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Systematic review of factors influencing household food waste behaviour: Applying the theory of planned behaviour

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Abstract

Globally, household food waste alone accounts for about $700 billion in environmental costs owing to the resources expended in producing discarded or uneaten food, along with social costs reaching approximately $900 billion. Reducing this waste by 25% could potentially feed 821 million chronically undernourished individuals. This systematic review examines household food waste behaviour using the Theory of Planned Behaviour (TPB). Comprehensive searches were conducted in PubMed and EMBASE using Elsevier supplemented by additional articles from the reference lists. The procedure followed the PRISMA flowchart. A descriptive analysis was conducted to summarize the characteristics of the 42 included studies from 17 countries. Significantly, 95% of these articles were published between 1 January 2010 and 19 April 2024, in Scimago Q1 ranked journals. The findings demonstrate an intersection of TPB components in explaining household food waste behaviour. This study suggests that a holistic strategy targeting attitudes, subjective norms and perceived behavioural control is essential for effectively reducing household food waste. Additionally, tailored interventions that consider demographic and socioeconomic factors are necessary to address the diverse needs of different populations. The study concludes that public education targeting mindful consumption, effective policies and community initiatives can significantly reduce food waste.

Keywords

Attitude, food waste journey, food waste reduction strategies, perceived behavioural control, social norms, socioeconomic influences

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Introduction

Despite limited global resources, a significant portion of the world's food supply is lost or wasted annually, which exacerbates hunger, strains natural ecosystems and contributes to greenhouse gas (GHG) emissions (Edjabou et al., 2016; Hermanussen and Loy, 2024; Nguyen et al., 2023; Spang et al., 2019; van Rooijen et al., 2024). Globally, an alarming 1.3 billion tonnes of food is wasted annually throughout the food supply chain (Principato et al., 2021), resulting in a staggering economic loss of approximately one trillion USD (FAO, 2014). Moreover, environmental ramifications are dire (Peronti et al., 2024), with household food waste alone accounting for $700 billion in environmental costs owing to the resources expended in producing discarded or uneaten food, along with social costs reaching approximately 900 billion USD (FAO, 2014; Principato et al., 2021). Mitigating this waste is critical, as reducing global food waste by just 25% could potentially provide sustenance for 821 million chronically undernourished individuals (FAO, 2013; Principato et al., 2021). Research indicates that households are a significant source of food waste (Attiq et al., 2021; Jungowska et al., 2021; Khalid et al., 2019), particularly during the consumption phase (Attiq et al., 2021; Laurenti et al., 2017). As such, understanding the factors contributing to household food waste is crucial, given its implications for food availability and accessibility (Pontes et al., 2022; Schanes et al., 2018; van der Werf et al., 2021). Several studies have documented the significant impact of food waste on GHG emissions (Batool et al., 2023; Daskiran et al., 2024; Li et al., 2024; Vazquez-Rowe et al., 2021). Governments, non-governmental organizations and international organizations have shown great interest in solving the challenge of food waste across the globe, with the United Nations Sustainable Development

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Goals 2 and 12 focusing on food availability and sustainable consumption and production patterns (Bhatia and Sharma, 2023; Damiani et al., 2021; United Nations, 2015).

The literature has shown that household food waste is a function of consumer behaviour, a point that has been elaborated by the theory of planned behaviour (TPB) (Oehman et al., 2022). TPB, a widely used social psychological theory developed by Icek Ajzen in 1991, provides a framework for understanding the determinants of food waste behaviours and designing effective reduction strategies (Lin and Guan, 2021). The TPB serves as a framework for deciphering human behaviour, particularly in the context of food waste. Numerous studies have discussed the demographic and socioeconomic factors that influence food waste and strategies for waste reduction (Fami et al., 2019). However, no systematic review has mapped the intersectionality of the three components of TPB in food waste behaviour. Related reviews have focused on food loss and waste (El Bilali et al., 2022), food generation and industrial uses (Girotto et al., 2015), strategies for improving anaerobic digestion of food waste (Rodriguez-Jimenez et al., 2022), management and prevention of food losses and waste in low- and middle-income countries (Mmereki et al., 2024) and determinants of food insecurity (Varela et al., 2023). Hence, this systematic review is relevant as it deploys TPB to explore complex cases of household food waste within diverse demographic and socioeconomic contexts.

This article offers a systematic review of the TPB to delve into household food waste behaviour. The TPB suggests that attitudes, subjective norms and perceived behavioural control (PBC) shape food waste behaviour (Aktas et al., 2018; Lin and Guan, 2021; Oehman et al., 2022). This review contributes to the body of knowledge by leading the way towards sufficiently using TPB in a review explaining demographic and socioeconomic influences on food waste determinants and reduction strategies. This systematic review found that TPB effectively explains food waste behaviour, with attitudes, subjective norms and PBC playing significant roles (Oehman et al., 2022). The review also found intersectionality between the three major components of TPB and how they influence different demographic and socioeconomic variables related to food waste. The intersectionality between attitude, subjective norms and PBC in food waste behaviour highlights how these factors interact and influence individuals' decisions. The authors then used the TPB to propose a framework for household food waste behaviour. Finally, the limitations of the included studies and those of the present study are highlighted and recommendations for future research are presented. The remainder of this article is subdivided into a conceptual framework, research questions and methods, results, discussion, limitations of both previous and current studies and recommendations for further research.

Conceptual framework: TPB

The TPB, a widely used social psychological framework developed by Ajzen in 1991, offers insights into the determinants of food waste behaviours and aids in designing effective reduction strategies (Lin and Guan, 2021). These three pillars also make meaningful contributions to the demography, norms and socioeconomic considerations around food waste behaviour (Akhter et al., 2024; Aydin and Aydin, 2022; Lourenco et al., 2022; Oehman et al., 2022). This encompasses beliefs about the outcomes of actions, social expectations and factors that may aid or hinder performance (Bosnjak et al., 2020). TPB suggests that human behaviour is influenced by attitudes, subjective norms and PBC (Coskun and Ozbuk, 2020; Ghani et al., 2013; Mak et al., 2018), which collectively shape intentions and subsequent actions (Fami et al., 2019; Lin and Guan, 2021). The TPB posits individuals as rational decision-makers who weigh the consequences of their actions beforehand. Attitudes represent positive or negative evaluations of a behaviour, whereas subjective norms reflect social pressures based on the beliefs of others (Lin and Guan, 2021). PBC pertains to one's confidence in performing a behaviour and their sense of control over it (Fami et al., 2019).

Attitudes

Attitude in the TPB refers to an individual's overall evaluation or appraisal of behaviours related to food waste, such as reduction, recycling or composting. Attitude here encompasses a positive or negative feelings, beliefs and perceptions regarding specific actions, and reflects personal evaluations of actions related to food waste, such as throwing away edible food or composting organic waste (Jabeen et al., 2023; Snelling et al., 2023). Positive attitudes towards reducing food waste may include beliefs about environmental responsibility, financial savings or ethical considerations. Conversely, negative attitudes may stem from perceptions of inconvenience, lack of awareness or cultural norms regarding food disposal (Fami et al., 2019; Lin and Guan, 2021). For instance, some people may find composting inconvenient or time-consuming, leading to negative attitudes towards the practice. Additionally, a lack of awareness of the negative environmental impacts of food waste or the benefits of composting may contribute to negative attitudes towards sustainable food disposal methods (Castro et al., 2023). Furthermore, cultural norms and practices surrounding food disposal may also play a role in shaping negative attitudes towards sustainable food waste management practices.

Subjective norms

Subjective norms in food waste behaviour are perceived social pressure or expectations regarding how one should behave in relation to food waste within social circles or communities (Lin and Guan, 2021). Subjective norms regarding food waste behaviours are influenced by social and perceived societal expectations. Individuals may feel pressure from peers, family members or cultural norms to either minimize or disregard food waste (Rastegari et al., 2023). Despite these pressures, it is important for individuals to recognize the negative impact of food waste on

the environment and take steps to reduce it. This could include planning meals more effectively, purchasing only what is needed, or using leftovers (Batool et al., 2023; Tonini et al., 2018). Additionally, individuals can participate in community initiatives or programmes that aim to reduce food waste, such as food banks and composting programmes. By working together and making conscious efforts to minimize food waste, we can help create a more sustainable future (GOV.UK, 2021). Perceptions of what others expect or approve of regarding food waste can strongly influence an individual's decision-making process.

Perceived behavioural control

PBC involves households' confidence in their ability to implement waste reduction strategies such as meal planning and proper storage.

> High-level PBC: Strong belief in the capacity to consistently carry out food waste management.
>
> Low-level PBC: Lack of confidence in their ability to effectively reduce waste.

PBC relates to an individual's beliefs about their ability to control actions related to food waste (Lin and Guan, 2021). Factors, such as access to food storage solutions, cooking skills, knowledge of food preservation techniques and financial resources, impact perceived control over food waste behaviours. Additionally, situational factors such as time constraints and household dynamics may influence perceived control over food waste reduction efforts (Fami et al., 2019). Furthermore, cultural beliefs and attitudes towards food waste play a significant role in determining an individual's perceived control over food waste reduction efforts (Fami et al., 2019). For instance, in some cultures, it is considered wasteful to not finish all food on one's plate, whereas in others, leaving some food behind is seen as a sign of respect for the host. These cultural differences can have a significant impact on an individual's perception of control over food waste reduction. Additionally, social norms and expectations regarding food consumption influence an individual's perceived control over food waste reduction efforts (Oria et al., 2020; Russell et al., 2017). For example, if a household does not finish every meal, it may be difficult for individuals to change their behaviour and reduce food waste. Therefore, it is important to consider situational factors, cultural beliefs and social norms when designing effective strategies for food waste reduction.

