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Unraveling Factors Affecting Food Waste Globally: A PRISMA-Based Systematic Literature Review and Bibliometric Analysis

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ABSTRACT

This study utilizes a systematic literature review and bibliometric analysis, following the PRISMA method, to explore behavioral and contextual factors influencing food wastage based on literature published from 2019 to 2024. It identifies key determinants such as perceived control, consumer intention, attitudes, subjective norms, religiosity, and household dynamics. Perceived control notably correlates with up to a 20% reduction in household food waste. The research highlights a scholarly trend towards incorporating sustainability into the food supply chain, with a focus on bioenergy recovery from waste. It also examines sociodemographic, cultural, and psychological influences on food wastage behaviors across various regions, illustrating the complexity of these behaviors and the need for tailored, region-specific approaches. The findings advocate for an interdisciplinary strategy that merges design, technology, and behavioral science to enhance food waste management systems. Such strategies should be adaptable to different cultural contexts and aim to minimize ecological footprints, supporting global sustainability goals. The implications suggest that policymakers and practitioners should develop sustainable, design-oriented solutions that account for local behaviors and systemic capacities to effectively curb food waste. This approach promotes culturally sensitive and environmentally sound interventions, leading to significant reductions in global food wastage.

1. INTRODUCTION

Food waste has become a significant social and environmental issue, impacting food security, nutrition, and safety. It contributes to contamination risks due to improper disposal, attracts pests, encourages the growth of harmful bacteria, and exacerbates environmental problems such as greenhouse gas emissions and resource wastage [1]. To clarify terminology, food waste and food loss are often used interchangeably but refer to different points within the food supply chain. According to the Food and Agriculture Organization (FAO), food loss primarily occurs during production, post-harvest, and processing stages, while food waste occurs at the retail and consumption stages, often due to consumer behavior, poor storage practices, and aesthetic standards. The Institute of Food Science Technology (2020) defines food waste as "a reduction in the quantity or quality of food resulting from the decisions and actions of retailers, food service providers, and consumers." For this study, food waste is defined as any edible food discarded, lost, or uneaten [2].

The scale of food waste continues to grow with the increase in global population and the effects of globalization, impacting economies, the environment, and food security on a global scale [3]. The issue of food waste is complex, involving various interconnected factors that influence the rates and types of waste at different stages. The impacts of food waste are profound, affecting not only the economy—through the cost of lost food and resources—but also the environment, considering the energy, water, and land resources expended in food production, transportation, and distribution.

Consequently, food waste has been recognized as a pressing global issue, influencing food security, environmental sustainability, and economic stability. With an increasing global population and demand for food, the need to mitigate food waste has become crucial. Understanding the various determinants of food waste is essential for creating effective strategies to reduce and manage this problem. Food waste occurs at various stages of the food supply chain and in households, resulting in a considerable negative impact. Notably, factors influencing food waste are multifaceted, encompassing behavioral, cultural, economic, and systemic elements. This study aims to investigate these factors through

a systematic literature review, offering insights into the complexity of food waste and enhancing understanding of the underlying causes.

Several studies have identified key drivers of household food waste. For example, studies [4, 5] found that factors such as geographic location, income level, household size, cultural practices, food consumption behaviors, educational level, eating frequency, gender, and household member count significantly influence food waste. Another study [6] highlighted that perceived behavioral control, attitudes toward waste prevention, and waste preventing behaviors also play a role. However, discrepancies in findings across studies indicate that more research is needed to understand these influences fully.

Methodologically, this research employs the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach combined with bibliometric analysis to systematically synthesize and evaluate existing literature on food waste factors. This dual-method approach ensures a rigorous and transparent review of current research, facilitating the identification of major works, prominent authors, and trends while highlighting gaps in the literature. By employing bibliometric techniques, the study offers a structured overview of accumulated knowledge on food waste determinants.

This research aims to identify and categorize the factors contributing to food waste occurrences. The study leverages a systematic literature review using the PRISMA framework, supplemented by bibliometric analysis, to examine findings from international journals, providing a comprehensive understanding of factors that influence food waste.

2. LITERATURE REVIEW

2.1 Food waste

Food waste is a critical issue that occurs when food that is still suitable for human consumption is discarded, often ending up in landfills. This waste results from negligence or inaccuracies in the consumption process, such as not finishing food, portions being too large, or purchasing/cooking food that is ultimately not consumed. Some main causes of food waste include: (1) Not finishing food—plate waste is a significant component of overall food waste in households, with many consumers not consuming all the food they serve themselves [7], (2) Portion sizes that are too large, leading to increased waste as consumers are less likely to finish oversized meals [8], and (3) Buying or cooking food that goes unused, often due to promotions or discounts that prompt consumers to purchase more than necessary [9].

To provide a more structured overview, the causes of food waste can be categorized by sector: household, retail, and food service. For example, in the household sector, food waste is largely driven by consumer behavior, including factors such as over-purchasing, improper storage, and misunderstandings of expiration dates. In the retail and food service sectors, waste often stems from inventory management issues and ineffective portion control. This sector-based approach enhances readability and clarifies how different settings contribute to the overall issue of food waste.

This phenomenon not only represents a significant loss of resources but also has far-reaching environmental, economic, and social implications. The global scale of food waste is staggering, with estimates suggesting that approximately one-third of all food produced for human consumption is wasted—about 1.3 billion tons annually [10]. In Europe alone, food waste reaches approximately 88 million tons per year, equating to 178 kilograms per person [11].

The environmental impact of food waste is profound. When food waste decomposes in landfills, it generates methane, a potent greenhouse gas that contributes significantly to climate change. Furthermore, the resources used in food production—such as water, energy, and labor—are wasted alongside the food itself, exacerbating environmental degradation [12]. For instance, the energy lost in landfills from food waste is estimated to be equivalent to 43% of the energy used to prepare food in the United States [12]. This highlights the urgent need for effective food waste management strategies.

Consumer behavior is a significant contributor to food waste generation. Research indicates that a substantial portion of food waste occurs at the household level, driven by factors such as over-purchasing, improper storage, and misunderstanding of expiration dates [13]. For example, Althumiri et al. [14] found that food waste at the consumption level accounts for 61% of all food loss in North America and Oceania. This suggests that increasing awareness and education about food management practices can play a crucial role in reducing waste.

In addition to consumer behavior, the role of food service providers and retailers is critical in addressing food waste. These stakeholders can implement strategies to minimize waste through better inventory management, portion control, and consumer education [13]. For instance, a study by Phooi et al. [15] emphasized the importance of educating young consumers about the consequences of food waste, which can lead to more sustainable behaviors. Furthermore, initiatives such as food redistribution programs can effectively mitigate food waste by donating surplus food to those in need, addressing both waste and food insecurity.

Legislation and policy frameworks also play a vital role in food waste reduction. Countries around the world are beginning to implement regulations aimed at reducing food waste at various stages of the supply chain, from production to consumption [16]. For example, the European Union has set ambitious targets to halve per capita food waste at the retail and consumer levels by 2030 [17]. Such policies create a supportive environment for businesses and consumers to adopt more sustainable practices.

2.2 Systematic literature review

Systematic Literature Review (SLR) is a structured and systematic method for identifying, evaluating, and synthesizing all relevant literature on a specific topic or research question [18]. The SLR process is characterized by a rigorous approach that ensures the review is comprehensive, transparent, and replicable. SLR allows for a complete mapping of existing research, highlighting areas of consensus and gaps, which is essential in complex topics like food waste. This methodology has been widely adopted across various fields, including business, healthcare, engineering, and environmental studies, as it provides a consolidated knowledge base and identifies potential areas for future research [19].

In this study, the SLR approach specifically aims to identify the major factors contributing to food waste across household, retail, and food service sectors. Research questions guiding

this SLR include: “What are the primary behavioral and systemic factors influencing food waste in each sector?” and “What gaps exist in the literature regarding food waste interventions and strategies?”. Inclusion criteria encompass studies addressing food waste determinants and management strategies, with exclusion criteria set for articles that do not focus on food waste in consumption contexts. The databases used in this review include Scopus, Web of Science, and Google Scholar to ensure comprehensive coverage [20].

The SLR process follows a series of well-established steps guiding literature identification, selection, and analysis. Kitchenham's guidelines, for example, emphasize the importance of clear research questions, well-defined inclusion and exclusion criteria, and rigorous data extraction methods [19]. This structured approach enhances the reliability of findings, as demonstrated in recent SLRs on food waste drivers, and facilitates the reproducibility of the review process, which is crucial for advancing knowledge in this field [20].

