UHASSELT

KNOWLEDGE IN ACTION

Faculty of Business Economics

Master of Management

Master's thesis

Understanding the Drivers of Food Waste in University Dining Facilities: A Systematic Literature Review

Wenny Widiantika

Thesis presented in fulfillment of the requirements for the degree of Master of Management, specialization Strategy and Innovation Management

SUPERVISOR :

Prof. dr. Stephan BRUNS

2023

2024

UHASSELT

KNOWLEDGE IN ACTION

www.uhasselt.be
Universiteit Hasselt
Campus Hasselt:
Martelarenlaan 42 | 3500 Hasselt
Campus Diepenbeek:
Agoralaan Gebouw D | 3590 Diepenbeek

UHASSELT

KNOWLEDGE IN ACTION

Faculty of Business Economics

Master of Management

Master's thesis

Understanding the Drivers of Food Waste in University Dining Facilities: A Systematic Literature Review

Wenny Widiantika

Thesis presented in fulfillment of the requirements for the degree of Master of Management, specialization Strategy and Innovation Management

SUPERVISOR :

Prof. dr. Stephan BRUNS

Acknowledgment

I would like to express my gratitude to my supervisor, Prof. dr. Stephan BRUNS, for his invaluable guidance, support, and encouragement throughout this thesis. His constructive feedback has been instrumental in shaping this work and achieving its completion.

I am deeply grateful to my parents and family for their continuous support and understanding. Their encouragement and belief in me have strengthened and motivated me throughout this academic journey.

I also wish to extend my thanks to my friends for their support and being good listeners.

Additionally, I would like to acknowledge that several AI tools were employed in preparing this master thesis to enhance the quality and accuracy of the work. Grammarly was used to correct grammar and to paraphrase some sentences, ensuring clarity and coherence throughout the text. ChatGPT assisted in providing explanations for my understanding of complex readings. Additionally, Mendeley was used to manage citations and references and ensure proper academic formatting.

Hasselt, 6 August 2024

Wenny Widiantika

Table of Contents

Abstract

Understanding the Drivers of Food Waste in University Dining Facilities: A Systematic Literature Review

Abstract

Purpose of Study: Addressing food waste in university dining facilities is a pressing global issue with significant environmental, economic, and social implications (Leal Filho et al., 2023). This study aims to identify the drivers of food waste among university students, evaluate current strategies to mitigate it, and assess interventions designed to stimulate behavioral change. By conducting a systematic literature review, this research seeks to provide insights into practical measures for reducing food waste in academic settings.

Methodology approach: The study utilized a systematic literature review designed to examine the existing research using transparent, accountable, and rigorous research techniques (Kaur et al., 2020). Furthermore, the ROSES approach was employed to identify and evaluate the quality of the database. As a result, eleven articles were qualified to be examined in the study.

Findings: The study identifies multiple drivers of food waste in university dining facilities, including material factors such as foreign objects, flavorless food, food presentation, food portion, plate shape, and date labeling. Economic factors, including the perceived value of cheaper food items, and psychological factors related to eating habits and frugality contribute significantly to food waste. Social and cultural factors, such as mealtime competition, adaptation to local cuisines, and health considerations, further complicate the issue. Practical strategies for mitigating food waste include educational interventions, such as food waste-related courses, and targeted campaigns utilizing social media and informational posters. Food diversion, improved hygiene standards, and thoughtful plate design can significantly reduce waste.

Keywords: Food Waste, University Dining Facilities, Systematic Literature Review, ROSES, Behavioral Change, Mitigation Strategies, Awareness Campaign.

I. Introduction

1.1 Problem Statement

Addressing food waste is an urgent global concern with significant environmental, economic, and social impacts (Leal Filho et al., 2023). Food waste occurs at different points in the food supply chain, including during production, distribution, and consumption. Reasons for food waste are excessive purchasing, inefficient food management methods, and lack of awareness (Kostakis et al., 2024). This loss not only means a waste of precious resources like water, energy, and land but also contributes to environmental harm through the emission of greenhouse gases as the wasted food decomposes (Cui et al., 2023). Additionally, food waste worsens food insecurity and economic inefficiency, as excellent food used to feed those in need is thrown away (Kostakis et al., 2024).

Food waste is well-documented and arises from inadequate consumer food management, inefficiencies in the food supply chain, and uncertainty regarding food safety standards. In the EU, except for a few leading countries, there is a lack of evidence-based, coordinated approaches among Member States. This does not address food waste effectively. Thus, governments have failed to effectively tackle food waste's behavioral and market drivers through evidence-based methods (EUROPEAN & COMMISSION, 2023).

More than $1 trillion worth of food is thrown away yearly, representing a market failure due to food waste (United Nations Environment Programme, 2024). In 2022, around 29.6 percent of the world's population experienced moderate or severe food insecurity, with approximately 783 million people suffering from hunger, about 122 million more than in 2019 (United Nations Environment Programme, 2024). Therefore, reducing food loss and waste could result in improved land utilization, more effective water resource management, climate change mitigation, and livelihoods (Nations, 2024).

According to the data from Eurostat, an average of 131 kilograms of food waste per person was produced within Europe in 2021. Of this waste, 54% was generated by households, equating to 70 kilograms per person. Household food waste exceeds food waste from primary production and food product manufacturing by nearly double (11 kg and 28 kg per person). Restaurants and food services contribute 12 kg of food waste per person (9%), while retail and food distribution has the lowest amount of food waste (9 kg) (Eurostat, 2024).

In the UAE, the annual worth of discarded food amounts to approximately USD 4 billion (14.69 billion dirhams) (Yagoub et al., 2022). In contrast, the urban catering industry in China wastes approximately 17 to 18 million tons of food per year, which could potentially feed 30 to 50 million people a year (Cui et al., 2023). One of the primary locations for food wastage in China is university canteens. Meanwhile, food waste per person in developing regions, such as sub-Saharan Africa and South and Southeast Asia, is approximately 6-11 kg per year (Deliberador et al., 2021).

According to UNEP, data on food waste in the retail and food service sectors remains unchanged, mainly regarding availability and coverage, with a persistent absence of accurate nationwide data in lower-income countries (United Nations Environment Programme, 2024). This significant data gap is partly due to the complexity of measuring various subsectors (which encompass diverse settings in both the food service and retail sectors) and the challenges involved in scaling estimates using relevant national factors (such as the volume of food distributed in a specific subsector) (United

Nations Environment Programme, 2024). Addressing this data gap is crucial, and businesses can lower costs in their operation and waste disposal by increasing measurement and minimizing food waste in these settings.

There is a noticeable lack of practical figures for the retail and food service industries, especially in middle- and low-income nations (United Nations Environment Programme, 2024). Frequently, some data is available, but it may require extra effort to create a sector-specific national assessment. Research studies are often limited to a single type of establishment or subsector, such as focusing on either restaurants or schools but not both simultaneously due to resource constraints. As a result, findings from these subsector-specific studies can provide standardized estimates for one or more sampling units.

The food service industry is complex and diverse, with variations in the types and reasons for waste generation, disposal methods, and waste management infrastructure across different businesses (United Nations Environment Programme, 2024). A large workplace canteen, for instance, faces unique challenges in accurately measuring waste. Developing a comprehensive national food waste estimate involves effectively addressing this diversity within resource constraints. Dealing with different subsectors and the expense of collecting and scaling data can be significant challenges (United Nations Environment Programme, 2024).

Universities have a vital role in tackling food waste, particularly in dining halls where immediate action is necessary to reduce waste. As educational institutions, universities have to tackle this sustainability issue. They can play a vital part in identifying its origins and developing successful strategies to reduce its harmful impacts (Silva et al., 2024a). Implementing sustainable practices in campus dining facilities can educate future leaders about caring for the environment (Leal Filho et al., 2023). Universities can reduce food waste by introducing methods for offering healthier food choices, teaching customers about appropriate portion sizes, advocating for waste separation during collection, and investigating options for reusing and recycling waste (Leal Filho et al., 2023).

Studies have categorized the main factors that affect food waste in school cafeterias into three groups: demographics, social and family structure, and dining habits (Cui et al., 2023). It can be challenging to measure certain factors, requiring the use of qualitative research methods to uncover them. Qualitative methods enable research participants to openly express their attitudes, beliefs, and behaviors about food waste, revealing influences scholars may not have foreseen (Cui et al., 2023). Therefore, this study included articles that used quantitative, qualitative, and mixed methodology.

Dining halls at universities provide an excellent environment for studying the factors that influence food selection and wastage because students, who are still developing their eating habits, are starting to establish their long-term behaviors around food, including their willingness to minimize food waste (Gloster & Armstrong, 2016). According to Kaur et al. (2020), focusing on consumer food choice, taste, and dining environment impacts food waste during production and consumption. They believe that food waste studies in university dining facilities are essential for two main reasons: the significant quantity of meals handled at a single location by the university (Kaur et al., 2020) and

the opportunity for this study to cultivate a sustainability culture and by raising awareness of the matters (Derqui & Fernandez, 2017).

However, most of the existing literature only focused on one university. This is insufficient to generate the result due to the lack of sample size. Thus, research that utilizes data from multiple campuses has the potential for more substantial analysis (Gloster & Armstrong, 2016). Furthermore, researchers must investigate the issue of food waste in universities in both developed and developing economies, as existing research tends to focus mainly on the United States (Kaur et al., 2020). Additionally, researchers can explore cross-cultural and cross-national comparisons to offer broader findings (Kaur et al., 2020)

Based on the existing literature, many suggested that there should be more study of food waste, particularly in university dining facilities. Some limitations include a lack of in-depth research identifying areas for improvement and proposing initiatives to address waste management specifically within university settings (Leal Filho et al., 2023). There is a limitation in the databases used (Deliberador et al., 2021). There is inadequate attention to the ethical implications of food waste and its effects on environmental sustainability and social equity (Leal Filho et al., 2023). There is a lack of research on the influence of living arrangements, whether the students live with family, a partner, or alone (Kaur et al., 2020). Previous research has generally assessed food waste intervention over short periods, typically three days to two weeks (Li et al., 2022).

1.2 Food Waste

According to Eurostat, ultimately preventing food waste is not technically feasible. Since particular food must be discarded due to safety concerns, food waste prevention cannot compromise food safety and animal or human health (Eurostat, 2024). Food waste occurs at every stage of the food supply chain: (a) farming; (b) processing and production; (c) retail and distribution; (d) restaurants and food services; (e) households (Eurostat, 2024; Kaur et al., 2020). Therefore, stages of restaurants, food services, and households are collectively referred to as the "consumption" stage in this document.

There are two categories of food waste based on the type of waste (Kaur et al., 2020).

- The unavoidable food waste includes expired or spoiled ingredients, as well as food scraps like meat scraps (e.g., the process of separating meat and bone, and meat pieces after trimming) and vegetable scraps (e.g., tomato ends, outer leaves of lettuce, potato peels, and vegetable stems).
- The avoidable food waste results from meal scraps. For instance, a peeling or trimming waste caused by less proficient handling of food items, overproduction for banquets, events, and catering, poor ordering procedures, poor food rotation practices leading to food spoilage, and poor inventory systems that result in food and plate waste such as unconsumed pasta (Derqui & Fernandez, 2017).

The reduction of food waste could contribute to creating a more sustainable global food system by promoting the efficient and ethical use of limited natural resources while also minimizing its substantial environmental impact. This is challenging in developed countries, where food waste is

strongly linked to individual behavior and cultural perspectives on food (Derqui & Fernandez, 2017). Therefore, starting with audits to increase visibility and awareness of food waste is a clear step forward. Once food waste is identified, individuals may be more inclined to take action against it; managers may become more careful about its financial consequences, and kitchen staff may become more mindful of its social ramifications (Derqui & Fernandez, 2017)

Consumers' ability to reduce food waste depends on their motivation, opportunity, and capability to take action (EUROPEAN & COMMISSION, 2023). Factors include lack of awareness about food waste, attitudes, and concern levels about food waste and its impacts, insufficient self-awareness about the amount of food produced, household income concerning food prices, and lack of role models and examples advocating for food waste prevention. Moreover, inadequate opportunities, such as time constraints affecting meal planning and preparation, lack of access to food management technologies, and absence of advice on safely storing and reusing food, can result in wasted food (EUROPEAN & COMMISSION, 2023).

Household food waste often occurs because food is not used before its expiration date due to a misunderstanding of date labeling. Additionally, the growing preference for healthier diets and the demand for fresher, chilled, and convenient foods will lead to more grocery products in food categories where date labeling problems are likely to cause food waste. Consumer preferences for the appearance of food, like the shape and size of fruits and vegetables, can also contribute to food waste (EUROPEAN & COMMISSION, 2023).

1.3 Waste and Surplus Destination

1.3.1 Retail

Retailers may collect and hand their food and other waste to another entity for disposal (United Nations Environment Programme, 2024). In the retail sector, the waste destinations are municipal waste collection, private waste collectors, and a combination of municipal and private services. Depending on the type of waste and the regulatory regime, retailers might use municipal services and private collectors (United Nations Environment Programme, 2024).

Meanwhile, the food surplus are distributed to food banks and charities. The food redistribution plays a vital role in mitigating food waste. Thus, food surplus redirected for human consumption is not considered waste (United Nations Environment Programme, 2024). Retailers, especially supermarkets, are encouraged to track and share data on food donations, and redistribution organizations like food banks are encouraged to keep records of food received from retailers (United Nations Environment Programme, 2024). This method helps to provide insights into redistribution volumes.

1.3.2 Food Service

Like retail, food service may handle food waste separately or mixed with other waste and passed on to municipal collection or private service (United Nations Environment Programme, 2024). Liquid waste, such as leftover drinks or broth, is often disposed directly into the sewer. Meanwhile, the surplus food in the food service depends on the local food safety regulations. For instance, some food services in Europe collaborated with the Too Good To Go app. This app aims to mitigate waste by selling unsold food on the same day or food near the expiration date at a lower price. Using the

Too Good To Go app helps users become more aware of reducing food waste (Haar & Zeinstra, 2019).