Research questions and methods

This systematic review synthesized studies that investigated the influence of demographic and socioeconomic factors on food waste determinants and reduction strategies, alongside those that explored interventions and adopted the TPB in their discussion and analysis (Ajzen, 1991; Fami et al., 2019; Lin and Guan, 2021). A systematic review is a comprehensive and structured synthesis of existing research evidence on a specific research question or topic (Ahn and Kang, 2018; Liberati et al., 2009; Moher et al., 2007). Despite the benefits of conducting a systematic review (Haddaway and Watson, 2016; Petticrew and Roberts, 2008), some researchers argue that this approach may not always provide a complete picture of the research landscape, because it relies on a predefined set of search terms that may miss some important studies, fall into systematic or random errors and transparency questions (Doleman et al., 2021; Helbach et al., 2022; Owens, 2021; Uttley et al., 2023). Systematic reviews rely on predefined search terms and may be misleading when data are inappropriately handled (Yuan and Hunt, 2009). Systematic reviews may also miss studies using different terminologies, or those published in languages unfamiliar to the authors (Jackson and Kuriyama, 2019), quality and bias (Jarvholm and Bohlin, 2014). Though the aforementioned does not in any way diminish the substantial benefits of conducting a systematic review, identifying and properly navigating through them is useful (Mallett et al., 2012; Mohseni et al., 2022). Systematic reviews are essential for the comprehensive synthesis of existing research to summarize the best available evidence in support of evidence-based practices (Cook et al., 1997; Kranke, 2010; Manchikanti et al., 2009), identify areas where future research is needed within a narrow field of inquiry, reduce redundancy in research efforts, prevent unnecessary duplication of studies and optimize the use of resources (Mulrow et al., 1997). To address some of the identified limitations of systematic reviews, the authors expanded the search strategies using a broader set of search terms, synonyms and related concepts to increase the sensitivity and specificity (Aromataris and Riitano, 2014; Harari et al., 2020). Multiple databases have also been used to increase the chance of capturing relevant studies. Furthermore, the authors searched the reference lists of both the included articles and existing reviews to identify relevant articles that met the inclusion criteria (Skoglund and Runeson, 2009). The authors also adhered to PRISMA reporting guidelines to ensure transparency in the review process (Chaabna et al., 2020; Helbach et al., 2022) and the study protocol was pre-registered in the Open Science Framework. To uncover the interconnectedness of socioeconomic and demographic factors of household food waste and their relationship to TPB, the following questions were addressed:

1. How has the TPB been applied to studies on household food waste behaviour?
2. How does TPB influence household food waste behaviour?
3. How do attitudes, subjective norms and PBC intersect with regard to household food waste behaviour?
4. What factors have been identified in the literature as having a significant influence on household food waste behaviour?
5. What is the journey of household food waste?
6. What are the strategies for reducing household food waste?

Additional insights were also provided to further the discussion and enhance the reader's understanding of the topic based on a critical review of eligible and included studies.

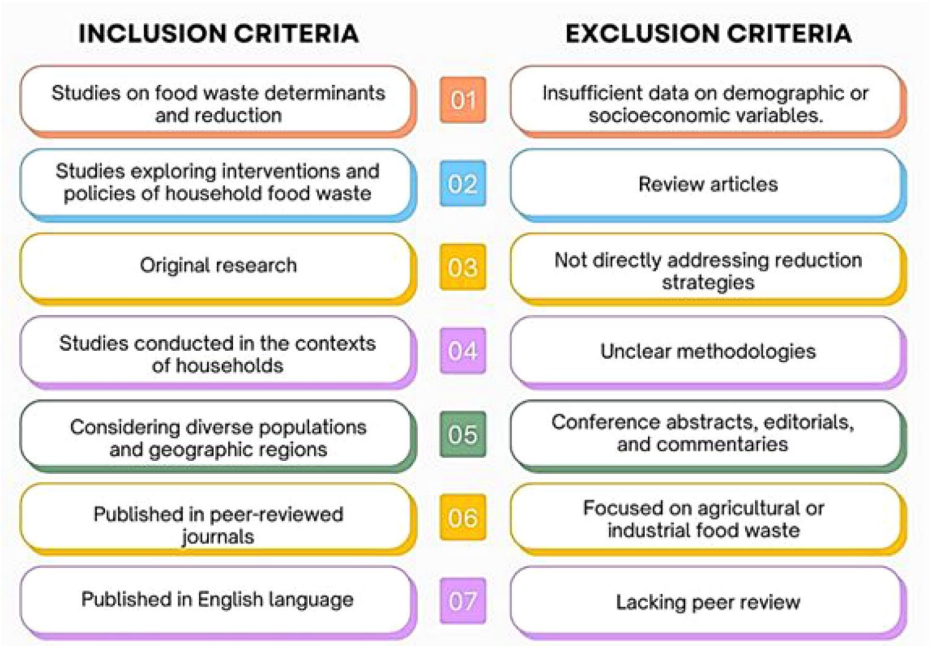

Figure 1. Inclusion and exclusion criteria.

Eligibility criteria

This section highlights the criteria used to include and exclude the articles. Specifically, the criteria were developed to ensure that only high-quality research papers were included in the analysis, and to exclude any papers that did not meet the necessary standards for scientific rigour. The eligibility criteria were based on a thorough review of the literature and consultation with experts in the field and were designed to capture the most relevant and impactful research in the field of household food waste. Studies of households with various demographic and socioeconomic backgrounds were included in this review. The inclusion and exclusion criteria are shown in Figure 1.

Studies with unclear methodologies, those not linked to TPB, or those that did not address reduction strategies were excluded. Additionally, review articles lacking empirical data and the necessary depth for robust analysis were not considered. Conference abstracts, editorials and commentaries, although potentially informative, often lack the empirical rigour required for substantive conclusions and were thus excluded from this study. Furthermore, studies focusing solely on agricultural or industrial food waste processes that overlooked crucial consumer behaviours and societal factors contributing to food waste were excluded. All included articles were methodologically robust, credible, peer-reviewed and published in reputable Scimago-ranked journals. This enhances the credibility and trustworthiness of the findings of this systematic review and underscores the importance of stringent quality standards in advancing knowledge in the field of food waste behaviour and related social sciences.

Search strategy

We searched the PubMed and EMBASE databases using the Elsevier software. The dates searched were 1 January 2010 to 19 April 2024. However, while the keywords search of 'food waste determinants and reduction strategies' on PubMed as of 19 April 2024, returned 184 results, only 3 articles met the inclusion criteria. A search on Science Direct using the same keywords returned 1668 results, including 233 review articles, 804 research articles, 97 encyclopaedias, 260 book chapters and 4 editorials (Figure 2). Although this review focused on research articles, we reviewed previous reviews to ensure that their efforts were not duplicated. Although checking previous related systematic reviews, the authors extracted articles from the reference list that focused on either the demographic or socioeconomic determinants of food waste or the TPB (Skoglund and Runeson, 2009). The authors' comprehensive approach to identifying relevant literature allowed for a deeper understanding of the factors contributing to food waste, including individual attitudes and social influences. The systematic reviews are: Aloysius et al. (2023); Iranmanesh et al. (2022); Jenkins et al. (2022); Principato et al. (2021); Rolker et al. (2022); Simoes et al. (2022); Wang et al. (2024).

Restrictions were applied to publication types. Conference abstracts, theses, articles in the press, books and book chapters were not included in the search. The authors first included the following in the search string MESH in PubMed and Science Direct (Elsevier).

> ('Household Food Waste' OR 'Food Waste Reduction' OR 'Food Waste Determinants') AND ('Demographic Factors' OR 'Socioeconomic Factors') AND ('Theory of Planned Behavior' OR 'Planned Behavior Theory').

To enhance the review's ability to locate all pertinent studies, the authors conducted separate searches using key terms such as 'food waste', 'demographic factors', 'socioeconomic factors', 'determinants', 'reduction strategies', 'interventions', 'household' and 'policies'. Additional articles pertinent to this review were identified through this process. We also explored the Wiley

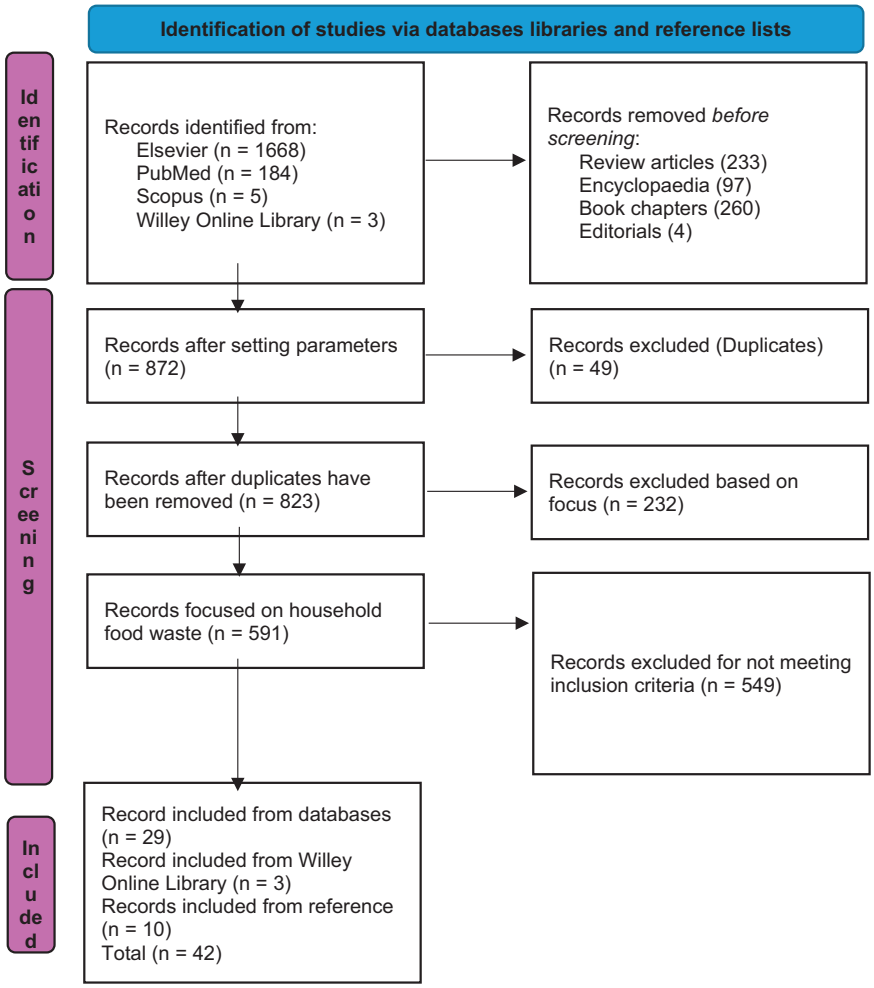

Figure 2. PRISMA table.
Table Design: Page et al. (2020).

Online Library for relevant studies and examined the reference lists of the included studies, uncovering further relevant research for incorporation.

Study selection, screening and data extraction

Screening by title and abstract was conducted by all the authors using a conventional double-screening strategy. All authors retrieved the full text and screened the full text for inclusion (Waffenschmidt et al., 2019). Two of the authors conducted a reference list search. Discrepancies were resolved through consensus. Figure 2 shows a PRISMA flow diagram of the selection process (Moher et al., 2010; Rethlefsen et al., 2021). The study characteristics and outcome data from each study were recorded using a data-extraction form. Following the identification process, data extraction was carried out systematically using a predefined extraction form, encompassing key variables, such as demographic characteristics, socioeconomic indicators, determinants of food waste and strategies for reduction. The extracted data were then synthesized and analysed to elucidate patterns, trends and associations between demographic and socioeconomic factors and food waste behaviours.

