A SURVEY TO IDENTIFY MOTIVATORS AND BARRIERS OF INTENTION TO REDUCE FOOD WASTE AMONG MALAYSIAN HOUSEHOLDS

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Abstract: Food waste is a serious global issue that contributes to the loss of nature and exacerbates environmental degradation. In Malaysia, the effects of food waste have garnered increased attention due to their impacts on the environment and food security. This study adopted a research framework based on the extended theory of planned behaviour to examine factors affecting the intention to reduce food waste and subsequent food waste behaviour among Malaysian households. A total of 397 samples were gathered through a questionnaire survey, and partial least square structural equation modelling was employed for data analysis. The study found that social norms, attitude, and negative emotions significantly and positively influence people's intention to reduce food waste. Furthermore, cost savings and a healthy diet also positively influence the intention to reduce food waste. Health risk concerns, however, have a negative impact on households' desire to cut food waste. The findings of this study can provide Malaysian policymakers with a foundation for future decisions aimed at reducing food waste, in line with three United Nations Sustainable Development Goals: Goal 2 (zero hunger), Goal 12 (sustainable consumption and production), and Goal 13 (climate action).

Keywords: Food waste, motivators, barriers, partial least square structural equation modelling, theory of planned behaviour.

Introduction

The United Nations Environment Programme (UNEP) reported that an estimated one billion tonnes of food are wasted globally each year (UNEP, 2022). This loss is equivalent to one-third of the food produced worldwide. In recent years, the issue of food wastage has gained much attention from researchers and policymakers due to its tremendous environmental, social, and economic impacts.

As food waste decomposes in landfills, it produces greenhouse gases, including methane, a pollutant 28 times more potent than carbon dioxide (International Energy Agency, 2021). The Intergovernmental Panel on Climate Change (2020) reported that greenhouse gases from food waste account for 8% to 10% of total global emissions, contributing to global warming. Consequently, climate change can lead to issues such as lower crop yields, higher food prices, and reduced nutritional value, potentially resulting in food insecurity.

Addressing food waste is a pressing concern for the international community, as 8.9% or 690 million, of the world's population are starving (Economic and Social Commission for Asia and the Pacific, 2023). Additionally, the number of hungry individuals globally rises by 10 million each year. Thus, the food wasted could have been used to feed the undernourished and hungry. Food waste also incurs economic costs, as it involves the loss of energy, water, and other resources required for production and transportation. The Food and Agriculture Organisation (2023) estimated that food waste has an annual cost of approximately 1 trillion USD. When accounting for environmental and social costs, the total annual cost of food wastage is nearly 2.6 trillion USD. Therefore,

investing in food waste reduction is essential for achieving environmental, social, and economic gains while mitigating global warming and improving food security.

As an upper middle-income[1] country, Malaysia faces a significant problem with food waste. According to the country's landfill operator, Solid Waste and Public Cleansing Management Corporation (SWCorp), Malaysians discard approximately 17,000 tonnes of food daily, of which 24% or 4,005 tonnes is still edible. This amount could have provided three meals a day for 2.9 million people (The Malaysian Reserve, 2023). One of the main factors contributing to Malaysia's food waste issue is the lack of effective food planning and management skills. Furthermore, people may perceive food waste as acceptable because they can afford to dispose of it (Xue *et al.*, 2017). Households are the largest contributor to food waste at 38%, followed by wet markets at 24%, restaurants at 23%, and hotels at 7% (SWCorp, 2022). Detailed statistics on food waste in Malaysia from 2019 to 2021 are presented in Table 1. Notably, the amount of edible food waste has been consistently high over the years.

In Malaysia, most food waste ends up in landfills, where it produces undesirable environmental pollutants such as carbon dioxide and methane. Decomposing food waste also creates leachate, which contaminates underground water and impacts aquatic ecosystems (The Star, 2022). Given that food waste contributes to significant issues like air pollution, water pollution, and climate change, it is crucial for Malaysian authorities to address this problem promptly. Reducing food waste aligns with Malaysia's commitment to becoming a carbon-neutral nation by 2050 and its goal of reducing carbon intensity relative to GDP by 45% by 2030 (United Nations Development Programmes, 2023).

Based on the preceding discussions, investigating the determinants that facilitate or hinder food waste reduction behaviour among Malaysian households is of utmost importance. Therefore, this study aims to explore the factors influencing consumers' intentions to reduce food waste in Malaysia. Specifically, it first examines the motivators driving individuals' intention to cut food waste and then addresses the barriers preventing such reductions among Malaysian households. A comprehensive literature review reveals that while numerous studies have explored the enablers and barriers to food waste practices in various contexts (Zhao *et al.*, 2019; Wakefield & Axon, 2020; Nunkoo, 2021; Bai *et al.*, 2022; Ananda *et al.*, 2023), research within the Malaysian context has been limited. In other words, studies that focus on both the motivators and barriers in reducing household food waste in Malaysia are still absent. Existing research on this topic in Malaysia has predominantly focused on analysing the intention to reduce food waste by examining motivating factors such as attitude, social norms, and perceived behavioural control (Loh *et al.*, 2021; Seng *et al.*, 2021; Phooi *et al.*, 2022), without incorporating

Table 1: Malaysia's food waste statistics (2019-2021)

Year	Total Solid Waste Generated (Tonnes Per Day)	Food Waste (Tonnes Per Day)	Types of Food Waste (Tonnes Per Day)	
			Inedible (e.g., Bones and Fruit Skins)	Edible (e.g., Leftover Meat and Vegetables)
2019	38,120	16,964	12,893	4,071
2020	38,294	17,041	12,952	4,089
2021	38,219	17,007	12,926	4,081

Source: Solid Waste Management and Public Cleansing Corporations (SWCorp) (2022)

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[1] The World Bank (2023) defined upper-middle-income countries as those economies with a GNI per capita within the range of USD4,256 to USD13,205

the role of barriers that could affect food waste reduction behaviour.