1.3.3 Household

Household food waste is usually collected in municipal waste collection, separate food waste collection, private waste service, sewer disposal, and home treatment such as composting. According to the United Nations Environment Programme (2024), feeding animals from household food is not considered waste. Thus, feeding animals is included in the redistribution of food surplus. Another redistribution of food surplus is to share it with friends, family, or neighbors. Users may also use it to prepare food for future meals.

1.4 Food Waste Policy Options

1.4.1 Support the Consumer's Behavioral Change

Changing consumer behavior is challenging to reduce food waste (Eurostat, 2024). When consumers are aware and adopt behaviors to minimize waste, they can save money and avoid unnecessary expenditures (Tarczyńska et al., 2023). The effectiveness of this intervention depends on the specific target group, the local context, and stakeholder engagement, such as food businesses. Additionally, the effectiveness of these interventions is influenced by the local policy environment, which can support or reject the program. Thus, the actual implementation should be managed at the national level (Eurostat, 2024).

1.4.2 Consumer Education

Giving education to European consumers plays a crucial role in reducing food waste (Eurostat, 2024). It helps to change their behavior to be more wise in purchasing foods and proper meal planning (Yagoub et al., 2022). Educating consumers about food waste's environmental, economic, and social consequences can enhance their awareness. Educated consumers are more likely to support waste reduction policies and initiatives (Fraj-Andrés et al., 2023)

1.4.3 Amendment of EU Legislation

Efforts have been made to improve EU legislation on food waste prevention (Eurostat, 2024). The prevention including food donation, using food for animal feed, and the food waste report. The EU platform is assessing the barriers and opportunities for better food redistribution. Thus, based on this assessment, the Commission may update the EU food donation guidelines to address new issues (Eurostat, 2024).

1.5 Existing Studies of Food Waste

Tarczyńska et al. (2023) found that Polish students acknowledge the problem of food waste. However, they are often unaware of their significant contributions to it. The study identified three distinct clusters of behavior: "aware students" discard food mainly due to spoilage or expiration but actively try to minimize waste through careful meal planning and shopping. The second group, "disengaged students," wastes food for sensory reasons, such as unappealing textures or large portions, and sometimes improper storage. The third cluster, "aware but disengaged students," spills food but is willing to share and use food waste creatively. Despite recognizing the issue, these students waste approximately 72 kilograms of food annually. Enhancing consumer knowledge and

skills and better industry practices such as various food weights and improved date labeling are essential steps in effectively reducing food waste (Tarczyńska et al., 2023).

Tsai et al. (2020) found that the connection between Chinese' students' attitudes and behavioral intentions toward food waste becomes increasingly significant as they transition into adulthood—emerging adults who recognize that reducing food waste positively impacts environmental protection and enhances quality of life. Feeling guilty when witnessing food waste also motivates them to act. Those who perceive a high degree of control over their behaviors are more inclined to take action to minimize food waste. A solid understanding of food waste leads to more conscientious consumption. As young adults become more aware of environmental issues, their environmental concerns positively correlate with their food waste behavior (Tsai et al., 2020).

Cui et al. (2023) revealed that there are six drivers of food waste in a Chinese university: material factors, economic factors, psychological factors, social factors, cultural factors, and health factors. They also provide some insightful interventions in mitigating food waste. First, universities need to increase student awareness about the environmental impacts of food waste, as many students are not fully informed about the issue. For instance, the university highlighted in the research implemented an empty plate campaign to encourage students to finish their meals and share their efforts on social media. Then, the canteen should focus on improving the flavor and quality of its offerings by providing well-prepared and diverse dishes. Additionally, enhancements to the serving system and process are necessary, including labeling each dish with ingredient information (Cui et al., 2023)

Miśniakiewicz et al. (2024) focused on the impact of Polish and Italian students' living arrangements on food waste. Students living with their families demonstrate a higher awareness of food waste than students living alone. That is because the members around them can keep reminding them to consume their food wisely, and they can share the surplus food. The study also highlights that Generation Z students are more responsive to environmental campaigns focused on reducing food waste than Millennials. Foodservice operators can implement several interventions such as offering small sample portions, educating them about food waste, building positive relationships with customers, maintaining a calm dining atmosphere, presenting food visibly on plates, and placing waste bins behind the counter. Additionally, the research indicates a significant impact in Italy, showing that university curricula can enhance students' environmental awareness (Miśniakiewicz et al., 2024).

Musicus et al. (2022) suggested some strategies universities in the USA can employ to minimize food waste. The methods are predicting demand to avoid overproduction (91%), preparing smaller batches (88%), implementing trayless dining (86%), adjusting menu planning (84%), and repurposing leftovers into other dishes (81%). Additionally, 84% of universities donate surplus food to community partners and charitable organizations, 74% engage in composting, 42% use food waste for industrial purposes, and 12% (all rural) repurpose it as animal feed. Continuous efforts are essential to manage food waste effectively, and among the strategies, donating food to charitable organizations becomes the most common approach, adopted by 84% of universities in the USA (Musicus et al., 2022).

Richardson et al. (2021) tried to evaluate the intervention in reducing food waste by changing the round plate into an oval plate. The oval plate has a smaller shape than the round plate, making it serve fewer foods. Their study revealed that using smaller plates has been shown to reduce overall food waste. Specifically, participants wasted an average of 56.8 grams of food with round plates, compared to 37.7 grams with oval platters, reflecting a decrease in waste from 15.8% to 11.8%. Introducing new tableware at the beginning of a term is recommended. Future research should investigate how plate shape and size impact food choices, consumption, and waste, as well as the effects on dietary preferences and unintended consequences like food spillage (Richardson et al., 2021).

Silva et al. (2024) revealed that the portion sizes served at Portugal's university canteen significantly exceed recommended values for meat, fish, pasta, potato, fruit, and bread. A shortage of regular utensils for plating and training and clear guidelines for standard portions contribute to food waste. The plant-based foods, such as fruit, had the highest waste percentage at 43.8%. Similarly, salad and vegetables had a waste percentage of 41.4%, followed by vegetable soup at 27.4%. Therefore, to foster healthier eating habits and minimize food waste, universities should enhance students' food knowledge through awareness campaigns and culinary workshops (Silva et al., 2024b).

Cruz Macein et al. (2023) highlight the crucial role of universities in Spain in enhancing awareness and encouraging more sustainable consumption habits. The findings strongly suggest educating the students, as informed individuals are more likely to make sustainable choices. Immediate and convenience-driven decisions often prevail without a clear understanding of the impacts of different production methods and the benefits of choosing sustainable products. They suggested that universities should promote local and seasonal foods in their dining facilities and improve awareness, providing compelling messages about the benefits of sustainable consumption to better influence consumer habits (Cruz Maceín et al., 2023).

Yagoub et al. (2022) suggested that adding environmental education into school and university curricula is essential for shaping the food waste habits of younger generations, given that many students regularly consume meals on campus. By implementing courses focused on food waste, educational institutions can significantly influence students' awareness and practices regarding food waste. Additionally, conducting regular food waste audits in university settings can provide accurate data on waste patterns and prevention strategies. The identified causes of food waste in universities in the UAE include over-purchasing (31%), attitudes (26.5%), poor management (24%), and expired items (18.5%) (Yagoub et al., 2022).

Pinto et al. (2018) found that raising staff awareness about food waste is crucial for effective waste reduction in Portugal's universities. Training on plating techniques, offering various utensil sizes, and allowing customers to select their portion sizes can significantly reduce food waste by engaging staff and promoting mindful food handling. Furthermore, a student-organized campaign's positive impact helps foster behavioral change. Educational efforts, practical guidance, and role modeling are critical strategies for mitigating food waste (Pinto et al., 2018).

Fraj-Andres et al. (2023) reported that students' awareness significantly improved food waste behaviors and reduced dairy waste at home. The research suggests that replicating a campaign within the academic community could further educate and guide young individuals in making more conscientious choices. Conducting a follow-up survey is also recommended to assess the long-term impact of these programs on awareness and behavior changes. The effectiveness of these awareness activities was evident in the positive shift in students' attitudes toward managing leftovers. The teaching program raised students' understanding of food waste consequences and improved their attitudes towards household waste management (Fraj-Andrés et al., 2023).

Painter et al. (2016) found that a university in South Africa has a pre-book meal program. However, this program has some weaknesses that can contribute to food waste. Some students mentioned that they skipped their booked meals due to insufficient time to travel from the central campus to the dining hall. Another reason is that they forgot to cancel the meal booking. A lack of awareness about the impact of food waste was also one of the most significant causes. Seventy-seven students indicated they were unaware of the daily amount of food wasted. Thus, they suggested the canteen's university reduce portion sizes, allowing self-serving, and enhancing the variety and quality of food. The researchers agreed that individual and external factors must be considered to tackle this issue. Further research should examine the impact of different interventions in dining facilities. It would also be valuable to investigate students' attitudes towards water and energy conservation to understand their views on environmental sustainability (Painter et al., 2016).

Ozanne et al. (2022) researched food waste at a university in New Zealand. They found out that students often discard food due to concerns about illness when it is near its expiration date. Thus, date labels play a significant role in guiding their decisions on when to dispose of the food. The other individual's characteristics and observation, such as their living arrangements, also impact their food waste habits. Therefore, daily activities like meal planning, inventory checks, and the use of shopping lists have a direct influence on food wastage. Policymakers might reconsider food date labels to address students' focus on quality. They could implement educational campaigns highlighting the cost-saving potential of reducing food waste. Additionally, policymakers could collaborate with social media influencers to encourage positive food waste behaviors on platforms like Instagram and Snapchat (Ozanne et al., 2022).

Abdelaal et al. (2019) mentioned that the problem of food wastage is not a specific matter in Qatar. However, they agree that the absence of data on food waste makes it difficult to understand the actual extent of the issue. Therefore, their study at Qatari university revealed that students often discard their foods due to low quality or unappealing taste, inadequate meal planning, and meal portions, resulting in the expiration of purchased ingredients and delayed consumption of food, especially fruits and dairy products. They also found that the primary food services operator in three dining areas mainly offered food in a buffet or semi-buffet style, leading to overproduction and food waste. This indicates the necessity for educating both consumers and food service providers. One recommendation is composting foods into possible energy production from displayed and plated food waste (Abdelaal et al., 2019).

Principato et al. (2015) revealed that students more conscious of food waste tend to be more inclined to change their behavior positively. These students are more aware because they understand the economic implications of food waste rather than the environmental consequences. Thus, while the positive link between awareness and food waste reduction was validated, providing accurate information to young individuals about the specific effects of food waste is crucial to encouraging favorable behavior modification. One significant factor that impacts food waste among young Italians is the freshness of foods. Therefore, providing additional information about the shelf-life of food is crucial for increasing awareness of this issue (Principato et al., 2015).

Gao et al. mentioned a significant lack of attention given to food waste and the environmental impact of Chinese university canteens. They observed that food waste in university canteens is higher than in household food waste. Therefore, they suggest that universities and canteen management work towards reducing food waste and environmental pollution. Continuously improving the quality of canteen meals and enhancing university students' satisfaction with their meals is a common intervention that can be implemented (Gao et al., 2024).

Coşkun & Yetkin Özbük (2020) found that perceived behavioral control affects the intention to decrease food waste in Turkish restaurants. Some practical implications are that restaurant managers can educate consumers so that they believe they can control the quantity of food they order and the leftovers they have. Providing smaller portions to reduce food waste in restaurants is also a way to offer consistent portion sizes. Restaurants can also inform consumers that taking home leftover food is an option. Furthermore, campaigns have the potential to shape positive attitudes towards food waste. Lastly, restaurants can create menus featuring appealing dishes to prevent food from being left (Coşkun & Yetkin Özbük, 2020).

1.6 Research Gap

University restaurants are often reputed to contribute high levels of waste (Deliberador et al., 2021). This is caused by various factors, including the large volume of food prepared daily to meet the students' diverse preferences and dietary needs. The lifestyle of students, combined with a lack of awareness or concern about food waste, further increases the problem. There is a lifestyle in China where students tend to order foods not to fulfill their hunger but to fulfill their prestige in front of colleagues or the community (Li et al., 2022). This reputation highlights the need for targeted waste reduction strategies and education initiatives within university dining facilities.

There is a lack of in-depth research identifying areas for improvement and proposing initiatives to address waste management specifically within university settings (Leal Filho et al., 2023). Research in this area mostly focuses on the USA and lacks a global perspective (Kaur et al., 2020). While some studies have examined general aspects of waste management, they often fail to consider academic institutions' unique challenges and opportunities. Consequently, there is a pressing need for comprehensive research that delves into the specific dynamics of university waste management.

A study shared that relevant articles may have been missed due to limitations in the databases used (Deliberador et al., 2021). It makes it difficult for practitioners and decision-makers to compare different measures and identify the most promising ones (Gusenbauer & Haddaway, 2020). Many studies missed some data from the respondents (Fraj-Andrés et al., 2023; Li et al., 2022; Pinto et

al., 2018; Yagoub et al., 2022). For instance, in the qualitative method, respondents did not give the correct or same ID before and after the intervention. Similarly, respondents failed to fill in some answers in the quantitative method. These matters may result in less ideal answers. Thus, more detailed data is needed to address food waste challenges in educational institutions.

There is inadequate attention to the ethical implications of food waste and its effects on environmental sustainability and social equity (Leal Filho et al., 2023). It shows the moral obligation to minimize harm to the environment. Wasting food also raises issues of social equity. Food waste represents a lost opportunity to address hunger and food insecurity. Furthermore, increased greenhouse gas emissions are the impact of food waste (EUROPEAN & COMMISSION, 2023). A more ethical approach to food waste would consider the immediate impacts and the broader consequences on society and the planet.