Quality assessment of included studies

The included studies were evaluated using criteria, such as sample representativeness, data collection methods and statistical analyses. Studies regarded as robust and included in this review were those that demonstrated comprehensive sampling techniques, clear operationalization of variables and rigorous statistical analyses, contributing reliable insights into the influence of demographic and socioeconomic factors on food waste behaviours (Shaheen et al., 2023).

Data synthesis and analysis methods

Thematic analysis was employed to identify recurring patterns and themes across the included studies, categorizing findings into overarching concepts such as demographic factors, consumer behaviour, cultural norms and economic influences (Nichols et al., 2009; Thomas and Harden, 2008). Additionally, a narrative synthesis approach allows for the integration of qualitative evidence from included sources, enabling the construction of a coherent narrative that elucidates the underlying issues of household food waste behaviours (Purssell and Gould, 2021; Raghu and Rodrigues, 2020). NVivo 14 (a qualitative data analysis

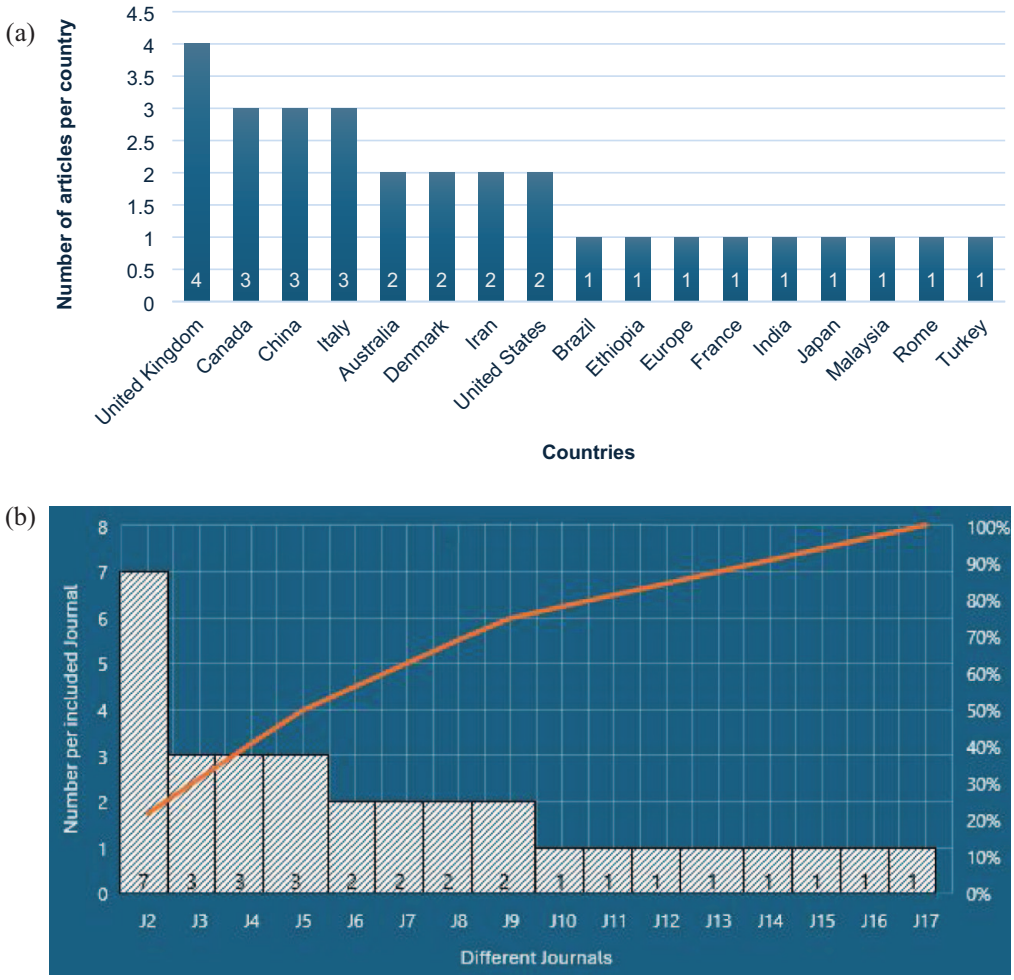

Figure 3. (a) Counts of regions/countries and (b) journals.
Journals: J1: *Resources, Conservation & Recycling*; J2: *Journal of Cleaner Production*; J3: *Appetite*; J4: *Journal of Retailing and Consumer Services*; J5: *Socio-Economic Planning Sciences*; J6: *China Economic Review*; J7: *Foods*; J8: *Journal of Environmental Management*; J9: *Journal of Environmental Psychology*; J10: *Food Quality and Preference*; J11: *International Journal of Consumer Studies*; J12: *International Journal of Environmental Research and Public Health*; J13: *International Journal of Hospital Management*; J14: *Journal of Business Research*; J15: *Journal of Consumer Behavior*; J16: *Nutrition Bulletin*; J17: *Waste Management*.

software package developed by Lumivero [formerly QSR International]) was used to keep all included articles in one location to identify themes for analysis, whereas Canva (a graphic design software by Canva Pty Ltd) was used to design the charts.

Results

Descriptive analysis

This systematic review encompassed research conducted across Oceania, South America, North America, Asia, Europe and Africa. By incorporating studies from multiple continents, this study offers a comprehensive and global perspective on household food waste. This inclusive approach enhances the generalizability of the findings and ensures their relevance in diverse settings. Moreover, the review encompasses various perspectives, methodologies and research approaches, enriching its insights. Policymakers, practitioners and stakeholders can leverage this synthesized evidence to inform decisions pertaining to the relationship between TPB components and household food waste behaviour, as well as strategies for reducing food waste at the household level.

In total, 95.2% of the articles included in this systematic review were published in Scimago Q1 journals that had undergone peer review and rigorous scrutiny to ensure reliability and credibility of the presented evidence (Figure 3b). This, together with the inclusion of studies from 17 different countries and regions, further enhances the value of this systematic review for both researchers and practitioners in the field of food waste and behavioural sciences (Figure 3a). Comparing data from different countries and regions is crucial for understanding household food waste behaviour because it reveals the diversity in practices, cultural influences and socioeconomic factors that impact waste. For instance, countries with high income levels might exhibit different waste behaviours compared to those with lower income levels owing to differences in purchasing power, availability of storage facilities and food preservation knowledge (Abubakar et al., 2022; Afriyie et al., 2022). By examining these variations, this review identified global trends and

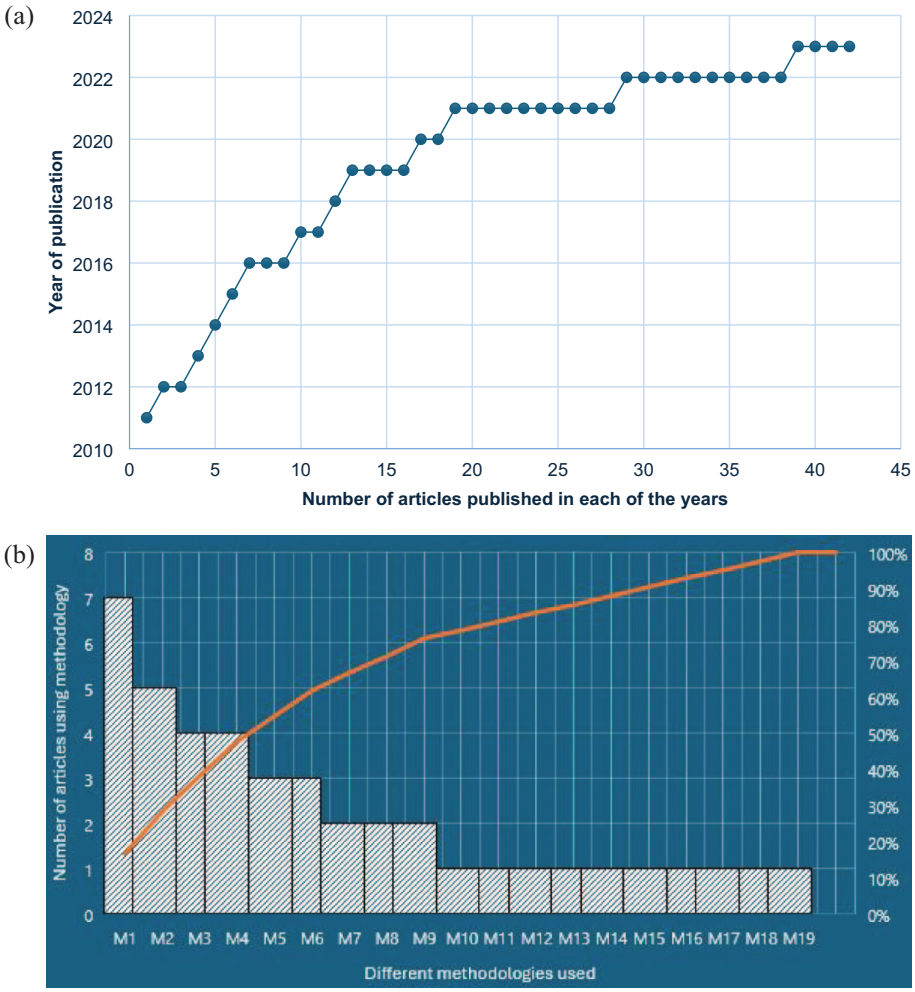

Figure 4. (a) Date and (b) methodologies.
Methodology: M1: SEM (structural equation modeling); M2: mixed-method; M3: CFA (confirmatory factor analysis); M4: PLS-SEM (partial least squares structural equation modeling); M5: correlation; M6: qualitative; M7: LCA (life cycle assessment); M8: regression; M9: Tobit regression methods; M10: case-control; M11: descriptive; M12: direct weighing; M13: EFA (exploratory factor analysis); M14: one-way experimental design; M15: propensity score matching; M16: questionnaire-based analysis; M17: RCTs (randomized Control Trials); M18: Spearman rank correlation coefficient; M19: Wilcoxon signed-rank test.

localized challenges, and allowed for the development of more tailored and effective interventions (Characteristics of included studies is attached to the Appendix [Table A1]).