Moreover, much of the current food waste research in Malaysia has focused on specific groups of households. For instance, Amirudin and Gim (2019) concentrated on households located only in the Klang Valley. Masdek *et al.* (2023) considered only urban households while Jarjusey and Chamhuri (2017) focused solely on residents from the state of Selangor. Other Malaysian studies have discussed food waste reduction behaviour in the commercial sector (Salim *et al.*, 2018; Goh & Jie, 2019; Kasavan *et al.*, 2019; Mak *et al.*, 2021). Unlike Loh *et al.* (2021), Seng *et al.* (2021), and Phooi *et al.* (2022), this research extends the scope by considering both motivators (including negative emotions, attitude, social norms, and perceived behavioural control) and barriers (including identity as good food provider, health risk concerns, healthy diet, and cost savings) in influencing food waste reduction behaviour in Malaysia. Thus, this study, if compared with Loh *et al.* (2021), Seng *et al.* (2021), and Phooi *et al.* (2022), offers a more comprehensive understanding of the factors affecting the intention to reduce food waste and provides insights for better future policy development and implementation. In terms of method, this study contributes to the existing literature by employing a new generation statistical data analysis technique, namely partial least square structural equation modelling (PLS-SEM). Many previous studies on food waste in Malaysia did not apply such an established and advanced approach (Seng *et al.*, 2021; Phooi *et al.*, 2022; Rahman & Tung, 2023).

The following sections are organised as follows: Section 2 provides an extensive review of past studies on food waste reduction. In Section 3, the research framework and hypotheses are presented. The following section discusses the research methodology. Then, Section 5 includes the structural model, results, and discussions. Finally, Section 6 concludes the study and provides relevant policy recommendations.

Literature Review and Hypotheses Development

Due to the benefits of tackling food waste for climate protection, food security and sustainable agriculture (Food and Agriculture Organisation, 2022), numerous studies have been conducted in recent years to address this issue. Specifically, research (Van Dooren *et al.*, 2019; Attiq *et al.*, 2021; Boulet *et al.*, 2021; Borg *et al.*, 2022; Everitt *et al.*, 2022; Elimelech *et al.*, 2023) has focused on food waste reduction among consumers, as they are responsible for the largest amount of food waste, particularly in higher-income countries with robust income growth and diversified food choices. In general, consumers exhibited inadequate knowledge and understanding of the drivers behind their food waste behaviour (Wakefield & Axon, 2020). Thus, a holistic approach is needed to address food waste by examining both motivating factors that encourage waste reduction and barriers that hinder such behaviour.

Based on the literature, most past studies have employed the theory of planned behaviour (TPB) to explain the effects of motivational factors on households' intention to reduce food waste and their food waste behaviour (Graham-Rowe *et al.*, 2015; Fami *et al.*, 2019; Goh & Jie, 2019; Soorani & Ahmadvand, 2019; Coşkun & Özbük, 2020; Teoh *et al.*, 2022; Jabeen *et al.*, 2023). The TPB focuses on three main constructs; "attitude", which refers to the extent to which performing the behaviour is perceived as positive or negative; "social norms", which denote the perceived social pressure to perform or not perform the behaviour; and "perceived behavioural control", which encompasses opinions about factors that drive or hinder a specific behaviour (Ajzen, 1991, p. 188) in predicting individuals' food management. Previous studies have confirmed that variables within the TPB model, including attitude, social norms, and perceived behavioural control are vital determinants of food waste reduction behaviour among households. For instance, attitude (Nguyen & Watanabe, 2019; Neubig *et al.*, 2020) and social norms (Heidari *et al.*, 2020; Huang & Tseng, 2020) have been identified

as strong drivers of food waste reduction behaviour. Consumers' intention to engage in a behaviour tends to increase when they hold a positive attitude towards it and when significant others expect them to adopt the behaviour. Similarly, perceived behavioural control has been shown to be a significant predictor of food waste management behaviours (Schmidt *et al.*, 2019). Individuals' intention to portray a particular behaviour is enhanced if when they feel they have adequate control over it.

In line with the TPB, it is expected that attitude, social norms, and perceived behavioural control will significantly impact the intention to reduce food waste. This study predicts that these TPB variables will positively influence intentions to reduce food waste. Thus, the following hypotheses are formed:

H₁: Perceived behavioural control is positively related to the intention to reduce food waste.

H₂: Social norms are positively related to the intention to reduce food waste.

H₃: Attitude is positively related to the intention to reduce food waste.