Assessing the effectiveness of current policies and interventions to reduce food waste and promote sustainable development requires further research. It is essential to evaluate the impact of policy measures in order to improve strategies and enhance their outcomes (Kostakis et al., 2024). Policymakers and stakeholders can identify successful approaches by systematically analyzing the impact of various strategies. This process helps optimize the current efforts and contributes to developing more innovative and efficient solutions for minimizing food waste.

There is a lack of research on the influence of living arrangements, whether the students live with family, a partner, or alone (Kaur et al., 2020). Understanding whether students live with family, a partner, or alone can provide valuable insights into their consumption patterns and attitudes toward food waste. For instance, those living alone contribute more food waste than those who share meals with others (Miśniakiewicz et al., 2024). The support systems and habits formed in a family or shared living environment could significantly affect food management practices.

The literature is limited to a few behavioral variables, such as how consumers behave, even though behavior significantly contributes to food waste, especially in developed nations (Li et al., 2022). This focus results in less capturing the full spectrum of behavioral influences, such as cultural norms, perceived abundance, and the convenience of food availability. A more comprehensive understanding of these behaviors is essential for developing targeted interventions that address the root causes of food waste.

Additionally, previous research has generally assessed food waste intervention over short periods, typically three days to two weeks (Li et al., 2022). For instance, studies by Fraj-Andres et al. (2023) and Pinto et al. (2018) conducted a small campaign in the university, showing positive changes among the students. They became more aware of food waste matters after the campaign. However, there has been no more evaluation or follow-up after two weeks of the campaign. It reflects that there is no guarantee of whether the university will keep arranging the campaign.

1.7 Research Objective

Based on the importance of this topic to the environmental, social, economic, and other sectors and the recommendations from existing literature, this study aims to examine the drivers of food waste behavior in university dining facilities. Additionally, the study aims to:

- Systematically review and synthesize existing studies to identify the drivers of food waste in university dining facilities,
- Examine whether awareness and concern about food waste lead to more sustainable behaviors, such as reducing portion sizes, taking leftovers, or choosing less wasteful food options.
- Use the findings to provide policy makers, university administrators, and dining service managers with practical strategies to promote sustainable behaviors among students.
- Contribute to giving new insight into the literature on promoting food waste reduction.

Therefore, the main research question is, '*What are the drivers of food waste among students in university dining facilities?'*. Additionally, the sub-research questions are:

- What are the relationships between students' knowledge about food waste and their actual food waste behaviors?
- What practical strategies can university administrators implement to reduce food waste in dining facilities?
- What policies can be developed to encourage students to adopt less wasteful food practices in university dining settings?
- How can new insights from this study contribute to the broader literature on food waste reduction in university settings?

In order to answer the research question, a systematic literature review is employed. Systematic literature review (SLR) uses transparent procedures to identify, assess, and synthesize all relevant studies on a specific topic. It helps to pinpoint deficiencies in the literature, such as areas that have not been sufficiently studied, methodological constraints, or conflicting results. Then, SLR clearly shows the necessity of this research and its potential impact. Finally, this research is expected to yield credible and reliable findings using the transparency approach of SLR. Therefore, this methodology ensures a comprehensive understanding of the current research on student food waste attitudes in university dining facilities.

1.8 Outline of the Master Thesis

Furthermore, this study is structured as follows:

(1) Introduction: This chapter presents the background of the study, the research problem, waste and surplus destination, food waste policy options, the existing studies of food waste, the research gap, and the research objective. (2) Theories Relevant to the Review: This chapter discusses the relevant food waste theories. (3) Research Methodology: This chapter presents the design of the study: a systematic literature review (SLR) using the ROSES approach. (4) Results & Discussions: This chapter presents the results, discussions, and managerial implications of the systematic literature review of university food waste. (5) Conclusion: This chapter presents a conclusion where the RQ has been answered. (6) Limitation and Future Recommendation: This chapter presents the limitations and recommendations for future research.

II. Theories Relevant to the Review

2.1 Theory of Planned Behavior (TPB)

The Theory of Planned Behavior currently stands as the prevailing conceptual framework for determining the factors influencing particular behaviors (R. et al., 2014). TPB has been widely employed in various research studies to gain deeper insight into a wide range of behaviors within social psychology and other disciplines. Furthermore, this theory has been effectively used to comprehend various environmentally responsible behaviors, such as recycling and waste management (Karim Ghani et al., 2013).

The Theory of Planned Behavior offers a thorough structure for comprehending how personal attitudes, social influences, and perceived control impact behavioral intentions and actions (Tsai et al., 2020). This theory builds upon the theory of reasoned action, which was developed by Ajzen and Fishbein in 1980 and Fishbein and Ajzen in 1975 (Ajzen, 1991). The extension was needed because the original model cannot fully address behaviors people cannot always control.

The theory of planned behavior emphasizes the importance of an individual's intention to carry out a specific behavior (Ajzen, 1991). Intentions are believed to encompass the motivational factors that impact behavior and indicate the level of effort and determination individuals are willing to put forth to accomplish the behavior. Generally, the stronger the intention to engage in a behavior, the more likely it is to be performed (Ajzen, 2020). It is important to note, however, that a behavioral intention can only manifest as behavior if the behavior is within voluntary control.

Ajzen stated that three factors influence behavioral intentions: attitude toward the behavior, subjective norm about the behavior, and perceived behavioral control (Ajzen, 2020). These factors are drawn in Figure 2.1.

- Attitude towards the behavior assumes that attitude towards the behavior is influenced by easily accessible beliefs about the likely outcomes of the behavior, known as behavioral beliefs. A behavioral belief reflects the individual's personal likelihood that engaging in a specific behavior will result in a particular outcome or provide a specific experience. For instance, if students think that minimizing food waste will be good for the environment, they are likely to have a positive attitude toward waste reduction.
- Subjective norms about behavior assume that the behavior is influenced by perceived social pressures, whether to perform it or not. For instance, if students believe their friends and family expect them to refrain from wasting food, they may sense a social responsibility to do so.
- Perceived behavioral control refers to the ability to carry out behavior that is influenced by past experiences and expected obstacles. When an individual feels in control of the behavior and believes they can execute it effectively, their intention to do so is higher. For instance, if students are confident in their ability to regulate portion sizes or have access to reduce food waste, they are more inclined to decrease food waste.

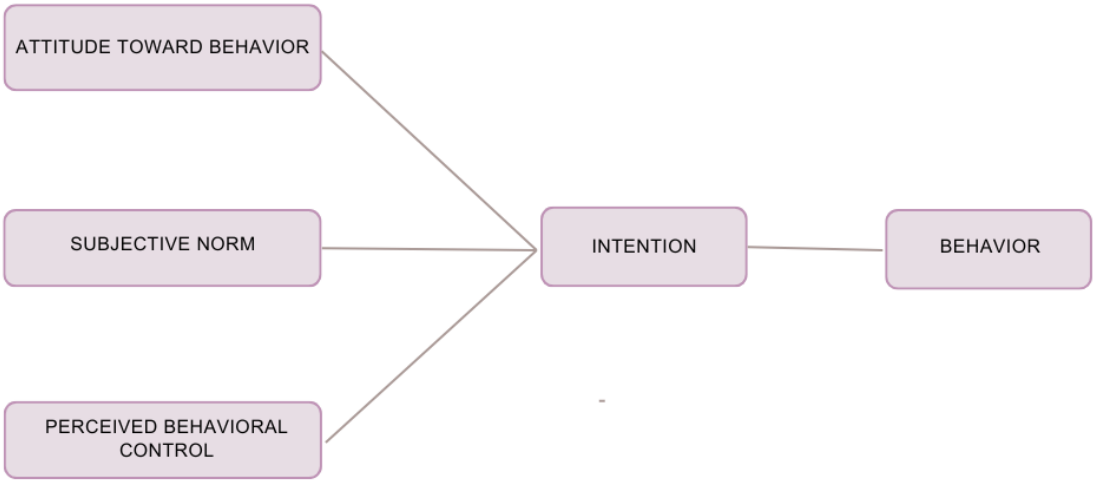

Figure 2.1: Theory of planned behavior (Ajzen, 1991).

The Theory of Planned Behavior offers a thorough structure for comprehending how personal attitudes, social influences, and perceived control impact behavioral intentions and actions (Tsai et al., 2020). Previous research indicates that environmental concerns (ECs) are linked to all three aspects of TPB and can impact people's behavioral intentions (Tsai et al., 2020). Therefore, including variables related to environmental awareness in the TPB model can enhance its reliability and effectiveness. The TPB model can analyze food consumption choices (Ajzen, 2020). Therefore, TPB helps comprehend the foundation of their beliefs, investigate the determinants of their behavioral intention, and then create promotional initiatives to reduce food waste behavior (Tsai et al., 2020).

2.2 Norm Activation Model (NAM)

The norm activation model was proposed by Schwartz in 1977. This theory has been extensively applied in analyzing different types of pro-environmental intention or behavior, as it is viewed as a form of pro-social behavior (Zhang et al., 2017). This framework provides valuable perspectives on how internalized ethical beliefs and a feeling of personal responsibility can inspire positive behaviors and support broader social and environmental objectives (De Groot & Steg, 2009).

The norm activation model (NAM) focuses on the behavior of individuals that arises from their moral beliefs, specifically their beliefs about what is ethical and unethical (Sejin, 2014). Based on NAM, people's behaviors are influenced by their personal standards, originating from their beliefs about right or wrong. This theory proposes that ethical norms trigger a feeling of personal duty, motivating people to behave according to their ethical principles. As a result, actions are influenced not just by external influences but also by the internal moral.

The prediction of pro-social behavior in the NAM involves three variables: personal norms, awareness of consequences, and ascription of responsibility (De Groot & Steg, 2009). Personal norms refer to having a moral duty to carry out particular actions. Awareness of consequences is when individuals are aware of the positive effects of pro-social actions on others. Meanwhile, ascription of responsibility refers to individuals' sense of responsibility for the outcomes of pro-social actions. When the individual recognizes himself as accountable for the outcomes of their actions, they will

take more steps that align with their values and ethical principles. Understanding these effects plays a vital role in inspiring selfless behavior. Being conscious of the positive or negative outcomes of their behavior encourages individuals to act in line with their moral values, particularly if they realize that their actions can mitigate harm or help others (De Groot & Steg, 2009; Rezaei et al., 2019; Zhang et al., 2017)

2.3 Self-Awareness Theory (SAT)

The self-awareness theory (SAT) is believed to be the social mechanism that explains how people behave when wasting food on their plates (Rasool et al., 2024). According to this mechanism, when individuals find themselves in a public setting or a situation that could affect their social position, social norms come into play, leading people to focus more on themselves than others. Consequently, people are more likely to adjust their behavior to align with social expectations and avoid negative judgments, leading to more mindful consumption and reduced food waste in such contexts.

There are four rationales of food consumption determinants in consumer behavior in SAT literature: benevolence, ecology or environmental concern, equality, and universalism (Rasool et al., 2024). Specifically, benevolence and universalism are stabilizing factors that ensure consistent and appropriate food consumption. Similarly, individuals with a strong awareness of environmental sustainability (defined as "living in harmony with the environment for a sustainable future") and equality (defined as "living in harmony with all other people") are inclined to minimize food wastage in their daily routines (Rasool et al., 2024).

Benevolence refers to individuals who believe their food choices will positively influence their family, friends, and community (Aertsens et al., 2009). Their self-awareness grows when their choices affect their surroundings. For instance, a student may opt to cook and enjoy a nutritious homemade meal with friends, thinking it enhances their well-being and fosters stronger social connections instead of choosing less healthy fast food options.

Ecology reflects individuals' dedication to preserving the natural environment (Rasool et al., 2024). By increasing their self-awareness, people become more mindful of the environmental impact of their food choices, including their carbon footprint, water usage, and sustainable practices in food production. Students who prioritize environmental sustainability might opt for plant-based foods at the campus dining hall over meat-based options or participate in a university-supported community garden to access locally grown produce.

Equality reflects a dedication to fairness and justice, aiming to give everyone access to resources and opportunities (Rasool et al., 2024). Awareness of the social impact of one's food choices, such as the labor conditions of food producers and the fairness of trade practices, can result from self-awareness. Opting to purchase fair-trade coffee or chocolate allows a consumer to acknowledge that such choices contribute to fair wages and ethical working conditions for farmers and producers in developing nations.

Universalism reflects understanding, appreciation, tolerance, and protection for the well-being of all individuals and nature (Aertsens et al., 2009). Self-awareness makes an individual recognize the global impact of their food choices. Selecting products not associated with deforestation or human

rights violations and choosing brands recognized for their ethical and sustainable practices can be a consumer's way of positively impacting global welfare, driven by a universalistic motive. This approach enables them to contribute positively to global welfare.

2.4 Stakeholder Theory

The concept of stakeholder theory is expanding the attention towards design, planning, and implementation efforts in addressing complex issues like food waste (Ramanathan et al., 2024). There are several distinct characteristics of stakeholder theory (Freeman & McVea, 2005). First, the stakeholder approach provides a flexible strategic framework that adapts to environmental changes. Second, the stakeholder approach is a strategic management process that sets a new direction for how the firm and the environment can influence each other. Third, the stakeholder approach focuses on the firm's survival by achieving its objectives. Fourth, the stakeholder approach motivates management to develop strategies by focusing on all relationships essential for long-term success. Fifth, the stakeholder approach combines prescriptive and descriptive elements, integrating economic, political, and moral analysis for strategic management. Sixth, the stakeholder approach focuses on real, specific stakeholders, and understanding the actual people and circumstances relevant to the firm is crucial for creating strategies to gain stakeholder support. Finally, the stakeholder approach requires a balanced approach to making strategic decisions. Successful strategies should consider everyone's perspectives, not just consider perspectives as a whole group. Additionally, stakeholder interests should be aligned with common goals.

Stakeholder theory is essential to food waste reduction because it helps identify and address the needs of everyone involved in the food supply chain (Ramanathan et al., 2024). Businesses can create more effective waste reduction strategies by understanding the roles of various parties, such as suppliers, customers, regulators, and employees. Moreover, commitment from management and staff is necessary to respond to customer demand. The theory encourages balancing these interests and finding collaborative solutions.

