Determinants of household behavioural intention towards reducing, reusing and recycling food waste management

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Abstract

Purpose – This study aims to investigate the determinants of household behavioural intention towards household reducing, reusing and recycling behaviour of food waste management.

Design/methodology/approach – The data were collected from 670 households in Malaysia and analysed by using the partial least square method.

Findings – The findings reveal that motivation to participate, ability to participate and perceived benefits are the crucial factors that significantly influence households' attitudes. Household attitude has a significant impact on household behavioural intention, whilst social influence and perceived behavioural control are not associated with it. Government support is positively related to perceived behavioural control. The result also indicates that household behavioural intention has a significant impact on household reducing, reusing and recycling behaviour.

Research limitations/implications – The participants of this study were involved in home planning and food preparation in Malaysia. The individuals in charge of the household might have more awareness of food planning and waste control. Thus, it is recommended to adopt findings from other countries and learn from the experience of the local and international communities.

Practical implications – The households' behavioural intentions can lead to the reducing, reusing and recycling behaviour of food waste management. The government policy mechanisms and households' awareness can work effectively against food waste reduction because evaluations of the food waste programme were found to be scarce.

Social implications – Food insecurity is one of the major social problems. Many people are not aware of the food waste impacts and consequences; thus, motivation, knowledge and information should be provided to the consumer through forums and campaigns.

Originality/value – The findings contribute to new insights of household behavioural intention towards food waste reduction management by assessing the determinants of household attitude and government support for food waste reduction management programmes towards household reducing, reusing and recycling behaviours.

1. Introduction

The sustainable future of Earth is a crucial topic and the world is shifting rapidly towards the notion of "Think Global, Act Local" (Steel, 1996). The quality of the environment is a global concern. Humans had taken 30% more resources than our Earth could replenish every year (Steel, 1996). Human activities are leading to the destruction of Earth and natural resource depletion, including deforestation, air and water pollution, land degradation and loss of biodiversity (Jowit, 2008; Lee *et al.*, 2016; and Rahman *et al.*, 2022). There are plenty of ways to save our planet. This study focused on the households' participation in food waste reduction programmes, which could help to save the earth through food waste reduction. This study has used the concept of the theory of planned behaviour (TPB) to focus on the key drivers of motivation to participate, ability to participate and perceived benefit, household attitude, social influence, government support and perceived behavioural control towards household behavioural intention, which reflect the household reducing, reusing and recycling behaviour.

There are a few essential processes of food before it reaches the consumer. Each of these processes require resources for operation. Food waste was estimated to make up nearly 15% of the disposed waste in the USA, wasting large amounts of energy and other resources, such as freshwater used in production, cropland and fertiliser (Thyberg and Tonjes, 2016). Food is everyone's basic need; thus, it is impossible to stop consuming food. Food waste matter has increased in parallel with the global population. As the global population is growing quickly, urbanising and becoming wealthier, demand for land and resources has subsequently increased over time. The food waste issue has become alarming. Growing incomes and demographic and cultural changes over time have led to consumer changes in eating habits [Food and Agriculture Organization (FAO), 2019]. Food waste management has been working out worldwide, resulting in bringing the highest environmental benefit compared with other types of waste management approaches (Patwary *et al.*, 2021). There is an increasing consensus about the need to reduce food waste, in terms of the political and scientific aspects.

In Malaysia, each individual produces 1.1 kg of solid waste on average and this will sum up to 33,000 tonnes of waste produced daily (Pariatamby, 2017). As a part of the United Nations, Malaysia has taken part in the sustainability-related indicator 12.3, in which, by 2030, Malaysia aims to halve the per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains [The Division for Sustainable Development Goals (DSDG), 2017; Think Eat Save, 2022]. The reduction of food waste is now part of the 2030 Agenda under the sustainable development goals 12 in Malaysia, which aim to ensure sustainable consumption and production patterns (FAO, 2019). Realising the impact of food waste as a global issue, the Malaysian government has extended the role and function of the Solid Waste Management and Public Cleansing Corporation as the amount of wasted food rises by 15%–20% during festive seasons, such as Ramadan (Yusop and Othman, 2019).

Ogiri *et al.* (2019) argued that to encourage recycling in Malaysian households, waste separation at the source needs to be implemented, which would make it mandatory for all

households to sort their waste into different categories before the waste is collected. A penalty system needs to be imposed on households that fail to sort their waste appropriately. Households have been found to not be aware of the benefits and advantages of recycling and waste separation (Fadhullah *et al.*, 2022). Moreover, they are not aware of the impact that will be caused if they do not practice good waste management. Not only raising awareness of food waste separation, but the campaign will also emphasise food waste recycling initiatives such as turning food waste into bio-fertiliser or potential bio-gas through composting or anaerobic digestion (Ismail, 2020). Nevertheless, the study found a low number of households in Kuala Lumpur willing to separate their wastes. Questions and doubts arise concerning whether people are prepared for waste minimisation, waste sorting and recycling.

Food production, including processing, marketing, consumption and disposal, has important environmental externalities because of the usage of energy and natural resources and emissions of associated greenhouse gas (GHG) (Lim *et al.*, 2016). There are still gaps to be explored to better understand the determinants of households' engagement in food waste reduction initiatives amongst households in Malaysia. The food waste problem happens globally, and the behaviour is subjective, highly contributed to by the action of local authorities and consumers' behaviours (Aschemann-Witzela *et al.*, 2019). In spite of a growing number of studies and action having been taken on this subject, especially in recent years, the issue seems to not have significantly improved. Ismail *et al.* (2020) focused on the extent of food waste reduction during the Malaysian movement control order in the COVID-19 outbreak, which was lacking in terms of a holistic approach and multidimensional study on households' behaviours towards the food waste reduction initiatives. To fill these gaps, this study explored the research question of how household attitudes, social influence, government support and perceived behavioural control reflect behavioural intention towards household reduction, reuse and recycling food waste management. In line with this research question, the main objective of this study has been to explore the determinants of the households' engagement in food reduction initiatives, as well as to examine the outcomes from that engagement.