Additional Variables

However, the TPB framework has faced criticism, particularly regarding its application in food waste research (Conner & Armitage, 1998). Quested *et al.* (2013) argued that food waste is influenced by a collection of behaviours rather than a single behaviour. Consequently, recent research has extended the core TPB model by including other constructs relevant to food waste behaviour, such as consumers' negative emotions towards food wastage and the identity as a good food provider. A review of the existing literature highlighted the importance of negative emotions (Septianto *et al.*, 2020; Wharton, 2021; Jabeen *et al.*, 2023), identity as a good food provider (Aschemann-Witzel *et al.*, 2015; Barone *et al.*, 2019; Stancu & Lähteenmäki, 2022), cost savings (Slorach *et al.*, 2019; Kasavan *et al.*, 2022; Meshulam *et al.*, 2022), health risk concerns (Barone *et al.*, 2019; Katt & Meixner, 2020), and healthy diets

(Reynolds *et al.*, 2019; Brennan & Browne, 2021) in explaining food waste behaviour. While numerous studies have adopted either the basic or extended TPB framework to examine food waste behaviour, none have considered all these additional variables—negative emotions, identity as a good food provider, health risk concerns, healthy diets, and cost savings—in a single study.

Negative Emotions

Based on the theory of interpersonal behaviour, emotions can influence food waste behaviour (Triandis, 1979). The neglect of negative emotions in food waste research is surprising, given they are an important variable explaining individual behaviour (Weiss & Beal, 2005). Emotions can be defined as an individual's feedback on an object or event, encompassing both a feeling and a cognitive component (Forgas, 1994). Previous research on the impact of negative emotions on food waste behaviour has primarily focused on guilt. For example, Quested *et al.* (2013) discovered that consumers experienced guilt when wasting food, which led to their intention to reduce food waste. Russell *et al.* (2017) found a positive link between negative emotions and intentions to reduce food waste through a questionnaire survey conducted in the United Kingdom, demonstrating that food waste association with food waste could likely prompt consumers to waste less in the future. More recently, Jabeen *et al.* (2023) confirmed a positive relationship between negative emotions and attitude towards food waste reduction among users of food delivery apps. Similarly, Wharton (2021) agreed that consumers' feelings and emotions can significantly affect their food wastage behaviour. Overall, these studies suggested that consumers were likely to reduce food waste to avoid the negative emotions associated with discarding edible food. However, research on the association between negative emotions and food wastage has been predominantly conducted in developed countries such as Italy (Barone *et al.*, 2019), the United States (Khalil *et al.*, 2022) and the United Kingdom (Yen *et al.*, 2022). Such studies have

not been conducted in developing countries, including Malaysia. Based on this, the following hypothesis is proposed:

H_4: Negative emotions are positively related to the intention to reduce food waste.

Cost Savings

Various past studies have looked into the relationship between monetary savings and the intention to reduce food waste (Fonseca, 2014; Radzymińska *et al.*, 2016). Usually, when food items are sold at discounted prices, consumers tend to buy more than necessary to save on overall costs. However, if the excess food is not consumed, it will be discarded and wasted (Stangherlin & De Barcellos, 2018). Similarly, Simões *et al.* (2022) have asserted that the availability of inexpensive food increases the likelihood that more food will be wasted after purchase. Based on these findings, this study proposes the following hypothesis:

H_5: Cost savings are negatively related to the intention to reduce food waste.

Healthy Diet

As food becomes less fresh, consumers often perceive it as having reduced nutritional value. As a result, the tendency to avoid such sub-quality food increases, particularly among health-conscious individuals (Barker *et al.*, 2021). A survey conducted in the United States found that the healthier the diet, the more food is wasted. Specifically, households with the highest-quality diets wasted 80% more food than those with the lowest-quality diets (Conrad *et al.*, 2018). A more recent study by Conrad (2020) revealed that, on average, adult Americans wasted 25% of the food they purchased, with much of this waste consisting of healthy and nutritious items like fruits and vegetables. Likewise, Conrad and Blackstone (2021) suggested that improvements in diet quality could lead to increased waste of healthy foods, including fruits and vegetables. In short, higher diet quality is negatively associated with the intention to reduce food waste. Thus, the following hypothesis is proposed:

H_6: A healthy diet is negatively related to the intention to reduce food waste.

Health Risk Concern

Health risk concern is another significant barrier that may deter individuals from reducing food waste. Consumers often discard products nearing their expiry dates or suboptimal items due to health concerns, preferring to consume safe and healthy food (Teng *et al.*, 2021). In other words, people are hesitant to eat leftovers or food past its expiry dates due to fears about the adverse health effects of such items (Barone *et al.*, 2019). The aversion to health risks can be so pronounced that individuals may feel repulsed by the idea of consuming perceived inferior foods (Aschemann-Witzel *et al.*, 2015). Additionally, consumers may discard food prematurely to avoid the potential inconveniences associated with foodborne diseases. Previous studies suggested that health risk concerns are particularly relevant to consumers with negative past experiences with food, and are likely to cause them to avoid donating food or to receiving food from others (Farr-Wharton, 2014; Lazell, 2016; Burlea-Schiopoiu *et al.*, 2021). Thus, that the following hypothesis is proposed:

H_7: Health risk concern is negatively related to the intention to reduce food waste.