2.5 The Institutional Theory

Institutional theory helps explain why food companies use technology to reduce food waste (Ramanathan et al., 2024). It includes three main ideas: regulative (rules and regulations), normative (social norms), and cultural-cognitive (shared beliefs) (Ramanathan et al., 2024). The regulative pillar of institutional theory focuses on the formal rules, laws, and regulations that shape organizational behavior (Owasi & Formentini, 2021). It includes how companies should operate, such as environmental laws or safety protocols, including penalties for violations. The normative pillar can drive companies to reduce waste if they believe that donating food is better than throwing it away (Ramanathan et al., 2024). The cultural-cognitive pillar of institutional theory analyzes how certain practices and behaviors become common and accepted in society. The focus on food waste reduction nowadays is more significant than it was in the past.

However, implementing effective food waste reduction practices in food companies can be challenging due to diverse barriers (Ramanathan et al., 2024). Issues within an organization often occur, such as coordination among different departments. Companies may also face behavioral challenges such as resistance to change. A lack of information, communication, and clear guidelines

can escalate these problems. By understanding these challenges, companies are encouraged to address the obstacles and develop strategies to improve their food waste reduction efforts.

2.6 The Paradox Theory

The paradox theory helps explain why firms handle food waste differently (Ramanathan et al., 2024). It highlights an organization's unavoidable conflicts and tensions, such as the need for stability versus change versus innovation (Smith & Lewis, 2011). Paradox theory suggests that organizations should embrace and balance them rather than trying to eliminate these contradictions (Smith & Lewis, 2011). Organizations can develop more subtle and effective solutions by acknowledging and navigating these unavoidable conflicts and tensions.

Changing behaviors or using technology can be implemented to reduce food waste (Ramanathan et al., 2024). The challenge is to decide which approach to prioritize. However, both approaches are complex because they will face difficulties in changing, such as learning the technology and accepting the behavior change. It creates a paradox in the technology investment. Given that it is unclear if the cost of investing in technology for food waste reduction is worth the amount of food that will be saved (Smith & Lewis, 2011).

Paradox theory emphasizes the importance of understanding and addressing paradoxes within organizational settings (Smith & Lewis, 2011). This theory provides educational materials that equip managers with the skills to navigate and embrace conflicting situations. By focusing on managing conflicting demands, managers can better adapt to the complexities of their professional environments.

III. Research Methodology

3.1 Research Question

The research questions were formulated using the PICO mnemonic. This approach enabled the author to establish the main research topic to be investigated in the study (Lockwood et al., 2015). 'P' represents Population or Problem, 'I' represents Intervention, 'C' represents Context or Comparator, and 'O' represents Outcome.

P: University students in dining facilities

I: Various drivers of food waste

C: Differences in food waste drivers or absence of these drivers

O: The amount of food wasted

By this, the main research question will be, *'What are the drivers of food waste among students in university dining facilities?'.* Additionally, the sub-research questions are:

- What are the relationships between students' knowledge about food waste and their actual food waste behaviors?
- What practical strategies can university administrators implement to reduce food waste in dining facilities?
- What policies can be developed to encourage students to adopt less wasteful food practices in university dining settings?
- How can new insights from this study contribute to the broader literature on food waste reduction in university settings?

3.2 Systematic Review

The idea behind systematic reviews is that they are a type of research that can be enhanced by applying precise methods. As a result, systematic reviews can be described as examining existing research using transparent, accountable, and rigorous research techniques (Kaur et al., 2020). Systematic review was initially developed in the 1990s within the field of medicine. It initially concentrated on combining quantitative evidence from randomized control trials (Haddaway et al., 2018). Since then, systematic review has become widely used in various fields such as software engineering, education, social welfare, international development, public and environmental health, and crime and justice. The criteria for evaluating the reporting quality also emerged from QUOROM (QUality Of Reporting Of Meta-analysis), PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses), and ROSES (RepOrting Standards for Systematic Evidence Syntheses).

The present systematic literature review (SLR) has employed a comprehensive four-step process, as illustrated below (Bavik, 2020):

- Step I. Review planning/ identification: Establishing the conceptual scope and determining the appropriate keywords and databases to locate relevant studies.
- Step II. Defining the screening criteria for the study: Clarifying the inclusion and exclusion criteria.
- Step III. Extracting data: Employing various screening levels to identify relevant studies.
- Step IV. Presenting the research profile

This study utilized the reporting quality evaluation from ROSES designed by Haddaway et al. (2018). ROSES provides an overview of the development and validation process. The primary objective of the ROSES initiative is to enhance and uphold high standards in the execution of systematic reviews and maps by promoting greater transparency and facilitating quality assurance for these reviews and maps (Haddaway et al., 2018).

ROSES is a new systematic review method specifically for environmental management and conservation. However, this protocol also can be employed in another field of study (Haddaway et al., 2018). Its tool is created to support the variety of methods used for a wide range of review topics. As a result, the tool naturally mirrors these subjects' diversity and interdisciplinary nature. The conservation and environmental management research synthesis community is equipped with specific reporting standards through ROSES that are customized for the field (Haddaway et al., 2018).

3.3 Systematic Searching Strategy

The goal of a systematic review is to conduct a thorough and transparent review in every stage of the review process to ensure it can be replicated and updated (Rodríguez, 2023). Among the existing reporting quality evaluation methods, this study employed the method by ROSES. ROSES initiative promotes transparency and quality assurance in systematic reviews and maps. It is dedicated to the initial and intermediate phases of the review process, which include searching, screening, data extraction, and critical appraisal. ROSES has an extended checklist compared to PRISMA (Haddaway et al., 2018). The checklist allows peer reviewers to see that the protocol or review report contains all the required information. This process helps to save significant time and resources by ensuring that manuscripts meet essential standards.

3.3.1 Identification

The initial step in identification is to select the keywords relevant to the research questions. Using broader keywords will yield a more significant number of articles, but some of them may not be relevant. Conversely, using particular keywords will lead to fewer articles, but there is a possibility of missing out on some records (Mohamed Shaffril et al., 2021). Thus, the primary keywords used were food waste, sustainability, university, campus, canteen, and cafeteria. This study only uses the Scopus database, widely acknowledged as one of the most trustworthy and thorough sources (Kostakis et al., 2024). The variations keyword combinations were manipulated using Boolean operators such as "OR" and "AND" in its advanced search. The Boolean string used in the Scopus is shown in table 3.1. Based on the articles retrieved, there were a total of 985 articles.

Database	**String**
Scopus	TITLE-ABS-KEY (food AND waste OR sustainability) AND (university OR campus) AND (canteen OR cafeteria)

Table. 3.1: String used in the articles collection procedure.

The identification process varies. Thus, there is no fixed answer when to stop searching for the articles (Mohamed Shaffril et al., 2021). However, they suggested the following factors during the identification process.

- Including additional key terms during the identification process helps obtain more relevant articles for the Systematic Literature Review.
- Acquiring proficiency in advanced search techniques (such as Boolean operator usage, phrase searching, truncation, wildcard, and field code functions) in specific databases is beneficial for researchers.
- Rather than depending solely on the database, researchers should use manual search methods (e.g., hand-searching and citation searching) to access a more significant number of articles.
- In their publication, Gusenbauer and Haddaway (2020) suggested that 14 databases are eligible as the leading database in the article-searching process.
- Google Scholar and Microsoft Academics can serve as secondary databases for article searches rather than the primary ones, as they have various limitations.

3.3.2 Screening

There is a consensus that no single database is flawless. Despite specific databases offering advanced features and benefits, they still have shortcomings, such as limited search functions and low keyword sensitivity (Mohamed Shaffril et al., 2021). Consequently, it is crucial for researchers to also engage in manual searching in order to expand the scope of literature.

The screening process is guided by the researchers' established inclusion and exclusion criteria (Mohamed Shaffril et al., 2021). The critical population features to address research questions are used to identify the inclusion criteria, and then exclusion criteria help to remove the unwanted results. The articles were eliminated first by screening tools in Scopus and then manually according to specific criteria. Table 3.2 shows the used string in the articles' collection procedure after being filtered to some inclusion criteria. Based on the first screening in Scopus, there were 307 potential articles.

Database	String
Scopus	TITLE-ABS-KEY ("food waste" OR sustainability) AND (university OR campus) AND (canteen OR cafeteria) AND (LIMIT-TO (SUBJAREA , "ENVI") OR LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "ECON")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (OA , "all"))

Table. 3.2: First screening: Used strings in the articles' collection procedure after being filtered to some inclusion criteria.

Inclusion Criteria	Exclusion Criteria	Explanation
Subject area: environmental science, social sciences, business, management and accounting, economics, econometrics and finance.	Subject area: energy, agricultural and biological sciences, computer science, engineering, medicine, immunology and microbiology, health professions, decision science, earth and planetary sciences, chemical engineering, biochemistry, genetics and molecular biology, psychology, pharmacology, toxicology and pharmaceutics, arts and humanities, nursing, neuroscience, materials science and chemistry.	The subject area listed in the exclusion criteria is irrelevant to the research questions and research objectives.
Document type: article	Document type: review, conference paper, book chapter, book, note, letter, and data paper.	The credibility of the article paper.
Language: English		The examination only considered articles written in English to reduce confusion.
Open access: all open access		Open access to public for accessibility and transparency (Haddaway et al., 2018).
Study design: Empirical studies such as quantitative, qualitative, and mixed methods, where case studies, surveys, and experiments are employed.		Focus exclusively on empirical studies where the phenomena are measured from the experience. It gives coherence and broader insights into the systematic review.
Paper match with keywords: food waste, sustainability, university, campus, canteen, and cafeteria	Paper with unmatched keywords: food waste to agriculture, biogas digestate, composting of biowaste, artificial	The examination only considered articles that match with keywords for the quality, structured, relevant study and able to answer the RQ.

	intelligence, waste in hotels, households, and primary schools, marketing plant-based vs animal-sourced food, energy-water-food security, policies on mineral and coal mining, and dietary carbon footprint.	

Table. 3.3: List of inclusion criteria and exclusion criteria.

The review process is not limited by the publication date of the articles. Due to the newness of the subject, finding more relevant articles is of utmost importance. To get relevant articles, the subject is restricted to environmental science, social sciences, business, management and accounting, economics, econometrics, and finance. Conference papers, books, notes, and letters were excluded, resulting in the evaluation of only empirical research papers. It is important to note that only articles written in English were considered to reduce confusion. Non-open-access articles can be considered to obtain broader literature and ensure all relevant studies are identified (Gusenbauer & Haddaway, 2020). However, only open-access articles were used in this research for accessibility transparency according to ROSES protocol (Haddaway et al., 2018). Open-access articles also help to mitigate potential publication bias and are available to all researchers without access restrictions (Gusenbauer & Haddaway, 2020). Table. 3.3 shows a list of inclusion criteria and exclusion criteria. After the first screening using Scopus tools, there were 307 potential articles.

The second screening was done manually by reading the title, abstract, conclusion, and entire text of some articles. The manual eligibility process is crucial for researchers to reduce any errors in the database (Mohamed Shaffril et al., 2021). It also helps to assess if the remaining articles meet the inclusion criteria. The other inclusion criteria are articles that use quantitative and qualitative methods as they provide primary data and coherent results. Next, articles that were unmatched with keywords were found. These articles cannot be included in the final evaluated articles because they are irrelevant and cannot answer the research question. After the second screening, 11 articles were identified from the chosen database.

3.3.3 Data extraction

The sample articles underwent additional manual screening to determine their relevance and quality (Bavik, 2020). Assessing the quality of articles is often done using tools, scales, checklists, or standard forms. The quality evaluation was based on the six criterion questions Deliberador et al. (2021) suggested. The scoring procedure involved assigning a score of 1 for "Yes" (Y), 0.5 for "Partly" (P), and 0 for "No" (N), as suggested by Zakaria et al. (2023).

QA1: Did the article contribute to the literature on food waste in university restaurants?

QA2: Did the article elaborate a comprehensive theoretical framework on this topic?

QA3: Did the article assess the quantity of food wasted in university restaurants?

QA4: Did the article effectively outline the research methodology utilized?

QA5: Did the article suggest managing food waste in university restaurants?

QA6: Did the article discuss its limitations and provide recommendations for future research?

Study	QA1	QA2	QA3	QA4	QA5	QA6	Points	Inclusion in the review
Silva et al., (2024)	Y	P	Y	Y	Y	Y	5.5/6	Y
Miśniakiewicz et al., (2024)	Y	P	Y	Y	Y	Y	5.5/6	Y
Tsai et al., (2020)	Y	Y	Y	Y	Y	Y	6/6	Y
Cui et al., (2023)	Y	Y	Y	Y	Y	Y	6/6	Y
Musicus et al., (2022)	Y		Y	Y	Y	Y	5/6	Y
Tarczyńska et al., (2023)	Y	P	Y	Y	Y	Y	5.5/6	Y
Richardson et al., (2021)	Y	P	Y	Y	Y	Y	5.5/6	Y
Cruz Maceín et al., (2023)	Y	Y	Y	Y	Y	Y	6/6	Y
Yagoub et al., (2022)	Y	P	Y	Y	Y	Y	5.5/6	Y
Pinto et al., (2018)	Y	P	Y	Y	Y	Y	5.5/6	Y
Fraj-Andrés et al., (2023)	Y	P	Y	Y	Y	Y	5.5/6	Y

Table 3.4: Results of the quality assessment.

Table 3.4 shows the results of the quality assessment. After the articles were individually examined, the remaining 11 articles passed the quality assessment.

