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Bibliometric Analysis of Research Trends on Food Waste and Food Loss (2014–2024): Subject Area Trends and Global Collaboration

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A B S T R A C T

Food waste and food loss are strategic issues in the food and nutrition sector that have a wide impact on environmental sustainability, food security, and global economic efficiency. The increase in the volume of food waste encourages the development of cross-disciplinary research, so comprehensive scientific mapping is needed to understand the direction and dynamics of its development. This study aims to analyze trends, knowledge structures, subject areas, and global collaboration patterns of food waste research and food loss during the period 2014–2024. The study used a bibliometric approach with data sources derived from the Scopus database, covering 5,390 journal articles analyzed using VOSviewer software and Microsoft Excel. The analysis was conducted to identify annual publication trends, geographical distribution, author and institutional productivity, dominant area subjects, and thematic clusters of research. The results show a significant increase in the number of publications until it peaked in 2022, with China's dominance in the number of articles, institutional affiliations, and scientific collaboration networks. However, the articles with the highest citation rates and journals with the greatest scientific impact are still dominated by European and American countries, indicating a gap between the quantity of publications and global scientific influence. In terms of subject areas, research is dominated by Environmental Sciences, Energy, and Engineering, while the contribution of Social Sciences and Economics is relatively limited. Overall, this study emphasizes the importance of a multidisciplinary approach and strengthening a more balanced international collaboration to improve the quality, relevance, and global impact of food waste and food loss research in supporting sustainable food systems

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INTRODUCTION

Food waste and food loss have become major global concerns alongside increasing environmental, economic, and social sustainability challenges. Approximately one-third of all food produced for human consumption is lost or wasted along the supply chain each year (Gustavsson et al., 2011). In 2022, an estimated 13% of total food production was lost, while 19% of food available to consumers was wasted at the retail, food service, and household levels (UNEP, 2024). Most food losses occur during production, handling, and storage stages, with as much as 54% taking place in the early phases of the supply chain (Chrisendo et al., 2023).

Food waste contributes substantially to environmental degradation, generating approximately 186 million tons of CO_2-equivalent emissions, which corresponds to around 4% of total global greenhouse gas emissions (Obersteiner & Scherhaufer, 2021). From an economic perspective, food loss and waste result in annual losses of approximately USD 750 billion worldwide (Jeremić et al., 2024). Socially, these losses exacerbate food price volatility, limit access to adequate nutrition, and increase the number of people living below the poverty line, while simultaneously undermining food availability and food security systems (Prakash et al., 2014).

The drivers of food waste and food loss differ significantly between developing and developed countries. In developing countries, major contributing factors include inadequate post-harvest handling, insufficient infrastructure, and economic constraints. Poor storage and transportation facilities can lead to losses of up to 50% of food products (Junior & Soares, 2020), while underdeveloped transportation infrastructure further increases losses during distribution (Petrunina et al., 2023a). In urban areas, food waste is largely driven by consumer behavior, retail practices, and food service systems. Urban consumers often exhibit low appreciation for food, resulting in large quantities of avoidable leftovers (Junior & Soares, 2020). At the retail level, overstocking frequently leads to product expiration (Nicastro & Carillo, 2021), while buffet-style serving and oversized portions at the consumer level further contribute to food waste (Durán-Sandoval et al., 2023). Overall, households in developed countries tend to waste more food per capita than those in developing countries (Jeremić et al., 2024), and higher GDP levels have been associated with increased food waste, despite relatively similar waste patterns across stages of human development (Gencia & Balan, 2024).

Various strategies have been implemented to address food loss and waste (Jeremić et al., 2024). At the production level, collaboration with farmers—particularly regarding harvest timing and post-harvest technologies—has been emphasized (Chang et al., 2024). In the retail sector, measures such as price discounts for near-expiry products, food donations, and product innovation have been adopted (Aleruchi, 2019). At the consumer level, advocacy and awareness campaigns promote responsible purchasing behavior and encourage waste treatment through composting (Chinie et al., 2021). These efforts are supported by government interventions, including regulatory frameworks, economic incentives, and international collaboration aimed at achieving food waste

reduction targets (Nadeau & Koebele, 2023). Communities also contribute through food banks, communal kitchens, and the adoption of zero-waste concepts to support sustainable food systems and environmental protection.

Over the past decade, research on food waste and food loss has increased significantly, reflecting the urgency and complexity of the issue (Jeremić et al., 2024). Contributions from multiple disciplines—ranging from environmental science and engineering to the social sciences—have enriched the understanding of food waste dynamics and potential solutions (Ng & Wong, 2024). However, the rapid growth of publications has created a need to systematically evaluate the evolution of the literature, scientific collaboration patterns, and emerging research trends in this field.