This review included studies with diverse methodologies to enrich the analysis of correlation studies that revealed variable relationships with the regression analysis that predicted the outcomes (Figure 4b). Additionally, the robustness and generalizability of the review findings were enhanced by including studies with different methodologies and sample sizes. For instance, studies with large sample sizes offered statistically significant results that were more representative of the population, whereas smaller in-depth studies uncovered insights overlooked by broader research (Andrade, 2020; Faber and Fonseca, 2014; Vasileiou et al., 2018). To bolster the robustness of the study and capture a contemporary understanding of TPB's application in household food waste behaviour, a large number of the included studies were published between 2019 and 2024 (Figure 4a). The authors also identified some strengths and weaknesses of the methodologies included in section 'Discussion'.

Table 1 serves as a valuable tool for synthesizing and organizing the vast array of research on household food waste behaviour and categorizes the key themes explored by various studies within the framework of TPB, which allows for a clear understanding of how different components of TPB and other relevant factors have been examined across a diverse set of research. This shows the most extensively researched aspects of household food waste behaviour and areas that require further exploration. In addition, by mapping out how different studies address the components of TPB, the table helps in understanding the interplay between these components and how they collectively influence behaviour.

Discussion

Application of TPB in household food waste behaviour

Attitude. The TPB provides for understanding household food waste determinants and devising effective reduction strategies and

Table 1. Themes identified among included studies.

Authors and date	1	2	3	4	5	6	7	8
Aka and Buyukdag (2021)	x	x		x	x		x	
Amicarelli et al. (2022)	x			x	x		x	x
Amirudin and Gim (2019)	x		x				x	
Ananda et al. (2022)		x	x	x	x		x	
Ananda et al. (2023)	x							
Aschemann-Witzel et al. (2021)	x	x			x			
Attiq et al. (2021)	x	x						
Damiani et al. (2021)	x						x	
Ding et al. (2022)	x						x	x
Everitt et al. (2022)				x	x			x
Fami et al. (2019)	x	x	x	x	x	x	x	x
Graham-Rowe et al. (2015)	x	x	x	x			x	x
Graham-Rowe et al. (2019)	x	x	x					
Hatab et al. (2022)	x	x	x	x				
Hoek et al. (2017)	x	x	x	x	x		x	x
Jabeen et al. (2023)	x			x				
Koivupuro et al. (2012)	x						x	x
Kumar and Yadav (2021)				x	x			x
Laila et al. (2022)	x		x	x	x			
Lazell (2016)	x	x						x
Lee (2018)	x	x		x			x	
Li et al. (2021)	x			x	x			
Lin and Guan (2021)	x	x	x	x	x	x		
Liu et al. (2023)							x	
Oehman et al. (2022)	x	x	x	x	x	x		
Pakpour et al. (2014)	x	x	x	x			x	x
Pelt et al. (2020)	x	x						
Pontes et al. (2022)		x			x			
Quested et al. (2011)	x	x	x				x	
Russell et al. (2017)	x	x	x				x	x
Skaf et al. (2021)					x		x	
Stancu and Lahteenmaki (2022)			x	x				
Stancu et al. (2016)	x	x	x	x	x		x	
Stefan et al. (2013)	x	x	x	x	x		x	
Talwar et al. (2021)	x	x	x	x	x		x	x
Talwar et al. (2022)	x	x		x	x			
Teng et al. (2021)	x	x	x	x				
Urrutia et al. (2019)	x							
Visschers et al. (2016)	x	x	x				x	x
Wakefield and Axon (2020)	x	x		x	x		x	x
Williams et al. (2012)	x						x	
Wu et al. (2023)	x	x	x	x	x			

Attitude = 1; subjective norm = 2; perceived behavioural control = 3; demographic factors = 4; socioeconomic factors = 5; situational factors = 6; reduction strategies = 7; and waste journeys = 8.

attitudes towards food management, as highlighted by Talwar et al. (2022), who found that pride influences individuals' attitudes towards reducing food waste in the United States. This pride stems from a sense of responsibility towards environmental sustainability and societal expectations. Jabeen et al. (2023) added that attitude was associated with both positive and negative emotions, and influenced by surrounding circumstances. Notably, the attitude of cooking at home, especially during events such as the COVID-19 pandemic, as observed by Amicarelli et al. (2022), Ananda et al. (2023) and Laila et al. (2022) was significantly related to food waste. Hence, the COVID-19 pandemic led to an increase in unavoidable food waste among households in Canada, possibly because of increased cooking at home and less frequent shopping trips. Whereas avoidable food waste decreased when there was an increase in the use of leftovers and better meal planning (Laila et al., 2022; Stancu et al., 2016; Stefan et al., 2013; Teng et al., 2021). However, these behavioural changes are influenced not only by attitudes but also by practical considerations, such as household income, which affects purchasing power and food consumption patterns (Ding et al., 2022; Li et al., 2021). Additionally, sociocultural factors, such as marital status, can influence attitudes and behaviours towards food waste reduction (Aka and Buyukdag, 2021; Wakefield and Axon, 2020). Even in the event of a pandemic, married women, often identified as a prestigious demographic (Amirudin and Gim, 2019), had heightened awareness and knowledge of household management practices, including waste reduction strategies (Aka and Buyukdag, 2021). Other attitudes included the perception of safe consumption after the best-before date and impulsive buying (Ananda et al., 2022; Attiq et al., 2021; Stancu and Lahteenmaki, 2022; Table 2a).

Subjective norms. Subjective norms, a key component of TPB, shed light on the social influences and cultural beliefs that shape household food waste determinants and reduction strategies (Table 2b). Subjective norms, such as social expectations regarding food consumption and waste management, are significantly influenced by household income (Lin and Guan, 2021; Talwar et al., 2022). This social expectation includes higher income levels, which usually leads to greater social pressure to adopt certain food waste behaviours (Ding et al., 2022; Fami et al., 2019). Social expectations are cut across by cultural beliefs and contextual factors. Aschemann-Witzel et al. (2021) conducted a cross-national study across Denmark, Germany, the Netherlands, Norway and Sweden, revealing how diversity in cultural beliefs and contextual factors influence subjective norms surrounding food waste. Here, cultural norms played a pivotal role in shaping individuals' attitudes and behaviours towards food management, with variations across different regions and demographic groups (Fami et al., 2019). However, these subjective norms are intertwined, and in some cases, are in contrast to individuals' preferences for consuming fresh food (Ananda et al., 2022). When individuals develop a habit of consuming only fresh food, the perception of safe consumption after the best-before period becomes an issue of great concern (Lazell, 2016). Therefore, social influences and cultural norms, while exacerbating the preference for fresh food, also lead to increased food waste as individuals continue to discard items perceived as less fresh (Fami et al., 2019; Jabeen et al., 2023).

Perceived behavioural control. Hatab et al. (2022) and Lee (2018) shifted from attitude and social norms to reveal that factors such as food shopping routines, perception of obligation to discard less food, knowledge of negative impacts, and the ability to

Table 2. Attitudes, subjetive norms and behavioural control.

Items	Source	Country	Method	Sample	Information
(a) Attitude					
Pride	Talwar et al. (2022)	United States	CFA	443	Household income
Increased cooking at home	Laila et al. (2022)	Canada	Wilcoxon signed-rank test	19	Increase household cooking at home, especially during COVID-19
Marriage	Aka and Buyukdag (2021)	Turkey	SEM	409	Awareness and knowledge Married women are the most prestigious demographics
Perception of safe consumption after best before date	Attiq et al. (2021)	Pakistan	PLS-SEM	391	Cognitive and emotional aspects on sustainable food waste reduction behaviour
	Urrutia et al. (2019)	Canada	Qualitative	17	Food waste because of due date
Impulsive buying	Stancu and Lahteenmaki (2022)	Denmark	CFA	508	Impulsive buying
(b) Subjective norms					
Social norms	Talwar et al. (2022)	United States	CFA	443	Household income
Diversity – cultural beliefs	Aschemann-Witzel et al. (2021)	Denmark, Germany, The Netherlands, Norway, Sweden	Exploratory Factor Analysis	4214	Diversity of individuals and context related factors
(c) Perceived behavioural control					
Food shopping routines	Hatab et al. (2022)	Ethiopia	SEM	698	Attitude and perceived behavioural control as intervention to reduce Perception of obligation to discard less food Knowledge about negative impacts Ability to interpret labels of food
Meal planning	Laila et al. (2022)	Canada	Wilcoxon signed-rank test	19	Increase household cooking at home, especially during COVID-19
	Liu et al. (2023)	China	Logistic regression analysis	461	Educational level Household income
Inventory management	Laila et al. (2022)	Canada	Wilcoxon signed-rank test	19	Increase household cooking at home, especially during COVID-19
Preference to consume fresh food	Ananda et al. (2022)	Australia	Tobit regression methods	5272	Perception of safe consumption after best before period Preference to consume fresh food
Increase cooking at home	Laila et al. (2022)	Canada	Wilcoxon signed-rank test	19	Increase household cooking at home, especially during COVID-19
Purchasing discipline	Amirudin and Gim (2019)	Malaysia	PLS-SEM	105	Perceived food accessibility Diet importance Price Purchasing discipline

interpret food labels significantly influence individuals' perceived control over food waste behaviours (Table 2c). Interventions targeting PBC can effectively reduce food waste by empowering individuals with the necessary knowledge and skills to make informed decisions regarding food management (Lin and Guan, 2021). Similarly, Amicarelli et al. (2022), Ananda et al. (2023) and Laila et al. (2022) emphasized the importance of meal planning, proper storage and inventory management in increasing

Table 3. Components of TPB.

Attitude	Subjective norms	Perceived behavioural control
• Pride • Increased cooking at home • Diet preference • Marriage • Perception of safe consumption after best before date • Impulsive buying	• Social norms • Diversity – Cultural beliefs • Preference to consume fresh food	• Food shopping routines • Meal planning • Proper storage • Inventory management • Preference to consume fresh food • Increase cooking at home • Purchasing discipline

TPB: theory of planned behaviour.

household cooking, particularly during pandemics. This is because there are either increases or decreases in food waste during these periods, which depend largely on an individual's attitude, as noted earlier. For instance, Everitt et al. (2022) found a 13.5% increase in food waste during the pandemic. On the contrary, Ananda et al. (2023) noted a 9% reduction in food waste in 2020 during the pandemic. Regardless, proper food management practices enhance individuals' perceived control of their food consumption habits, leading to reduced waste generation and improved sustainability. Regardless of whether it is during a pandemic, Ding et al. (2022) and Liu et al. (2023) found that household income, educational attainment and preference for fresh food consistently shape individuals' sense of control over their food waste habits. Ananda et al. (2023), Fami et al. (2019) and Talwar et al. (2022) added that household income plays a crucial role in influencing individuals' capacity to adhere to proper storage practices, underscoring the significance of socioeconomic factors in shaping perceptions of control over food waste. Overall, Ding et al. (2022) and Liu et al. (2023) revealed that both educational level and household income can influence individuals' ability to effectively manage food inventory. These findings highlight the importance of PBC in understanding household food waste behaviours (Fami et al., 2019; Lin and Guan, 2021).