3.3.4 Data execution

Following this stage, the articles were individually examined. The articles were sourced and recorded in a standardized spreadsheet (Bavik, 2020) that is shown in table 3.5, categorized by author, year of publication, journals, publisher, and demographic. The publications show that few research studies were conducted on food waste within food service establishments operating in higher education. Additionally, research findings were featured in a range of publications on food sustainability, the environment, and health, resources, conservation, and recycling. From eleven articles, a total of two papers from Portugal (Pinto et al., 2018; Silva et al., 2024a), two papers from Spain (Cruz Maceín et al., 2023; Fraj-Andrés et al., 2023), two papers from USA (Musicus et al., 2022; Richardson et al., 2021), one paper from Poland (Tarczyńska et al., 2023), one paper from Poland and Italy (Miśniakiewicz et al., 2024), and one paper from UAE (Yagoub et al., 2022). Furthermore, the process of selecting primary studies can be seen in Figure 3.1. they were using the ROSES flowchart.

No	Author	Year	Journal	Publisher	Demographic
1	Silva et al.,	2024	Sustainability	MDPI	Portugal
2	Miśniakiewicz et al.,	2024	Sustainability	MDPI	Poland & Italy
3	Tsai et al.,	2020	Foods	MDPI	China
4	Cui et al.,	2023	Sage Open Journal	Sage	China
5	Musicus et al.,	2022	International Journal of Environmental Research and Health	MDPI	USA
6	Tarczyńska et al.,	2023	Sustainability	MDPI	Poland
7	Richardson et al.,	2021	Resources, Conservation & Recycling	Elsevier	USA
8	Cruz Maceín et al.,	2023	Foods	MDPI	Spain
9	Yagoub et al.,	2022	Sustainability	MDPI	UAE
10	Pinto et al.,	2018	Waste Management	Elsevier	Portugal
11	Fraj-Andrés et al.,	2022	International Journal of Sustainability	Emerald	Spain

Table 3.5: The selected primary studies.

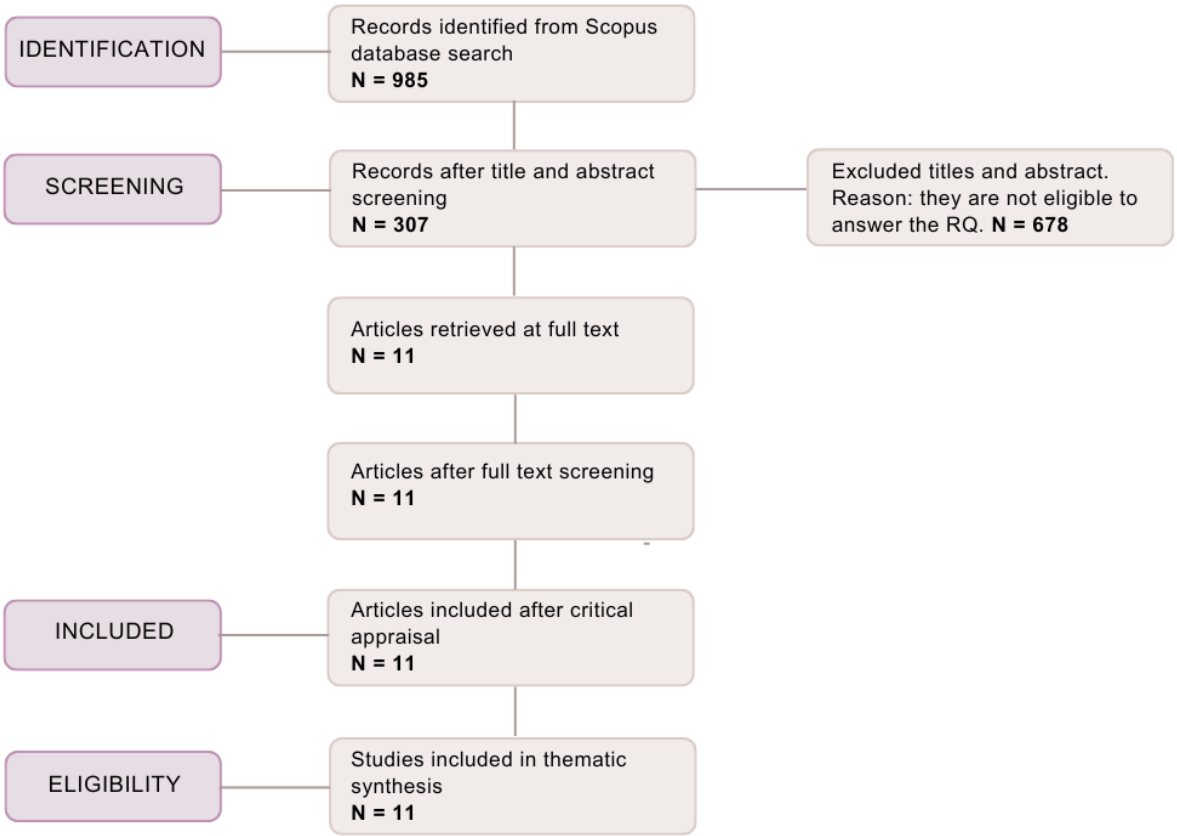

Figure 3.1: The process of selecting primary studies (Haddaway et al., 2017).

IV. Results & Discussions

4.1 Background of the selected studies

Table 4.1 shows the drivers of food waste and interventions to reduce it in university dining facilities from the selected articles. There are 18 drivers of food waste discussed in the selected articles, such as three papers mentioning foreign objects, nine papers highlighted the importance of food presentation, four papers about flavorless food, and all papers discussing the food portion and other factors. Furthermore, four papers suggested doing food diversion, five suggested creating a course on food waste, and ten highlighted the importance of a food waste campaign. Finally, all papers suggested that the university's canteen refine and improve the material factors, such as maintaining high hygiene standards during preparation and serving visually appealing food.

Definition	Silva et al.,	Misniakiewicz et al.,	Tsai et al.,	Cui et al.,	Musicus et al.,	Tarczynska et al.,	Richardson et al.,	Cruz Macein et al.,	Yagoub et al.,	Pinto et al.,	Fraj-Andres et al.,	Total
Foreign object	Students discovered foreign items, such as tiny rocks and insects in their food.				.				.	.			3
Food presentation	Unattractive food is more likely to be thrown away.	.	.	.	.		.	.	.	.	.		9
Flavorless foods	Canteens struggle to guarantee that the food is flavorful due to the large amount of food cooked.			.	.				.	.			4
Food portion	Food waste occurs when an excessive amount of food is offered.	.	.	.	.	.	.	.	.	.	.	.	11
Plate shape	Different plate's shape contains different portion.				.	.		.		.	.		5
Date labeling	The expiration date.				.		.			.			3
Cheap price	Cheap foods tend to be wasted because students do not feel guilty about the price.		.		.		.			.			4
Economic affluence	Students from higher-income families can order a wide range of foods to satisfy their craving for diversity.		.		.		.			.			4

Eating habit	They avoid specific foods because they label them as inedible and unpalatable.	.	.	.	.	.	.	.	.	.	.	.	11
Frugality	Not understanding the idea of food waste, saying, "I do not feel strongly that leftovers are waste."			.	.								2
Mealtime competition	Limited time due to long queue and short break.				.								1
Gender impression	Perceived gender images in front of others.	.		.	.					.		.	5
Pressure from co-dinner	Some tend to stop eating and leave the table once their companion has finished their meal.				.								1
Food culture difference	Non-local students must adjust to the local cuisine, and food waste may occur during this adaptation process.				.								1
Living arrangement	Students live with family and live alone.		.				.			.		.	4
Balanced diet	Balancing meat and vegetarian dishes to ensure a healthy diet.	.		.	.		.		.				5
No overeating	Ensure not to overeat.	.		.	.		.		.				5
FW course	Give a course related to food waste.		.	.		.				.		.	5
Campaign	Posters and containers utilized for waste separation in educational campaigns.	.	.	.	.	.	.	.		.	.	.	10
Food diversion	Alternative use of surplus food that can be beneficial to people, animals, or the environment.					.	.			.		.	4
Material factor improvement	Improve the material factors such as maintaining high hygiene standards during preparation and serving food, as well as serving visually appealing food.	.	.	.	.	.	.	.	.	.	.	.	11

Table 4.1: Drivers of food waste and interventions to reduce it in university dining facilities.

4.2 Thematic Analysis

Thematic Analysis is the most suitable method for research to uncover meaning through interpretations (Braun & Clarke, 2006). It has a structured approach to analyzing data and enables the researcher to link theme frequency analysis to the entire content (Alhojailan & Ibrahim, 2012). Moreover, thematic analysis can connect different concepts and viewpoints in various situations at different points in the project (Braun & Clarke, 2021).

Braun & Clarke (2006) mentioned some advantages of thematic analysis in their article below:

- Flexibility. Allows researchers to apply thematic analysis across various disciplines and research topics.
- Learning and implementing this method is relatively easy and fast. Thematic analysis has straightforward procedures and steps that can be easily understood and followed.
- It is suitable for researchers with minimal or no experience in qualitative research.
- The results are generally understandable to the educated public. The results are presented in a clear and narrative format, making them accessible and comprehensible to a broad audience, including those outside the academic community.
- It is a valuable method for collaborating with participants in participatory research.
- This method can effectively summarize the main aspects of a large dataset and provide a detailed description of the data.
- It is capable of identifying similarities and differences across the dataset.
- It can produce unexpected insights. Thematic analysis can uncover themes and patterns that were not anticipated at the outset of the research.

Here are some steps for thematic analysis (Alhojailan & Ibrahim, 2012; Braun & Clarke, 2006).

1. Familiarizing the data: Transcribing data as needed, carefully reviewing the data, and recording initial thoughts. It is best to go through the complete data set at least once.

2. Generating initial codes: Systematically code exciting aspects of the data throughout the entire dataset and gather data related to each code. For this phase, it is essential to (a) code for as many potential themes/patterns as (b) inclusively code data extracts to retain a small amount of the surrounding data if relevant.

3. Searching for themes: Grouping codes into potential themes and collecting all data related to each potential theme. The analysis phase starts after all the data has been initially coded and collected, resulting in a lengthy list of codes found in the dataset. This phase involves shifting the focus of the analysis from codes to broader themes, sorting the codes into potential themes, and gathering all relevant coded data extracts within the identified themes.

4. Reviewing themes: Understand the various themes, their interconnectedness, and the overall narrative they communicate about the data.

5. Defining and naming themes: Continuously refining the details of each theme and the overall narrative conveyed by the analysis, establishing precise definitions and labels for each theme. The

process of defining and refining aims to pinpoint the fundamental nature of each theme and the overall themes and identify the specific aspect of the data that each theme encompasses.

6. Producing the report: Conducting the final analysis phase by connecting the analysis to the research question and existing literature to produce a scholarly analysis report.

4.3 The Developed Themes

This analysis identified three main themes: drivers of food waste in university, intervention to stimulate behavioral change to mitigate food waste, and strategies for university stakeholders to mitigate food waste. The main themes is illustrated in Figure 4.1. Furthermore, these central themes led to the discovery of 10 sub-themes, as illustrated in Figure 4.2, Figure 4.3, and Figure 4.4. The findings of this systematic literature review addressed the primary research question, '*What are the drivers of food waste among students in university dining facilities?'*. Additionally, the sub-research questions:

- What are the relationships between students' knowledge about food waste and their actual food waste behaviors?
- What practical strategies can university administrators implement to reduce food waste in dining facilities?
- What policies can be developed to encourage students to adopt less wasteful food practices in university dining settings?
- How can new insights from this study contribute to the broader literature on food waste reduction in university settings?

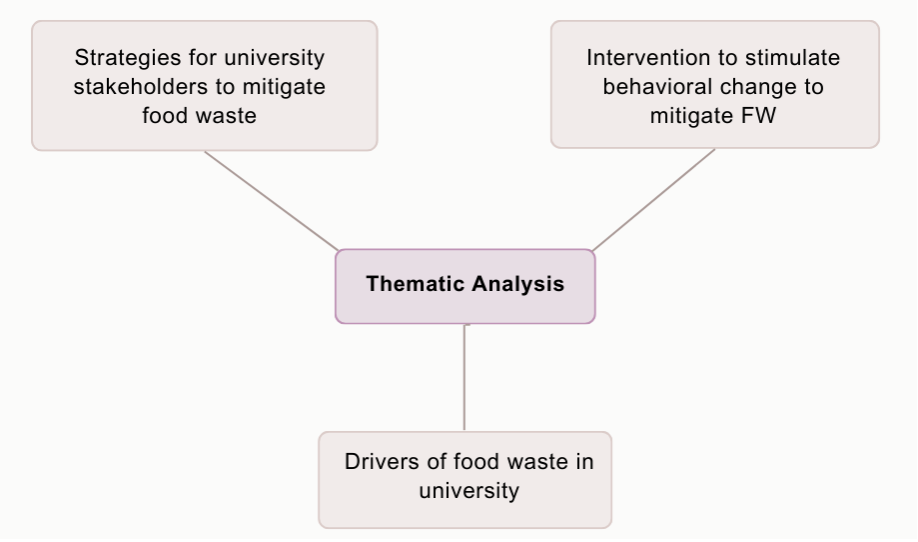

Figure 4.1 The developed themes of thematic analysis.

4.4 Drivers of food waste at university

4.4.1 Material factor

Foreign object. Improper handling of ingredients or inadequate cleaning practices can cause the students to waste their food. This foreign object can be a small piece of potato skin, a tiny rock, a

fish's scale, a steel wire, and even a dead worm inside vegetables (Cui et al., 2023). The study conducted by Cui et al. (2023) revealed that students once threw away fish because the scales were not removed. They said, "I will not eat the fish skin because the scales are not removed". The inadequate cleaning practice occurred due to the large number of cooks simultaneously (Cruz Maceín et al., 2023; Cui et al., 2023; Yagoub et al., 2022). The manager explained that preventing this cause of food waste is challenging.

Flavorless foods. Canteens struggle to guarantee that the food is flavorful due to the large amount of food being served (Cruz Maceín et al., 2023; Yagoub et al., 2022). Evidence is that students wasted their food because it was undercooked, like the frozen chicken stir-fry with sauerkraut, where the chicken was not fully cooked and not warm (Cui et al., 2023). This issue highlights the challenge of maintaining food quality in large-scale food service settings, ensuring every meal meets taste and safety standards.