Identity as Good Food Provider

Stancu and Lähteenmäki (2022) asserted that food waste is not only an environmental behaviour but also a food-related behaviour that involves food provision activities. Good food providers, i.e., those who can be good hosts or have a large variety of food to serve guests, tend to waste more food (Visschers *et al.*, 2016). As good food providers, consumers feel the need to fulfil the tastes, preferences, and nutritional requirements of family members of guests. This may result in overprovision and subsequent wastage of food. Other scholars such as Graham-Rowe *et al.* (2015) and Porpino (2016) also opined that the "good food provider" identity is a significant barrier to overcoming

the issue of food wastage. Recently, Wang *et al.* (2021) confirmed a positive nexus between the status of a good food provider and the volume of food wasted among Australian and Singaporean consumers. Thus, the following hypothesis is proposed:

H_8: The identity as a good food provider is negatively related to intention to the reduce food waste.

Intention to Reduce Food Waste and Food Waste Behaviour

The TPB suggests that one's intention is likely to be the driving force behind actual behaviour. In an empirical study evaluating drivers and barriers of food waste behaviour among households in Switzerland, Visschers *et al.* (2016) conceptualised the variable of intention within the TPB framework as individuals' willingness to minimise food waste (Figure 1). Accordingly, in line with the premise of the TPB and the empirical framework of Visschers *et al.* (2016), this study suggests that individuals' intention to reduce food waste would likely result in their actual behaviour to avoid discarding food while it is still edible. Hence, the intention

will impact negatively and significantly food waste behaviour. In other words, as the intention to reduce food waste increases, it is predicted that less food waste behaviour will be observed (Barone *et al.*, 2019). Thus, the following hypothesis is proposed for this study:

H_9: Intention to reduce food waste is negatively related to food waste behaviour.

Methodology

Sampling and Data Collection

The targeted population of this study is Malaysian households comprising individuals above 18 years old. The study followed a non-probability sampling strategy and employed a convenient sampling technique to gather data from targeted respondents based on their accessibility and willingness to participate in the research. Before the formal distribution of research questionnaires, a pilot study was conducted with a sample size of 30 participants to verify the clarity of the questionnaire items. Following the pilot study, a comprehensive cross-sectional survey was conducted among Malaysian households from March to May 2023.
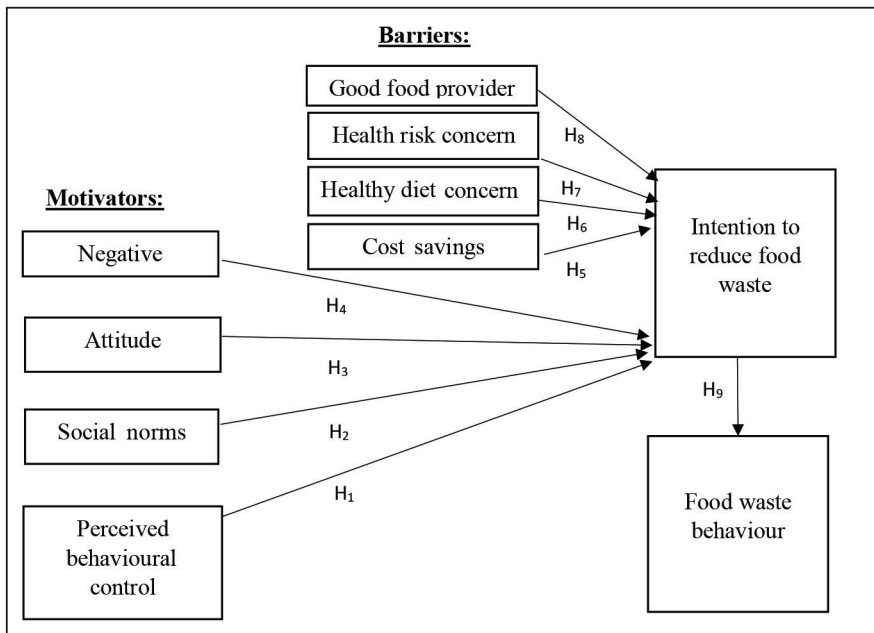

Figure 1: Proposed research framework

Respondents received the research questionnaire via both online and face-to-face distribution.

The on-site survey was primarily conducted in locations such as the Klang Valley (including Selangor and Kuala Lumpur), Penang, and Perak. They were selected due to their large populations, with household populations estimated to be around 1.8 million in Selangor and Kuala Lumpur, 0.7 million in Perak, and 0.5 million in Penang (Department of Statistics Malaysia, 2022). Additionally, these areas are known for their relatively higher income levels, making them relevant for research aligned with the interests of stakeholders such as policymakers and corporate entities, who frequently prioritise high economic development regions due to their pivotal role in fostering economic growth and societal advancement. The online survey was developed using Google Forms and targeted respondents from the same regions. The study aimed to include individuals above 18 years old from Malaysia with diverse backgrounds in terms of age, gender, occupation, education, household size, and monthly income.

Based on Krejcie and Morgan (1970), the minimum sample size for a population of more than 1,000,000 is 384, with a 95% confidence level and 5% margin of error. The survey study collected a total of 401 responses. Out of these, 378 responses were collected through face-to-face distribution while the remaining 23 responses were gathered via online distribution. There were four unusable responses, thus, data analysis was conducted based on the remaining 397 responses. This resulted in a response rate of 99%.