Households should plan to practice appropriate storage and as such determine the method of storing and refrigerating accordingly to avoid contributing to food wastage because of inappropriate storage. Households should only cook what is needed and make sure everything on the plate is eaten. The government has also introduced several efforts at the national level such as the National Solid Waste Management (2002–2020), National Recycling Programme (2000–2005) and Waste Minimisation Master Plan (2005) by enabling the waste management strategy (MHLG, 2006). There is a supportive environment for the waste management strategy in Malaysia (Patwary *et al.*, 2022). However, this study has provided an interesting argument by pointing out that even when there is a supportive environment provided, the effectiveness of the waste management strategy could still impact households' food waste treatment.

To substantially reduce waste, certain measurements need to be taken, such as generating public awareness and changing consumer behaviour. Given this situation, food waste management is an interesting issue to study. Thus, this study has aimed to explore the critical determinants that affect households' participation behavioural intentions for the outcome of households' reusing, reducing and recycling behaviour. More detailed analyses at the household level are still needed, especially those that provide an understanding of the benefits of the different types of strategies adopted by households to tackle the issues of food waste. Because of the need to shed more light on the implications of food waste reduction programmes on households' behaviours and ways of promoting the household

food waste culture, this study believes that the determinants and the outcomes from such behaviours of food waste reduction amongst households over time should be investigated.

2. Literature review

2.1 Underpinning theory

This study used the concept of Ajzen's (1991) TPB. This theory has been widely used with human psychological factors and has provided significant results related to attitudes, norms, perceived control and intentions on behaviour (Hagger *et al.*, 2022; Ajzen, 1991). In this study, household attitudes referred to a general measure of self-performance, motivation, perceived benefits and ability to participate in food waste reduction programmes. Fadhullah *et al.* (2022) identified a relationship between household waste management practices and residents' perceptions. Social influence was used in this study as it may influence household participants towards food waste reduction management. The government effort can help the community in the reduction of food waste management, and the perceived behavioural control of the households reflects the behavioural intention towards reuse, reduction and recycling of food waste management.

The perceived behavioural control indicates how hard a person is willing to try, or how much effort a person is willing to put forth to complete certain activities or behaviours. The concept of the TPB has been considered for this study on households' intentions to perform a given behaviour of food waste reduction management. In this regard, intentions are expected to be influenced by psychological factors such as attitude, social influence and perceived behavioural control, which may relate to behaviour. The TPB asserts that psychological behaviour has a direct function from behavioural intention, which is a function of attitude (Bani-Khalid *et al.*, 2022; Taylor and Todd, 1995). Accordingly, this study has analysed households' attitudes, social influence, government support, perceived behavioural control and behavioural intention towards food waste reduction management including reducing, reusing and recycling behaviours.

2.2 Motivation to participate

Motivation refers to the reason behind a specific behaviour that is influenced by an individual's willingness and volition (Wolters, 2003). Motivation involves an individual's beliefs, values, interests, perceptions and actions related to the specific action. The relationship between motivation and food waste attitude is not straightforward because motivational factors that encourage everyone can be varied and cover a range of themes. Annunziata *et al.* (2020) found that saving money is a powerful motivator that relates to food waste reduction. Quested *et al.* (2013) indicated that environmental concerns influence food behaviour and the intention to reduce food waste. Falasconi *et al.* (2019) supported financial concerns and social concerns as motivations that predict food waste reduction behaviour. This study adopted that the motives of consumers towards food-handling practices might be influenced by customer attitude. Therefore, the study set the following hypothesis:

H1a. Motivations of households are positively associated with household attitude.

2.3 Ability to participate

The ability to participate refers to the belief in one's own ability to accomplish a certain task (Soma *et al.*, 2021). Ability incorporates both a habit and knowledge element (Kusumowardani *et al.*, 2022; Soma *et al.*, 2021). If a person intends to perform a certain action, e.g. participate in a waste separation programme, but does not know how, the person

most likely will not participate properly (Cordova-Buiza *et al.*, 2022; Marek-Andrzejewska and Wielicka-Regulska, 2021 and Verhallen and Pieters, 1984). Similarly, if a person intends to participate in the programme, the existing waste management and handling patterns must be changed, and a new pattern should be formed and maintained. People generally will only attempt things that believe they can accomplish, but not try something that they do not think they can do. Ability was also found in a study on the factors influencing environmental attitudes and behaviours (Barr, 2007). As also suggested by the studies, the ability to participate has been shown to be significantly related to influencing attitude and also bringing a direct impact on food-waste levels (Lin and Guan, 2021; Stancu *et al.*, 2016; Visschers *et al.*, 2016). Given that food waste is linked to many food-handling practices, the framework could refer to a wide range of considerations such as knowledge of nutrition, food handling, date labelling or planning skills. Therefore, the study proposed the following hypothesis:

H1b. The ability to participate is positively associated with household attitude.

2.4 Perceived benefits

Perceived benefit refers to the positive perception of certain consequences after performing a specific action (Al-Debei *et al.*, 2015). A perceived benefit from the behaviour can influence the attitude of the person. The food waste behaviours have been influenced by the consumers' perceptions of the effects on waste management (Dorce *et al.*, 2021). For example, reducing food waste could help in saving money (Werf *et al.*, 2021). Food waste reduction programmes may reflect households' buying attitudes because many people believe that buying extra food is a waste of money. Taylor and Todd (1995) have termed benefits and defined them as the cost and benefits of recycling. Ajzen (1991) suggested that the responsibility to perform, personal feelings from moral obligation or willingness to perform will be taken into consideration when tested on intentions and attitudes. The National Academies of Sciences, Engineering and Medicine (2020) reported that environmental attitudes and beliefs, concerns about the future and an individual's sense of responsibility can shape the determinants to affect food waste decisions. According to Jiang *et al.* (2021) and Chu and Chiu (2003), the social relative benefits were the key determinants of attitude. This study designed the construct to reflect the perceived benefit that the consumers expected from participating in a food waste reduction programme, including money saved from food waste reduction, concern for the environment and avoiding depletion of natural resources. The study set the following hypothesis:

H1c. Perceived benefit is positively associated with household attitude.