Food presentation. Many research studies have discovered that unappealing food has more potential to be thrown away (Cruz Maceín et al., 2023; Cui et al., 2023; Miśniakiewicz et al., 2024; Pinto et al., 2018; Richardson et al., 2021; Silva et al., 2024b; Tarczyńska et al., 2023; Yagoub et al., 2022). The other case is that canteens do not provide a correct name menu and a picture, causing students to order by mistake. The student's perception of what the canteen serves is different. For instance, there was a time when the canteen served scrambled eggs with green vegetable stalks, but students perceived it as scrambled eggs with bitter melon (Cui et al., 2023). Consequently, they left the vegetable stalks. Additionally, Tarczyńska et al. (2023) found that loss of visual appeal caused 7.5% of students to waste their food.

Food portion. All articles used in this study found that waste occurs when an excessive amount of food is offered (Cruz Maceín et al., 2023; Cui et al., 2023; Fraj-Andrés et al., 2023; Miśniakiewicz et al., 2024; Musicus et al., 2022; Pinto et al., 2018; Richardson et al., 2021; Silva et al., 2024b; Tarczyńska et al., 2023; Tsai et al., 2020; Yagoub et al., 2022). The study by Cui et al. (2023) found that in Chinese university canteens, food is served to students by staff members instead of students serving themselves. In contrast, the rest of the article mentioned that the foods were generally served where canteens have a templated portion. A study by Tarczyńska et al. (2023) revealed that too big a portion was a problem for 11.3% of the students. The issue with this system is that the canteens do not consider or care less about the students' actual food needs (Cui et al., 2023).

Plate shape. Richardson et al. (2021) compared the foods served on round plates and oval platters. They found a noticeable decrease in food selection, consumption, and waste when oval platters were utilized. Participants wasted an average of 56.8 g of their chosen meal on round plate days, while on oval platter days, the mean waste was 37.7 g. Using smaller plates reduced overall waste (Musicus et al., 2022; Pinto et al., 2018; Richardson et al., 2021; Yagoub et al., 2022).

Date labeling. Misunderstanding foods due to improper date labeling significantly contributes to food waste (Cruz Maceín et al., 2023; Tarczyńska et al., 2023; Yagoub et al., 2022). The issue possibly occurred due to improper food storage. For instance, the food spoiled before the expiration date,

causing students to waste it. The expiry date concerns made up 14.9% of students leaving their foods (Tarczyńska et al., 2023).

4.4.2 Economic factor

Cheap price foods. The students frequently waste cheaper meals because they feel less psychological pressure compared to wasting expensive meals (Cui et al., 2023; Miśniakiewicz et al., 2024; Tarczyńska et al., 2023; Yagoub et al., 2022). For instance, a study by Cui et al. (2023) shared, "I will eat expensive meals first, the cheap meals I can leave without eating." Consequently, cheaper food is more commonly wasted. This observation clarifies why much green vegetables are wasted in university dining facilities (Cui et al., 2023).

Economic affluence. Students desire to have a wide range of foods to fulfill their craving for diversity (Cui et al., 2023; Miśniakiewicz et al., 2024; Tarczyńska et al., 2023; Yagoub et al., 2022). Certain students may be limited in ordering various foods due to their financial situation, whereas those with abundant resources do not face such limitations. Wealthier students may be less aware of food waste's environmental and social impacts because they may not directly feel the financial consequences of wasted food (Yagoub et al., 2022). That case was found by Cui et al. (2023), "I only want to consume these meals, nothing else. Whenever I place an order, it is slightly more than what I can eat". Thus, they will choose whatever they desire without thinking about the issue of waste.

4.4.3 Psychological factor

Psychological eating habits. All articles used in this study found that waste occurred due to the individuals' eating habits (Cruz Maceín et al., 2023; Cui et al., 2023; Fraj-Andrés et al., 2023; Miśniakiewicz et al., 2024; Musicus et al., 2022; Pinto et al., 2018; Richardson et al., 2021; Silva et al., 2024b; Tarczyńska et al., 2023; Tsai et al., 2020; Yagoub et al., 2022). Some avoid consuming specific foods because they label them inedible and unpalatable. For instance, a student mentioned, "I often find myself with extra side dishes, like the vegetables in the dish with salted vegetables, the fungus in the steamed chicken dish with tree fungus, and the broccoli in the fried beef with Chinese broccoli" (Cui et al., 2023). The vegetables are being discarded despite being edible.

Frugality. Students who are not frugal may waste food (Cui et al., 2023). They do not acknowledge the idea of food waste, saying, "I do not feel strongly that leftovers are waste." Forcing themselves to finish their food is unpleasant for them.

4.4.4 Social factor

Mealtime competition. The meal times in Chinese university canteens are fixed to fit between classes and break activities. A large number of students eat during busy hours, leading to long queues for meals and making it difficult for students to choose their favorite dishes. Due to the limited availability of favorite dishes and the need to eat, students have to pick unfamiliar dishes, resulting in a higher waste of food (Cui et al., 2023).

Gender impressions. Some students, particularly female students, engage in food wastage to maintain their perceived gender roles or images in front of others (Cui et al., 2023). For instance, they may pick smaller servings or not finish their food to conform to societal ideals of femininity,

such as projecting a dainty appetite or emphasizing slimness. This performative eating is motivated by the aspiration to traditional gender expectations.

Pressures from co-dinners. The influence of dining companions can also lead to food waste. When dining together, some individuals stop eating and leave the table once their companion has finished their meal (Cui et al., 2023). People consume varying quantities of food at different paces. If a dining companion is left waiting, it can cause the person to eat quicker or leave the meals.

4.4.5 Cultural factor

Food culture differences. Not all of the students come from the same culture. Thus, non-local students must adjust to the local cuisine, and food waste may occur during this adaptation process (Cui et al., 2023). For instance, the study by Cui et al. found out from students such as "I am a fan of spicy food. However, the spicy dishes available in the canteen do not satisfy my spicy food craving. Consequently, I less enjoy them and end up being unable to finish them". "The method of preparing chicken soup in Guangdong does not sit well with me. Although I am okay with the soup itself, the chicken meat lacks any taste".

Living arrangements. Students who live alone are more likely to have higher levels of food waste (Fraj-Andrés et al., 2023; Miśniakiewicz et al., 2024; Tarczyńska et al., 2023; Yagoub et al., 2022). Students living alone may struggle with estimating portion sizes accurately and preparing more food than they can consume. Additionally, there is no communal eating environment where people can share the food. Moreover, solo students may be less inclined to cook balanced meals regularly, choosing convenience foods or takeout instead, which often come in fixed portions and contribute to food waste. Students who live with their families are more aware of the issue since they can share the food.

4.4.6 Health factor

Balanced diet. Students take special care when balancing meat and vegetarian dishes to ensure a healthy diet. They understand that if they order both dishes, they will have more food than they can eat at once. Even though they want to enjoy different culinary options, they know they might have leftovers that cannot be stored or reheated easily, especially in university dining facilities with limited take-out options. Nevertheless, they prioritize including both meat and vegetarian options in every meal for the sake of their health (Cruz Maceín et al., 2023; Cui et al., 2023; Silva et al., 2024b; Tarczyńska et al., 2023).

No overeating. The students made sure not to overeat. If they were already full but there was food remaining, some of them could not finish although they felt guilty (Cruz Maceín et al., 2023; Cui et al., 2023; Silva et al., 2024b; Tarczyńska et al., 2023; Tsai et al., 2020). A student shared, "I am aware that it is not beneficial to waste food, but it is also unhealthy to overeat and have an excessively full stomach" (Cui et al., 2023).

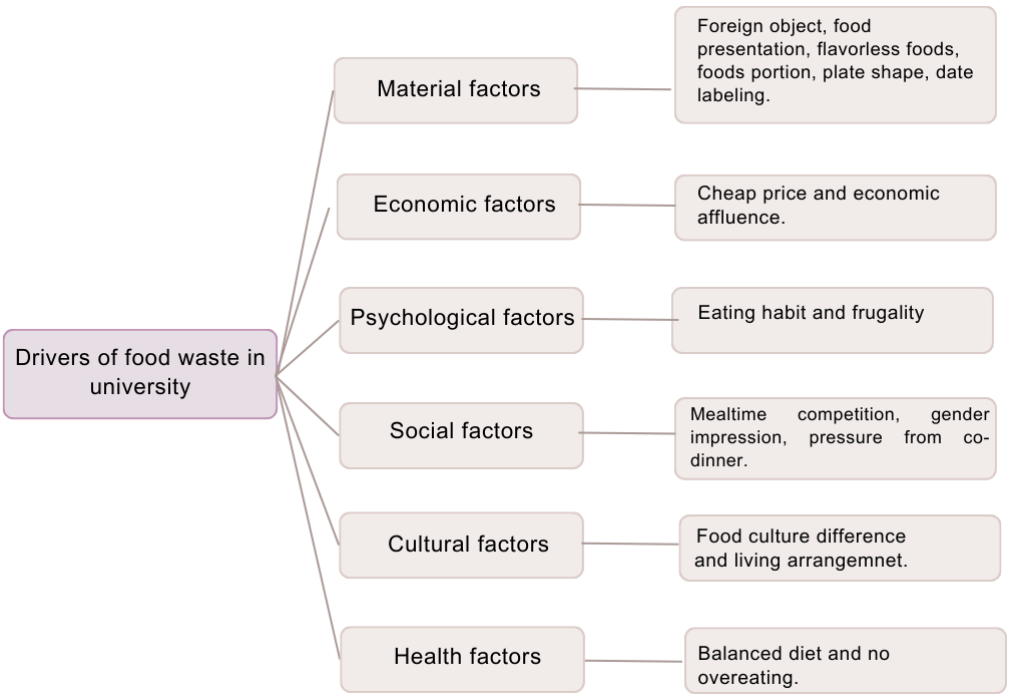

Figure 4.2: Drivers of food waste in University.

4.5 Intervention to stimulate behavioral change to mitigate food waste

4.5.1 Food waste course

Universities could introduce food waste-related courses to effectively change the food waste behavior of students (Fraj-Andrés et al., 2023; Miśniakiewicz et al., 2024; Musicus et al., 2022; Tsai et al., 2020; Yagoub et al., 2022). These courses could educate students about food waste's environmental, social, and economic impacts, fostering a greater awareness of their consumption habits. By incorporating practical strategies for reducing waste, such as portion control, meal planning, and proper food storage techniques, these programs can empower students to make more sustainable choices. Through education and awareness, universities can play a pivotal role in shaping a more sustainable food culture among their student bodies (Yagoub et al., 2022).

The students felt that the program increased their awareness of food waste, influenced their behavior in managing leftover food at home, and reduced the amount of dairy products wasted (Miśniakiewicz et al., 2024). Based on these findings, it can be cautiously inferred that the educational program focusing on reducing food waste has been effective for university students. This is evident from the increased awareness of food waste's consequences and the improved perception of managing household food waste (Fraj-Andrés et al., 2023).

4.5.2 Campaign

All of the articles in this study suggested doing a campaign within the university to mitigate food waste (Cruz Maceín et al., 2023; Cui et al., 2023; Fraj-Andrés et al., 2023; Miśniakiewicz et al., 2024; Musicus et al., 2022; Pinto et al., 2018; Richardson et al., 2021; Silva et al., 2024b; Tarczyńska et al., 2023; Tsai et al., 2020; Yagoub et al., 2022). Such campaigns could raise awareness about the issue of food waste and educate students on practical ways to reduce it. Involving consumers in reducing food waste and making them active participants in the effort will

create a sense of engagement and grow the sense of food waste (Pinto et al., 2018). A study conducted by Pinto et al., 2018 reported a significant improvement in students who cooperated in a university's campaign. Before the campaign, there was a significant amount of leftover soup in the bowls as the students accepted the standard portion without finishing it. To address this, informational posters with the message "If you cannot eat all the soup, ask for half!" were placed near the soup collection area. Similar posters were also used to encourage students to request modified portions according to their needs or to decline food items they knew they would not eat. These posters emphasized, "Ask for the right amount of food, and together we can reduce waste!". The reduction in total plate waste was 15%, leading to a 17% decrease in daily meal waste, a 55% cut in bread waste, and a 42% decrease in meat waste (Pinto et al., 2018).

Another recommendation is to conduct the campaign through social media (Yagoub et al., 2022). Social media plays a crucial role in fostering connections among people. The campaign can include engaging content such as infographics, videos, and challenges highlighting the importance of reducing food waste and offering practical tips. For instance, the university mentioned in the research conducted a week-long "empty plate campaign" to motivate students to finish all the food on their plates and share pictures on social media (Cui et al., 2023). By leveraging the power of social media, universities can create a dynamic and interactive campaign that encourages students to adopt more sustainable food practices. Overall, the consensus across the literature points to the effectiveness of targeted campaigns in driving behavioral change and reducing food waste in university settings.

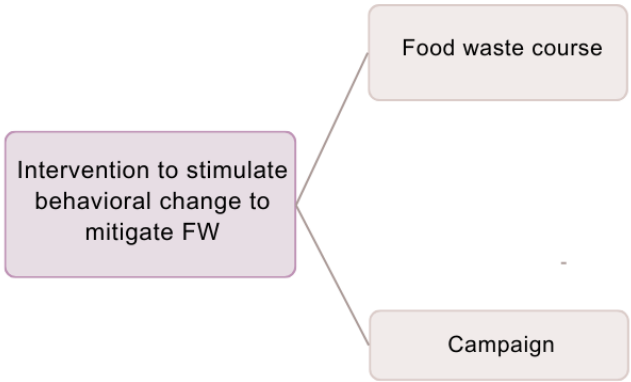

Figure 4.3: Intervention to stimulate behavioral change to mitigate food waste.