Measurement Instrument

The questionnaire was initially created in English and later translated into *Bahasa Malaysia*, the national language of Malaysia. To ensure that the translated questionnaire accurately reflected the original meaning, a back-translation process into the English language was carried out. The questionnaire adapted items from previous empirical studies, as demonstrated in Table 2, which lists the sources of references for all constructs used. The questionnaire consists of two parts. Part one measures each of the 10 constructs and includes a total of 43 items. Specifically, there are three questions for cost savings; four questions each for negative emotions, attitude, health risk concern, intention to reduce food waste, and food waste behaviour; and five questions each for social norms, perceived behavioural control, identity as a good food provider, and healthy diet. Part one of the survey employed a five-point Likert scale, with respondents rating each item on a scale of 1 to 5, where 1 corresponded

Table 2: Sources of construct measurement

Constructs	Items	Sources
Attitude (AT)	4	Russell *et al.* (2017) & Stefan *et al.* (2013)
Cost savings (CS)	3	Barone, Grappi & Romani (2019)
Good food provider (FP)	5	Visschers, Wickli & Siegrist (2016)
Healthy diet concern (HD)	5	Visschers, Wickli & Siegrist (2016)
Health risk concern (HR)	4	Amirudin & Gim (2019); Visschers, Wickli & Siegrist (2016)
Intention to reduce food waste (IN)	4	Aka & Buyukdag (2021)
Negative emotions (NE)	4	Russell *et al.* (2017)
Perceived behavioural control (PB)	5	Barone *et al.* (2019); Russel *et al.* (2017); Visschers *et al.* (2016)
Social norms (SN)	5	Aschemann-Witzel *et al.* (2015); Barone *et al.* (2019); Russel *et al.* (2017); Visschers *et al.* (2016)
Food waste behaviour (WB)	4	Aktas *et al.* (2018)

to "strongly disagree" and 5 corresponded to "strongly agree". Part two consists of items related to the demographic information of respondents, including age, educational level, gender, occupation, household monthly income, and household size.

Data analysis was conducted using version 4 of the Smart PLS software, employing PLS-SEM to evaluate the proposed research hypotheses. As a second-generation technique, it has the advantage of facilitating both confirmatory and exploratory factor analyses of the research model (Hair *et al.*, 2017). The analysis involved several techniques. Firstly, the PLS algorithm procedure was applied to assess the measurement of constructs. Then, a bootstrapping procedure with 5,000 resamples was performed. Finally, predictive power was assessed through a blindfolding procedure to determine whether the exogenous variables could predict the endogenous latent variable within the research model.

Table 3 shows that 31 items were retained in the measurement model as their factor loadings exceeded the 0.707 threshold suggested by Hair *et al.* (2017), indicating reliability of the measurement item of the construct. Items with factor loadings ranging from 0.500 to 0.699 were retained only if their respective constructs achieved an Average Variance Extracted (AVE) greater than 0.500, as recommended by Barclay *et al.* (1995). These constructs include one item each from health risk concern, cost savings, perceived behavioural control, and social norms, two items each from a healthy diet and good food provider. Four items were excluded due to factor loadings below 0.500. These include one item each from health risk concern and social norms, two items from good food provider. The AVE for the constructs ranged from 0.550 (good food provider) to 0.833 (food waste behaviour). Additionally, all constructs achieved a composite reliability exceeding the threshold of 0.700. Thus, the measurement model demonstrated acceptable convergent validity, as per Hair *et al.* (2017).

The study confirmed the discriminant validity of the constructs by evaluating item cross-loadings, the Fornell-Larcker criterion, and the Heterotrait-Monotrait (HTMT) ratio. The analysis showed that all items had factor loadings that exceeded their cross-loadings by at least 0.100. Additionally, each construct exhibited a square root value of the AVE that surpassed its respective correlation values, in accordance with the Fornell-Larcker criterion (Fornell & Larcker, 1981). As reported in Table 4, all constructs also achieved HTMT values lower than 0.85. Therefore, the constructs demonstrated adequate discriminant validity.

Discussion of Results

This section begins by discussing the socio-demographic characteristics of the sample derived from the 397 valid questionnaires. It is followed by an analysis of the descriptive statistics for each construct employed in the study. To meet the research objective of identifying determinants influencing consumers' intention to reduce food waste in Malaysia, the results of the hypotheses testing are examined in detail.

Table 5 illustrates the demographic profile of all the 397 respondents. The number of female participants (n = 266, 67%) exceeded that of male respondents (n = 131, 33%). Regarding age, half or 50% (n = 197) of the respondents were in the 35 to 49 years old age group. This was followed by those aged 18 to 34 years (n = 152, 38%), 50 to 64 years (n = 43, 11%), and those above 65 years (n = 5, 1%). In terms of academic qualifications, the majority of respondents held a Bachelor's degree (n = 143, 36%), followed by those with a Master's degree (n = 101, 25%), and a secondary school certificate (n = 63, 16%). The remaining respondents had completed a Doctorate programme (n = 52, 13%), primary school education (n = 2, 1%), or other qualifications (n = 36, 9%). With regard to occupation, most respondents were employed in the private sector (n = 266, 67%), followed by public sector employees (n = 41, 10%), self-employed