Bibliometric analysis offers an effective quantitative approach for mapping and evaluating scientific literature. This method enables the identification of publication trends, leading authors and institutions, international collaboration networks, and dominant subject areas. Furthermore, bibliometric analysis facilitates the exploration of citation patterns, scientific networks, and national contributions to food waste and food loss research.

Accordingly, this study aims to analyze the development of scientific literature on food waste and food loss published in the Scopus database between 2014 and 2024. By employing VOSviewer and Microsoft Excel, this research visualizes publication trends and maps collaboration networks among authors, institutions, and countries. The findings are expected to provide strategic insights for researchers, policymakers, and practitioners in understanding the global research landscape and identifying future research opportunities in food waste management.

THEORETICAL REVIEW

Food Waste and Food Loss in the Perspective of a Global Food System

Food waste and food loss are structural issues in the global food system that are receiving increasing attention in the international scientific literature. Within the framework of a sustainable food system, food loss and waste are not only understood as production inefficiencies, but also as failures of resource governance that have an impact on the environment, nutrition, and social justice. Global studies show that food loss generally occurs at the initial production and distribution stages, while food waste is more dominant at the retail and final consumption stages, especially in middle- and high-income countries (Caldeira et al., 2021). These differences in characteristics confirm that the approach to handling food loss and food waste must be adjusted to the social, economic, and institutional context of each region.

In the context of food and nutrition, food waste has direct implications for the availability of essential nutrients and the quality of people's diets. Recent research shows that food waste often involves foods with high nutritional value such as fruits, vegetables, and protein products, thus widening the nutritional gap, especially in vulnerable groups (Conrad et al., 2022). Therefore, the up-to-date literature emphasizes that reducing food waste is an integral part of

strategies to increase food security and improve the nutritional status of the global population.

Multidisciplinary Approach in Food Waste and Food Loss Research

The development of food waste and food loss research shows the involvement of various disciplines, ranging from environmental science, engineering, economics, to social and behavioral sciences. Engineering and environment-based research generally focuses on supply chain optimization, post-harvest technology, and the processing of food waste into energy or value-added products (Kumar et al., 2021). This approach places food waste as a potential resource within the framework of the circular economy.

On the other hand, the study of social and economic sciences highlights the role of consumer behavior, cultural norms, and public policy in shaping patterns of food waste. Cross-country studies show that attitudes towards food, consumption habits, and perceptions of food value have a significant influence on household food waste levels (Principato et al., 2021). However, compared to technical research, the contribution of the social sciences in the food waste literature is still relatively limited, especially in developing countries, thus opening up space for more contextual and interdisciplinary follow-up research.

Bibliometrics as a Food Waste Knowledge Mapping Tool

As the volume of publications increases, bibliometric analysis is becoming an important approach to understand the structure and dynamics of knowledge in the field of food waste and food loss. Bibliometrics enable the mapping of research trends, the identification of key scientific actors, and the systematic and data-driven analysis of global collaboration networks. Recent bibliometric studies show that food waste research has accelerated significantly post-2020, as attention to the sustainable development agenda and the impact of the global crisis on food systems increases (Liu et al., 2022).

In addition, VOSviewer-based analysis and co-occurrence techniques reveal the existence of dominant thematic clusters focusing on bioenergy, circular economy, food security, and environmental policy. These findings indicate that food waste research is no longer sectoral, but is developing as a cross-disciplinary field of study with a solution orientation (Santos et al., 2023). Nevertheless, some bibliometric studies also highlight the inequality of geographical contribution, where East Asian countries excel in the quantity of publications, while European and North American countries still dominate global scientific influence.

Global Collaboration and the Knowledge Gap

International collaboration plays a crucial role in improving the quality and impact of food waste and food loss research. Research shows that articles produced through cross-border collaboration tend to have a higher citation rate than domestic research (Zhou & Li, 2021). However, the global collaboration pattern still shows inequality, with the dominance of research networks in specific regions and limited involvement from low-income countries.