Moreover, the versatility of SLR extends beyond traditional applications, as demonstrated in sectors like healthcare and technology. For instance, the systematic review by Ahmed et al. [21] on data provenance in healthcare demonstrates the importance of well-defined methodologies to address specific research questions and challenges. Similarly, Ilyas and Khan's review of software integration challenges in global software development illustrates how SLR can be applied to identify challenges and propose solutions based on existing literature [22]. In the context of food waste, a systematic review by Thyberg and Tonjes on consumer behavior and waste prevention strategies highlights the role of SLR in consolidating findings across diverse settings, underlining the potential for evidence-based policy recommendations. These studies exemplify the adaptability of SLR across domains, showcasing its value in informing practice and policy through evidence-based insights.

2.3 PRISMA

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) is an iterative method aimed at enhancing the quality of SLR by ensuring comprehensive and systematic reporting. The PRISMA approach is considered a more rigorous examination process within systematic mapping, emphasizing increased inclusion of qualitative studies to assure the quality of mapping [23]. In this study, the PRISMA methodology was applied to document the review design meticulously, covering steps from literature identification to data synthesis and interpretation. The initial step involved defining the scope and protocol of the review, identifying primary studies across databases, and implementing inclusion/exclusion criteria [24].

After planning, primary studies are identified, selected, assessed for quality, and the data extracted and synthesized. In this review, each study underwent quality assessment using predefined criteria based on relevance, publication date, and methodological rigor. Studies were then categorized into sectors (household, retail, and food service) for clearer analysis, which addresses the need for a structured approach as recommended by the PRISMA framework. This iterative approach concludes with data analysis, discussion, and final conclusions, providing a comprehensive synthesis that aids in identifying actionable insights [24-27].

The PRISMA framework has been widely used in environmental studies to ensure transparency and thoroughness in reporting, as seen in studies by Elshaer et al. [28] on food waste in retail and household sectors, and Bell and Ulhas [29] on global food loss trends. These applications underscore the robustness of PRISMA in achieving high-quality reviews, especially in complex fields like food waste management.

2.4 Bibliometrics

Bibliometrics is a quantitative approach to analyzing and tracking developments within a specific research area. By organizing data—such as author affiliations, citations, keywords, methods, and themes—bibliometrics helps map trends, collaborations, and research patterns across a field, often using advanced statistical methods [25]. This method evaluates scientific journals, books, and other media, applying mathematical and statistical techniques to identify influential publications and research themes.

In the current study, bibliometric analysis is used to identify leading authors, predominant themes, and research trends within food waste literature, contributing to a structured overview of key developments in the field. By analyzing citation patterns and publication networks, bibliometric analysis offers insights into knowledge dissemination pathways, informing future research directions. For example, the analysis reveals significant contributions from researchers such as Beretta and Hellweg on environmental impacts and waste prevention strategies, as well as Alattar et al. [30] and Kritikou et al. [31] on household food waste dynamics. This mapping provides a framework to assess the impact and evolution of food waste studies.

Moreover, bibliometric studies on food waste management, such as those by Nisar et al. [32] and Chang and Suki [33], highlighted emerging research clusters and help identify gaps in cross-sectoral studies on waste reduction, revealing areas in need of further exploration. Bibliometric techniques not only assess progress within the field but also provide critical insights into interdisciplinary approaches needed to tackle food waste challenges effectively.

3. METHODOLOGY

This Systematic Literature Review (SLR) research follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and uses bibliometric analysis. This approach includes several steps, starting from establishing eligibility criteria, determining information sources, selecting studies, to the data collection and selection process.

3.1 Research question

The Research Question (RQ) used in this research is as follows:

RQ1: What are the variables that influence "Food Waste" that can be identified through empirical research?

RQ2: How many research articles have been published by each journal based on the extent of their relevance to the topic of Food Waste?

RQ3: Who are the most relevant authors for research related to the Food Waste theme?

RQ4: How have writers' production patterns related to the Food Waste theme developed over time?

RQ5: What are the documents most frequently cited globally in research on the Food Waste theme?

RQ6: What are the most dominant words related to research on the theme of Food Waste?

RQ7: How will topics related to Food Waste develop in academic literature from 2019 to 2024?

RQ8: What are the patterns and relationships between keywords that often appear together (co-occurrences) in the literature on Food Waste

3.2 Eligibility criteria

Eligibility criteria applied in conducting systematic literature review analysis are as follows:

EC1: All literature sources are original and have gone through a review process by fellow experts, written in English, and published in the 2019-2024 time period.

EC2: Studies that aim to understand factors impacting Food Waste, including research that explores specific aspects such as consumer behavior, inventory management, and policies related to food waste management.

EC3: Studies that are original research articles.

The choice of the 2019–2024 time range was made to ensure that the literature used in this study reflects the latest developments and findings in the field of Food Waste. This period also encompasses studies that reflect shifts in trends and increased attention to food sustainability, particularly in the context of the global climate crisis and heightened awareness of food waste management.

3.3 Data sources

In this research, data searches were carried out on the scientific database Scopus and the Google Scholar database, one of the largest and most well-known scientific databases that provides access to various journal articles that have gone through a peer-review process. In this research, the articles used cover the period from 2019 to 2024. This time range was chosen to ensure the relevance and novelty of the literature data used in the research analysis.

3.4 Research steps

3.4.1 PRISMA

The steps of the PRISMA method in this research were carried out in three stages as follows:

1. By using search keywords that match the research objectives, namely:

TITLE-ABS-KEY ("Food Waste") AND PUBYEAR > 2018 AND PUBYEAR < 2025 AND (LIMIT-TO (OA, "all")) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (SUBJAREA, "ENVI") OR LIMIT-TO (SUBJAREA, "AGRI")).

2. Explore and select the title, abstract, and keywords of the articles based on the eligibility criteria.
3. Sort and select all articles that were not eliminated in the previous selection by reading each article based on the Eligibility Criteria.

These steps follow the PRISMA framework to ensure that the screening and selection processes are conducted systematically and transparently. This approach is critical for ensuring the quality and reliability of the findings produced in the Systematic Literature Review.

3.4.2 Bibliometrics

The steps in carrying out Bibliometrics analysis in this research using Scopus and RStudio are presented as follows:

1. Determine search keywords. In this case it is Food Waste.
2. Perform a keyword search on Scopus with the following Scopus search query:

TITLE-ABS-KEY ("Food Waste") AND PUBYEAR > 2018 AND PUBYEAR < 2025 AND (LIMIT-TO (OA, "all")) AND (LIMIT-TO (DOCTYPE, "ar") AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (SUBJAREA, "ENVI") OR LIMIT-TO (SUBJAREA, "AGRI").

3. Compile data according to the Research Question prepared with the help of RStudio.
4. Download and install the latest versions of RStudio and R.
5. Open the RStudio application, and enter the code:
6. Install.packages(“bibliometrix”)
7. Library(bibliometrix)
8. Biblioshiny()
9. RStudio will redirect to the new link.
10. The files that have been saved are uploaded to the page
11. Complete data analysis.

3.5 Data items

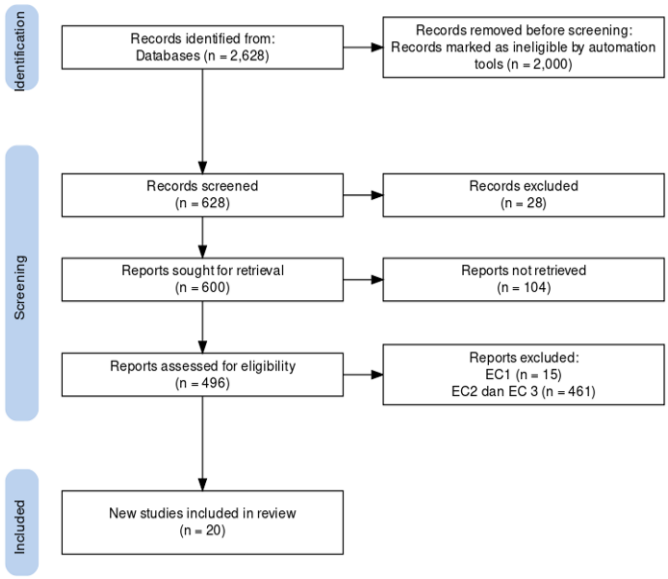

Figure 1. PRISMA flowchart

The information extracted from each article was compiled into the following categories: journal publication year, researcher details, country or sample information, project objectives, investigated factors or variables, their influence on Food Waste, and findings regarding the determining variables on Food Waste. The stages of the SLR (Systematic Literature Review) analysis method are presented in full in Figure 1.