2.5 Household attitudes

Attitudes are a general measure of the self-performance of a specific behaviour (Ajzen, 1991). According to Si *et al.* (2020), attitude develops from what people's beliefs hold about the subject, by associating it with certain attributes. They can be an object, characteristic or any event. Geffen *et al.* (2020) described attitudes on food waste as reflected by their thoughts and feelings on how problematic a person finds it to or not to waste food. Naturally, when we are in a position of making a decision, we learn to form favourable attitudes when we believe there are desirable consequences of a certain behaviour, and vice versa (Ajzen, 1991). Attitudes of households on food waste reduction programmes describe the belief of individuals on the outcome anticipated after participating in the food waste reduction

programmes. A few studies found that attitudes were positively related to intention (Stancu *et al.*, 2016; Geffen *et al.*, 2020). Therefore, the study proposed the following hypothesis:

H2. Household attitude has a significant impact on behavioural intention.

2.6 Social influence

Social influence is like a subjective norm mentioned in the TPB (Wang *et al.*, 2020). Social influence reflects the effects of a person, such as opinions from friends, family, relatives or superiors on user behaviour (Chen *et al.*, 2022). Zainal and Hassan (2019) stated that social influence is influenced by third-party expectations. Previous studies identified that social influence has a direct effect on individual behaviour. Researchers believed that good examples set by a family can positively influence an individual on waste management and food waste reduction (Li *et al.*, 2021; Geffen *et al.*, 2020). This study postulated the following hypothesis:

H3. Social influence has a significant relationship with behavioural intention.

2.7 Government support

Local authorities play an important role when it comes to enforcement. Food waste management policies need to be introduced to encourage people on adopting food waste initiatives. The government policies have played important roles in securing the success of the food waste reduction programme. Annunziata *et al.* (2020) suggested that the behavioural model was to be taken into consideration when designing new policies and campaigns. Xu *et al.* (2017) stated that the effectiveness of campaigns and policies can promote residents' participation in waste management programmes. This was also supported by Wan *et al.* (2014) who focused on perceived policy effectiveness against waste management intention. Sarbassov *et al.* (2019) indicated that individuals were willing to participate in the separation at source programme, provided facilities were provided and they were ease to use. Schmidt and Matthies (2018) supported that intervention programmes should be organised to provide information and knowledge to the consumer on food waste storing, leftover food handling and perceived health risks (Ai *et al.*, 2022; Rahman *et al.*, 2021a, 2021b). Therefore, the study set the following hypothesis:

H4. Government support has a significant impact on perceived behavioural control.

2.8 Perceived behavioural control

The facilitating condition was adopted from the TPB model. Perceived behavioural control refers to the opportunity and sufficient resources to perform the behaviour (Zainal and Hassan, 2019). Ajzen (2002) stated that a person has a high level of intention if he/she feels that he/she has a high degree of control over a given behaviour (Chen *et al.*, 2022; Rahman *et al.*, 2021a, 2021b). Ajzen (1991) explained that perceived behavioural control refers to people's perceptions of the matter, whether it is easy or difficult to be performed. Usually, these perceptions are varied across different situations and actions. They have also provided some evidence that the participation behaviour is under a degree of volitional control. Ajzen (1991) also suggested capturing the respondents' salient control factors such as the availability of waste management facilities and barriers to reduce food waste. Past studies found that perceived behavioural control was significantly related to the intention of

reducing food waste (Mondéjar-Jiménez *et al.*, 2016). Therefore, the study set the following hypothesis:

H5. Perceived behavioural control has a significant impact on household behavioural intention.

2.9 Household behavioural intention

Household food waste-reducing behaviour takes place in the early stage. The aim is to reduce the amount of food turning into food waste, which means avoiding unnecessary food waste by changing habits in lifestyles. Several studies find that the frequency of participation in planning behaviours correlated to quantities of food waste generated (Abdelradi, 2018; Stefan *et al.*, 2013). Shopping routines, shopping planning and meal planning behaviours have been found to be important factors in terms of food waste reduction management (Mosler *et al.*, 2006). Falasconi *et al.* (2019) tested food shopping habits and found that they played a key role in food waste. Individuals with a strong value and knowledge base, along with good awareness of the waste problem, were more likely to reduce waste. Reuse refers to the action of using a substance, material or product with its original form. Different from recycling, reuse is referred to as a preventive measure action taken before the subject turns into waste. The previous studies supported reuse for combatting food waste (Jörissen *et al.*, 2015; Annunziata *et al.*, 2020). Mourad (2016) mentioned the reuse of leftover food for the next meal, whilst the EPA (2020) reported donating surplus food to feed others. Recycling is the process of turning waste into new products. Benefits of food waste recycling include the reduction of waste in landfills (Yu *et al.*, 2021). One of the food waste recycling methods is composting. Composting is a natural process that transforms food waste into compost that benefits agriculture, because of its rich nutrients and being good for the soil. This technique not only lowers the number of landfills but also contributes socially, ecologically and economically. Recycling is the best alternative transformation of organic waste before the waste is directly sent to the landfill (Sewak *et al.*, 2021). Therefore, this study postulated the following hypothesis:

H6a. Household behavioural intention has a significant impact on household reducing behaviour of the food waste.

H6b. Household behavioural intention has a significant impact on household reusing behaviour of food waste.

H6c. Household behavioural intention has a significant impact on household recycling behaviour of food waste.

Based on the review of the literature and underpinning theory, Figure 1 shows a conceptual model of this study.