This gap has implications for limited representation of local contexts, especially related to food and nutrition issues in developing countries. Therefore, the current literature emphasizes the importance of expanding inclusive and local needs-based global collaboration to produce more effective and equitable food waste reduction policies (Mbow et al., 2022)

METHODOLOGY

Types and Approaches to Research

This study uses a quantitative approach with a bibliometric study design, which aims to analyze and map the development of the scientific literature systematically and based on data. Bibliometric analysis was used to study publication patterns, knowledge structures, author and institutional productivity, collaborative networks, and subject area dynamics in the field of food waste and food loss. This approach focuses on the enumeration and quantitative interpretation of publication data without conducting a methodological quality assessment of individual articles, making it appropriate to identify macro trends and patterns in scientific research (Öztürk et al., 2024; Montazeri et al., 2023). Bibliometrics is also understood as a tool for evaluating research activities and scientific performance of authors, institutions, and countries in certain fields, so it is relevant to examine the development of food waste and food loss research on a global scale (Okubo, 1997; Walsh & Rowe, 2023).

Population and Sampling Techniques

The population in this study is all scientific articles that discuss the topic of food waste and food loss indexed in the Scopus database. The sampling technique used is non-probability sampling with the purposive sampling method, which is the selection of documents based on certain criteria that are relevant to the research objectives. The inclusion criteria applied include: (1) documents in the form of journal articles, (2) published in the 2014–2024 period, (3) containing the keyword food waste or food loss in the title of the article, (4) published in journal sources (source type: journal), and (5) included in relevant area subjects, such as Environmental Science, Energy, Engineering, Social Sciences, Economics, Agricultural and Biological Sciences, and other related fields. Based on these criteria, 5,390 articles were analyzed in this study.

Data Collection Techniques and Sources

Research data was collected through scientific documentation by searching and downloading publication metadata from the Scopus database (https://www.scopus.com). The data collection process will be carried out on November 1, 2025. The keywords used in the search are "food waste" OR "food loss", which is applied to the article title column. Article metadata is downloaded in Comma-Separated Values (CSV) format because this format allows for analysis flexibility, whether using data processing software such as Microsoft Excel or bibliometric analysis tools such as VOSviewer. Compared to other formats such as RIS or BibTeX, the CSV format provides more complete analytical output and is compatible for advanced bibliometric mapping.

The search queries used in this study are as follows:

Figure 1. Scopus Search Query for Food Waste and Food Loss Bibliometric Analysis (2014–2024)

Research Procedure

The research is carried out through several systematic stages. The first stage is the formulation of keywords and document inclusion criteria. The second stage involves collecting bibliographic data from Scopus and converting the data into CSV format. The third stage is the initial cleaning and processing of the data using Microsoft Excel to ensure the consistency of author, affiliation, and year of publication information. The fourth stage was conducted bibliometric analysis using VOSviewer to visualize the citation network, co-authorship, keyword co-occurrence, and thematic clusters of research. The final stage is the descriptive and analytical interpretation of the results of the analysis in accordance with the research objectives.

Data Analysis Techniques

Data analysis was carried out using a descriptive quantitative approach. VOSviewer software is used to build and visualize bibliometric networks based on citation relationships, co-authorship, bibliographic coupling, and keyword co-occurrence (van Eck & Waltman, 2013). In addition, Microsoft Excel is utilized for supporting analysis, such as tabulation of publication frequency, country and institution distribution, and simple descriptive statistical calculations. The results of the analysis are presented in the form of visual maps and narrative descriptions to illustrate publication trends, geographical dominance, subject area structure, and global collaboration patterns in food waste and food loss research.

RESEARCH RESULTS AND DISCUSSION

Overview of the Number of Articles based on Year of Publication

The results of the analysis from Scopus show that there has been an increase in the number of articles from 2014 to 2024. The most increase occurred in 2022, which was 143 articles and in 2020 there was an increase of 139 articles. However, there was a decrease in 2023, as many as 43 articles. The number of articles increased from 2014 to a peak in 2022, before declining in 2023 (Figure 1).

The number of articles in the 5 journals is the most during the period 2015 to 2024, which consists of 90 journals (Figure 2). During this period, the journal Bioresource Technology has the most publications, followed by the Journal of Cleaner Production, Waste Management, Sustainability (Switzerland) and

Science of the Total Environment. In general, the five journals have an upward trend until 2022, but there is a decline in 2023.