TPB's influence on household food waste behaviour

This review revealed that the three components of the TPB impact household food waste behaviour to varying degrees (Table 3).

The role of attitude is paramount in shaping household food waste behaviour, as it encompasses both positive and negative aspects. Negative attitudes, such as pride and excessive food production, lead to leftovers (Pontes et al., 2022) and influence individuals to avoid storing or consuming leftovers to avoid their peers' perception of them as experiencing economic hardship. Pride spurs impulsive buying, resulting in unnecessary purchases at local stores and food delivery applications (Jabeen et al., 2023; Stancu and Lahteenmaki, 2022). Conversely, positive attitudes towards waste reduction inspire behaviours, such as meal planning and proper storage, ultimately decreasing food waste (Ananda et al., 2023; Hoek et al., 2017; Talwar et al., 2021). A positive attitude towards homemade meals was found to drive increased cooking at home, which in turn contributes to less food waste, as individuals are more likely to utilize ingredients efficiently (Hoek et al., 2017). Nevertheless, when it comes to cooking at home, factors such as attitudes towards dietary preferences, household size and marital status are significant considerations because of their potential to complicate the situation (Li et al. 2021). For example, even individuals who regularly cook at home may still generate waste if they prefer perishable items in their diet. Additionally, variations in food preferences resulting from marital status can exacerbate waste. This review's examination of attitudes towards best-before dates revealed their potential impact on food waste, as a perception of safety beyond these dates may prompt unnecessary disposal of food. Ananda et al. (2022) investigated the socioeconomic factors that influence food waste practices in Australia. Their study, employing Tobit regression analysis of 5272 participants, showed the significance of perceptions regarding post-best-before consumption safety and preferences for fresh food. However, these attitudes are substantially influenced by the economic status and income level of the household, and in some instances, cultural norms (Fami et al., 2019). Individuals with greater financial resources may demonstrate a stronger preference for fresh produce and heightened aversion to consuming items past their best-before dates, thereby contributing to increased levels of food waste.

On the other hand, social norms, such as those related to sharing or hospitality, lead to overpreparation and excess food and contribute to waste. Here, shifts in social norms towards sustainability and waste minimization can promote behaviours such as portion control and creative use of leftovers (Lin and Guan, 2021; Teng et al., 2021). Cultural beliefs about food, such as preference for freshness and certain preparation methods, can also affect waste levels (Fami et al., 2019). Preference for consuming fresh food over preserved or leftovers results in more waste, if not balanced with efficient meal planning and storage practices (Ananda et al., 2022, 2023; Pontes et al., 2022). In Taiwan, this argument was supported by Teng et al. (2021), who conducted a qualitative research involving 27 household food providers. This study revealed that the acquisition of skills to keep food fresh for longer periods is a key factor in reduction interventions (Teng et al., 2021).

Finally, PBC encompasses a range of factors that influence household food waste behaviour. From managing food shopping routines, driven by a sense of control over purchases and

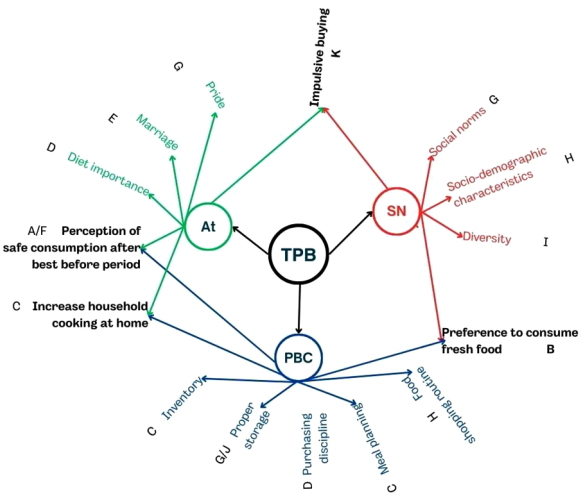

Figure 5. Intersectionality between attitude, subjective norms and PBC in household food waste behaviour (A = Attiq et al., 2021; B = Ananda et al., 2022; C = Laila et al., 2022; D = Amirudin and Gim, 2019; E = Aka and Buyukdag, 2021; F = Urrutia et al., 2019; G = Talwar et al., 2022; H = Hatab et al., 2022; I = Aschemann-Witzel et al., 2021; J = Liu et al., 2023; K = Stancu & Lahteenmaki, 2022).
At: attitude; PBC: perceived behavioural control; SN: subjective norms.

budgeting, to effective meal planning, guided by control over preparation and consumption patterns, these strategies help minimize waste (Russell et al., 2017; Stefan et al., 2013). According to Visschers et al. (2016), to reduce food waste in households, interventions should focus on increasing consumers' PBC over food waste and persuading them that they can be good providers without wasting food. In situations where shopping routines and meal planning are lacking, emphasis on proper storage practices is crucial, supported by a sense of control over food preservation and freshness (Ananda et al., 2023). It is important to note that proper storage should not impede efficient inventory management, which relies on a sense of control over tracking and utilizing existing food stock (Russell et al., 2017). Overall, various PBCs, such as a preference for fresh food and increased home cooking, along with disciplined purchasing habits, lead to reduced food waste by aligning consumption with actual needs and preferences. Building on the understanding of how TPB influences household food waste behaviour, the following section elaborates on the intersectionality between attitude, subjective norms and PBC.

Intersectionality between attitude, subjective norms and PBC in household food waste behaviour

Figure 5 illustrates the various components of TPB and their relevance to food waste behaviours. It also highlights the intersection of these components with different factors influencing food waste behaviours, such as marital status, food shopping routines, perception of safe consumption after the best-before period and increased household cooking at home. These factors were identified from the included studies and positioned based on their application in each study. This visual representation helps us understand how attitudes, subjective norms and PBC interact with these specific factors to shape household food waste behaviours.

It is worth noting that factors contributing to food waste behaviour can fall into multiple categories within the TPB. For instance, impulsive buying can be influenced by both subjective norms and attitudes, a condition tied to emotions (Jabeen et al., 2023). As previously discussed, subjective norms are often shaped by social pressures stemming from the community or social circles, whereas attitudes are shaped by an individual's appraisal of behaviours related to food waste (Lin and Guan, 2021). Similarly, preference for fresh food can be influenced by subjective norms – the opinions of friends, family and spouses – and PBC – one's ability to afford groceries (Fami et al., 2019). Moreover, attitudes and PBCs intersect with other aspects of food waste behaviour. For example, the perception of safe consumption after the best before period increases household cooking at home. Attitudes here reflect individuals' evaluation of eating food after the best before period (Li et al., 2021), whereas PBC, on the other hand, can be extended to include actions taken by food producers, such as providing clear expiration date information, making it instructive to work with retailers and manufacturers in this regard (Quested et al., 2011).

Ananda et al. (2022) from Australia and Urrutia et al. (2019) from Canada explored the intersection of PBC and attitude towards food waste but employed different methodologies. Ananda et al. (2022) used Tobit regression methods with a large sample size of 5272, whereas Urrutia et al. (2019) adopted a qualitative approach with a smaller sample size of 17 participants. This contrast in methodology and sample size, while suggesting a diverse range of perspectives and depth of analysis, pointed towards a similar direction around the intersection of behavioural control and attitude in household food waste management. Furthermore, Laila et al. (2022) used the Wilcoxon signed-rank test with 19 households in Canada to explain household cooking at home, which falls under both PBC and attitude. Regarding the intersectionality among these components, Ananda et al. (2022) focused on the preference for consuming fresh food as it relates to social norms and PBC, whereas Stancu and Lahteenmaki (2022) examined the relationship between attitude and subjective norms in impulsive buying behaviour.

Factors influencing household food waste behaviour

Firstly, demographic factors play a significant role in shaping household food waste patterns. Age has been found to correlate with lifestyle and consumption habits (Li et al., 2021). Younger individuals or families are prone to food waste owing to hectic schedules and lack of cooking skills, whereas older adults exhibit more frugality in food management (Attiq et al., 2021).

Gender dynamics also influence food waste, with studies suggesting that women typically take more responsibility for meal planning and waste reduction efforts (Koivupuro et al., 2012). However, although women are known to take more responsibility for meal planning, marital status and household composition affect portion sizes and meal planning, potentially leading to food waste depending on family size and dynamics (Amirudin and Gim, 2019).

Secondly, socioeconomic factors interact with household food waste in different ways. For instance, income level directly impacts purchasing power and access to diverse food options, influencing both the quantity and quality of food bought and discarded (Ding et al., 2022; Fami et al., 2019). It has also been argued that educational level correlates with awareness of sustainable practices and efficient food management techniques, reducing waste through informed decision-making (Pakpour et al., 2014; Wakefield and Axon, 2020). Higher awareness levels of food waste and its environmental impacts lead to more conscientious consumption habits (Fami et al., 2019). In addition to awareness level, is the price of foodstuffs. This determines the purchase patterns and translates into impulsive or planned purchases. It has been found that both impulsive and planned purchases are influenced by income level (Ding et al., 2022; Fami et al., 2019; Teng et al., 2021).

Urbanization has emerged not as a demographic or socioeconomic factor but rather as a situational factor that presents distinct challenges to household food waste management. In urban areas, fast-paced lifestyles and smaller living spaces are common, resulting in greater dependence on convenience foods and limited storage capacity for perishable items. These factors contribute to higher rates of food waste (Ananda et al., 2023; Lin and Guan, 2021). In developing countries, urbanization and demographic changes lead to increased food waste at the household level, with attitudes, perceived control, knowledge and sociodemographic factors playing key roles in influencing behaviours towards reducing food waste (Hatab et al., 2022). Urbanization not only presents challenges but also fosters opportunities for community initiatives such as food sharing networks and composting programmes. These initiatives leverage collaborative efforts and resource optimization to mitigate waste. The subsequent section will elaborate on the household food waste journey within the context of the demographic, socioeconomic and situational factors mentioned above, considering both challenges and potential solutions.

Household food waste journey

This section elucidates the food waste journey within the framework of attitude, subjective norm and PBC. It delineates how each of these components interrelates with the household food waste journey (Figure 6a).