4.6 Strategies for university stakeholders to mitigate food waste

4.6.1 Food diversion

Food diversion can be donated to charitable organizations or food banks, composted, utilized for industrial purposes, and animal feed (Fraj-Andrés et al., 2023; Musicus et al., 2022; Tarczyńska et al., 2023; Tsai et al., 2020; Yagoub et al., 2022). In the UAE, there is already a practice of donating and delivering excess food to needy individuals. These initiatives should be encouraged to stimulate

a sense of generosity, unity, and empathy among community members (Yagoub et al., 2022). A study in the USA reported that 84% of overproduced food was donated to community partners and charitable organizations. 74% of the food waste was composted, 42% was utilized for industrial purposes, and 12% was repurposed as animal feed (Musicus et al., 2022). In China, 87.78% of students decided to dispose of the food, 11.14% used leftovers as animal feed, and the rest chose other options (Tsai et al., 2020).

4.6.2 Material factor improvement

The studies recommended that the university's stakeholders improve the material factors. By maintaining high standards of hygiene during preparation and food serving, stakeholders can obtain trust and confidence among students, encouraging them to consume their entire meals rather than disposing of them due to concerns over cleanliness (Cruz Maceín et al., 2023; Cui et al., 2023; Yagoub et al., 2022). Serving visually appealing and appetizing food is more likely to be consumed completely (Cruz Maceín et al., 2023; Cui et al., 2023; Miśniakiewicz et al., 2024; Pinto et al., 2018; Richardson et al., 2021; Silva et al., 2024b; Tarczyńska et al., 2023; Tsai et al., 2020; Yagoub et al., 2022). Furthermore, the canteen should enhance the flavor and quality of its food. If this strategy is too expensive for the management, alternative vendors could be invited to operate additional food stalls (Cui et al., 2023). The serving system and process also require additional enhancements, including the creation of a label for each dish to inform students about the ingredients, providing variable portions for some dishes instead of only a standardized portion, and ensuring that the dishes served after canteen hours remain appetizing (Cruz Maceín et al., 2023; Cui et al., 2023; Tarczyńska et al., 2023; Tsai et al., 2020; Yagoub et al., 2022). Additionally, considering the shape and size of plates can influence portion control and perception of fullness (Miśniakiewicz et al., 2024; Musicus et al., 2022; Pinto et al., 2018; Richardson et al., 2021; Yagoub et al., 2022).

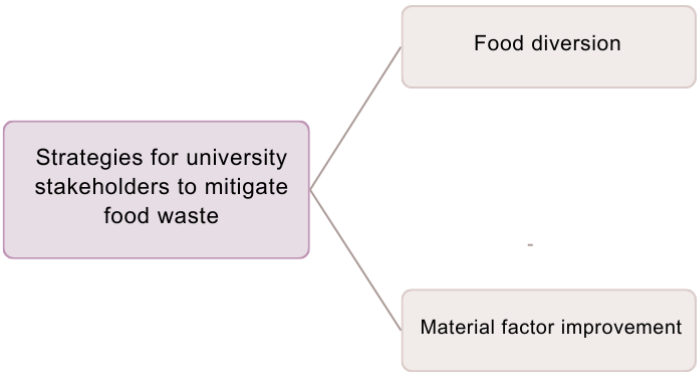

Figure 4.4: Strategies for university stakeholders to mitigate food waste.

V. Conclusion

Eleven articles were assessed in this study using a systematic literature review, ROSES approach, and thematic analysis. The thematic analysis produced three main themes: drivers of food waste in university, intervention to stimulate behavioral change to mitigate food waste, and strategies for university stakeholders to mitigate food waste. These central themes led to the discovery of 10 sub-themes.

Analyzing food waste drivers in university dining facilities highlights several key factors contributing to the problem. Material factors such as foreign objects in food, unappealing or undercooked meals, inadequate food presentation, excessive portions, and improper date labeling significantly influence students' decisions to waste food. Economic factors also play a role, with cheaper food items being more likely to be wasted due to lower perceived value and less psychological pressure to finish them. Psychological factors: some students may avoid certain foods they find unpalatable, while others, driven by a lack of frugality, may not fully appreciate the value of minimizing waste. Social factors, such as mealtime competition, gender impressions, and the influence of dining companions, also impact food waste behavior, with some students discarding food to conform to social norms or due to peer pressure. Cultural and health factors additionally influence food waste. Non-local students may struggle with unfamiliar local cuisines, leading to increased waste during the adaptation process. Moreover, health-conscious behaviors, such as balancing diet or avoiding overeating, can paradoxically contribute to waste, as students prioritize their health over finishing their meals. These findings underscore the complexity of food waste behavior in university settings, driven by a mix of drivers.

A combination of educational interventions and targeted campaigns have proven effective in stimulating student behavioral change. Introducing food waste-related courses can significantly enhance students' understanding of food waste's environmental, social, and economic impacts. These courses equip students with practical strategies such as portion control, meal planning, and proper food storage, empowering them to make more sustainable choices. The effectiveness of such educational programs is evidenced by increased student awareness and improved management of food waste, particularly in reducing the wastage of dairy products.

Additionally, implementing campaigns within universities is a powerful tool to raise awareness and encourage active participation in waste reduction efforts. Campaigns can utilize informational posters and social media to deliver engaging and educational content, promoting conscious consumption and portion management. For example, initiatives like the "empty plate campaign," where students are encouraged to finish their meals and share their efforts on social media, foster a culture of mindfulness and collective responsibility towards food waste.

Several strategies have been identified for university stakeholders to mitigate food waste. First is food diversion, where excess food can be redirected to charitable organizations or food banks, composted, used for industrial purposes, or repurposed as animal feed. This practice reduces waste and fosters a sense of community and empathy, as seen in initiatives in the UAE and the USA, where significant portions of overproduced food are donated to those in need.

Improvement in material factors also plays a crucial role in reducing food waste. By maintaining high hygiene standards during food preparation and serving, universities can build trust and confidence among students, encouraging them to consume their entire meals. Serving visually appealing and appetizing food, enhancing the flavor and quality of meals, and considering cost-effective alternatives, such as inviting additional vendors, can significantly decrease the amount of food wasted. Moreover, enhancing the serving system by providing detailed labels for each dish, offering variable portion sizes, and ensuring food quality after regular canteen hours can further reduce waste. Additionally, the shape and size of plates have been found to influence portion control and the perception of fullness, suggesting that thoughtful selection of tableware can aid in reducing food waste. By implementing these strategies, universities can minimize food waste and promote a more sustainable and responsible approach to food consumption among students.

VI. Limitations and Future Recommendations

The systematic literature review in this study identifies, categorizes, and fills the gap of the various drivers of food waste in university settings, including material, economic, psychological, social, cultural, and health factors. This analysis provides a detailed understanding of the complex factors contributing to food waste. This study contributes methodologically to the academic field by employing a systematic literature review. It demonstrates the effectiveness of this approach in synthesizing existing research, identifying gaps, and suggesting new areas for future investigation.

Furthermore, the present study provides a comprehensive analysis of strategies that university stakeholders can implement to reduce food waste, such as food diversion and material factor improvements. This contributes to the academic discourse by highlighting practical, evidence-based approaches that can be adopted by similar institutions to address food waste issues. By assessing various interventions, such as educational programs and awareness campaigns, this study contributes to a deeper understanding of how behavior can be influenced to reduce food waste.

However, there is no perfect research, and this study has several limitations. First, future research is recommended to gather more data for a more robust result. Some primary studies found it challenging to gather structured and complete data from the respondents. The database search was also limited to Scopus, potentially excluding studies not listed in Scopus. Second, the present study only included English articles, potentially missing the findings in other languages. For instance, Chinese, Spanish, Turkish, Russian, Portuguese, Persian, Hungarian, and Czech languages were listed in the database but were excluded based on the inclusion criteria. Third, the present study has limitations in the sample location, such as China, Poland, Italy, UAE, Portugal, Spain, and the USA. Moreover, the findings from these primary articles cannot be generalized as established in each country. Therefore, researchers need to investigate the issue of food waste in universities within developed and developing economies.

Reference

Abdelaal, A. H., McKay, G., & Mackey, H. R. (2019). Food waste from a university campus in the Middle East: Drivers, composition, and resource recovery potential. *Waste Management*, *98*, 14–20. https://doi.org/10.1016/j.wasman.2019.08.007

Aertsens, J., Verbeke, W., Mondelaers, K., & van Huylenbroeck, G. (2009). Personal determinants of organic food consumption: A review. *British Food Journal*, *111*(10), 1140–1167. https://doi.org/10.1108/00070700910992961

Ajzen, I. (1991). The Theory of Planned Behavior. *Organizational Behavior and Human Decision Processes*.

Ajzen, I. (2020). The theory of planned behavior: Frequently asked questions. *Human Behavior and Emerging Technologies*, *2*(4), 314–324. https://doi.org/10.1002/hbe2.195

Alhojailan, M. I., & Ibrahim, M. (2012). Thematic Analysis : A Critical Review of Its Process and Evaluation. *WEI International European AcademicConference Proceedings*, *1*(2011), 8–21.

Bavik, A. (2020). A systematic review of the servant leadership literature in management and hospitality. *International Journal of Contemporary Hospitality Management*, *32*(1), 347–382. https://doi.org/10.1108/IJCHM-10-2018-0788

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Braun, V., & Clarke, V. (2021). Can I use TA? Should I use TA? Should I not use TA? Comparing reflexive thematic analysis and other pattern-based qualitative analytic approaches. *Counselling and Psychotherapy Research*, *21*(1), 37–47. https://doi.org/10.1002/capr.12360

Coşkun, A., & Yetkin Özbük, R. M. (2020). What influences consumer food waste behavior in restaurants? An application of the extended theory of planned behavior. *Waste Management*, *117*(2020), 170–178. https://doi.org/10.1016/j.wasman.2020.08.011

Cruz Maceín, J. L., Hocine, M. A., Hernández-Jiménez, V., Zamorano Rodríguez, J. P., & Sayadi Gmada, S. (2023). The Gap in Sustainable Food Services in Public Institutions: The Perceptions of Young Consumers from Public Universities in the Madrid Region (Spain). *Foods*, *12*(22). https://doi.org/10.3390/foods12224103

Cui, Q., Lin, G., Qiu, S., & Duan, T. (2023). Identifying the Drivers of Food Waste in University Canteens in China: A Qualitative Approach. *SAGE Open*, *13*(3), 1–12. https://doi.org/10.1177/21582440231198223

De Groot, J., & Steg, L. (2009). Morality and prosocial behavior: The role of awareness, responsibility, and norms in the norm activation model. *Journal of Social Psychology*, *149*(4), 425–449. https://doi.org/10.3200/SOCP.149.4.425-449

Deliberador, L. R., da Silva César, A., & Batalha, M. O. (2021). How to fight food waste in university restaurants? *Gestao e Producao*, *28*(2). https://doi.org/10.1590/1806-9649-2020V28E5415

Derqui, B., & Fernandez, V. (2017). The opportunity of tracking food waste in school canteens: Guidelines for self-assessment. *Waste Management*, *69*, 431–444. https://doi.org/10.1016/j.wasman.2017.07.030

EUROPEAN, & COMMISSION. (2023). Impact Assessment Report. *Angewandte Chemie International Edition, 6(11), 951–952.*, *6*(November), 5–24. http://www.nber.org/papers/w16019

Eurostat. (2024). *Food waste and food waste prevention - estimates*. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Food_waste_and_food_waste_prevention_-_estimates

Fraj-Andrés, E., Herrando, C., Lucia-Palacios, L., & Pérez-López, R. (2023). Informative initiatives as a useful tool to raise awareness of food waste. An application to higher education. *International Journal of Sustainability in Higher Education*, *24*(4), 840–858. https://doi.org/10.1108/IJSHE-03-2022-0103

Freeman, R. E. E., & McVea, J. (2005). A Stakeholder Approach to Strategic Management. *SSRN Electronic Journal*, *March*. https://doi.org/10.2139/ssrn.263511

Gao, D., Li, X., Ma, J., & Qian, L. (2024). Lost Food and Associated Phosphorus Footprint: Evidence from China. *Foods*, *13*(8). https://doi.org/10.3390/foods13081262

Gloster, A., & Armstrong, J. (2016). Menus of Change University Research Collaborative. *Journal of the Academy of Nutrition and Dietetics*, *116*(9), A24. https://doi.org/10.1016/j.jand.2016.06.075

Gusenbauer, M., & Haddaway, N. R. (2020). Which academic search systems are suitable for systematic reviews or meta-analyses? Evaluating retrieval qualities of Google Scholar, PubMed, and 26 other resources. *Research Synthesis Methods*, *11*(2), 181–217. https://doi.org/10.1002/jrsm.1378

Haar, S. van der, & Zeinstra, G. G. (2019). *The impact of Too Good To Go on Food Waste Reduction at The Consumer Household Level : An Explorative Study*.