3. Methodology

3.1 Measurement

In this study, the measures of the construct were developed based on previous studies. Based on Abdelradi (2018) and Aktas *et al.* (2018), seven items were measured for motivation to participate. For evaluating the ability to participate, seven items were adopted from Mondéjar-Jiménez *et al.* (2016) and Aktas *et al.* (2018). Eight items were modified from Falasconi *et al.* (2019) and Graham-Rowe *et al.* (2015) to evaluate the perceived benefits. To measure the household attitude and social influence, 17 items were adopted from Liu *et al.* (2020). Seven
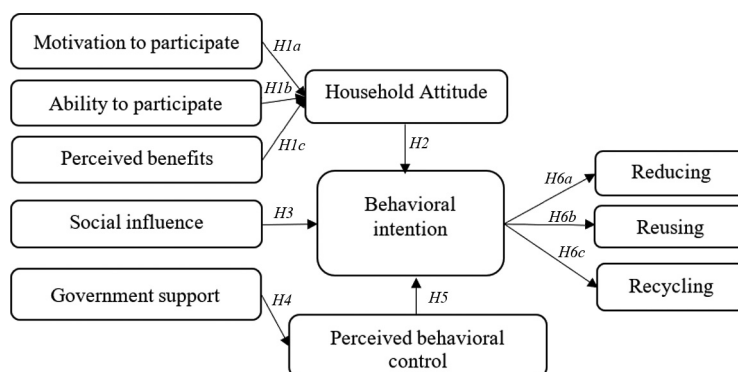
Figure 1.
Conceptual model

items were adopted from Zhang *et al.* (2019) for evaluating the government support, whilst seven items were modified from Zhang *et al.* (2019) and Abdelradi (2018) for measuring the perceived behavioural control. To measure the household participation behavioural intention, six items were modified from Liu *et al.* (2020), Parizeau *et al.* (2015) and Zhang *et al.* (2019). Six items were adopted from Stancu *et al.* (2016) and Khushi *et al.* (2020) for measuring household reusing behaviour, whilst six items were modified from Liu (2020), Werf *et al.* (2020) and Zhang *et al.* (2019) for evaluating household reducing behaviour. For evaluating household recycling behaviour, six items were adopted from Zhang *et al.* (2019) and Fami *et al.* (2019).

A five-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree, was used for the determinants of household participation in food waste reduction programme, including motivation to participate, ability to participate, perceived benefit of food waste reduction programme, attitude of household, social influence, government support and perceived behavioural control. A five-point Likert scale, ranging from 1 = very unlikely to 5 = very likely, was used for evaluating the households' participation behavioural intentions. A five-point Likert scale, ranging from 1 = rarely to 5 = almost always, was used for measuring the households' reusing, reducing and recycling behaviours.

3.2 Sampling and data collection

The unit of analysis of the study was the individual in the household, preferably the individual in charge of household planning and responsibility for food preparation for the household. Our study relates to food waste; thus, we presumed that the individuals who were involved in the household planning and food preparation would clearly understand and be aware of the food preparation sequences and habits, and food waste management in that household. Targeting such a unit helped to increase the accuracy of our study. The sampling for this research was based on convenient sampling with the target of a convenient correspondent. The data collection was carried out on an online platform from December 2020 to March 2021, for three months. Because of the COVID-19 pandemic, face-to-face communication was not recommended. Therefore, our study solely used an online questionnaire. The questionnaires were compiled using an online survey, namely, Google Survey, and were shared via electronic communication, such as social media, email and messenger. The English version questionnaire was translated into the Malay language. The online questionnaire was shared amongst friends and family, colleagues, forums and social media platforms.

Before going to the final survey, the questionnaire was passed to five volunteers for further review of the contents and validity. The respondents were asked to evaluate for readability, clarity of words, smoothness of flow and the general adequacy of the items for the concepts measured. Eventually, it helped in providing suggestions for wording improvement and sentence construction. The wording of certain questions was amended based on the feedback given by the respondents. Overall, the questions were clear and covered most of the elements required in this study. Amendments were made accordingly to the feedback to ensure consistency and smoothness in the later stage.

The survey questionnaires were distributed to the households in Malaysia. Because the survey was self-administered and without incentive given, the respondents diligently took part in this survey. Approximately 1,000 sets of questionnaires were distributed and shared via electronic communication, such as social media, email and messenger. This survey focused only on Malaysian households. Therefore, five survey responses that were from outside of Malaysia were removed. After the initial scanning of the data, a total of 670 questionnaires were found without any missing values and were usable for data analysis, which presented a 67% response rate. The sample size is one of the elements that could determine the power of a test. To evaluate the sample size of 670, a power analysis using G*power 3.1 version statistic software was conducted. The result showed a strength of 0.95, which was larger than 0.80 (VanVoorhis and Morgan, 2007; Cohen, 1988; Chin, 2001). It indicated the acceptable level of the sample power of the current study (Faul *et al.*, 2009). Thus, the response rate is acceptable in this study on food waste reduction programme participation amongst the households.

4. Data analysis
4.1 Demographic information
The survey had a total of 66.2% female respondents and 33.8% male respondents. The population in this study was homogeneous, where the major respondents were Chinese (77%) followed by 17% Malay respondents. The respondents' ages stood out at 28% from the age group of 18–29, 54% from 30–39, 11% from the age group of 40–49 and the rest of them were 50 years and above, which was 6% of the total respondents. This study tended to focus on household behaviour intention in a city area, including Cyberjaya, Putrajaya, Selangor and Kuala Lumpur, which took up 86.7% of the total surveys, whilst the rest of the 13.3% came from other areas. When looking into the education level, 79.3% of the respondents had tertiary education, whilst the other 20.7% had graduated from secondary school. Most of the respondents worked full time, as high as 85.7%, whilst the rest were homemakers, part-time workers or retired, which took up to 4%, 8.2% and 2%, respectively, of the total respondents. The highest group of respondents had a monthly income ranging from RM 3,000 to RM 6,500, which was 39.8% of the total, followed by 26.5% for the group ranging from RM 6,501 to RM 10,000 and 21.4% for the monthly income above RM 10,000. On household size, the result shows that the largest group had three people in the household (25.5%). Asking about the number of children at home, 55% of the respondents replied that they did not have kids at home, whilst 26% had two or more children below 18 years old at home. To further understand the behaviour and involvement related to food preparation and food waste reduction, we asked the respondents whether they were involved in household planning and food preparation. For household planning, 77.8% answered yes, whilst the rest (22.2%) of the respondents were not involved in household planning. On the other hand, 76.8% of the respondents were responsible for their food preparation, whilst 23.2% of them were not responsible for food preparation (Table 1).