Planning level. The absence of food waste planning can be attributed to several factors within the TPB framework. Individuals may lack a positive attitude towards planning meals and shopping trips, seeing them as time-consuming or unnecessary, which leads to spontaneous and excessive purchases. Social influence also plays a role; if peers do not prioritize meal planning and waste reduction, individuals may conform to these norms rather than adopt sustainable practices (Lin and Guan, 2021). Additionally, barriers such as limited time, resources, or cooking skills can create a perceived lack of control, further discouraging planning behaviours, and leading to impulsive buying.

Shopping. According to the TPB, impulsive buying occurs when individuals act on sudden urges, without considering their consequences. Jabeen et al. (2023) noted that emotions drive this behaviour, often leading to unnecessary or excessive purchases. Social pressure, marketing tactics and perceived pleasure of spontaneous buying also contribute to impulsive buying (Hatab et al., 2022; Lin and Guan, 2021). This behaviour significantly contributes to food waste, as it leads to the overconsumption and accumulation of unused perishable items. Impulsive purchases are often made without considering the actual needs or meal plans, resulting in perishable goods going unused and expiring. Additionally, buying in bulk exacerbates food waste as excess items spoil before consumption. This lack of consideration of long-term sustainability prioritizes immediate gratification and poses challenges for proper food storage.

Pre-consumption level. The lack of proper storage significantly contributes to food wastage (Ananda et al., 2023). Individuals who perceive food storage as inconvenient or unnecessary are prone to improper storage, leading to quicker spoilage and disposal. Negative attitudes stem from the belief that storage is time-consuming or ineffective. Social pressure also influences storage practices: if people see their peers discarding food because of improper storage, they may do the same (Lin and Guan, 2021). Additionally, societal preferences for convenience over sustainability discourage proper storage. The perceived lack of control over storage resources and techniques exacerbates this issue (Ananda et al., 2023). Again, feeling ill-equipped, individuals may choose to discard excess or near-expiry items rather than properly store them (Williams et al., 2012).

Consumption level. Food safety perceptions significantly influenced food consumption after the best before date. Individuals' attitudes towards the edibility of food past these dates reduce the likelihood of consumption, even if the food appears fine (Li et al., 2021). Subjective norms shaped by societal perceptions and peer behaviours also affect decisions. If friends and family dispose of food at the best-before date, individuals may follow suit because of social pressure (Lin and Guan, 2021). Poor leftover handling, such as improper storage and neglect of food safety, was linked to PBC (Ananda et al., 2023; Teng et al., 2021). Furthermore, a lack of confidence in proper storage and handling leads to premature disposal to avoid foodborne illnesses, which is influenced by knowledge of food safety, access to storage containers, culinary skills and societal expectations (Lin and Guan, 2021).

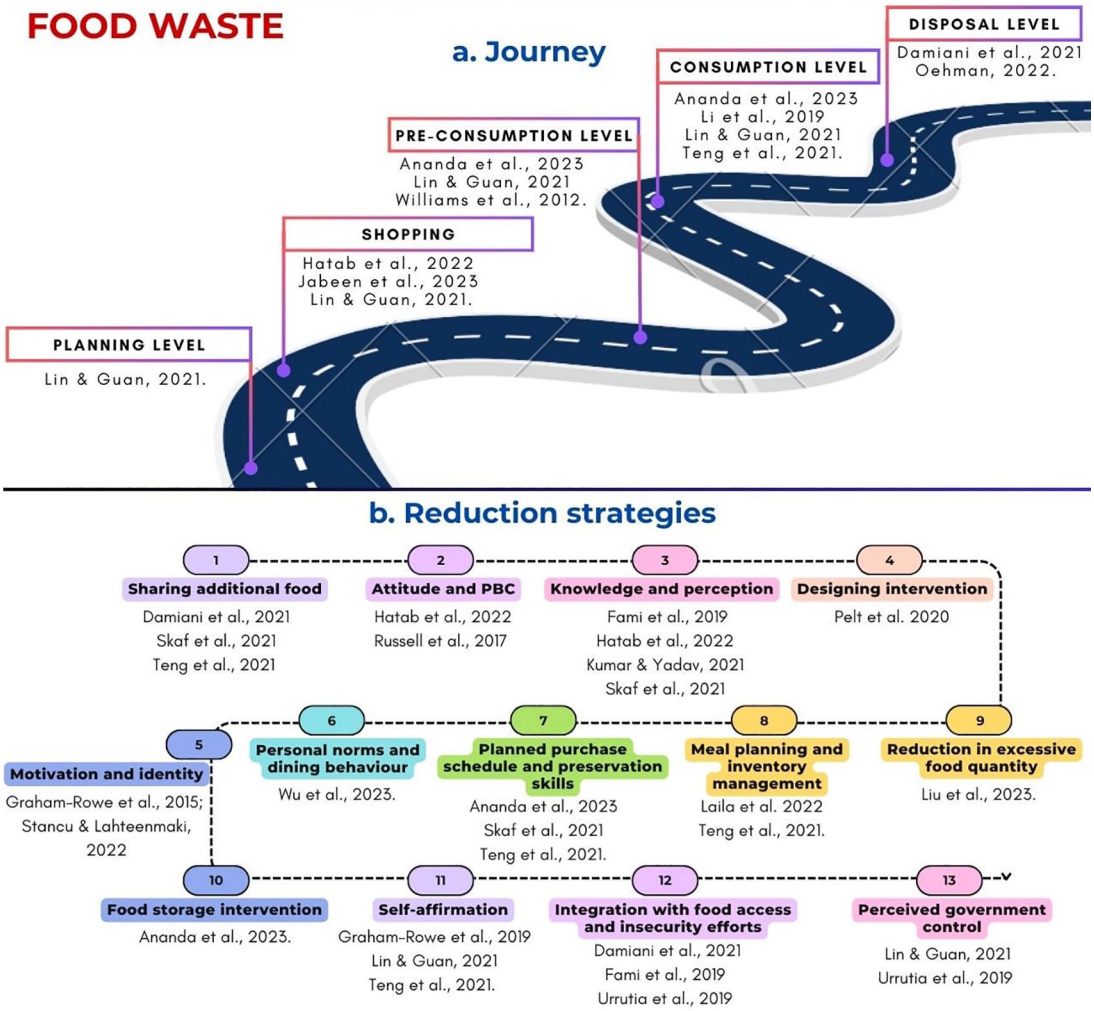

Figure 6. (a) Household food waste journey and (b) reduction strategies.

Disposal level. A study in New York found that attitudes, subjective norms and perceived control influence the intent to separate food waste, with concerns about odour and messiness being major barriers (Oehman et al., 2022). If individuals perceive composting to be inconvenient or unnecessary, they are less likely to compost. Additionally, if they believe that their social circle is not composted, they may not feel motivated to do so (Oehman et al., 2022). Damiani et al. (2021) suggested that composting could be effective when it is considered socially desirable. However, perceived difficulties such as a lack of infrastructure or knowledge can deter people from engaging in composting. Barriers, such as limited access to composting facilities or insufficient information on waste separation, also reduce participation. What, then, are reduction strategies? (Figure 6b).

Food waste reduction strategies

This section explores various strategies suggested to mitigate food waste across the food supply chain, from production to consumption. These strategies range from sharing surplus food to integrating waste reduction efforts with food access initiatives to efficiently use resources (Figure 6b). Firstly, sharing additional food can reduce waste and foster community responsibility by redistributing surplus food to those in need through food banks and shelters (Damiani et al., 2021). This addresses food insecurity and reduces the environmental burden associated with food waste (Skaf et al., 2021), thereby promoting a culture of generosity and solidarity (Teng et al., 2021). Secondly, attitude and PBC are crucial in shaping food waste behaviour. Positive attitudes towards minimizing waste and a strong sense of control can motivate sustainable practices such as meal planning and portion control (Hatab et al., 2022; Russell et al., 2017). Conversely, negative attitudes and helplessness may lead to inaction. Interventions and education can promote mindful consumption and waste reduction (Hatab et al., 2022). Thirdly, understanding the consequences of food waste requires individuals to make informed decisions. Positive perceptions of one's ability to make a difference and a strong awareness of food waste impacts motivate behaviours such as meal planning and proper storage (Fami et al., 2019; Hatab et al., 2022; Skaf et al., 2021). Gender and information availability also play a role, and misconceptions can lead to complacency (Hatab et al., 2022; Kumar and Yadav, 2021). Fourthly, tailored interventions targeting specific stages of the food system could effectively address waste. Behavioural insights such as nudges and incentives encourage sustainable food practices without imposing restrictions (Pelt et al., 2020). Collaborative

initiatives foster collective responsibility and a holistic approach to waste reduction. Fifthly, motivation, which is influenced by values such as sustainability and social responsibility, predicts waste-reducing behaviours. Individuals intrinsically motivated by these values are more likely to minimize waste, whereas external factors, such as social norms and convenience, can hinder their efforts (Graham-Rowe et al., 2015; Stancu and Lahteenmaki, 2022). Sixthly, personal norms and dining behaviours influence food waste. Individuals who practice mindful eating and portion control are less likely to waste food than those who discard edible items without consideration (Wu et al., 2023).

Seventhly, a planned purchase schedule minimizes overpurchasing and waste by ensuring that the perishable items are consumed before spoiling. Food preservation techniques complement this by extending the shelf life of food by using appropriate storage techniques (Ananda et al., 2023; Teng et al., 2021), leading to economic savings and environmental sustainability (Skaf et al., 2021; Teng et al., 2021). Eighthly, meal planning and inventory management can reduce food waste by effectively utilizing ingredients and ensuring that perishable items are consumed before their best-before period (Laila et al., 2022; Teng et al., 2021). On a larger scale, these practices conserve resources, reduce emissions and alleviate landfill pressures (Laila et al., 2022). Furthermore, excessive food quantities lead to waste at various stages of the supply chain. Over-purchasing results in items expiring before use, whereas retail practices, such as removing items near expiry, contribute to waste, despite the product's actual quality (Liu et al., 2023). Additionally, food storage interventions prolong the shelf life of perishable items by educating consumers on proper techniques and providing resources, such as airtight containers (Ananda et al., 2023). These measures prevent premature spoilage and empower individuals to make informed decisions regarding food consumption (Ananda et al., 2023). Self-affirmation can reduce food waste behaviour by reinforcing one's values and priorities, leading to increased mindfulness and intentionality in food-related decisions (Graham-Rowe et al., 2019; Lin and Guan, 2021; Teng et al., 2021). Furthermore, integrating food waste reduction efforts with food access initiatives can reduce waste and alleviate hunger by redirecting surplus food to those required (Damiani et al., 2021; Urrutia et al., 2019). This collaborative approach enhances public awareness and engagement (Fami et al., 2019; Urrutia et al., 2019). Finally, government interventions and policies are essential for addressing food waste. Effective regulations and initiatives can foster accountability and encourage sustainable practices (Lin and Guan, 2021; Urrutia et al., 2019). However, scepticism towards government efforts may undermine their effectiveness (Lin and Guan, 2021).