Table 3: Convergent validity

Constructs	Items	Full Sample (n = 397)		
		Loadings	AVE	CR
Attitude	AT1	0.771	0.682	0.895
	AT2	0.777		
	AT3	0.888		
	AT4	0.860		
Cost savings	CS1	0.680	0.700	0.873
	CS2	0.943		
	CS3	0.865		
Good food provider	FP3	0.985	0.550	0.774
	FP4	0.578		
	FP5	0.586		
Healthy diet concern	HD1	0.802	0.596	0.878
	HD2	0.874		
	HD3	0.871		
	HD4	0.661		
	HD5	0.613		
Health risk concern	HR2	0.797	0.619	0.825
	HR3	0.938		
	HR4	0.585		
Intention to reduce food waste	IN1	0.874	0.709	0.907
	IN2	0.880		
	IN3	0.864		
	IN4	0.743		
Negative emotions	NE1	0.848	0.741	0.920
	NE2	0.906		
	NE3	0.868		
	NE4	0.820		
Perceived behavioural control	PB1	0.813	0.570	0.868
	PB2	0.727		
	PB3	0.689		
	PB4	0.819		
	PB5	0.719		
Social norms	SN1	0.602	0.554	0.831
	SN2	0.767		
	SN3	0.822		
	SN4	0.768		
Food waste behaviour	WB1	0.900	0.833	0.952
	WB2	0.943		
	WB3	0.915		
	WB4	0.893		

Table 4: HTMT criterion results

No.	Construct	1	2	3	4	5	6	7	8	9	10
1	Attitude										
2	Cost savings	0.119									
3	Good food provider	0.068	0.440								
4	Healthy diet concern	0.297	0.299	0.321							
5	Health risk concern	0.051	0.191	0.145	0.162						
6	Intention to reduce food waste	0.556	0.214	0.094	0.371	0.097					
7	Negative emotions	0.626	0.105	0.047	0.237	0.105	0.525				
8	Perceived behavioural control	0.086	0.160	0.429	0.131	0.182	0.086	0.111			
9	Social norms	0.463	0.194	0.182	0.458	0.133	0.452	0.358	0.194		
10	Food waste behaviour	0.269	0.088	0.282	0.081	0.275	0.317	0.255	0.361	0.226	

individuals (n = 37, 9%), students (n = 20, 5%), and unemployed, pensioners, and housewives (n = 19, 5%). A small proportion were classified as others (n = 14, 4%). Most respondents had a household monthly income within the range of RM4,851.00 to RM10,970.00 (n = 185, 47%), followed by those with a household monthly income of RM4,850.00 and below (n = 163, 41%). Only a minority of respondents belonged to the high-income group with a household monthly income of more than RM10,970.00 (n = 49, 12%). Concerning household size, most respondents are from households with four persons (n = 122, 31%) or two persons (n = 72, 18%) while 16% (n = 64) had three persons in their households. A considerable number of respondents had households with five persons (n = 57, 14%) or six persons and above (n = 50, 13%). The remaining 8% (n = 32) were the sole member in their households.

Referring to Table 6, all constructs within the research model, except for food waste behaviour, reported mean values exceeding the mid-point of 3.0. This indicates that, on average, respondents agreed with these constructs. Respondents exhibited a negative attitude towards food waste ($\bar{x}$ = 4.24, s_x = 0.74). They were also motivated by negative emotions ($\bar{x}$ = 4.19, s_x = 0.78) to reduce food waste. Respondents perceived themselves as somewhat in control over the volume of food wasted at home ($\bar{x}$ = 3.18, s_x = 0.87). Furthermore, friends and family members were perceived as influential in shaping households' food waste behaviour ($\bar{x}$ = 3.58, s_x = 0.63). The results also suggest that the tendency to save costs could be a barrier to reduce food waste ($\bar{x}$ = 3.65, s_x = 0.84). However, the identity as a good food provider is not a strong determinant for food waste in this sample ($\bar{x}$ = 3.21, s_x = 0.81). Interestingly, respondents were more concerned about maintaining a healthy diet ($\bar{x}$ = 3.94, s_x = 0.70) than about health risk concerns ($\bar{x}$ = 3.04, s_x = 0.73) when deciding whether to discard food. Although households' intention to reduce food waste was relatively high ($\bar{x}$ = 4.21, s_x = 0.67), the results show that households were reluctant to change their food waste behaviour, as indicated by the construct's lowest mean value compared with other constructs in the study ($\bar{x}$ = 2.03, s_x = 0.94).

Table 7 presents the structural model and hypothesis testing results. The explanatory power of the structural model is 0.365 for the intention to reduce food waste and 0.084 for food waste behaviour. The results indicate that perceived behavioural control, social norms, attitude, negative emotions, cost savings, healthy diet, health risk concern, and good food provider

Table 5: Demographic profile of respondents

Characteristics	Full Sample (n = 397)	
	Frequency	%
Gender		
Male	131	33
Female	266	67
Age		
18-34 years	152	38
35-49 years	197	50
50-64 years	43	11
Above 65 years	5	1
Education		
Primary	2	1
Secondary	63	16
Bachelor	143	36
Masters	101	25
Doctorate	52	13
Others	36	9
Occupation		
Self-employed	37	9
Public sector employee	41	10
Private sector employee	266	67
Unemployed, pensioner, housewife	19	5
Student	20	5
Others	14	4
Household income level		
RM4,850.00 and below	163	41
RM4,851.00 to RM10,970.00	185	47
More than RM10,970.00	49	12
Household size		
1 people	32	8
2 people	72	18
3 people	64	16
4 people	122	31
5 people	57	14
6 people and above	50	13