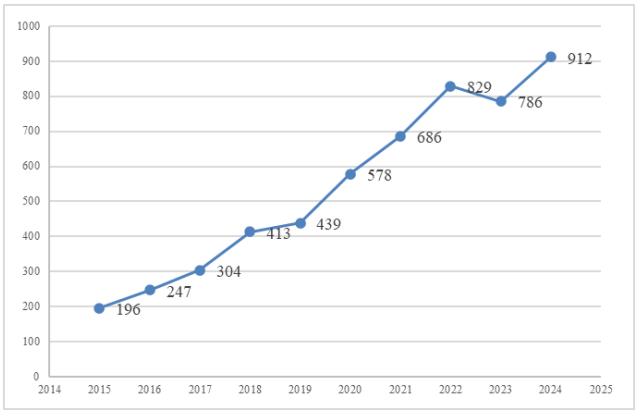


Figure 2. Number of Articles by Year of Publication

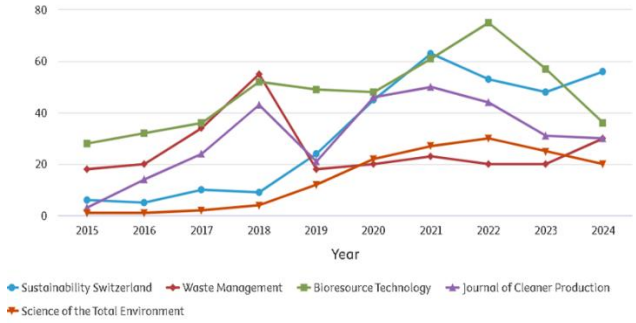


Figure 3. Number of Articles per Year on the 5 Most Journals

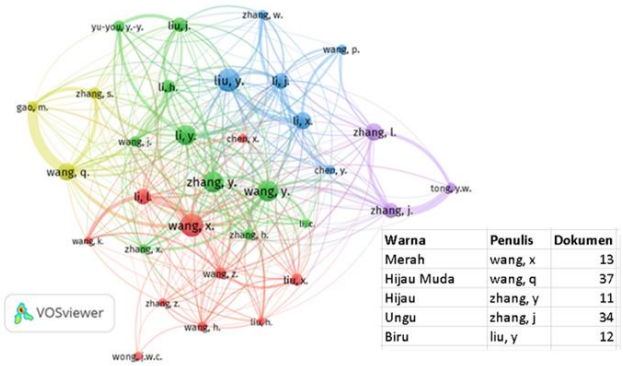
Author Overview and Author Collaboration

Collaboration in writing articles is a necessity, considering that research can not always be done alone, so writers need the help of others (Rahayu & Christiani, 2020. The size of the collaboration refers to VOSviwer, it can be based on writers, people of alliances and countries. Through a search of the scopus analysis output, it is possible to find the 10 most productive authors in food waste and food loss research. Of the 10 authors, as many as 6 authors came from universities in China. More clearly can be seen in table 1.

Table 1. Overview of the Number of Articles by Author, Affiliate and H-Index of Authors

Author	Affiliates	Article FWFL	Article Total	H-Index
Yu-You, Li	Tohoku University Sendai, Japan	45	646	81
Tong, Yen Wah	National University of Singapore, Singapore	43	284	74
Wong, Jonathan W.C.	Hong Kong Baptist University, Hong Kong	43	325	76

Gao, Ming	University of Science and Technology Beijing, China	37	141	35
Wang, Qunhui	Xi'an University of Architecture and Technology, China	37	654	71
Zhang, Jingxin	Shanghai Jiao Tong University, Shanghai, China	34	101	45
Ren, Lianhai	Beijing Technology and Business University, Beijing, China	30	88	21
There, she	Chongqing University, Chongqing, China	28	99	25
Wu, Chuanfu	University of Science and Technology Beijing, China	28	130	31
Lin, Carol Sze Ki	City University of Hong Kong, Hong Kong	27	266	66



From the analysis of VOSviewer, it can be seen that there are 5 top clusters in author collaboration. The largest cluster is red, led by Wang, Xiaochang (13 articles). Then the blue cluster, led by Li Yu-You with 12 articles. The third cluster is light green, led by Wang, Qunhui (37 articles). The fourth green cluster is led by Zang, Y with 11 articles, and the purple cluster with 34 articles. In this case, it can be explained that the size of the cluster has nothing to do with the number of articles owned by the most productive authors, but is determined by the number of networks and the number of members of the network.