Limitations

Limitations of included studies

Firstly, generalizability: Many of the included studies faced challenges in generalizing their findings because of their specific location (Aka and Buyukdag, 2021; Amirudin and Gim, 2019; Talwar et al., 2021; Teng et al., 2021). Therefore, there is a need for broader and more diverse study samples to capture the nuances of food waste on a global scale. Additionally, it would be beneficial to incorporate diverse geographical regions and cultural contexts to ensure that the findings are applicable across different settings. *Secondly, data collection methods* that rely on self-reported data in some studies introduce a potential bias (Ananda et al., 2022; Aschemann-Witzel et al., 2021; Laila et al., 2022; Lin and Guan, 2021; Stancu and Lahteenmaki, 2022; Talwar et al., 2021). Future studies should prioritize the use of more objective measures, such as physically weighed data, to enhance the reliability and validity of the findings. *Thirdly, sampling bias*: Studies that involve self-selection in the recruitment process may inadvertently overrepresent individuals with a particular interest in food waste. To mitigate this bias, researchers should consider employing random sampling techniques and ensuring diverse participant demographics to capture a broader range of perspectives and behaviours related to food waste.

Implications and limitations of current study

This study offers several practical contributions to understanding and mitigating household food waste. Firstly, it highlights the importance of addressing food waste in a global context by highlighting the necessity of incorporating diverse geographical regions and cultural contexts into future research. Secondly, this study emphasizes the need for more objective data collection methods, such as physically weighed data, to enhance the reliability and validity of research findings. Finally, the study acknowledges that, while TPB offers valuable insights into behavioural intentions, its predictive power may be limited in certain contexts. The findings of this study imply that a holistic strategy targeting attitudes, subjective norms and PBC is essential for effectively reducing household food waste. Tailored interventions that consider demographic and socioeconomic factors may be suitable to address the diverse needs of different populations. In addition, promoting sustainability through education, effective policies and community initiatives can significantly reduce food waste and its associated environmental, economic and social impacts. Despite these important findings, the present study has several limitations that should be considered when determining the factors that influence food waste globally. Firstly, while TPB is a widely used framework for predicting consumer behaviour, it primarily focuses on measuring behavioural intentions rather than actual behaviour. This could result in a gap between what people intend to do and what they do regarding food waste. Secondly, although TPB offers valuable insights into behavioural intentions, its predictive power may be limited in certain contexts. The complexity of food waste behaviour, influenced by a multitude of factors beyond the scope of the TPB, suggests that relying solely on this framework may not fully capture all the determinants of food waste, particularly in diverse cultural and socioeconomic settings.

Recommendations for further studies

Given the limitations identified in both the included studies and the current study, several recommendations for future research on understanding and addressing food waste have been proposed. Firstly, future research should encompass diverse geographical regions and cultural contexts to ensure global applicability of these findings. This could involve multisite studies or collaborative efforts among researchers from different regions. Secondly, to enhance the reliability and validity of the findings, there should be a shift towards more objective measures of data collection. Although self-reported data can be valuable, their reliance introduces potential biases; thus, future studies should prioritize using physically weighed data or other objective measures to complement self-reported data for a more comprehensive understanding of food waste behaviours. Thirdly, sampling bias must be addressed, particularly in studies involving self-selection during recruitment. Researchers should consider employing random sampling techniques and ensuring diverse participant demographics to capture a broader range of perspectives and behaviours related to food waste, leading to more representative findings.

Fourthly, although TPB is widely used to predict consumer behaviour, it primarily measures behavioural intentions rather than actual behaviour. Future studies should aim to bridge this gap by incorporating measures of actual behaviour, possibly through longitudinal studies tracking behaviour over time, or observational studies in real-life settings. Fifthly, criticism of the TPB for its limited consideration of emotional and environmental factors in food waste reduction suggests the need to examine articles that have attempted to expand this theory. Future research could explore integrating TPB with other theories or models that account for these factors, providing a more holistic understanding of the drivers behind food waste behaviours and informing more effective intervention strategies.

Conclusion

The application of TPB to household food waste determinants highlights the relationship between attitudes, subjective norms and PBC in shaping individuals' behaviours related to food waste. Firstly, the reviewed articles clearly showed that attitudes towards food management, influenced by factors such as pride, societal expectations and perceptions of food safety, significantly affected waste generation. Positive attitudes towards waste reduction strategies such as meal planning and proper storage are essential for fostering behaviours that minimize waste. Conversely, negative attitudes such as impulsive buying tendencies and preferences for fresh food can contribute to excessive food purchases and subsequent waste generation. Secondly, subjective norms encompassing social influences and cultural beliefs play a crucial role in shaping individuals' perceptions and behaviours related to food waste. Social pressures, cultural norms and preferences for freshness can either promote or hinder waste reduction efforts, highlighting the importance of societal influences in driving sustainable behaviours. Finally, PBC, including factors such as food shopping routines, knowledge of food waste impacts and the ability to interpret food labels, significantly influenced individuals' perceived control over food waste behaviours. Empowering individuals with the necessary knowledge and skills to make informed decisions regarding food management is crucial to reducing waste generation and promoting sustainability. Moreover, the intersectionality of these components within the TPB framework highlights the complexity of food waste behaviours and the need for sustainable strategies to address them effectively. Interventions targeting attitudes, subjective norms and PBC can contribute to a holistic strategy for reducing household food waste. Furthermore, this review shows how demographic and socioeconomic factors, such as age, gender, income level and urbanization, intersect with TPB components to shape food waste patterns. Understanding these influences is essential for designing tailored interventions to address the diverse needs and contexts of different populations.

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Author contributions

Emma Etim conceptualized and drafted original draft. Karma Tashi Choedron supervised, reviewed and edited. Olawale Ajai conceptualized, reviewed and edited. Otu Duke contributed to the drafting. Hemen Emmanuel Jijingi contributed to the draft writing.

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Appendix A

Table A1. Characteristics of included studies (Systematic review of factors influencing household food waste behaviour: applying the TPB).

Authors and date	Regions/ countries	Aim	Methodology	N	Findings	Journal
Aka and Buyukdag (2021)	Turkey	The purpose of this research was to delineate how factors like awareness, knowledge, and habits mediate the relationship between the goal to reduce food waste and subsequent behaviour.	SEM	409	Individuals' determination and routines to reduce food waste (FW) are crucial factors in preventing waste. FW behaviour can be mitigated if the goal of decreasing it accompanies awareness. Knowledge also has a significant and detrimental effect on food waste behaviour (FWB) when habits and intentions serve as mediators, but it cannot explain FWB on its own.	*Journal of Retailing and Consumer Services*
Graham-Rowe et al. (2019)	United Kingdom	The study examined whether or not affirming phrases could increase receptivity to data highlighting the negative consequences of household food waste, with a special emphasis on wasted produce such as vegetables and fruits.	One-way experimental design		The results indicate that self-affirmation may encourage pro-environmental actions.	*Journal of Environmental Psychology*
Oehman et al. (2022)	United States	To examine the motivations, attitudes, and perceptions that drive people to sort their household food waste.	SEM		Separating FW at home strongly and positively correlates with attitudes, subjective norms, and the belief that one can control one's actions.	*Resources, Conservation & Recycling*
Wu et al. (2023)	Japan	To investigate the role of individual psychology and persistent patterns of conduct in shaping food-waste patterns at home.	SEM		Findings revealed a significantly smaller percentage of persons in the three Chinese cities than Tokyo and Bangkok who never take any food home after dining out. In addition, home cooks were more likely to throw away food during the preparation and storage phases than during the consumption phase.	*Resources, Conservation & Recycling*
Amicarelli et al. (2022)	Italy	The articles seek to examine customer behaviour following the lockdown with reference to unpredictable lives, clever advancements in food delivery, and new time management.	Questionnaire-based analysis		The findings show that consumers who are usually at home are more likely to notice FW and take steps to prevent it than others. Smart food delivery also improves consumers' knowledge of meals, which leads to wiser purchasing decisions and less FW.	*Socio-Economic Planning Sciences*

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Table A1. (Continued)

Authors and date	Regions/ countries	Aim	Methodology	N	Findings	Journal
Ananda et al. (2023)	Australia	Using a natural experiment methodology, this research examines the causal effects of the COVID-19 epidemic on household food management and food waste.	Propensity score matching		The results show that in 2020 (during COVID-19), Australian households cut their FW by an average of 9% compared to the level in 2019.	*Journal of Environmental Management*
Laila et al. (2022)	Canada	This study sought to determine the effects of COVID-19 on household food waste, as well as the views and practices of households regarding food consumption, preparation, and waste.	Wilcoxon signed-rank test	19	It's possible that the rise in unavoidable FW is due to people cooking at home more often, as indicated by interviews, or to people shopping less frequently and purchasing more in each visit, as revealed by surveys.	*Socio-Economic Planning Sciences*
Fami et al. (2019)	Iran	The major goal of this study was to create a model that will investigate the connection between food consumption management (FCM) elements and the quantity of food waste experienced by households, with a particular emphasis on urban women.	PLS-SEM		Better food consumption management is associated with less FW in the home. The findings also demonstrated the direct and indirect effects of other characteristics, such as demographics, economic power, information use, ability, and motivation, on FCM and the volume of FW produced.	*Resources, Conservation & Recycling*
Hatab et al. (2022)	Ethiopia	To investigate the factors that influence food waste behaviour in urban residents in Ethiopia.	SEM	698	The empirical results revealed that attitudes and perceived behavioural control were the most important predictors of intention towards food waste reduction. With regard to food waste behaviours, the results showed that the more an individual feels obliged to discard less food, the higher the odds that the quantity of food that gets wasted by the household would be reduced.	*Resources, Conservation & Recycling*
Li et al. (2021)	China	To investigate the levels and causes of food waste production in rural households.	Tobit regression methods		Waste is significantly reduced in rural Chinese families compared to urban Chinese families.	*Resources, Conservation & Recycling*
Lin and Guan (2021)	China	The primary goal of this study is to determine the factors that influence household food waste (HFW) reduction intentions and to comprehend the significance of perceived government control and perceived policy success from the viewpoint of households.	PLS-SEM		The findings indicated that shareholders' FW intentions are influenced by the less well-studied variables of perceived government control. Consistent with predictions based on TPB variables, environmental concern and perceived consumer efficacy are positively connected to intentions to reduce FW.	*Journal of Environmental Management*

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Table A1. (Continued)