Table 6: Descriptive statistics

Construct	Mean (x̄)	Standard Deviation (s_x)
Attitude	4.24	0.74
Cost savings	3.65	0.84
Good food provider	3.21	0.81
Healthy diet concern	3.94	0.70
Health risk concern	3.04	0.73
Intention to reduce food waste	4.21	0.67
Negative emotions	4.19	0.78
Perceived behavioural control	3.18	0.87
Social norms	3.58	0.63
Food waste behaviour	2.03	0.94

explain 36.5% of the variances in the intention to reduce food waste. However, the intention to reduce food waste explains only 8.4% of the variance in food waste behaviour, which is considered to have low explanatory power (Cohen, 1988).

The results indicate that perceived behavioural control positively influences the intention to reduce food waste. However, this effect is not significant ($\beta = 0.089$, t = 1.173, p = 0.057), leading to the rejection of Hypothesis 1. Conversely, three other motivators—social norms ($\beta = 0.140$, t = 2.877, p = 0.002), attitude ($\beta = 0.230$, t = 3.844, p = 0.000), and negative emotions ($\beta = 0.257$, t = 4.481, p = 0.000)—

demonstrate a positive and significant effect on the intention to reduce food waste, thus, supporting Hypotheses 2, 3, and 4. Regarding barriers, the results show that cost savings ($\beta = 0.088$, t = 1.973, p = 0.025) and a healthy diet ($\beta = 0.158$, t = 2.635, p = 0.004) have a positive and significant relationship with the intention to reduce food waste, refuting Hypotheses 5 and 6. In contrast, Hypothesis 7 is supported as health risk concern is found to have negatively and significantly influence the intention to reduce food waste ($\beta = -0.111$, t = 2.137, p = 0.016). The relationship between being a good food provider and the intention to reduce food waste is positive but not significant ($\beta = 0.013$, t = 0.265, p = 0.395), leading to the rejection

Table 7: Structural model and hypothesis testing results

Hypotheses	Path	Beta	Standard Error	t-statistics	p-value	Results	f2	R2	Q2
H₁	PB > IN	0.089	0.054	1.173	0.057	Unsupported	0.011		
H₂	SN > IN	0.140	0.049	2.877	0.002	Supported	0.024		
H₃	AT > IN	0.230	0.060	3.844	0.000	Supported	0.053		
H₄	NE > IN	0.257	0.056	4.481	0.000	Supported	0.068		
H₅	CS > IN	0.088	0.042	1.973	0.025	Supported	0.009	0.365	0.318
H₆	HD > IN	0.158	0.060	2.635	0.004	Supported	0.031		
H₇	HR > IN	-0.111	0.053	2.137	0.016	Supported	0.019		
H₈	FP > IN	0.013	0.060	0.265	0.395	Unsupported	0.000		
H₉	IN > WB	-0.293	0.054	5.383	0.000	Supported	0.091	0.084	0.055

of Hypothesis 8. Hypothesis 9 is confirmed, as the intention to reduce food waste is negatively and significantly correlated with food waste behaviour ($\beta = -0.293$, $t = 5.383$, $p = 0.000$). To complement the results above, the effect sizes for each hypothesised path were generated (Sullivan & Feinn, 2012). Social norms, attitude, negative emotions, healthy diet, and health risk concern all have effect sizes greater than the medium level cut-off value of 0.15. Among these, negative emotions have the highest effect size, indicating it has the biggest influence on the intention to reduce food waste. The effect size of the intention to reduce food waste on food waste behaviour is also relatively high.

The results indicate that social norms, attitude, and negative emotions are significant motivators for the intention to reduce food waste among Malaysian households. Notably, negative emotions are identified as the primary driver for this intention. This suggests that Malaysian consumers experience guilt when they waste food, which increases their commitment to reducing food waste. Respondents who associated food disposal with feelings of guilt were likely to have stronger intention to reduce food waste. These findings are consistent with Quested *et al.* (2013), Wharton (2021), and Jabeen *et al.* (2023), who also reported that negative emotions and the intention to reduce food waste are positively related. Additionally, this research underscores the significant role of social norms and attitude in influencing food waste reduction in Malaysia. One key finding is the need to establish effective anti-wastage social norms to address food waste issues in the country. Creating such norms can bring about a change in people's attitude towards food waste (Radzymińska *et al.*, 2016). The observed positive correlation between social norms and food waste reduction intention is consistent with Heidari *et al.* (2020) and Huang and Tseng (2020).