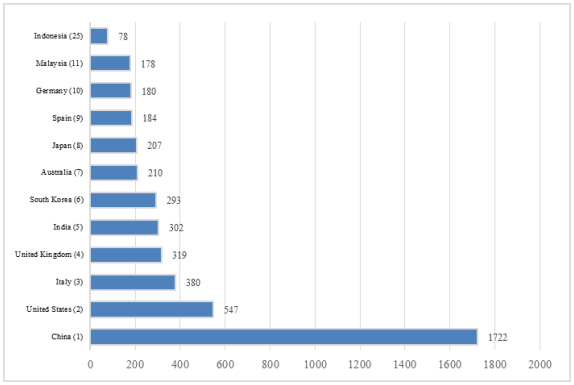


Figure 5. Number of Articles by Country

The origin of the country or region that conducts the most research related to "food waste" or "food loss" comes from China. Of the top 10 university data, 8 are universities in China. Table 1 shows that there are only two countries other than China that are in the top 10, namely Singapore and Taiwan. In figure 5, China even dominates in the number of articles published, out of the 10 most countries, which is 1,722 articles from 2015 to 202.

Table 2. Number of Articles by Affiliation and Country of Origin

Affiliates	**Country of Origin**	**Number of Articles**
Ministry of Education of the People's Republic of China	China	227
Chinese Academy of Sciences	China	157
Tongji University	China	133
Tsinghua University	China	125
University of Chinese Academy of Sciences	China	75
National University of Singapore	Lion Pretend	73
China Agricultural University	China	71
Shanghai Jiao Tong University	China	69
Tohoku University	China	67
Xi'an University of Architecture and Technology	China	59

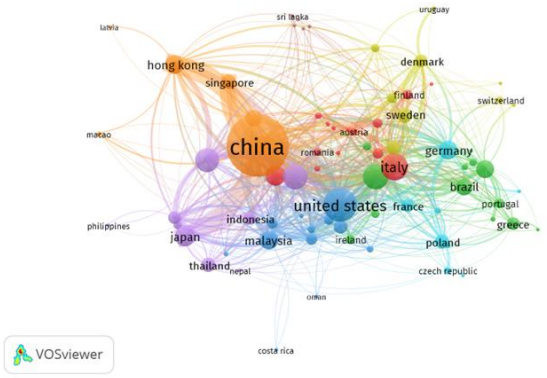


Figure 6. Visualization based on Number of Articles and Collaboration between Countries from VOSviewer

Figure 6 is a visualization of bibliometric data from VOSviewer which also describes the country of origin of the article. However, in contrast to Figure 5 and Table 1, this visualization maps scientific collaborations or publications between countries based on color and the relationship between points. From the color, it can be seen that there are 6 clusters, namely blue, red, pink, green, purple and light green. The dominant pink is the State of China, and has a network that is close to all countries. But from the thick line, China is more in contact with Singapore and Hong Kong. The blue cluster of the United States collaborates more with Malaysia and Indonesia.

Overview of the Subject Area of the Article

The subject area of a manuscript refers to the specific field of science or study material discussed in the article. The results of the analysis from scopus.com, the articles were grouped into 26 subject areas. This information can be seen that "food waste" has been studied with various scientific angles. The most studied subjects are in the Environmental Science area, followed by Energy and Engineering. The number of subject areas that discuss a topic can show that the topic is needed by the community. Table 2 only presents 12 subjects.

Table 3. Overview of the Number of Articles by Subject, Area and Country Origin

Subject Area	Number of Articles	Country of Origin (Dominant)
Environmental Science	3.268	China
Energy	1.770	China
Chemical Engineering	870	China
Engineering	792	United States or China
Agricultural and Biological Sciences	730	China
Social Sciences	600	China
Business, Management and Accounting	451	United States or China

Economics, Econometrics and Finance	268	United States or China
Chemistry	257	China
Biochemistry, Genetics and Molecular Biology	216	China
Medicine	216	China
Computer Science	210	China
Other	820	-

From table 3, the subject of the Environmental Science area ranks the highest in the number of published articles, which is 3,268 articles. Of the top 12 area subjects, China dominates as the article's country of origin. If it is related to figure 5, China also dominates in the number of articles, which is 1,722 or more than 30%. Even in table 2 shown, the 10 most affiliates, 9 affiliates are from China.

Overview of the Number of Citations

Citation measurement is also a core indicator in some university rankings, such as the Leiden ranking and the Academic Ranking of World Universities (ARWU). Table 4 and table 5 show the number of citations based on article titles and the number of citations based on journals. (Piro & Sivertsen, 2016)

Table 4. Number of Citations based on Author, Country, Article Title, Journal Name and Journal H-Index