Characteristics	(%)
Gender	
Female	66.2
Male	33.8
Age	
18–29	28.6
30–39	55.1
40–49	11.2
50 and above	5.1
Occupation	
Full-time work	85.7
Homemaker	4.1
Part-time work	8.2
Retired	2.0
Household size	
1	10.2
2	17.3
3	25.5
4	17.3
5	7.1
6 or more	22.4
Food waste at home	
Always	20.4
Sometimes	12.2
Never	67.3
Food waste shopping mall	
Always	17.3
Sometimes	9.2
Never	73.5
Reason food ends up in garbage	
It spoils or becomes stale	46.0
I clean out the refrigerator/pantry	24.4
Others in my household don't want to eat it	15.9
I don't want to eat it	6.8
It is more food than I want to eat	6.8
Location of residence	
Cyberjaya/Putrajaya	4.1
Selangor	52
WP Kuala Lumpur	30.6
Others	13.3
Academic level	
Secondary school	20.7
Tertiary education	79.3
Income level	
<RM 3,000	12.2
RM 3,001–RM 6,500	39.8
RM 6,501–RM 10,000	26.5
>RM 10,000	21.4
	(*continued*)

Table 1.
Demographic information

Characteristics	(%)
Children younger than age 18 at home	
None	55.1
1	18.4
2 or more	26.5
Types of food most often in garbage	
Meal leftovers	69.7
Fresh produce	33.3
Animal product	20.2
Shelf-stable items	21.2
Milk	16.2
Bread	32.3
Used cooking oil	35.4
Cheese or yogurt	9.1
Rice	25.3
Others	8.1
Participated in food waste reduction programme	
Yes	77.8
No	22.2
Participate in future food waste reduction	
Yes	76.8
No	23.2

Table 1.

4.2 Measurement model evaluation

A partial least square (PLS) statistical tool was used for analysing the data. The PLS provides a more appropriate statistical technique compared with multiple linear regressions because the PLS can avoid specification errors and enhance the validity of the results, providing better results and eliminating structural errors. Besides that, the PLS is able to provide a measurement of overall model fit and allows multiple relationship analysis altogether at the same time (Fornell and Larcker, 1981). Smart PLS software 3.0 was used in the aid for model measurement. In this study, a reflective model was used to measure the first-order variables, which were indicators of the constructs. In this study, outer loadings were examined for all the variables. For the standardised loading, the value should be higher than or nearly 0.70. Indicators with outer loadings below 0.60 were eliminated from their constructs (Sarstedt *et al.*, 2017). According to Chin and Newsted (1999), loadings ranging from 0.50 and 0.70 are still considered good and acceptable if other items have greater loadings in the same construct. The findings indicated that most of the indicator loading values on their corresponding latent variables were greater than 0.70. However, there were several indicators (AP_1 = 0.559, SI_2 = 0.589, SI_6 = 0.675, GS_1 = 0.653, GS_5 = 0.655, GS_6 = 0.632, ATT_4 = 0.681, RC_5 = 0.691) giving results lower than 0.7, implying that they could be otherwise removed according to the composite reliability (CR) and average variance extracted (AVE) values obtained.

Reliability is concerned with the consistency and stability of the instrument in evaluating the concept. Cronbach's alpha and CR indices were used to indicate the internal consistency reliability. By using Cronbach's alpha and CR as the lower bound, internal consistency reliability can be assessed. For the CR criterion, higher values mean a higher level of reliability (Sarstedt *et al.*, 2017). Gefen *et al.* (2000) suggested that CR should be 0.70 or higher to indicate internal consistency. Panayides (2013) recommended a value of 0.70 as an acceptable alpha. From Table 2, the Cronbach's alpha value achieved the reasonable

Constructs	FL	Cronbach's alpha (α)	CR	AVE
Motivation to participate	0.851	0.840	0.892	0.675
I am in favour of participating in the food waste reduction programme as it benefits me to buy less food which means more money is saved (mp2)	0.851			
I am in favour of participating in the food waste reduction programme as it supports reducing the pollution issue (mp3)	0.779			
I am in favour of participating in the food waste reduction programme as it conserves lots of energy and natural resources (mp6)	0.825			
I am in favour of participating in the food waste reduction programme as it relieves my worry regarding food safety (mp7)	0.830			
Ability to participate		0.814	0.867	0.523
I cook and prepare meals for my family; therefore, I'm able to participate in the food waste reduction programme (ap1)	0.559			
I have enough time to carry out waste separation if required by the food waste reduction programme (ap2)	0.727			
I find it easy to store leftovers in its required food storage place as required by the food waste reduction programme (ap3)	0.766			
Even if I do not participate in the food waste reduction programme, it would be possible for me to reduce the amount of food waste in my way (ap5)	0.757			
I do have transport to deliver the food waste to a centralised composting facility as directed by the programme (ap6)	0.757			
I find that the composting process is handy because the comprehensive instructions are given in the programme (ap7)	0.752			
Perceived benefit		0.947	0.957	0.759
By participating in a food waste reduction programme, I know that buying extra food is a waste of money (pb1)	0.827			
Participating in a food waste reduction programme will contribute to a good environment (pb2)	0.831			
By participating in the food waste reduction programme, not only can I reduce the amount of household waste but also lessen the costs associated with the rubbish collection (pb4)	0.886			
By participating in a food waste reduction programme, I can support my community in reducing our landfill waste (pb5)	0.902			
By participating in a food waste reduction programme, I can control the amount of food I make or put on my plate (pb6)	0.892			
By participating in a food waste reduction programme, I can be creative with leftover food (pb7)	0.870			
By participating in the food waste reduction programme, I will know how to compost my food and kitchen scraps which is good for my gardening (pb8)	0.888			
Household attitude		0.909	0.926	0.612
I believe it is critical to participate in a food waste reduction programme as it can prevent wasting food when there are so many hungry people in the world (att1)	0.781			
I think participating in a food waste reduction programme is a good idea (att2)	0.802			
Because I am the one responsible for grocery shopping in the household, I am always distressed if food is wasted by my family members (att4)	0.681			

(*continued*)