4. RESULT AND DISCUSSION

4.1 PRISMA analysis and discussion

RQ1: What are the variables that influence "Food Waste" that can be identified through empirical research?

Based on research using the PRISMA method, the analysis results present a list of 20 selected articles that are relevant to this topic. The 20 selected articles are displayed in Table 1.

Table 1. List of selected articles

No.	Years	Authors	Title	Country & Sample	Purpose
1	2019	Grasso et al.	"Socio-demographic predictors of *Food Waste* behavior in Denmark and Spain".	Based on a survey involving 1,518 Danish consumers and 1,511 Spanish consumers, we examined the relationship of age, gender, education, marital status, employment status, and household size with FWB.	The objective of this study was to investigate socio-demographic predictors of FWB among consumers in two European countries: Denmark and Spain.
2	2019	Heidari et al.	"A theoretical framework for explaining the determinants of food waste reduction in residential households: A case study of Mashhad, Iran".	This study involved 382 households in Iran as research samples. Data were collected from this sample using a systematic random sampling technique to explore food waste reduction behavior among Iranian households.	The aim of this study was to examine food waste reduction behavior among Iranian households. This study uses the Theory of Planned Behavior (TPB) as its conceptual framework, and attempts to expand the TPB by including new variables (e.g., marketing addiction, perceived attribution of responsibility, moral attitudes, waste prevention behavior, and characteristics sociodemographic) to understand the factors that influence intentions to reduce food waste.
3	2020	Bell & Ulhas	"Working to reduce *Food Waste*: Investigating determinants of *Food Waste* amongst Taiwanese workers in factory cafeteria settings".	In this study, the research sample consisted of 156 participants who were factory workers in Taiwan. They were the subjects of a survey conducted using a pen-and-paper-based questionnaire method.	The aim of this study was to investigate the factors influencing the behavioral intentions of Taiwanese factory workers in reducing food waste in factory canteens. This research uses a conceptual framework that utilizes the Theory of Planned Behavior and expands it with the Norm action model and pro-environmental factors, as well as additional factors such as habits, canteen service quality, and situational factors.
4	2020	Alattar et al.	"*Food Waste* knowledge, A nowledge, Attitudes, and Beha ttitudes, and behavioral intentions among university students".	This research involved 495 students from a university as research subjects. These participants are the student population used to analyze the factors that influence behavior related to food waste in the university student environment.	The aim of this research is to understand the factors underlying student behavior regarding food waste, with a focus on understanding the potential for improving targeted food waste diverticulation programs in university settings.
5	2020	Ariyani & Ririh	"Understanding Behavior of household *Food Waste* Management: *Food Waste* hierarchy context".	This research involved households in Indonesia as the research sample.	The aim of this research is to expand the Theory of Planned Behavior (TPB) by using constructs such as intentions, attitudes, subjective norms, perceived behavioral control, government intervention, environmental knowledge and awareness, and household planning and purchasing habits, to understand management behavior household waste from a 'reduce-reuse-recycle' perspective.
6	2021	Kritikou et al.	"Investigating the determinants of greek households *Food Waste* prevention behaviour".	This research involved 921 households in Greece. They used a structured questionnaire based on the explanatory framework of the Theory of Planned Behavior, a cognitive model widely used in environmental psychology.	This study aims to analyze consumer food waste behavior and identify factors influencing the generation of food waste in Greek households. The study also wanted to examine the relationships between the main parameters in the model (attitudes towards food waste, subjective norms, perceived behavioral control, intentions, and reported behavior), as well as knowledge about food waste prevention, general environmental knowledge, planning and shopping habits, as well as demographic characteristics.

No.	Years	Authors	Title	Country & Sample	Purpose
7	2021	Elshaer et al.	"The impact of religiosity and food consumption culture on *Food Waste* intention in Saudi Arabia".	This research involved 1135 restaurant customers in the Kingdom of Saudi Arabia (KSA). They use questionnaires that have been pre-tested and filled in by the respondents themselves.	This study aims to answer questions regarding to what extent and through what mechanisms religiosity can influence food disposal intentions. This research also examines the direct impact of both religiosity and food consumption culture on food disposal intentions, as well as indirect impacts through constructs from the Theory of Planned Behavior.
8	2022	Setiawan et al.	"Factor affecting the behaviour of the households of *Food Waste* of vegetables and fruits in Sleman District, Yogyakarta, Indonesia."	This research involved 150 respondents living in Sleman Regency, Yogyakarta, Indonesia. They were interviewed to find out the amount of food waste from vegetables and fruit produced by households.	This research has two main objectives. First, to find out the amount of vegetable and fruit waste produced by households. Second, to understand the influence of food waste management and other factors on food waste behavior from vegetables and fruit by households.
9	2022	Niha et al.	"Factors influencing behavior to reducing household *Food Waste* in Indonesia."	The research sample consisted of 132 people in Indonesia who were research subjects. They are part of the population used to examine variables related to food waste reduction behavior in households.	The purpose of this research is to expand the theory of planned behavior, the theory of interpersonal characteristics, and the complete model of environmental behavior by using variables such as intentions, attitudes, subjective norms, perceived behavioral control, habits, and emotions. This study aims to determine significant factors in behavior to reduce food waste, finding that intention, habit, attitude, and perceived behavioral control are important factors. In addition, this study also emphasizes the important role of habits in food waste reduction behavior, indicating the need to focus on the importance of practice to eliminate addiction and the importance of cultivating positive habits in this regard.
10	2022	Azazz and Elshaer	"Amid the COVID-19 pandemic, social media usage and *Food Waste* intention: The role of excessive buying behavior and religiosity."	This study involved 1250 restaurant customers in the Kingdom of Saudi Arabia (KSA) as research samples. They are the subjects of this research which is used to explore the influence of social media usage (Social Media Usage, SMU) on the intention to throw away food (Food Waste Intention, FWI) by considering the mediating role of religiosity and excessive purchasing behavior in the midst of the coronavirus pandemic (COVID-19).	The aim of this study was to examine the impact of social media use (SMU) on food waste intention (FWI) by considering the mediating role of religiosity and excessive purchasing behavior amidst the COVID-19 pandemic among restaurant customers in the Kingdom of Saudi Arabia.
11	2023	Pandey et al.	"Factors influencing consumers' *Food Waste* reduction behaviour at university canteens."	An online survey was conducted in Denmark among university canteen users (n = 438). Hierarchical cluster analysis identified four segments, (1) Consumers who are sensitive to familiarity – 34.9 % of participants, (2) Consumers who do not care – 19.9 %, (3) Consumers of food for health and mood – 19.2 %, and (4) Unfamiliar consumers – 26 %.	This study groups consumers based on their food choice motives and investigates the main factors influencing food waste reduction behavior in university cafeterias using an attitudinal, social influence, and self-efficacy (ASE) framework expanded with environmental, situational, and sociodemographic and style concerns factors. life.