Author	**Country**	**Article Title**	**Journal Name**	**Citation**	**H-Index**
Schanes, K., et al., 2018	Austria	Food waste matters - A systematic review of household food waste practices and their policy implications	Journal of Cleaner Production (Q1)	1.059	354
Stancu, V., et al., 2016	USA	Determinants of consumer food waste behaviour: Two routes to food waste	Appetite (Q1)	834	190
Xue, L., et al., 2017	USA	Missing Food, Missing Data? A Critical Review of Global Food Losses and Food Waste Data	Environmental Science and Technology (Q1)	542	504
Parizeau, K., et al., 2015	English	Household-level dynamics of food waste production and related beliefs,	Waste Management (Q1)	517	239

		attitudes, and behaviours in Guelph, Ontario			
Nguyen, T.T.X., et al., 2015	USA	Ability of Black Soldier Fly (Diptera: Stratiomyidae) Larvae to Recycle Food Waste	Environmental Entomology (Q2)	454	105
Russell, S.V., et al., 2017	Netherlands	Bringing habits and emotions into food waste behaviour	Resources, Conservation and Recycling (Q1)	453	218
Secondi, L., et al., 2015	English	Household food waste behaviour in EU-27 countries: A multilevel analysis	Food Policy (Q1)	445	145
Ishangulyyev, R., et al., 2019	Swiss	Understanding food loss and waste-why are we losing and wasting food?	Foods (Q1)	440	123
Salomone, R., et al., 2017	English	Environmental impact of food waste bioconversion by insects: Application of Life Cycle Assessment to process using Hermetia illucens	Journal of Cleaner Production (Q1)	432	345
Chan, M.T., et al., 2016	English	Reducing nitrogen loss and salinity during 'struvite' food waste composting by zeolite amendment	Bioresource Technology (Q1)	427	383

Widely cited articles are often considered important and influential sources in their field, indicating that the work is recognized and appreciated by the academic community. Meanwhile, a journal that is widely cited can be interpreted as having a high level of influence and reputation in the scientific community.

Judging from table 4, it turns out that the number of articles that are cited the most does not come from the number of journals that have the most citations. The title Food waste matters - A systematic review of household food waste practices and their policy implications, which is in 3rd place with the most journal citations. Then, it turned out that an article in the Journal of Bioresource Technology, entitled Biogas production from co-digestion of dairy manure and food waste, ranked fifth with the most citations.

In table 5 it looks interesting, because the Journal of Bioresource Technology, which has the highest number of articles and citations, but on average article citations is 57.2, it ranks 4th. The average article with the most citations comes from the Journal of Applied Energy (UK) with an average number of 75.7 citations per article. More clearly can be seen in table 5.

Table 5. Number of Citations based on Journal Name

Journal Name	Quartile/ H-Index	Quantity Citation	Number of Articles	Average
Bioresource Technology (UK)	Q1/ 323	29.841	522	57.2
Waste Management	Q1/ 383	16.800	263	63.9
Journal of Cleaner Production (Austria)	Q1/ 285	14.243	269	52.9
Resources, Conservation and Recycling (Belanda)	Q1/ 354	6.602	106	62.3
Sustainability (Swiss)	Q1/ 268	4.336	226	19.2
Science of the Total Environment (Belanda)	Q1/ 218	4.195	126	33.3
Journal of Environmental Management (AS)	Q1/ 399	3.506	112	31.3
International Journal of Hydrogen Energy	Q1/ 207	3.432	70	49.0
Applied Energy (UK)	Q1/ 239	2.272	30	75.7
Water Research (UK)	Q1/ 396	2.216	39	56.8

Word Cluod in Article Title

Figure 7 is the result of analysis from VOSviewer to visualize a dataset based on words or phrases based on keywords from articles downloaded through the Scopus database. The visualization shows various terms related to "food waste". Size indicates the frequency or importance of the term in the dataset, and the color indicates the cluster of each term (Kirby, 2023).

The VOSviewer analysis not only produces a single word cluod, but also has a pattern that shows clusters and the association of one word with another. The command used in bringing up images that resemble word cloud in the VOS viewer is a co-occurrence then keyword index. There are 4 clusters based on color, namely red, green, blue and yellow. In red, the dominant keywords are food waste, anaerobic digestion, biogas, methane, fermentation. This cluster is very dominant and focuses on technical solutions to convert food waste into energy (biogas, methane) or chemicals through biological processes (anaerobic digestion, fermentation). In the green cluster, the dominant keywords are circular economy, sustainability, life cycle assessment, environmental management, and policy. If described, this cluster represents more macro- and systemic-oriented research. Its focus is on economic frameworks, sustainability, and environmental impact assessments and the role of policy.