Table 2.
Convergent validity

Constructs	FL	Cronbach's alpha (α)	CR	AVE
I will always be committed to applying activities of the food waste reduction programme (att5)	0.798			
I will always assure that my family members are participating in the food waste reduction programme (att6)	0.764			
I will pay attention to the standard of operation of the food waste reduction programme (att7)	0.888			
I could be exposed to food contamination if I don't know how to eliminate the food waste properly (att8)	0.804			
I do not have a problem participating in a food waste reduction programme as long as it doesn't cost me anything (att9)	0.728			
Social influence		0.796	0.857	0.548
Most people who are important to me would encourage me to participate in the food waste programme (si1)	0.841			
Most people around me would disapprove of my food waste behaviours (si2)	0.589			
Most people whose opinions I value would agree with my actions in trying to reduce wasted food by participating in the food waste programme (si4)	0.780			
Most people who are important to me would always remind me of my religious obligation to my food-wasting behaviour (si6)	0.675			
Most people who are important to me often influence me to change my food-wasting behaviour (si7)	0.790			
Government support		0.854	0.879	0.551
Low participation of households in the food waste recycling is because of a lack of government effort to make recycling compulsory amongst the community members (gs1)	0.653			
Public announcements from the government on the importance of food waste reduction programmes stimulate me in waste sorting around my living community (gs2)	0.776			
The government invests a lot in food waste reduction programmes; therefore, I should be appreciated of it and participate (gs3)	0.840			
Government policies on sustainable food waste management will support the food waste reduction programmes (gs4)	0.861			
The government should aggressively draw the interests of the local people to participate in any food waste reduction programmes on what is sustainable food waste disposal and consumption in the programmes (gs5)	0.655			
The government should aggressively educate the local people on what is sustainable food waste disposal and consumption so that the people will be interested to participate in the programmes (gs6)	0.632			
Perceived behavioural control		0.927	0.942	0.699
The food waste reduction programme provides an appropriate capacity for each waste sorting bin (pbc1)	0.720			
The location for each waste sorting bin provided by the food waste reduction programme is nearby to my place (pbc2)	0.874			
There are sufficient facilities for waste sorting around my living community provided by the food waste reduction programme (pbc3)	0.914			

Table 2.

(continued)

Constructs	FL	Cronbach's alpha (α)	CR	AVE
The facilities for food waste reuse/recycling provided by the food waste reduction programme are available around my living community (pbc4)	0.911			
The community often shares with me their experiences on how to manage the food waste because they have participated in the food waste reduction programme (pbc5)	0.855			
The environment surrounding my living area is so fresh and elicits a stronger motivation for me to reduce food waste by participating in the food waste reduction programme (pbc6)	0.781			
Door stepping campaigns on the food waste reduction programme have improved my knowledge of food waste initiatives and R&D (pbc7)	0.777			
Household participation in behavioural intention (If a food waste reduction programme is available at your neighboring area . . . .)		0.939	0.953	0.802
how likely would you plan to participate in that programme during the next three months? (pbi1)	0.917			
how likely would you be interested to participate in the programme within the next three months? (pbi2)	0.899			
how likely would you plan to start meal planning to reduce unnecessary food waste within the next three months? (pbi3)	0.884			
how likely would you strategise to isolate food waste separately when discarding it within the next three months? (pbi4)	0.873			
how likely would you be interested to contribute to the objectives of the programme within the next three months? (pbi5)	0.905			
Household reducing behaviour (How often do you do the following . . . .?)		0.916	0.933	0.700
Plan your meals for the week before you go shopping and buy only the things needed for those meals (rd1)	0.888			
Look in your refrigerator and cupboards first to avoid buying food you already have, make a list each week of what needs to be used up and plan upcoming meals around it (rd2)	0.848			
Buy only what you need and will use (rd3)	0.846			
Include quantities on your shopping list noting how many meals you'll make with each item to avoid overbuying (rd4)	0.750			
Make your shopping list based on how many meals you'll eat at home at one time (rd5)	0.874			
Store bananas, apples and tomatoes by themselves, and store fruits and vegetables in different bins (rd6)	0.805			
Household reusing behaviour (How often do you do the following . . . .?)		0.847	0.897	0.686
Skills in reusing bones from meat can be put to use for making stock (ru1)	0.787			
Grow some vegetable waste that can be re-grown after use (ru2)	0.806			
Skills in repurposing vegetable and fruits scraps for some stock (ru3)	0.912			
Transform leftovers into a different dish by adding some ingredients (ru4)	0.804			
Household recycling behaviour (How often do you do the following . . . .?)		0.897	0.915	0.642

(*continued*)

Table 2.

Constructs	FL	Cronbach's alpha (α)	CR	AVE
Establish a compost bin or pile and break all food scraps down into smaller particles (rc1)	0.837			
Use eggshells to fertilise green plants (rc2)	0.842			
Use coffee grounds as a natural fertiliser (rc3)	0.870			
Use several types of kitchen leftovers to create natural skincare products, e.g. cucumber leftovers (rc4)	0.772			
Use a banana peel to clean surfaces and remove dust (rc5)	0.691			
Use a biodegradable bag instead of a regular plastic bag (rc6)	0.784			

Table 2.

Notes: CR: composite reliability; AVE: average variance extracted

threshold between 0.796 and 0.939, whilst the CR ranged from 0.867 to 0.957. Both results have been proven to meet the recommended values. Convergent validity shows to what extent the indicators of a specific construct share or converge a high proportion of common variance. It is evaluated based on the extent to which the construct captures the same concept (Sarstedt *et al.*, 2017). The AVE is calculated as the mean of the squared loadings of each indicator related to the construct. The AVE should exceed 0.5 to suggest adequate convergent validity (Fornell and Larcker, 1981). Based on the findings in Table 2, all the indicators were above the threshold (AVE > 0.5), and the lowest AVE was 0.523. Therefore, the result had met recommended value, and it was concluded that further indicator removal with loading values lower than 0.7 was not necessary.

To test the statistical significance and relevance of the indicator weights, the researcher ran the bootstrapping method using 5,000 subsamples. Collinearity values had been determined to range between 1.721 and 2.207 by variance inflation factor (VIF) assessment and given acceptable results. The higher the VIF, the greater the level of collinearity. VIF values are suggested to be lower than 5 to avoid collinearity issues (Sarstedt *et al.*, 2017). The findings of this study indicated that the VIF value of each underlying construct did not exceed 5, which implies that there was no multicollinearity issue. In this study, we used the heterotrait–monotrait (HTMT) ratio to test the discriminant validity of the model. According to the Fornell and Larcker (1981) criterion, the AVE for each variable needs to be greater than the squared correlations amongst the constructs and the other variables to demonstrate discriminant validity (Fornell and Larcker, 1981). The findings indicated the square roots of the AVE values for the constructs were greater than the correlations amongst the constructs, implying that the model met the discriminant validity (Table 3). The HTMT criterion had recommended that the values for all the constructs be less than 0.85 (Kline, 2015) or 0.90 (Sarstedt *et al.*, 2017), to demonstrate discriminant validity. The findings show that none of the constructs was greater than 0.85, which indicates the appropriateness of discriminant validity.