No.	Years	Authors	Title	Country & Sample	Purpose
12	2023	Vasela et al.	"From the shopping basket to the landfill: Drivers of consumer *Food Waste* behaviour."	identified the main factors influencing food waste by surveying 1,551 respondents regarding stated preferences.	This study responds to unmet needs by drawing attention to food waste and its reduction, and may even serve as a model example for EU targets, as well as identifying the main factors influencing food waste.
13	2023	Hao et al	"Factors influencing food-waste behaviors At University Canteens in Beijing, China: An investigation based on the theory of planned behavior."	The sample for this research was 705 respondents who participated in a field survey at the China Agricultural University canteen. In the context of the theory of planned behavior, this sample represents the population that the researcher wishes to study or understand. Thus, from these 705 respondents, researchers were able to analyze and evaluate the behavior and attitudes that might be reflected in the student population or canteen visitors at the university.	To understand the factors influencing students' food-waste behavior in university canteens in Beijing. In addition, this paper examines the factors that influence students' food throwing behavior from three dimensions: sociopsychological factors, individual characteristics, and eating factors.
14	2023	Rahman & Tung	"Household *Food Waste* behaviour in Sarawak, Malaysia: A hierarchical regression analysis."	The sample in this study was households in the state of Sarawak, Malaysia. The research involved 2,059 respondents selected using a multistage random sampling technique.	The aim of this research is to apply the Theory of Planned Behavior in identifying factors associated with food waste behavior in Sarawak. This study aims to understand the factors that influence attitudes, subjective norms, and behavioral control related to food waste behavior among Sarawak residents.
15	2023	Agwa & Elnadory	"Food Handlers' Intentional Behaviors toward *Food Waste* in Hospitals."	This research involved 243 food handlers working in private hospitals as research samples. They are the subjects used to investigate intentional behavior regarding food waste in hospital settings.	The aim of this study was to explore the intentional behavior of food handlers regarding food waste in the hospital environment. This research uses the Theory of Planned Behavior (TPB) as a theoretical framework for understanding intentional behavior regarding food waste.
16	2023	Watanabe et al.	"*Food Waste* in restaurants: Evidence from Brazil and the United States."	This study involved 573 consumers from à la carte restaurants, with 283 respondents from America and 290 respondents from Brazil. They are the subject of a transcultural study used to explore factors influencing intentions to reduce food waste by American and Brazilian consumers in à la carte restaurants.	The aim of this study is to identify factors influencing Brazilian and American consumers' intentions to reduce food waste in à la carte restaurants, based on the Theory of Planned Behavior (TPB).
17	2023	Ma et al	"Modeling the intention and adoption of *Food Waste* prevention practices among Chinese households."	This study involved household consumers in China as the research sample. Data was collected through a cross-sectional survey approach that uses social media platforms to collect information from households.	The aim of this study is to investigate the factors influencing Chinese household consumers' intentions to reduce food waste and their actual behavior regarding food waste. In doing this, this research integrates the Theory of Interpersonal Behavior (TIB) to fill existing knowledge gaps, particularly in the context of a developing country such as China, where most research on motivations for reducing food waste has been conducted in rich countries.

No.	Years	Authors	Title	Country & Sample	Purpose
18	2023	Viccaro et al.	"Young people are not all the same! The theory of planned behaviour applied to *Food Waste* behaviour across young Italian generations."	This study involved 322 young Italian people consisting of two groups, namely Generation Y and Generation Z. They were the subjects of this research which was used to explain and predict food waste behavior (FWB) among young Italians.	The test of this research is to expand the Theory of Planned Behavior (TPB) by including personal norms and environmental concerns to explain and predict food waste-related behavior of Generation Y and Generation Z in Italy.
19	2023	Schrank et al	"Factors of *Food Waste* reduction underlying the extended theory of planned behavior: A study of consumer behavior towards the intention to reduce *Food Waste*."	This study used a sample of 369 individuals in Thailand as research subjects. These participants constitute the population used to examine the food waste reduction behavior of individual consumers and to explore factors that may explain intentions to reduce food waste.	The aim of this research is to study the food waste reduction behavior of individual consumers and to explain the factors that may explain the intention to reduce food waste. This study uses the Theory of Planned Behavior (TPB) as its conceptual basis to explain the relationship between individual attitudes, subjective norms, and perceived behavioral control.
20	2023	Nguyen et al.	"Motivations behind daily preventative household *Food Waste* behaviours: The role of gain, hedonic, normative, and competing goals."	This study uses data from a household survey with a total of 1030 participants as the research sample.	The aim of this research is to show how various consumer motivations, including profit motivation, hedonic, normative, and competitive motivation, can influence food waste through daily food management (planning, purchasing, storing, preparing, and managing food waste) . This study aims to highlight how these motivations influence food management behavior which then impacts food waste.

1. **Food Waste Management in Denmark and Spain**
   Table 1 provides an overview of studies investigating food waste management across different countries and contexts. In Denmark and Spain, Grasso et al. [26] examined the relationship between socio-demographic factors and food waste behavior, revealing that age, gender, and household size significantly influence food disposal habits. This study contributes to understanding how demographic factors impact food waste, with findings suggesting that socio-demographics may play varying roles across cultural contexts. In contrast, Heidari et al. [27] in Iran applied the Theory of Planned Behavior (TPB) with additional variables like marketing addiction and perceived responsibility, offering deeper insights into behavioral motivations for food waste reduction. The contrasting cultural and demographic settings between Europe and Iran highlight the need to adapt intervention strategies based on regional factors.
2. **The Influence of Culture and Religion on Food Waste Management in Saudi Arabia**
   Religiosity and food consumption culture were found to significantly influence food disposal intentions in Saudi Arabia, as demonstrated by Elshaer et al. [28]. The study suggests that integrating cultural and religious dimensions into food waste awareness campaigns can be effective, especially in regions where these factors are deeply ingrained in daily life. Additionally, Bell and Ulhas [29] in Taiwan and Alattar et al. [30] among university students reveal the role of socio-psychological factors, such as injunctive norms and situational factors, indicating the importance of considering diverse cultural and environmental contexts in food waste studies.
3. **Sociodemographic Factors and Their Influence on Food Waste in Denmark and Spain**
   Socio-demographic factors, such as age, gender, and employment status, were found to have limited predictive power in Denmark and Spain; however, certain trends emerged, such as older individuals generating less waste [26]. Interestingly, men and larger households in Denmark waste more food, whereas these factors are not significant in Spain, suggesting regional differences in consumer habits. These differences underscore the complexity of food waste behavior and the importance of tailoring strategies to specific demographic profiles.
4. **Theory of Planned Behavior (TPB) and Food Waste Reduction in Iran**
   In Iran, Heidari et al. [27] expanded the TPB model with additional factors, such as moral responsibility and behavioral control, to understand food waste reduction behavior. Their findings show that individual attitudes, subjective norms, and perceived behavioral control are crucial in shaping intentions to reduce food waste. This study indicates that psychological factors, such as moral awareness and social pressure, have a significant influence on consumer behavior regarding food waste, suggesting that multidimensional interventions are essential in reducing waste.
5. **The Influence of Environmental Awareness and Situational Factors on Food Waste Reduction**
   Bell and Ulhas [29] in Taiwan employed the TPB framework, adding environmental and situational factors to explore food waste behavior. Their findings indicate that awareness of climate change and injunctive norms are strong motivators for waste reduction. This approach emphasizes the need to integrate environmental education in food waste prevention programs, as awareness of environmental impact may enhance motivation to reduce waste.
6. **Planning and Shopping Habits in Household Food Waste Management**

Kritikou et al. [31] found that food waste prevention is influenced by environmental attitudes, perceived behavioral control, and awareness of waste prevention impacts, with shopping and planning habits playing a crucial role. Their research suggests that excessive purchasing increases waste, while regular planning reduces it, reinforcing the importance of responsible shopping behaviors in household waste reduction.

7. **Food Consumption Culture and Religiosity in Saudi Arabia**
   In Saudi Arabia, Elshaer et al. [28] identified that food consumption culture and religiosity significantly affect food waste intentions, especially in social gatherings where hospitality norms prevail. While religiosity showed a weaker influence, the study suggests that subjective norms may mediate the impact of religiosity on food waste intentions. This finding underscores the role of cultural factors in shaping waste behavior and highlights the need for culturally sensitive interventions.
8. **Consumer Behavior and Situational Factors in University Cafeterias**
   In university cafeterias, situational factors like food quality, pricing, and service impact food waste behaviors. Nisar et al.'s [32] research indicated that quality and menu diversity significantly affect students' satisfaction and waste habits. Similarly, Chang and Suki [33] and Cárdenas et al. [34] found that service efficiency and cafeteria ambiance play vital roles in student dining choices, indicating that enhancing the overall dining environment can reduce food waste in institutional settings.
9. **The Influence of Sustainability Values and Social Norms on Food Waste Reduction**
   Ma et al. [35] applied the Theory of Interpersonal Behavior (TIB) to examine the influence of sustainability values, social norms, and anticipated guilt on food waste intentions in China. Their study, along with Viccaro et al.'s [36] findings on personal norms and environmental concerns in Italy, emphasizes the influence of normative and emotional factors on food management behaviors, suggesting that awareness of environmental impact and guilt may strongly motivate waste reduction efforts.
10. **Waste Prevention Behavior and Normative Motivation**
    Schrank et al. [6] found that waste prevention behavior and perceived behavioral control significantly impact waste reduction intentions, with normative motivation and environmental concerns playing key roles in shaping food management practices. Normative motivations, including environmental and moral concerns, were found to greatly influence food planning and leftover management, aligning with the findings of studies [37-39] that normative motivations strongly affect food management behaviors, significantly reducing waste.