In the blue cluster, it is dominated by the keyword's food security, food loss, agriculture, resource management, climate change. It seems that in this cluster highlighting the root of the problem and its broader consequences, namely how food wate and food loss affect food security, agriculture, and their relationship to climate change and resource management. The last is yellow, dominated by the keyword's wastewater treatment, nutrient recovery, sewage, sludge, heavy metals. In terms of keywords, this cluster highlights specific engineering solutions for liquid waste, which shows efforts to treat wastewater and sludge to recover nutrients (e.g., nitrogen, phosphate) and remove contaminants (heavy metals). About the theme-based grouping represented by keyword-based colors, it can be seen in table 6.

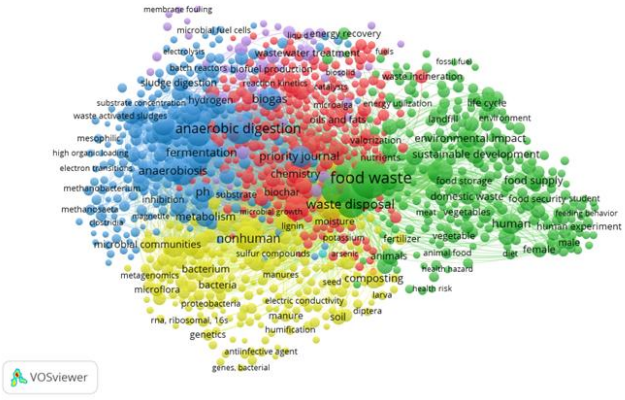


Figure 7. Data Collection Based on Keywords or Phrases from Articles

Table 7. Keyword Grouping of Article Titles by Theme

Cluster Colors	Dominant Keywords	Nama Category (Research Theme)	Theme Focus Explained
Red	food waste, anaerobic digestion, biogas,	Bioconversion and Bioenergy Technology	This cluster is very dominant and focuses on technical solutions to convert food waste into energy (biogas, methane) or chemicals

	methane, fermentation		through biological processes (anaerobic digestion, fermentation).
Green	circular economy, sustainability, life cycle assessment, environmental management, policy	Policy, Circular Economy, and Environmental Impact	This cluster represents more macro- and systemic-oriented research. Its focus is on economic frameworks, sustainability, and environmental impact assessments and the role of policy.
Blue	food security, food loss, agriculture, resource management, climate change	Food Security, Agriculture and Global Challenges	This cluster highlights the root of the problem and its broader consequences. Focus on how food waste and food loss affect food security, agriculture, and their relationship to climate change and resource management.
Yellow	wastewater treatment, nutrient recovery, sewage, sludge, heavy metals	Environmental Engineering: Nutrient and Water Recycling	This cluster focuses on specific engineering solutions for liquid waste. The dominant keyword indicates efforts to treat wastewater and sludge to recover nutrients (e.g., nitrogen, phosphate) and remove contaminants (heavy metals).

Based on this visualization, it can be focused on the interconnectedness between groups to reduce food waste, explore technologies, make innovations for waste treatment and resource recovery. Furthermore, it is necessary to formulate policies, the role of consumer behavior, and the economic aspects of food waste management. The goal is in food waste management by converting organic waste into renewable energy (biogas). It can also be decomposed of nutrient-rich waste to be used as fertilizer. Of course, this can be used as a sustainable alternative to waste management which also has its own problems. Food waste processing such as composting greatly contributes to reducing greenhouse gas emissions (Karne et al., 2023; Ries et al., 2023; Pérez et al., 2023).

CONCLUSIONS

Trends and Dynamics of Food Waste and Food Loss Research Publications

The results of bibliometric analysis show a significant increase in the number of research publications related to food waste and food loss during the period 2014–2024. This growth pattern reflects the increasing global attention to food waste as a multidimensional problem that has an impact on food system sustainability, food security, and economic and environmental stability. Previous literature confirms that research topics tend to thrive when they have broad and long-term social implications (Stephan et al., 2012), and the findings in this study corroborate this argument.

The surge in publications that peaked around 2022 can be attributed to increasing global awareness of the magnitude of losses due to food loss and waste (FLW). Various studies show that about one-third of the food produced globally is lost or wasted along the supply chain, with a significant proportion coming from the household level (Setti et al., 2016a; Sunday et al., 2022a). The impact of food waste is not only ecological, but also includes global economic losses that are estimated to reach hundreds of billions of US dollars every year (Luna & Suryana, 2023).

In addition to environmental and social factors, the dynamics of publications are also influenced by the magnitude of FLW's economic impact in various countries. Studies in developing and developed countries show that economic losses due to FLW occur at almost all stages of the food chain, from production, post-harvest, distribution, to consumption (Khalid et al., 2023; Petrunina et al., 2023). Thus, the increase in the number of publications can be understood as a scientific response to the urgency of problems that are increasingly real and documented globally.