4.3 Assessment of the structural model
The assessment of the structural model was assessed by learning about the predictive capabilities of the model, which are indicated by the coefficient of determination R-square (R^2), cross-validated redundancy (R^2) and the path coefficients. The R^2 indicates the variance explained in each of the endogenous constructs. Ranging from 0 to 1, higher levels

Constructs	AP	ATT	GS	MP	PB	PBC	PBI	RC	RD	RU	SI
AP											
ATT	0.746										
GS	0.679	0.788									
MP	0.657	0.814	0.689								
PB	0.583	0.846	0.737	0.720							
PBC	0.609	0.363	0.507	0.320	0.311						
PBI	0.558	0.664	0.543	0.607	0.588	0.323					
RC	0.403	0.340	0.283	0.206	0.278	0.533	0.356				
RD	0.444	0.431	0.356	0.375	0.480	0.386	0.466	0.493			
RU	0.345	0.440	0.386	0.466	0.580	0.481	0.401	0.818	0.588		
SI	0.634	0.692	0.597	0.649	0.681	0.609	0.508	0.398	0.396	0.526	

Notes: AP: ability to participate; ATT: household attitude; MP: motivation to participate; PB: perceived benefit; PBC: perceived behavioural control; PBI: behavioural intention; RC: household recycling behaviour; RD: household reducing behaviour; RU: household reusing behaviour; SI: social influence

Table 3.
Discriminant validity

indicate more predictive accuracy. From the rule of thumb, values of 0.75, 0.5 and 0.25 are considered substantial, moderate and weak, respectively (Cohen, 1988). Besides that, the, R^2 can also be used to assess the model's predictive accuracy. By using the blindfolding procedure, the researcher omits single points in the data matrix, imputes the omitted elements and estimates the model parameters. The blindfolding procedure predicts the omitted data points, and the process is repeated until each of the data points has been omitted and the model re-estimated. The smaller the difference between the predicted values and the original values, the greater the R^2 criterion. This also means higher accuracy and relevance. From the rule of thumb, values larger than zero indicate that the path model's predictive accuracy is acceptable (Sarstedt *et al.*, 2017). The blindfolding process with an omission distance of 5 was run and the result has been tabulated as below. The R^2 values indicated that the model was able to clarify 72.2% of the variance in household attitude, 30.8% of household perceived behavioural control and 40.1% of households' participation in behavioural intentions. The R^2 values were presented for a household attitude of 0.427, perceived behavioural control of 0.203, households' participation behavioural intentions of 0.305, reducing behaviour of 0.139, reuse behaviour of 0.115 and recycling behaviour of 0.087, which were all above zero, giving evidence that the values observed were well reconstructed and the model had predictive relevance.

The strength and significance of path coefficients are evaluated by the hypothesis relationship between the constructs. To analyse the structural model, we applied a non-parametric bootstrapping technique with 5,000 subsamples. Referring to our stated hypothesis, the set contained only one condition, which was that the path coefficient was positive. One-tailed *p*-value estimation was applied in this test (Kock, 2015). *t*-Values above 1.96 and *p*-values below 0.05 are recommended to support the significant relations of path coefficients (Hair *et al.*, 1998; Gefen *et al.*, 2000). Based on the findings in Table 4, motivation to participate ($\beta = 0.202$, $p < 0.01$), ability to participate ($\beta = 0.277$, $p < 0.001$) and perceived benefit ($\beta = 0.500$, $p < 0.001$) had significant positive effects on household attitude. Government support revealed a significant positive effect ($\beta = 0.555$, $p < 0.001$) on perceived behavioural control. Household attitude ($\beta = 0.519$, $p < 0.001$) had also shown a significant effect on household participation behavioural intention; thus, *H1a*, *H1b*, *H1c* and *H4* were supported. The results revealed that *H3* and *H5* were insignificant because the effect of the *t*-values was below 1.96 and the *p*-value was above 0.05. The household

Relationships	Hypothesis	Beta	t-values	p-values	Decision
H1a	MP → ATT	0.202	2.443*	0.007	Supported
H1b	AP → ATT	0.277	3.533**	0.000	Supported
H1c	PB → ATT	0.500	5.194**	0.000	Supported
H2	ATT → PBI	0.519	4.856**	0.000	Supported
H3	SI → PBI	0.107	0.954	0.170	Not supported
H4	GS → PBC	0.555	8.364**	0.000	Supported
H5	PBC → PBI	0.094	0.903	0.183	Not supported
H6a	PBI → RD	0.477	5.773**	0.000	Supported
H6b	PBI → RU	0.369	4.278**	0.000	Supported
H6c	PBI → RC	0.384	4.968**	0.000	Supported

Notes: $*p < 0.05$; $**p < 0.01$

Table 4.
Path coefficient

behavioural intention had a significant impact on household reducing behaviour ($\beta = 0.477$; $p < 0.001$), household reusing behaviour ($\beta = 0.369$; $p < 0.001$) and household recycling behaviour ($\beta = 0.384$; $p < 0.001$), respectively; therefore, H6a, H6b and H6c were supported.