4.1.1 Conclusion and key insights

Based on the various studies discussed, several important conclusions can be drawn about the behavior of food waste reduction and management in different social and geographical contexts.

1. **Food waste behavior is influenced by multidimensional factors:** Many studies show that food waste behavior cannot be explained solely through a single perspective, such as demographics. For example, studies in Denmark and Spain show that sociodemographic factors such as age, gender, and employment status provide limited predictive value for food waste behavior. More significant factors tend to be rooted in shopping and food preparation habits, as well as psychological factors like attitudes and moral awareness.
2. **Theory of Planned Behavior (TPB) and psychological approaches:** The use of TPB in various studies, such as those in Iran and other contexts, demonstrates that individual attitudes, subjective norms, and perceived behavioral control play important roles in shaping intentions to reduce food waste. Additionally, the inclusion of variables like moral responsibility and marketing addiction provides deeper insights into the psychological factors influencing food waste reduction. This psychological approach further emphasizes the importance of considering mental and social aspects to encourage more responsible behavior.
3. **Consumption culture and religiosity play key roles in certain contexts:** Studies conducted in Saudi Arabia highlight the role of consumption culture and religiosity in shaping intentions to waste food. Social traditions, such as hospitality and excessive celebrations, lead to an increase in the amount of food served, which ultimately ends up as waste. Although religiosity plays a smaller role in this context, subjective norms and individual attitudes still act as important mediators. This suggests that approaches to reducing food waste must consider cultural and religious factors in specific regions.
4. **Shopping habits and consumption planning:** Some studies, such as those conducted by Kritikou et al. [31] show that excessive purchasing and shopping without proper planning significantly contribute to increased food waste. However, research also finds that regular planning, such as purchasing based on actual needs and avoiding impulsive buying, can help reduce the amount of waste generated.
5. **Environmental awareness and social norms:** Another recurring factor in research is environmental awareness and social norms. Studies by Alattar et al. [30] and Ma et al. [35] show that awareness of the environmental impact of food waste, as well as social pressure from existing norms, can drive individuals to reduce food waste. In some cases, emotional factors such as anticipated guilt also motivate waste reduction behavior.
6. **Behavior in specific environments:** Studies in university and factory canteen settings show that food waste behavior is also influenced by situational factors, such as portion size, meal timing, and expectations of the food served. These findings suggest that effective interventions need to consider the context in which food is consumed, not just individual and social factors.

4.1.2 Key takeaways

1. **A multidimensional approach is crucial:** No single approach is sufficient to address the issue of food waste. Instead, a comprehensive understanding is required, encompassing demographic, psychological, social, and cultural factors. This means that policy interventions or food waste reduction programs must be designed with consideration for the diverse contexts in which food waste occurs.
2. **The critical role of consumption planning and**

individual awareness: Educating the public on the importance of consumption planning and reducing excessive purchasing habits is vital. By increasing awareness of the environmental impact of food waste and the importance of managing unused food, more responsible behavior can be cultivated.

3. **Local culture and traditions must be considered:** In regions with strong consumption cultures, such as Saudi Arabia, interventions must include approaches that take into account the social norms and traditions underpinning excessive consumption habits. Education on the importance of not wasting food and cultural change related to excessive consumption should be carried out in a way that respects local traditions.
4. **Emotional factors as drivers of change:** Anticipated guilt or a sense of moral responsibility can be strong drivers in encouraging food waste reduction. Interventions that emphasize emotional aspects, such as responsibility toward the environment and future generations, can enhance individual motivation to reduce waste.

4.2 Systematic impact

Based on 20 selected articles and analysis using a Systematic Literature Review method, the impacts, findings, conclusions and references related to food waste are shown in Table 2 below.

Table 2. Impact of mental health

No.	Variable Determinant Factors	Previous Research	Results	Conclusion
1	*Perceived Behavioral Control (PBC)*	Agwa and Elnadory (2023) Ariyani and Ririh (2020) Heidari et al. (2020) Rahman and Tung (2023) Vicaro et al. (2023)	Not significant	Inconsistent results
		Elshaer et al. (2021) Niha et al. (2022) Schrank et al. (2023) Hao et al. (2023)	Positive	
		Kritikou et al.(2021) Setiawan et al. (2022)	Negative	
		Hao et al. (2023) Rahman and Tung (2023)	Not significant	
2	*Intention*	Bell and Ulhas (2020) Setiawan et al.(2022) Watanabe et al. (2023) Agwa and Elnadory (2023)	Positive	Inconsistent results
		Ma et al. (2023) Vicaro et al. (2023)	Negative	
3	*Attitude*	Ariyani and Ririh (2020) Rahman and Tung (2023) Pandey et al. (2023) Vasela et al. (2023)	Not significant	Inconsistent results
		Kritikou et al. (2021) Elshaer et al. (2021) Niha et al. (2022) Alattar (2020) Schrank et al. (2023)	Positive	
		Elshaer et al. (2021) Kritikou et al. (2021)	Negative	
4	*Subjective Norm (SN)*	Niha et al. (2022) Rahman and Tung (2023) Schrank et al. (2023)	Not significant	Inconsistent results
		Heidari et al. (2020)	Positive	
		Elshaer et al. (2021)	Negative	
5	*Religiosity*	Elshaer et al. (2021)	Not significant	Inconsistent results
		Azazz and Elshaer (2022) Setiawan et al.(2022)	Negative	
6	*Household*	Hao et al. (2023) Grasso et al. (2019)	Not significant	Inconsistent results
		Alattar (2020)	Positive	

The table above explores various determinant factors such as Perceived Behavioral Control, Intentions, Attitudes, Subjective Norms, Religiosity, and Household, as well as their impact on mental health based on a synthesis of various research studies. Results from studies appear to be mixed, highlighting inconsistent results in the relationship between these variables and mental health outcomes. For example, Perceived Behavioral Control shows varying impacts across research conducted by Nguyen et al. [39] and Ariyani et al. [40], ranging from insignificant impacts to positive and negative impacts.

Likewise, other variables such as Intention and Attitude also show inconsistent results across studies, indicating a complex interaction between these factors in influencing mental health, with some studies showing a positive impact, while others showing a negative or insignificant impact. This review

suggests a need for more nuanced research to disentangle the impact of psychological and social variables on mental health.

4.3 The influence of variables in food waste research

The research results show that there are three determining variables with inconsistent effects on Mental Health, namely: Perceived Behavioral Control (PBC), Intention, Attitude, Subjective Norm (SN), Religiosity and Household. The following is a detailed explanation of these six variables.

1. Perceived Behavioral Control (PBC)

Based on the results of the Literature Review, it shows that there are varying results in relation to the influence of Perceived Behavioral Control (PBC) on the dependent variable Food Waste. Research conducted by Nguyen et al. [39] and Ariyani and Ririh [40] did not find a significant relationship, while other research conducted by Elshaer et al. [28] and Fan et al. [41] showed a significant relationship and positive. In contrast, research conducted by Kritikou et al. [31] found a negative relationship between Perceived Behavioral Control and Food Waste. These data illustrate inconsistent results in the existing literature, highlighting the uncertainty regarding the influence of Perceived Behavioral Control on Food Waste. Some studies show the existence of a significant relationship, while others find none, and even contradictory findings.

This highlights the need for further research that is more focused and comprehensive in understanding the role of Perceived Behavioral Control in influencing Food Waste. These inconsistencies may indicate the complexity and diversity of factors influencing food waste behavior, as well as the importance of paying in-depth attention to this aspect to obtain a clearer and more consistent picture.

2. Intention

The results of the Literature Review show that there are variations in results in the relationship between variables that influence Food Waste. Several studies by Fan et al. [41] and Rahman and Tung [42], did not find a significant relationship, while Bell and Ulhas [29] and Setiawan et al. [43] showed a positive relationship. In contrast to research by de Morais Watanabe et al. [44] did not provide information regarding the results. On the other hand, Ma et al. [35] and Nguyen et al. [39] found a significant relationship, but Ariyani and Ririh [40] found a negative relationship between the determinant variables and Food Waste. However, information from Viccaro et al. [36] is not yet available.

This shows the diversity of findings in the literature, highlighting the uncertainty in the relationship between determinant variables and Food Waste. There are findings that support a significant relationship, other findings that show no relationship, and even conflicting findings. This highlights the importance of further research to understand in depth and focus the role of determinant variables on Food Waste.