Authors and date	Regions/ countries	Aim	Methodology	N	Findings	Journal
Everitt et al. (2022)	Canada	This study investigates the effects of HFW on household demographic, socioeconomic, and neighbourhood food environment traits.	Spearman rank correlation coefficient		Socioeconomic status and neighbourhood food environment characteristics, such as the availability, density, and proximity of retail food outlets, were found to have a moderate effect on the amount and composition of food waste produced by households.	*Socio-Economic Planning Sciences*
Pontes et al. (2022)	Brazil	This study measures the amount of food wasted in a chain of industrial restaurants in a Brazilian industrial park.	Direct weighing		There was a daily waste of 1297 kg, with 938 kg being wasted as leftovers and 359 kg being thrown away as unused plates. These figures point to an overabundance of food being produced and then being left uneaten on plates. Based on the average quality of the food served in the restaurants used in this study, the amount of food wasted here would be enough to provide 1638 meals.	*Journal of Cleaner Production*
Skaf et al. (2021)	15 Countries	Uses a few carefully chosen LCA-based indicators to reveal the hidden environmental impacts of FW on 15 nations at the national and individual levels.	LCA		The main production of food, notably that of animals, has the biggest effect on the environment along the entire food chain. Donating edible surpluses to those in need is one strategy to mitigate these effects after FW has been reduced during production.	*Journal of Cleaner Production*
Damiani et al. (2021)	Italy	The study uses attributional and consequential LCA methods to examine food redistribution's environmental costs and benefits.	LCA		The average impact of the analysed systems is reduced due to food donations.	*Journal of Cleaner Production*
Amirudin and Gim (2019)	Malaysia	This study measures perceived food accessibility in terms of perceived time and perceived effort.	PLS-SEM	105	FW at the household level would increase in direct proportion to the amount of work required to obtain food. This could be the result of making excessive purchases to avoid the loss of opportunity.	*Resources, Conservation & Recycling*
Ding et al. (2022)	China	Through the lens of varying famine experiences, this research aims to offer a creative explanation for the varied FW behaviours observed across age cohorts.	Case-control		The results show that less food was wasted and less calories were lost per person, particularly during adolescence during the famine, the more severe the famine the household head experienced in his or her early life.	*China Economic Review*

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Table A1. (Continued)

Authors and date	Regions/ countries	Aim	Methodology	N	Findings	Journal
Stancu and Lahteenmaki (2022)	Denmark	Investigating the root causes of significant food provisioning behaviours that contribute to FW and desire to reduce FW were the objectives.	CFA		Consumers who identified as frugal, environmentally conscious, or hedonistic were more motivated to reduce FW, while those who identified as the first two were less likely to toss out food that was past its best before date.	*Food Policy*
Ananda et al. (2022)	Australia	This study looks at the behavioural factors that affect how much of six different food categories are wasted.	Tobit regression methods	5272	The attitudes of the families regarding the safety of eating food past its best before date have a strong negative correlation with all types of food waste. The findings also show that overprovisioning increases food waste in frozen, dairy, and fresh produce. Food storage interventions present the most promising starting point for minimising waste in the food categories examined.	*Food Policy*
Pelt et al. (2020)	France	Creating a treatment plan to cut down on family FW.	Mixed-design analysis of variance		The most effective intervention was based on dissonance, but only from a middle-term standpoint.	*Resources, Conservation & Recycling*
Urrutia et al. (2019)	Canada	This article expands on earlier structural techniques to comprehend the driving forces behind behaviour related to FW.	Qualitative	17	Conclusions point to the necessity of integrating household-level measures to reduce FW with more comprehensive policies addressing food access and food insecurity, particularly those that target food insecurity at the systems level.	*Resources, Conservation & Recycling*
Aschemann-Witzel et al. (2021)	Europe	Investigated the relation between FW-related lifestyle patterns and self-reported FW.	EFA	4214	The findings classify consumers into five groups, each with its own unique habits and levels of food waste, poor dietary choices, and awareness.	*Journal of Retailing and Consumer Services*
Jabeen et al. (2023)	India	This research looked into what factors influence food delivery app users' anti-waste sentiments and plans to take action.	SEM		Positive associations between negative emotions and attitude were also supported, as were positive associations between attitude and intentions.	*Journal of Business Research*

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Table A1. (Continued)

Authors and date	Regions/ countries	Aim	Methodology	N	Findings	Journal
Talwar et al. (2022)	United States	To examine the drivers of leftover reuse and over-ordering.	CFA	443	Found that household income moderates the relationship between moral norms and intentions, as well as between anticipated pride and over-purchasing of food and that this effect is positive for higher-income households and negative for lower-income households, demonstrating the mediation effect of intentions on these associations.	*Journal of Retailing and Consumer Services*
Graham-Rowe et al. (2015)	United Kingdom	The study tested the utility of applying an extended TPB model to household food waste reduction.	Correlation	279	Results demonstrate the utility of applying an extended TPB model to predict motivation.	*Resources, Conservation & Recycling*
Russell et al. (2017)	United Kingdom	This study examined consumer food waste behaviour using a comprehensive model integrating the TPB, the theory of interpersonal behaviour, and the comprehensive model of environmental behaviour.	SEM	172	Results also show that participants with a greater sense of control, and more normative support for reducing food waste also had stronger intentions to engage in the behaviour.	*Resources, Conservation & Recycling*
Pakpour et al. (2014)	Iran	To examine factors associated with household waste behaviours in the context of the TPB.	Correlation	1782	Results indicate that educational materials which target moral obligation and action planning may be particularly effective.	*Waste Management*
Stefan et al. (2013)	Rome	This exploratory study aims to investigate the role of food choices and other food-related activities in producing food waste.	CFA	244	Results show that consumers' planning and shopping routines are important predictors of food waste. Planning and shopping routines are determined by moral attitudes towards food waste and perceived behavioural control.	*Food Quality and Preference*
Stancu et al. (2016)	Denmark	Examines the effect of psycho-social factors, food-related routines, household perceived capabilities and socio-demographic characteristics on self-reported food waste.	CFA	1062	Results show that perceived behavioural control and routines related to shopping and reuse of leftovers are the main drivers of food waste, while planning routines contribute indirectly.	*Appetite*
Lazell (2016)	United Kingdom	Examines consumer food waste behaviour in a university setting and the implications for encouraging sharing as a means of mitigating food waste.	Mixed-method	104	Consumer food waste behaviour can be better understood by focusing on the practices, routines and habits of consumers given the hidden nature of the food waste issue.	*Journal of Consumer Behaviour*

(Continued)

Table A1. (Continued)

Authors and date	Regions/ countries	Aim	Methodology	N	Findings	Journal
Kumar and Yadav (2021)		To investigate the impact of shopping motivation on consumers' intention to buy green apparel.	SEM	329	Gender was found to have a moderating relationship for information availability with utilitarian motivation and for authority and status with hedonic motivation.	*Journal of Cleaner Production*
Quested et al. (2011)	United Kingdom	Describes recent insights gained from research by the Waste and Resources Action Programme and others into the types of food wasted, why it is wasted and what can be done to minimise it.	Mixed-method	1679	Working with retailers and manufacturers can help reduce food waste in the home.	*Nutrition Bulletin*
Talwar et al. (2021)	United States	Addresses this gap by undertaking a mixed-method study to examining a broad spectrum of diners' behaviour, beginning from planning the meal and ending with bringing the leftovers home.	Mixed-method	276	A positive association of food-ordering and planning routines with motives, which, in turn, are positively associated with attitude and the behaviour of taking away leftover.	*International Journal of Hospital Management*
Visschers et al. (2016)	Switzerland	To investigate which determinants, explain the self-reported amount of food waste in households.	Mixed-method	829	To reduce food waste in households, interventions should focus on increasing consumers' perceived behavioural control over food waste and persuading them that they can be a good provider without wasting food.	*Journal of Environmental Psychology*
Koivupuro et al. (2012)	Finland	Influence of socio-demographical, behavioural and attitudinal factors on the amount of avoidable household food waste.	Correlation	380	The factors that influenced the amount of food wasted were the size of the household, the gender of the person mainly responsible of grocery shopping, the frequency of buying discounted food products, the respondent's own view of the potential to reduce food waste and the respondent's own view of the influence of purchasing particular food packet sizes.	*International Journal of Consumer Studies*
Williams et al. (2012)		Examines reasons for food waste in household and especially how and to what extent packaging influences the amount of food waste.	RCT	67	The environmentally educated households wasted less, especially of prepared food. They also wasted less food due to passed 'best before date'.	*Journal of Cleaner Production*

(Continued)

Table A1. (Continued)

Authors and date	Regions/ countries	Aim	Methodology	N	Findings	Journal
Lee (2018)	South Korea	Explores the causes of household food waste from this perspective, drawing from practice theory and the concept of systems of provision.	Regression	460	The influence of food retailers on household food waste is not limited to marketing promotions, but also extends to the ways they may shape households' grocery shopping patterns.	*Journal of Cleaner Production*
Hoek et al. (2017)	Australia	To assess consumer perceptions, experiences and attitudes towards healthy and environmentally friendly foods and four target behaviours.	Qualitative	29	Participants had the most positive attitude and highest motivation for eating less processed and packaged foods, mostly to avoid excessive packaging and 'chemicals' in foods.	*Appetite*
Wakefield and Axon (2020)	United Kingdom	Investigates lack of understanding about food waste management affects the 'how to' carry out sustainable food waste practices.	Descriptive	120	It is clear that 'food waste' is not well understood by laypeople given that it is an ambiguous concept that results in confusion about effective ways to address the problem.	*Journal of Cleaner Production*
Attiq et al. (2021)	Pakistan	To investigate the theory of interpersonal behaviour and food waste behaviour.	PLS-SEM	391	Findings reveal significant impacts from both cognitive and emotional aspects on sustainable food waste reduction behaviour.	*International Journal of Enviornmental Research and Public Health*
Teng et al. (2021)	Taiwan	Identifies factors and management strategies for the reduction of household food waste in the Taiwanese household setting.	Qualitative	27	Four major prevention strategies are identified to help reduce household food waste: (1) planned purchase schedule; (2) skills to keep food fresh and longer; (3) understanding family preferences and leftover management, and (4) sharing additional food and co-procurement and cooking.	*Foods*
Liu et al. (2023)	China	To accurately estimate household food waste generation and calculate the carbon footprint related to edible food waste.	Regression	461	Although the Shanghai municipal government attaches great importance to the issue of food waste, the current policies mainly focus on the catering industry, and there is still a need for further strengthening measures to address food waste at the household level.	*Foods*

TPB: theory of planned behaviour.