Haddaway, N. ., Macura, B., Whaley, P., & Pullin, A. . (2017). *RepOrting standards for Systematic Evidence Syntheses*. https://www.roses-reporting.com/

Haddaway, N. R., Macura, B., Whaley, P., & Pullin, A. S. (2018). ROSES Reporting standards for Systematic Evidence Syntheses: Pro forma, flow-diagram and descriptive summary of the plan and conduct of environmental systematic reviews and systematic maps. *Environmental Evidence*, *7*(1), 4–11. https://doi.org/10.1186/s13750-018-0121-7

Karim Ghani, W. A. W. A., Rusli, I. F., Biak, D. R. A., & Idris, A. (2013). An application of the theory of planned behaviour to study the influencing factors of participation in source separation of food waste. *Waste Management*, *33*(5), 1276–1281. https://doi.org/10.1016/j.wasman.2012.09.019

Kaur, P., Dhir, A., Talwar, S., & Alrasheedy, M. (2020). Systematic literature review of food waste

in educational institutions: setting the research agenda. *International Journal of Contemporary Hospitality Management*, *33*(4), 1160–1193. https://doi.org/10.1108/IJCHM-07-2020-0672

Kostakis, I., Papadaki, S., & Malindretos, G. (2024). Analyzing the relationship between consumers' and entrepreneurs' food waste and sustainable development using a bibliometric approach. *Frontiers in Sustainability*, *5*(April), 1–11. https://doi.org/10.3389/frsus.2024.1373802

Leal Filho, W., Ribeiro, P. C. C., Setti, A. F. F., Azam, F. M. S., Abubakar, I. R., Castillo-Apraiz, J., Tamayo, U., Özuyar, P. G., Frizzo, K., & Borsari, B. (2023). Toward food waste reduction at universities. *Environment, Development and Sustainability*, *0123456789*. https://doi.org/10.1007/s10668-023-03300-2

Li, C., Bremer, P., Harder, M. K., Lee, M. S., Parker, K., Gaugler, E. C., & Mirosa, M. (2022). A systematic review of food loss and waste in China: Quantity, impacts and mediators. *Journal of Environmental Management*, *303*(September 2021), 114092. https://doi.org/10.1016/j.jenvman.2021.114092

Lockwood, C., Munn, Z., & Porritt, K. (2015). Qualitative research synthesis: Methodological guidance for systematic reviewers utilizing meta-aggregation. *International Journal of Evidence-Based Healthcare*, *13*(3), 179–187. https://doi.org/10.1097/XEB.0000000000000062

Miśniakiewicz, M., Amicarelli, V., Chrobak, G., Górka-Chowaniec, A., & Bux, C. (2024). Do Living Arrangements and Eating Habits Influence University Students' Food Waste Perception in Italy and Poland? *Sustainability (Switzerland)* , *16*(5). https://doi.org/10.3390/su16052102

Mohamed Shaffril, H. A., Samsuddin, S. F., & Abu Samah, A. (2021). The ABC of systematic literature review: the basic methodological guidance for beginners. *Quality and Quantity*, *55*(4), 1319–1346. https://doi.org/10.1007/s11135-020-01059-6

Musicus, A. A., Amsler Challamel, G. C., McKenzie, R., Rimm, E. B., & Blondin, S. A. (2022). Food Waste Management Practices and Barriers to Progress in U.S. University Foodservice. *International Journal of Environmental Research and Public Health*, *19*(11). https://doi.org/10.3390/ijerph19116512

Nations, F. and A. O. of the U. (2024). *No Title*. https://www.fao.org/platform-food-loss-waste/en/

Owasi, Y. R., & Formentini, M. (2021). Investigating the Role of Institutional Frameworks in Food Waste Reduction at the Retailer Interface in the European Union. *IFIP Advances in Information and Communication Technology*, *631 IFIP*, 620–629. https://doi.org/10.1007/978-3-030-85902-2_66

Ozanne, L. K., Ballantine, P. W., & McMaster, A. (2022). Understanding Food Waste Produced by University Students: A Social Practice Approach. *Sustainability (Switzerland)*, *14*(17). https://doi.org/10.3390/su141710653

Painter, K., Thondhlana, G., & Kua, H. W. (2016). Food waste generation and potential interventions

at Rhodes University, South Africa. *Waste Management*, *56*, 491–497. https://doi.org/10.1016/j.wasman.2016.07.013

Pinto, R. S., Pinto, R. M. dos S., Melo, F. F. S., Campos, S. S., & Cordovil, C. M. dos S. (2018). A simple awareness campaign to promote food waste reduction in a University canteen. *Waste Management*, *76*(2018), 28–38. https://doi.org/10.1016/j.wasman.2018.02.044

Principato, L., Secondi, L., & Pratesi, C. A. (2015). Reducing food waste: An investigation on the behavior of Italian youths. *British Food Journal*, *117*(2), 731–748. https://doi.org/10.1108/BFJ-10-2013-0314

R., S., W., S., & A., S. (2014). Integration of Theory of Planned Behavior and Norm Activation Model on Student Behavior Model Using Cars for Traveling to Campus. *Civil Engineering Dimension*, *16*(2), 117–122. https://doi.org/10.9744/ced.16.2.117-122

Ramanathan, R., Ramanathan, U., Pelc, K., & Hermens, I. (2024). How Do Existing Organizational Theories Help in Understanding the Responses of Food Companies for Reducing Food Waste? *Sustainability (Switzerland)*, *16*(4). https://doi.org/10.3390/su16041534

Rasool, S., Cerchione, R., Centobelli, P., Oropallo, E., & Salo, J. (2024). Sustainability and socially responsible food consumption: an empirical investigation based on self-awareness and self-congruity theories. *Asia Pacific Journal of Marketing and Logistics*, *36*(4), 993–1023. https://doi.org/10.1108/APJML-07-2022-0559

Rezaei, R., Safa, L., Damalas, C. A., & Ganjkhanloo, M. M. (2019). Drivers of farmers' intention to use integrated pest management: Integrating theory of planned behavior and norm activation model. *Journal of Environmental Management*, *236*(November 2018), 328–339. https://doi.org/10.1016/j.jenvman.2019.01.097

Richardson, R., Prescott, M. P., & Ellison, B. (2021). Impact of plate shape and size on individual food waste in a university dining hall. *Resources, Conservation and Recycling*, *168*(August 2020). https://doi.org/10.1016/j.resconrec.2020.105293

Rodríguez, A. D. R. (2023). Systematic reviews in education? In *Revista de Ciencias Sociales* (Vol. 29, Issue 4).

Sejin, P. J. & H. (2014). Understanding Consumer Recycling Behavior : Combining the Theory of Planned Behavior and the Norm Activation Mode. *Family and Consumer Sciences Research Journal*.

Silva, S. S., Pereira, A. C., Marques, B., & Liz Martins, M. (2024a). Inadequacy of Meals Served and Food Waste in a Portuguese University Canteen. *Sustainability (Switzerland)* , *16*(10), 1–10. https://doi.org/10.3390/su16104317

Silva, S. S., Pereira, A. C., Marques, B., & Liz Martins, M. (2024b). Inadequacy of Meals Served and Food Waste in a Portuguese University Canteen. *Sustainability (Switzerland)* , *16*(10), 1–11. https://doi.org/10.3390/su16104317

Smith, W. K., & Lewis, M. W. (2011). Toward a Theory of Paradox: a Dynamic Equilibrium Model of Organizing. *Academy of Management Review*, *36*(2), 381–403. https://doi.org/10.5465/amr.2011.59330958

Tarczyńska, A. S., Malinowska, E., & Urbanowicz, A. (2023). Attitudes and Behaviours of Young Consumers towards Wasting Food: Case Study Based on Polish Students. *Sustainability (Switzerland)*, *15*(4). https://doi.org/10.3390/su15043328

Tsai, W. C., Chen, X., & Yang, C. (2020). Consumer Food Waste Behavior among Emerging Adults: Evidence from China. *Foods*, *9*(7). https://doi.org/10.3390/foods9070961

United Nations Environment Programme. (2024). Food Waste Index Report 2024. *United Nations Environment Programme*, 99. https://www.unep.org/resources/publication/food-waste-index-report-2024

Yagoub, M. M., Al Hosani, N., AlSumaiti, T., Kortbi, O., Alshehhi, A. A., Aldhanhani, S. R., & Albedwawi, S. A. (2022). University Students' Perceptions of Food Waste in the UAE. *Sustainability (Switzerland)*, *14*(18). https://doi.org/10.3390/su141811196

Zhang, X., Geng, G., & Sun, P. (2017). Determinants and implications of citizens' environmental complaint in China: Integrating theory of planned behavior and norm activation model. *Journal of Cleaner Production*, *166*, 148–156. https://doi.org/10.1016/j.jclepro.2017.08.020

Appendix

Item number	Section/sub-section	Topic	Description	Further explanation	Checklist/ Meta-data
1	Title	Title	an update/amendment: e.g. "...A systematic review update."	The title should normally be the same or very similar to the review question.	Meta-data
2	Type of review	Type of review	review update, systematic review amendment, systematic review from a	See CEE Guidance on amendments and updates [1]	Meta-data
3	Authors' contacts	Authors' contacts	must be provided.		Checklist
4	Abstract	Structured summary	structured into separate sections: Background, the context and purpose of the		Checklist
5	Background	Background	Reviews must indicate why this study was necessary and what it aims to	the intervention or exposure to the outcome.	Checklist
6	Stakeholder engagement	Stakeholder engagement	the formulation of the question) must be described and explained (using a		Checklist
7	Objective of the review	Objective	Describe the primary question and secondary questions (when applicable).	questions are usually linked to sources of heterogeneity (effect modifiers).	Checklist
8		Definition of the question components	intervention(s)/exposure(s), comparator(s), and outcome(s).	For other question types see [3,4]	Meta-data
9	Methods	Protocol	Provide citation, DOI or open-access link to published protocol.	access).	Meta-data
10		Deviations from protocol	those set out in the protocol along with a justification.		Checklist
11	Searches	Search strategy	searching, institutional subscriptions (or date ranges subscribed for each		Checklist
12		Search string	string is formatted (e.g. Web of Science format)		Meta-data
13		Languages - bibliographic databases	List languages used in bibliographic database searches		Meta-data
14		Languages – grey literature	engines		Meta-data
15		Bibliographic databases	Provide the number of bibliographic databases searched		Meta-data
16		Web-based search engines	Provide the number of web-based search engines searched		Meta-data
17		Organisational websites	Provide the number of organisational websites searched		Meta-data
18		search	was assessed (i.e. list of benchmark articles)		Checklist
19		Search update	Describe any update to searches undertaken during the conduct of the review	searches were performed more than two years prior to review completion.	Checklist
20	study inclusion criteria	Screening strategy	Methods for consistency of screening decisions (at title, abstract, and full texts		Checklist
21		Inclusion criteria	articles/studies. These must be broken down into the question key elements		Checklist
22	Critical appraisal	Critical appraisal strategy	assessment of individual studies and the evidence base as a whole). Describe		Checklist
23		Critical appraisal used in synthesis	Describe how the information from critical appraisal was used in synthesis.		Checklist
24	Data extraction	strategy	providing lists of variables that will be extracted as meta-data and those that	Optional, a map database can be included within a systematic review	Checklist
25		Data extraction strategy	findings. Describe how repeatability of data extraction was tested.		Checklist
26		Approaches to missing data	information or data from authors.		Checklist
27	modifiers/reasons for	heterogeneity	heterogeneity that will be considered in the review. Also provide details of		Checklist
28	presentation	Type of synthesis	(narrative only, narrative and quantitative, narrative and qualitative,		Meta-data
29		Narrative synthesis strategy	form of descriptive statistics, tables (including SM database) and figures.		Checklist
30		Quantitative synthesis strategy	calculating effect sizes, methods for handling complex data, statistical	Compulsory (if quantitative synthesis performed)	Checklist

Table 1.1: Review report of ROSES (Haddaway et al., 2017).

Item number	Section/sub-section	Topic	Description	Further explanation	Checklist/ Meta-data
31		Qualitative synthesis strategy	methodological choices. Describe if and how you plan to analyse	Compulsory (if qualitative synthesis performed)	Checklist
32		Other synthesis strategies	qualitative and quantitative syntheses (e.g. mixed methods) and justify your	Compulsory (if other synthesis performed)	Checklist
33		Assessment of risk of publication bias	the synthesis.	statistical tests.	Checklist
34		identification strategy	(unrepresented or underrepresented subtopics that warrant further primary	Optional	Checklist
35		independence	be considered within the review) in decisions regarding inclusion or critical	should be prevented from unduly influencing inclusion decisions, for example	Checklist
36	Results (review findings)	Description of review process	all sources and retained through each stage of the review. Must also display		Checklist
37		Number of search results	updates if conducted) prior to duplicate removal.	website searches: this will help assessment of the efficiency of the primary	Meta-data
38		duplicate removal	searches following duplicate removal.	website searches: this will help assessment of the efficiency of the primary	Meta-data
39		Full text screening excludes	Additional file containing list of and reasons for full text exclusions.		Checklist
40		Title screening results	Provide the number of articles retained following title screening.	Optional if screening titles and abstracts together	Meta-data
41		Abstract screening results	Provide the number of articles retained following abstract screening.	Optional if screening titles and abstracts together	Meta-data
42		Title and abstract screening results	Provide the number of articles retained following title and abstract screening.	Optional if screening titles and abstracts separately	Meta-data
43		Retrieval results	Provide the number of articles retrieved at full text.		Meta-data
44		Unobtainable articles	Additional file containing list of unobtainable articles.		Checklist
45		Full text screening results	Provide the number of articles retained following full text screening.		Meta-data
46		Consistency checking: screening	critical appraisal) must be provided. Provide the number of titles, abstracts		Checklist
47		Critical appraisal exclusions	excluded from further synthesis during critical appraisal.	authors may prefer to perform a sensitivity analysis (repeating analyses to	Meta-data
48		Narrative synthesis	vote-counting (tallying of studies based on results; direction or significance).		Checklist
49		Extracted data	findings) from included studies.		Checklist
50		Systematic map database	Additional file containing meta-data and coding for included studies.	Optional, a map database can be included within a systematic review	Checklist
51		Quantitative synthesis	analysis).	Compulsory (if quantitative synthesis performed)	Checklist
52		Qualitative synthesis	identified themes or categories). Also provide additional file with the identified	Compulsory (if qualitative synthesis performed)	Checklist
53		Other synthesis	Present results of any other synthesis methods used.	Compulsory (if other synthesis performed)	Checklist
54		Risk of publication bias	bias on the synthesis.	statistical tests	Checklist
55		Limitations of the review	Discuss possible limitations in the methods used.		Checklist
56		Limitations of the evidence base	Discuss possible limitations in the evidence base.		Checklist
57	Conclusions	Implications for policy/management	identified evidence may inform policy/practice decision making in relation to	recommendations or advocacy.	Checklist
58		Implications for research	including options for increasing the reliability of study design that could	permissible provided it is clearly justified by the review outcome/critical	Checklist
59	Declarations	Competing interests	authors may have.		Checklist