3. Attitude

Based on the analysis of existing literature, there are varying results in the relationship between the independent variable Attitude and the dependent variable Food Waste. Several studies, such as by Elshaer et al. [28] and Alattar et al. [30] show a significant relationship between Attitude and Food Waste. On the other hand, several other studies by Rahman and Tung [42] and Niha et al. [45] did not find a significant relationship, while research by Kritikou et al. [31] showed a positive relationship but at the same time also found a negative relationship.

This data shows that there are inconsistencies in the literature regarding the influence of Attitude on Food Waste. Some studies show a significant and unidirectional relationship, while others do not find a consistent relationship or even find an inverse relationship. This variability may indicate the complexity of factors influencing Food Waste behavior, as well as the possibility that there are additional factors that need to be considered. In this context, further research that is more focused and comprehensive in understanding the role of Attitude in influencing Food Waste is very important.

4. Subjective Norm (SN)

Based on the results of the Literature Review, there are variations in the influence of Subjective Norm (SN) on the dependent variable Food Waste. Several studies such as did not find a significant relationship between SN and Food Waste [6, 31, 42, 45]. Meanwhile, the results of other research show that there is a significant and positive relationship between these two variables [27], and a significant but negative relationship between SN and Food Waste [28]. These results reflect inconsistencies in the literature regarding the influence of Subjective Norms on Food Waste. Some studies show a significant relationship, while others find none. There are conflicting findings, highlighting the complexity of the variables that influence Food Waste.

5. Religiosity

Based on existing literature research, there are significant variations in results related to the influence of Religiosity on the dependent variable Food Waste. Research by Azazz and Elshaer [46] found a significant and positive relationship, while Setiawan et al. [43] showed a significant and negative relationship. The results of other studies did not show significant results so there were inconsistencies in the findings [28].

This confirms that the existing data has significant differences in the interpretation of the influence of Religiosity on Food Waste. Some studies found a significant correlation, while others did not show similar results, and even found the opposite results. This variability reflects the complexity and diversity in factors that influence food waste behavior, as well as the need for more focused and comprehensive research in understanding the role of religiosity in food waste.

6. Household

Based on the results of the Literature Review, there are varying results regarding the influence of the Household variable on the dependent variable Food Waste. Some studies did not show a significant relationship and had inconsistent results [26, 41]. Other results found a significant and positive relationship [30], and a significant but negative relationship between the Household and Food Waste variables [31].

These results indicate uncertainty in the literature regarding the influence of household variables on food waste. There are some studies that show the existence of a significant relationship, while other studies do not find it, some even find the opposite results. These inconsistencies highlight the complexity and diversity of factors that influence food waste behavior, and demonstrate the need for more focused and comprehensive research in understanding the role of the household in food waste.

4.4 Bibliometric analysis and discussion

This bibliometric analysis covers data from 2019 to 2024, as presented in Figure 2, showing the scope of the analysis

taking place over a long period and using the most recent sources.

- There are 523 sources used in this research, indicating the use of data from a variety of diverse reference sources.
- In this analysis, 2.628 documents were used, such as articles, papers and other scientific documents.
- The annual growth rate was -38.3%, indicating a significant decrease in the number of research-relevant articles during the analysis period.
- In the documents analyzed, there were 10.398 authors who contributed to this topic, showing diversity in the authors involved.
- A total of 73 documents were written by a single author, demonstrating individual contributions to this research topic.
- International collaboration reached 32.88%, indicating collaboration between authors from various countries on most documents.
- An average of 5.1 authors are involved in each document, indicating team collaboration in scientific research.
- The author's use of 7.468 keywords provides insight into the main focus of the topics in the document.
- An average of one reference is used in the documents, perhaps indicating a focus on primary data analysis or innovative research approaches.
- The average age of documents is 2.63 years, indicating the use of relatively new documents in the analysis.
- Each document received an average of 13.49 citations, indicating recognition in the scientific literature by other researchers.

This bibliometric analysis provides an overview of data sources, research growth, author characteristics, and other important aspects related to this research. Identification of key elements such as Annual Scholarly Production, Primary Sources, Notable Authors, and others provides a deeper understanding of the research contribution in understanding the topic under study, presented in Figure 2.

Figure 2. Main information

4.5 Identification of key elements

RQ2: How many research articles have been published by each journal based on the extent of their relevance to the topic of Food Waste?

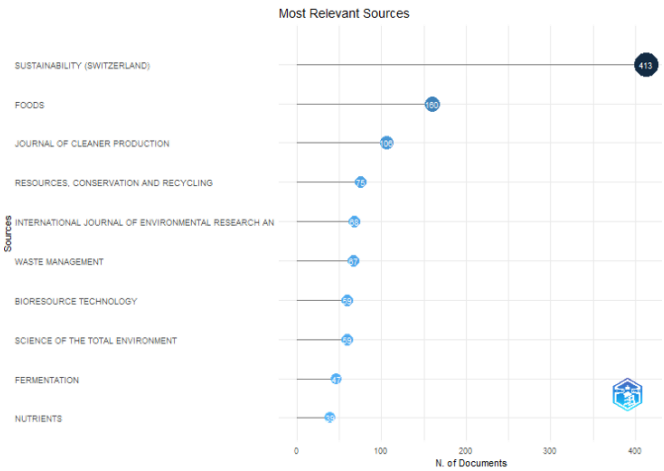

Figure 3. Most relevant source

Based on Figure 3 which shows the "Most Relevant Sources" related to Food Waste, it can be seen that several journals have made significant contributions to research on this topic. The journal "Sustainability (Switzerland)" has the highest contribution with 413 documents related to Food Waste, followed by "Foods" with 160 documents, and "Journal of Cleaner Production" with 106 documents.

Data shows that the journal "Sustainability (Switzerland)" publishes significantly more documents related to Food Waste compared to other journals. The high number of publications from this journal may indicate a strong focus on supporting research on food waste reduction. The journals "Foods" and "Journal of Cleaner Production" also have significant contributions, although not as much as "Sustainability (Switzerland)".

From the results of this research, it can be concluded that "Sustainability (Switzerland)" is the main source in providing information related to Food Waste, while "Foods" and "Journal of Cleaner Production" also play an important role in disseminating knowledge and research on this topic.

RQ3: Who are the most relevant authors for research related to the Food Waste theme?

Figure 4 illustrates the published contributions of several authors that are highly relevant to research on Food Waste. Based on this data, there are several authors who stand out in the relevance and contribution of their publications related to the Food Waste theme. In these results, author Zhang Y stands out as the main contributor with 27 documents related to Food Waste, followed by Eriksson M and Wang X with 20 documents each, and Wang Y with 19 documents.

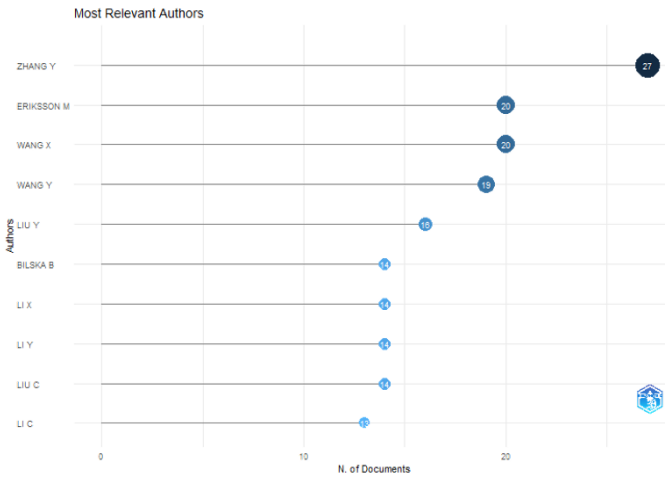

Figure 4. Most relevant authors

The mentioned authors have significantly contributed to the scientific literature on food waste. Zhang Y, holding the highest number of publications, consistently contributes to spreading knowledge on this topic. Although no single author dominates in terms of publication volume, this group collectively plays a crucial role in advancing our understanding of food waste. This situation highlights the diverse contributions of different authors to the research field of food waste.

RQ4: How do writers' production patterns related to the Food Waste theme develop over time?