Regarding barriers, the study confirmed that health risk concerns and the intention to reduce food waste are negatively related, as anticipated. The results indicate that Malaysian households are concerned about health and food safety in food choices and purchases, increasing their intention to discard food. This is particularly true for consumers who have had negative experiences with food in the past. These findings are consistent with Barone *et al.* (2019) and Teng *et al.* (2021), who noted that concerns over health risks discouraged people from consuming food past its expiry date. In contrast to initial expectations, the study found a positive impact of cost savings on the intention to reduce food waste in Malaysia. This unexpected result suggests that consumers who purchase discounted food items are more likely to have the intention to reduce food waste. Aschemann-Witzel *et al.* (2018) observed that cost savings often result from food suppliers reducing prices of sub-optimal products (products of close expiration dates, bruised fresh produces, dented tin products, etc.) to reduce in-store waste. Although some studies such as Stangherlin and De Barcellos (2018) and Simões *et al.* (2022) found a negative relationship between cost savings and the intention to reduce food waste, Aschemann-Witzel *et al.* (2018) reported a positive association. The current study's respondents disagreed that cost savings led to more food waste, suggesting they managed to use the discounted items before they expired. Aschemann-Witzel *et al.* (2018) proposed that this phenomenon might stem from consumers' denial of increased food waste or from the waste being less noticeable. This result contradicts Radzymińska *et al.* (2016), Stangherlin and De Barcellos (2018), and Simões *et al.* (2022), who argued that the availability of inexpensive food often leads to higher food wastage. Furthermore, this study revealed a positive relationship between a healthy diet and the intention to reduce food waste. This finding aligns with Conrad *et al.* (2018) and Conrad and Blackstone (2021), who noted that households with higher-quality diets tend to waste more food, particularly fruits and vegetables. This result may be attributed to the fact that many Malaysians consume lower-quality diets due to financial constraints.

As anticipated, the intention to reduce food waste had a negative impact on food waste behaviour. Specifically, individuals with a

stronger intention to reduce food waste reported lower levels of food waste. This finding is consistent with Russell *et al.* (2017), Barone *et al.* (2019), and Oehman *et al.* (2022), who suggested that the intention to reduce food waste would ultimately lead to behavioural changes that decrease the amount of food wasted.

Conclusions

Households' food waste behaviour is influenced by a range of factors, making it crucial to identify the determinants to design effective policies for reducing food waste in Malaysia. This study reveals a positive relationship between the motivating factors—social norms, attitude, and negative emotions—and the intention to reduce food waste, with the exception of perceived behavioural control. Interestingly, the study found that two of the barriers, cost savings and a healthy diet, positively impacted the intention to reduce food waste, which contradicts theoretical expectations. Conversely, health risk concern was negatively related to the intention to reduce food waste. Additionally, the intention to reduce food waste was negatively associated with food waste behaviour.

Theoretical Implications

This study offers several important theoretical implications. Firstly, it shows that the motivators—social norms, attitude, and negative emotions—are directly related to the intention to reduce food waste. Notably, negative emotions exert the strongest influence on Malaysian consumers' intention to reduce food waste. This finding addresses a research gap by exploring these motivational variables in the context of Malaysia.

Second, this study found that both cost savings and a healthy diet positively and significantly influence the intention to cut food waste. However, the relationship between health risk concern and the intention to reduce food waste is negative. This research fills a gap in the literature by being the first to examine these barriers in the Malaysian context, offering new

insights into the factors that hinder the intention to reduce food waste.

Practitioners' Implications

This study offers several practical implications for reducing food waste among Malaysian households. Educating households on effective handling and storage of leftover cooked food can help preserve food for safe and later consumption. Since health risk concerns negatively impact the intention to reduce food waste, food handlers should acquire new skills in food preservation to minimise waste due to health fears. Food providers can support this by offering practical guidance on the handling and storage of fresh produce, including the use of technologies that extend food shelf life. Additionally, community initiatives such as establishing community gardens and composting programmes can further contribute to food waste reduction efforts.

This study also provides crucial policy implications and recommendations for policymakers in designing and implementing appropriate strategies to address food waste challenges in Malaysia. The findings highlight that social norms, attitude and negative emotions are significant drivers of food waste reduction. Policymakers should focus on shaping anti-wastage social norms to influence people's attitudes towards food waste. Raising awareness about the environmental impact of food waste can help reduce the amount, especially among environmentally conscious consumers. The government should emphasise the environmental consequences of food waste to encourage people to engage in reduction efforts. Furthermore, integrating food waste education into school curricula can foster long-term changes in attitudes towards food waste, promoting more sustainable practices form an early age.

Policymakers should also encourage households to share food surplus with other families or donate extra edible items to charitable organisations, such as orphanages and senior care facilities. These measures can help

prevent food from being wasted before expiry and discarded due to safety concerns. The study also suggests establishing food banks across the country as a strategy to reduce food waste. Families with excess food could contribute to these food banks, which would then distribute the food to underprivileged groups in society.

Limitations and Recommendations for Future Research

This study has several limitations. First, the research is confined to Malaysia, which limits the generalisability to other countries with different values and attitudes towards food waste. It is therefore recommended that future studies explore the same research topic in other nations. Second, the study employs a quantitative approach through a questionnaire survey. Future research may consider a mixed-methods approach, integrating both quantitative and qualitative data to better understand households' food waste behaviour. Third, the data of this study was collected mainly from households in urban areas, namely the Klang Valley, Penang, and Perak. Thus, the findings may be biased and primarily relevant to urban households in Malaysia. Future studies should examine food waste behaviour in urban and rural areas to obtain a broader perspective on the issue.

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Conflict of Interest Statement

The authors declare that they have no conflicts of interest.

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