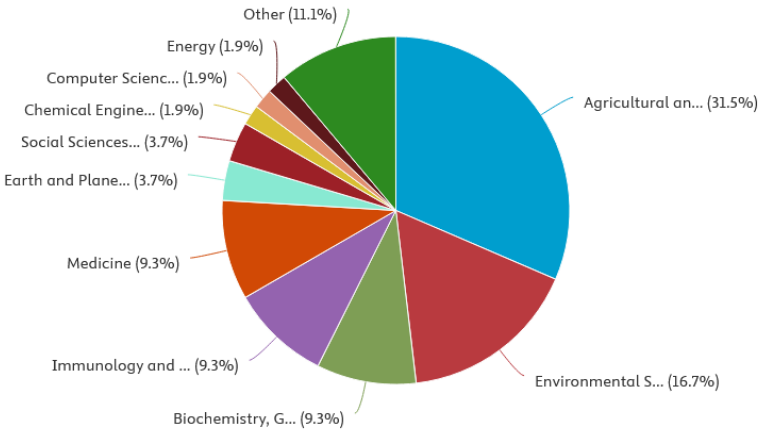

Fig. 6. Documens by subject area

Furthermore, the Environmental Science field contributed 16.7%, highlighting the relevance of this topic to environmental issues. Other fields that also have significant contributions include Biochemistry, Genetics and Molecular Biology (9.3%), Immunology and Microbiology (9.3%), and Medicine (9.3%), reflecting the relevance of this research in the aspects of biochemistry, microbiology, and health. Earth and Planetary Sciences and Social Sciences accounted for 3.7%, while Chemical Engineering, Computer Science, and Energy accounted for the remaining 1.9%. The Other category covers 11.1% of the documents, indicating the diversity of disciplines in studying the use of larvae for bioconversion of organic waste.

4 Conclusion

A bibliometric analysis of 30 relevant articles documented an interesting study in research interest and publication trends in the field of organic waste processing as a potential poultry feed ingredient, through integrating farming based on organic waste processing. The management of organic food waste is necessary to consider the environmental damage and uselessness of organic waste. The main lessons from this analysis are that consumer behaviour, waste management, integration of food waste management systems, circular economy. Much less environmental damage mitigation efforts imply strong interventions and more in-depth studies from various sectors and other elements to ensure efficient and sustainable use of resources.

References

1. D. Dzepe, P. Nana, M. K. Hervé, M. M. Janaina, M. Ornela, T. Timoléon, and D. Rousseau, SN Appl. Sci. **3**, 2 (2021)
2. E. Gunggot, M.L.T. Lardizabal, *Unveiling the hidden prospect of insect*, In 5th International Symposium On Insects (Isoi2023), September 11-13, 2023, Kuching, Sarawak (2023)
3. P. Gani, A. K. Hua, N. M. Sunar, H. M. Matias-Peralta, N. Apandi, IOP Conf. Ser. Earth Environ. Sci. **646**, 1(2021)
4. J. G. Kirimi, J. N. Riungub, D. Kiogorab, E. N. Mareteb, D. Kagendob, P. Deyc, and V. A. Oyoo, J. Water Sanit. Hyg. Dev. **13**, 9 (2023)

5. O. A. Ojumoola, K. Haddi, I. O. Sanusi, O. M. Salaudeen, R. S. Onabanjo, R. Y. Farro Barbarán, and A. A. Omoloye, Int. J. Trop. Insect Sci. **45**, (2025)
6. L. A. P. Logan, T. Latty, T. H. Roberts, J. Appl. Entomol. **145**, 6 (2021)
7. Z. Cohn, T. Latty, A. Abbas, Waste Manag. **137**, 8 (2022)
8. M. Murod, B. Suwignyo, B. Ariyadi, Vet. Integr. Sci. **23**, 1 (2025)
9. S. Diener, C. Zurbrügg, K. Tockner, Waste Manag. Res. **27**, 6 (2009)
10. S. Diener, C. Zurbrügg, and K. Tockner, J. Insects as Food Feed **1**, 4 (2015)
11. S. J. J. Schreven, S. Yener, H. J. F. van Valenberg, M. Dicke, J. J. A. V. Loon, J. Insects as Food Feed, **7**, 1 (2021)
12. T. E. Akwa, H. N. Tsafack, G. R. P. Djoko, L. T. Azefack, Int. J. Trop. Insect Sci. **45** (2025)
13. A. Liberati, D. G. Altman, J. Tetzlaff, C. Mulrow, P. C. Gøtzsche, J. P. A. Ioannidis, M. Clarke, P. J. Devereaux, J. Kleijnen, D. Moher, Expl. Elabor. **62**, 10 (2009)
14. X. Wei, Y. Long, C. Yi, A. Pu, Q. Hou, S. Wu, X. Wan. Nutrients **15**, 373 (2023)
15. I. Hamidah, Sriyono, M. N. Hudha, Indones. J. Sci. Technol. **2507**, 2 (2020)
16. T. Spranghers, M. Ottoboni, C. Klootwijk, A. Ovyn, S. Deboosere, B. De Meulenaer, J. Michiels, M. Eeckhout, P. De Clercq, S. De Smet, J. Sci. Food Agric. **97**, (2017)
17. H. A. Adebayo, K.A. Kemabonta, S. S. Ogbogu, M. C. Elechi, M. T. Obe, Int. J. Trop. Insect Sci. **41**, 3 (2021)
18. E. Koutridi O. Christopoulou, Smart Agric. Technol. **4**, 2 (2023)