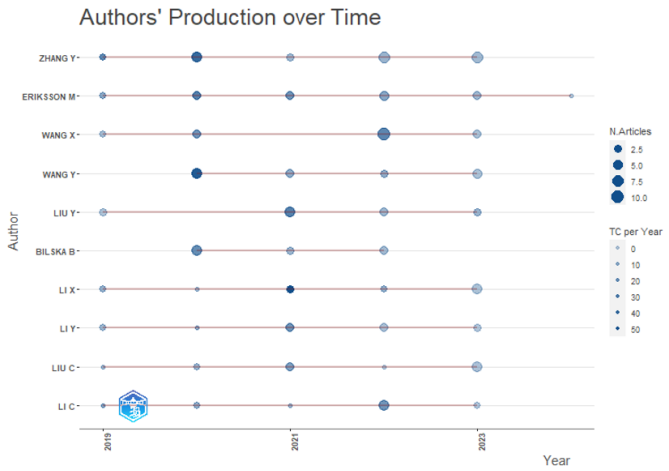

Figure 5. Authors production over time

Figure 5 displays the author's production patterns related to the Food Waste theme during the time period studied. In the graph, it can be seen that several authors have made significant contributions to the production of articles related to Food Waste in 2023. Zhang Y, Eriksson M, Wang X, Wang Y, Liu Y, Bilska B, Li X, Li Y, Liu C, and Li C are the authors who are active in writing articles on the topic of Food Waste in 2023. They have made quite a large contribution in producing literature related to this theme in that year. The data shows that there is a group of authors who are consistently contributing to the literature related to Food Waste, especially in 2023. This could indicate a strong interest or deep research focus of this group of authors in the topic.

RQ5: What are the documents most frequently cited globally in research on the Food Waste theme?

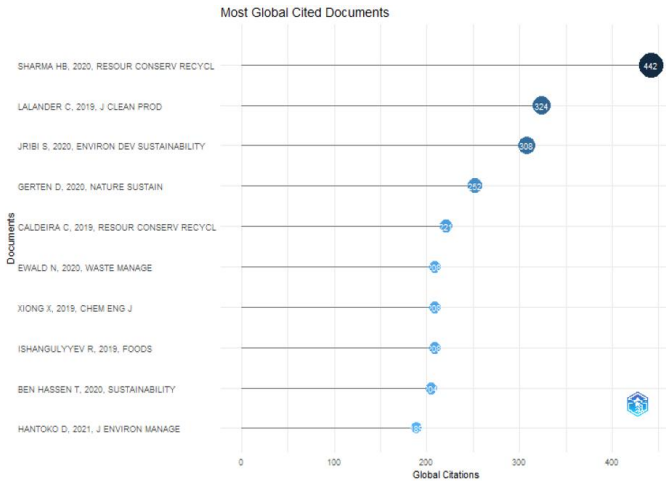

Figure 6. Most global cited documents

Figure 6 shows the most frequently cited documents globally in research on Food Waste. Based on this data, several documents have a significant number of citations from global literature related to the Food Waste theme. The most cited document is an article written by Sharma HB in 2020, published in the journal "Resources, Conservation and Recycling," with a total of 442 citations. This article highlights important issues regarding the role of circular economies and sustainability efforts in reducing food waste.

The second most cited document is by Lalander C in 2019, published in the journal "Journal of Cleaner Production" with 324 citations. This article likely focuses on cleaner production methods that support the reduction of food waste through improved industrial processes. Third on the list is a 2020 article by Jribi S in the journal "Environmental Development and Sustainability," with 308 citations. This document explores sustainable development practices, particularly how societies can implement strategies to better manage food waste.

These documents represent a significant contribution to research related to Food Waste and may have a major impact on the understanding and development of literature on the topic. This shows that certain works have had a broad influence in supporting research and global understanding of Food Waste.

RQ6: What are the most dominant words related to research on the theme of Food Waste?

Figure 7. Words count

Figure 7 presents a word cloud that visually represents the most dominant words in research articles related to the theme of Food Waste. The word cloud is generated based on the frequency of words appearing in the article data set, with the

more frequently occurring words displayed in a larger font size, making them more prominent in the visualization.

In the word cloud, the most dominant word is clearly "Food Waste", which is expected, given that the analysis revolves around this theme. Following this, the terms "Anaerobic Digestion," "Waste Management," "Article," "Food," and "Waste Disposal" appear in relatively large sizes, suggesting that these are key areas of focus and recurrent concepts in Food Waste research.

Anaerobic digestion is a biological process that converts organic waste materials into biogas or methane, and its prominence in the word cloud indicates its significant role in food waste treatment and management strategies. Waste Management is also highly relevant, representing various methods and systems designed to handle, reduce, and process food waste efficiently. The presence of terms like "Waste Disposal" emphasizes the importance of how food waste is ultimately discarded and the associated environmental impacts.

Additionally, smaller but still visible terms such as "Methane," "Sustainability," "Environmental Impact," "Recycling," and "Biogas" indicate that the research on Food Waste frequently overlaps with topics related to environmental sustainability and energy recovery. Methane, a by-product of food waste decomposition in landfills or through anaerobic digestion, is a significant greenhouse gas, and its inclusion in the cloud reflects the growing concern over its contribution to climate change.

RQ7: How will topics related to Food Waste develop in academic literature from 2019 to 2024?

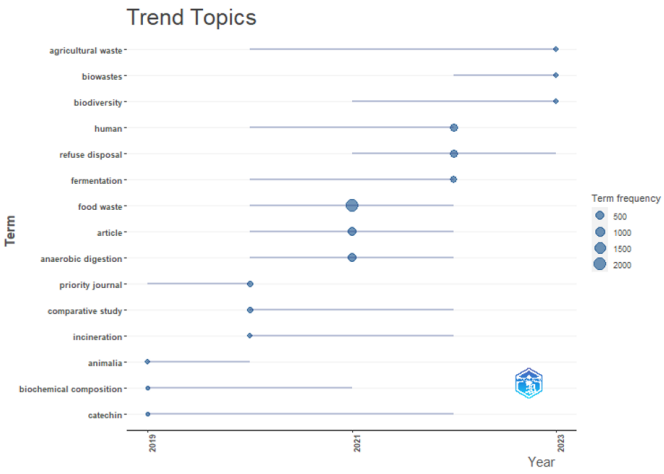

Figure 8. Trend topics in food waste research (2019-2024)

Figure 8 illustrates the trends in academic topics related to Food Waste from 2019 to 2024. By analyzing the frequency of key terms over this time period, we can gain insight into the evolution of research themes and priorities in the field of Food Waste management and sustainability. The size of the circles in the figure represents the frequency with which these terms appear in academic literature, with larger circles indicating a higher frequency of occurrence.

The terms "Agricultural Waste," "Biowastes," and "Biodiversity" are prominent topics across this period, which suggests a growing interest in the environmental and ecological dimensions of food waste. Agricultural Waste and Biowastes reflect the importance of addressing food waste at the production and processing stages, while Biodiversity emphasizes the impact of waste on ecosystems, showcasing the interconnectedness between food waste and broader environmental concerns. Human is also a key term, underscoring the significant role that human activity—both consumption and production—plays in the generation of food waste. It may also point to research that explores consumer behavior, food distribution, and societal patterns that contribute to waste.

Refuse Disposal and Fermentation are terms that reflect the technological and waste management processes that have become central to addressing food waste. The focus on Fermentation is particularly notable, as it signifies interest in biotechnological processes that convert food waste into value-added products, such as biofuels or other useful chemicals. This highlights a shift in research toward more sustainable and circular economy approaches. Food Waste itself, unsurprisingly, remains a dominant term, indicating that it continues to be a central topic of inquiry. The prominence of Anaerobic Digestion alongside Food Waste reinforces the relevance of bioenergy recovery technologies, where food waste is utilized to produce biogas, helping to mitigate environmental impacts.

In conclusion, Figure 8 presents a comprehensive overview of the evolving research landscape related to food waste. It shows a clear shift towards sustainability, circular economy solutions, and the biotechnological valorization of food waste. At the same time, it highlights the persistent need to address the environmental impact of food waste, while also focusing on human behavior and system-wide approaches to achieve more effective food waste management.

RQ8: What are the patterns and relationships between keywords that often appear together (keyword-co-occurrences) in the literature about Food Waste?