Geographical Dominance and Its Implications for Knowledge Production

One of the main findings in this study is China's dominance in the number of publications, institutional affiliations, and author productivity on the topic of food waste and food loss. This dominance is inseparable from the context of China's national policy which explicitly targets the reduction of food waste. Since the launch of the Clean Your Plate campaign in 2013 and the passage of the Anti-Food Waste Law in 2020, scientific research has played an important role in supporting the formulation, implementation, and evaluation of such policies (Wang et al., 2022).

However, these findings also reveal an imbalance between the quantity of publications and the scientific influence reflected in the citation pattern. Although China dominates the number of articles, the publications with the highest citation rates and journals with the greatest scientific impact are still dominated by European and North American countries. This phenomenon shows the existence of a citation gap, where the high volume of publications is not always directly proportional to the level of global scientific influence. Similar patterns have been reported in other bibliometric studies and are often attributed to language factors, international collaborative networks, as well as the reputation of the journal in which the article was published.

These findings indicate an asymmetry in global knowledge production, where certain countries excel in quantitative output, while others are more

dominant in shaping internationally influential conceptual frameworks, methodologies, and research agendas. The implications of this condition are important to consider in an effort to encourage more balanced and integrative cross-border collaboration.

Subject Area Analysis and Research Focus Shift

The analysis of the subject area shows that food waste and food loss research is most in the realm of Environmental Science, Energy, and Engineering. The dominance of this technical discipline indicates that the research approach still focuses on technology-based solutions, such as waste treatment, energy conversion, and systems engineering. These findings are in line with the results of a thematic cluster that places bioconversion and bioenergy as the most dominant research themes.

However, although food waste is a phenomenon that is closely related to consumer behavior, culture, and social systems, the contribution of subjects in the areas of Social Sciences, Economics, and Management is still relatively limited. This inequality shows that there are research opportunities that have not been fully utilized, especially in understanding the root causes of food waste behavior and the effectiveness of policy interventions at the household and community levels. Therefore, the results of this study underscore the importance of developing a more balanced multidisciplinary approach to answer the complexity of FLW problems.

Patterns of Scientific Collaboration and Global Research Networks

Mapping of collaborative networks shows that food waste and food loss research forms geographically strong collaboration clusters. Institutions and authors from China tend to build dense intra-national collaborations, while European and North American countries serve as key links in international collaboration networks. This pattern reflects geographical specialization in knowledge production, where China focuses on technical solutions and publication volumes, while Western countries are more dominant in the development of policy frameworks and scientific validation at the global level.

The strength of internal collaboration in China is likely to be driven by a focused national funding system and the large scale of domestic problems. However, the limitations of cross-border collaboration have the potential to limit the diffusion of ideas and the integration of global perspectives. Therefore, increasing international collaboration that is more open and cross-disciplinary is important to enrich the quality and impact of research in the field of food waste and food loss.

Theoretical, Methodological, and Policy Implications

Theoretically, this study enriches the literature by mapping the knowledge structure and global dynamics of food waste and food loss research until 2024. From a methodological perspective, the application of bibliometric analysis based on Scopus and VOSviewer allows the identification of publication trends, thematic clusters, and collaboration patterns that are difficult to obtain through conventional narrative reviews. From a policy perspective, the findings of this study confirm that the success of FLW reduction does not only depend on

technological innovation, but also requires policy integration, behavior change, and the strengthening of effective and sustainable international collaboration.

CONCLUSIONS AND RECOMMENDATIONS

Bibliometric analysis of 5,390 articles indexed by Scopus during the period 2014–2024 shows a significant increase in food waste and food loss research publications, reflecting the growing scientific attention to the implications of food waste on environmental sustainability, food security, and global economic efficiency. Geographically, China dominates the productivity of publications and institutional affiliations, but the scientific influence reflected through the level of citations and contributions to high-impact journals is still dominated by European and North American countries, signaling a gap between the quantity and quality of scientific impact. From the perspective of subject areas and thematic clusters, research is still dominated by technical, engineering, and environmental approaches, while the contribution of social and economic sciences is relatively limited. The pattern of global collaboration shows the strength of intra-national collaboration in a particular country and the central role of Western countries in international networks. These findings underscore the need to strengthen multidisciplinary approaches and more balanced global collaboration to improve the quality, policy relevance, and scientific impact of food waste and food loss research in supporting sustainable food systems.

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