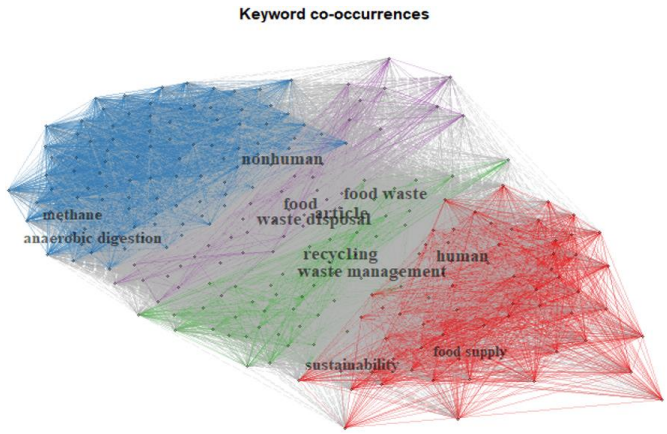

Figure 9. Keyword co-occurences

Figure 9 illustrates the co-occurrence of keywords that frequently appear together in academic literature about Food Waste from the period 2019 to 2024. The visualization reveals distinct clusters of keywords that are strongly connected to one another, indicating thematic areas where research overlaps and integrates multiple concepts. These connections represent the relationships and patterns of discussion in Food Waste research, helping to uncover the broader framework of related topics.

The keywords that stand out prominently in the figure include "waste disposal," "recycling," "waste management," "human," "non-human," "food supply," "sustainability," "methane," and "anaerobic digestion." Each of these keywords is closely associated with certain thematic clusters, suggesting the main areas of focus within Food Waste research.

Detailed Interpretation of the Keyword Clusters:

1. Blue Cluster (Anaerobic Digestion & Methane): This cluster, dominated by terms like "methane" and "anaerobic digestion," indicates a strong focus on the bioenergy recovery aspect of food waste. Anaerobic digestion is a key technology for converting organic waste into biogas, with methane being the primary component of this process. The presence of this cluster suggests that a substantial portion of the literature is devoted to studying how food waste can be transformed into renewable energy sources. This cluster is strongly connected to environmental sustainability goals, particularly in terms of greenhouse gas reduction and energy recovery.
2. Purple Cluster (Non-Human & Waste Disposal): The purple cluster, revolving around keywords like "non-human" and "waste disposal," reflects a distinct body of literature that may focus on non-human actors involved in waste management. This could include research related to animal consumption of food waste, microbial digestion, or the role of ecosystems in breaking down waste. The focus on waste disposal links this cluster to discussions around the final stage of waste processing, ensuring that waste is safely and efficiently disposed of to minimize environmental harm.
3. Green Cluster (Recycling & Waste Management): The green cluster, centered around "recycling" and "waste management," highlights the practical and operational side of managing food waste. This cluster emphasizes research dealing with waste treatment technologies, material recovery, and sustainable waste management practices. Recycling, in particular, ties into circular economy principles, aiming to reduce waste by turning it into useful products rather than discarding it. The connection between waste management and sustainability reflects ongoing efforts to integrate environmentally friendly practices into large-scale waste disposal systems.
4. Red Cluster (Sustainability & Food Supply): The red cluster focuses on keywords such as "sustainability," "food supply," and "human." This cluster suggests a close connection between food waste research and broader concerns related to the global food system and sustainable consumption. Issues like food security, food distribution, and the environmental impacts of food supply chains are likely the focus here. Research in this area is concerned with addressing human behavior in relation to food consumption and waste generation, highlighting the social and economic dimensions of food waste.
5. Keyword Overlaps: The overlaps between these clusters highlight the interconnectedness of these topics. For example, "sustainability" spans both the red and green clusters, indicating that sustainable waste management practices are closely tied to both food supply issues and recycling technologies. Similarly, "food waste" acts as a central theme connecting all clusters, reinforcing the idea that food waste research is inherently multidisciplinary, involving technical, environmental, economic, and social dimensions.

5. CONCLUSION

Based on the results of the PRISMA and Bibliometric analyses, several key insights can be drawn regarding the state of research and factors influencing Food Waste:

1. **Key Variables Influencing Food Waste**. The primary variables that influence food waste behaviors include Perceived Behavioral Control (PBC), Intention, Attitude, Subjective Norm (SN), Religiosity, and Household Factors. These variables indicate that both psychological and social influences play a crucial role in determining how individuals and households manage food consumption and waste. Specifically, the inclusion of religiosity highlights the significance of cultural and ethical values in shaping attitudes toward waste, suggesting potential areas for policy intervention or community-level awareness programs targeting cultural norms.
2. **Leading Journals Disseminating Food Waste Research**. The journal "Sustainability (Switzerland)" is the leading source of publications on Food Waste, reflecting its strong focus on research that addresses sustainable practices and environmental issues. The prominence of "Sustainability" in this field is likely due to its interdisciplinary approach, which aligns well with the complex nature of food waste, involving environmental, economic, and social factors. Other important journals, such as "Foods" and the "Journal of Cleaner Production," contribute significantly by covering intersections of food science, production processes, and waste management solutions. These journals have become critical platforms for researchers and policymakers aiming to develop food waste reduction strategies in alignment with sustainability goals. The focus of these journals on practical, scalable solutions to food waste issues supports their influence and high citation rates in the academic community.
3. **Most Prolific Author and Knowledge Dissemination.** Zhang Y stands out as the most prolific author in Food Waste research, producing the highest number of publications in this field. Zhang's work is influential in advancing methods for food waste reduction and waste-to-energy strategies, which are highly relevant in the context of growing global concerns about resource recovery and environmental sustainability. The contributions of other notable researchers, such as Eriksson M, Wang X, Wang Y, Liu Y, Bilska B, Li X, Li Y, Liu C, and Li C, are instrumental in exploring food waste issues, particularly through the lenses of behavioral studies, technological innovations, and policy analysis. These authors' repeated focus on food waste reduction highlights the sustained scholarly engagement needed to create a comprehensive understanding and address this multifaceted global issue.
4. **Most Influential Document in Food Waste Research**. The most cited document in this field is the article by Sharma HB, published in 2020 in "Resources, Conservation and Recycling," with a total of 442 citations. This article's widespread influence highlights the impact of circular economy principles and sustainability in shaping modern food waste research, especially regarding resource recovery and environmental conservation. Sharma's focus on integrating circular economy practices has resonated with global trends toward reducing waste and recovering value, underscoring the practical relevance of sustainable waste management in food-related research.
5. **Dominant Keywords in Food Waste Research**. The dominant keywords in Food Waste research include

"Food Waste," "Anaerobic Digestion," "Waste Management," "Article," "Food," and "Waste Disposal." These keywords underscore a central focus on waste management technologies and bioenergy recovery (notably through anaerobic digestion), highlighting the field's growing interest in converting food waste into renewable energy sources. The prevalence of these terms suggests that technological and operational aspects of food waste reduction are critical, as they provide both environmental and economic benefits through resource recovery.

6. **Emerging Themes and Topics in the Food Waste Literature**. Prominent themes in the literature, such as "Agricultural Waste," "Biowastes," "Biodiversity," "Human," "Refuse Disposal," "Fermentation," and "Anaerobic Digestion," reflect the expanding diversity of research in food waste. The inclusion of terms like "Sustainability," "Comparative Study," and "Biochemical Composition" indicates that researchers are seeking multidisciplinary solutions, addressing sustainability from various angles, such as environmental impact, resource recovery, and biochemical valorization of food waste. The recurring appearance of keywords like "Incineration" and "Animalia" shows that traditional waste disposal methods and alternative uses for food waste (e.g., animal feed) continue to be researched, now with a modern and sustainable focus.

This analysis reveals a dynamic and evolving research landscape that is increasingly centered around sustainability, technological innovation, and human behavior in food waste reduction. The growing emphasis on bioenergy recovery, through processes like anaerobic digestion, shows the field's shift toward creating value from waste rather than simply minimizing its impact. Moreover, the influence of psychological and socio-cultural factors in food waste behavior highlights the need for holistic approaches that incorporate behavioral insights alongside technological solutions.

Furthermore, the focus on food supply chains, agricultural waste, and sustainability underlines the global recognition of food waste as both an economic and environmental challenge. Addressing this issue is key to achieving sustainable development goals (SDGs), particularly in terms of reducing hunger, conserving natural resources, and mitigating climate change.

In conclusion, future research should continue to explore how integrated strategies, combining technological innovation, policy reform, and consumer behavior change, can more effectively tackle the global food waste problem. By drawing on insights from different fields and leveraging the contributions of prolific researchers, the academic community is well-positioned to lead the way in transforming food waste into a resource for a sustainable future.

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