5. Discussions
Household food waste has become an interesting topic worth being studied. Whilst food management is an important topic in sustainable development, our findings aimed to examine the determinants that affect household participation and behavioural intention in food waste reduction programmes and their outcomes. The findings revealed that the motivation to participate, ability to participate and perceived benefit had higher significant and positive impacts on household attitude. These findings are aligned with Stancu *et al.* (2016), Stefan *et al.* (2013) and Geffen *et al.* (2020), who highlighted food waste management and examined the relationships between consumer ability, motivation, benefit and their perceived attitude towards food waste management. Annunziata *et al.* (2020) and Falasconi *et al.* (2019) found a positive relationship between motivation for household participation and attitude. Visschers *et al.* (2016) identified the ability of the households to participate in food waste programmes is positively associated with the attitudes to participate in the food waste reduction programmes. Households will possess knowledge and habits before they decide to be involved in given behaviours (Barr, 2007; Stefan *et al.*, 2013). Chu and Chiu (2003) and Taylor and Todd (1995) found that the perceived benefit of food waste reduction programmes is positively associated with attitudes to participate in the food waste reduction programmes. Another study has a similar finding that food waste behaviour was influenced by the consumers' perceptions of the effects on waste management. For example, reducing food waste could help in saving money (Falasconi *et al.*, 2019; Amirudin and Gim, 2019).

The results revealed that social influence is not associated with behavioural intention in food waste reduction programmes. In this study, social influence did not show a significant relation to household participation behaviour intention perhaps because of the cultural differences and involvement in the motivation, and the benefit of the food waste reduction programme. The result shows a conflict with Geffen *et al.* (2020) and Aschemann-Witzel *et al.* (2015) in which the attitude towards food waste participation was influenced by the neighbours in the environment. This study found that most of the respondents agreed and were willing to participate in a food waste reduction programme (FWRP) in the future. We can presume that most of the respondents in Malaysia had already taken time to participate in a FWRP. Therefore, without influence from people around, the respondents had

implanted the awareness of food waste themselves, which shows, in turn, that social influence did not result in a significant effect on the intention of participating in the programme.

Government support was found to be related to perceived behaviour control. Jereme *et al.* (2017) stated that government effort is one of the crucial factors in making food waste reduction programmes successful. The findings also suggested that a food waste policy should be introduced to influence food waste reduction programme participation within households (Jereme *et al.*, 2017; Thyberg and Tonjes, 2016). The waste collection system, which is controlled and organised by the government, is one of the important factors to reflect household intention.

The results indicate that perceived behavioural control was not associated with the behavioural intention in food waste reduction programmes. This finding is similar to Tonglet *et al.* (2004), who found that there was no significant relationship between perceived behavioural control and intention. Tonglet *et al.* (2004) argued that this might be caused by respondents having the ease to access a waste collection point in the neighbourhood and perceived behavioural control would be a stronger determinant of recycling behaviour in non-recyclers or non-access to recycling resources. In this study, the majority of the households had been involved or were willing to participate in the FWRP. This condition is like the case argued by Tonglet (2004), in which respondents already had high consciousness of food waste.

The result shows that household behavioural intention had a positive significant effect on reduction, reuse and recycling behaviours. This result was aligned with Abdelradi (2018) and Annunziata *et al.* (2020) found that households' participation behaviours towards food waste were positively associated with the reducing, reusing and recycling behaviours of the food waste management. According to the EPA (2020), food waste recovery is food reduction behaviour, followed by food reuse behaviour, and food recycling was the last preferred behaviour. In Malaysia, food waste has been taken as part of municipal solid waste. Not much focus has been put on food waste-related programmes. For example, when Malaysian consumers were asked about source separation or recycling of matter, they indicated paper, plastic and glass rather than food waste.

When resources are consumed in the processes of harvesting, producing, distributing and preparing, wasting food simply means wasting all the resources which have been used in the earlier processes. According to Kusumowardani *et al.* (2022), the economic cost of global food wastage was estimated to reach US$750m in the year 2007. The result from waste reduction and efficient resource usage has the potential of cost savings, and with the savings obtained, new business fields would be identified, which subsequently increases the employment rate. On the other hand, food insecurity is often caused by the difficulty to access food, rather than food supply problems. Singh *et al.* (2021) reported that food insecurity because of the COVID-19 ongoing uncertainty can be caused by financial or resource constraints. When the efficiency of food increases, the amount of food available in the market would be increased (Kusumowardani *et al.*, 2022), and this will subsequently lower the cost of food and thus increase food accessibility in the market.

6. Theoretical and practical implications

This study has significant theoretical and practical implications. The findings have identified that household motivation, ability to participate, perceived benefit, government support and household attitude are the crucial dimensions for household participation

attitudes and behavioural intention in food waste reduction programmes. The households' behavioural intentions can lead to the reducing, reusing and recycling behaviours of food waste programmes. The government policy mechanisms and households' awareness could be working detrimentally against food waste reduction because evaluations of the food waste programme were found to be scarce. The findings of this study indicate that household behavioural intention can reflect on household reducing, reusing and recycling food waste management.

In Malaysia, not many people are aware of the food waste impacts and consequences; thus, it is suggested that knowledge and information should be provided to the consumer through forums and campaigns. By understanding the consequences, the consumer could put effort into supporting food waste reduction programmes and knowing how the most effective way is to reduce food waste. The knowledge is important to create awareness of food waste and could alter a person's behavioural intention in food waste reduction efforts, such as educating the consumer on source separation. Consumer concern for the environment influences food behaviour and intention to reduce food waste. Similar to reuse, knowledge is one of the factors to motivate food reuse behaviour. A household might not have the skills and knowledge on how to turn the leftover food into their next meal. Waste cookery classes are suggested to further improve participation rates in the food waste programme.

Consumer uncertainty regarding leftover edibility and safety give an impact to reuse behaviour. Food banks and food collection systems in the neighborhood are certainly able to increase the participation rate of the household. As one of the initiatives in combating food waste, the Ministry of Domestic Trade and Consumers has developed the Centre of Food Collection and Distribution (PPPM) for the Malaysia Food Bank Programme located in Bukit Kajang. This is the first distribution centre in the programme, and they hope to expand the coverage to all zones, including East Coast, Central, Northern and Southern Zones (Rahim, 2020). Besides the government, there is a non-governmental organisation that supports and participates in food waste reduction programs. The post-COVID-19 effects have affected people's food consumption behaviours. Because of the post-COVDI-19 pandemic, there has been food insecurity, which has been caused by resource constraints. The fear and lockdown processes of C0VID-19's uncertainty has led to changes in the household food waste and decrease in food waste.

Food waste prevention requires changes in people's behaviours. In terms of policy approach, we would suggest that the government address the values and perceptions that drive behaviour. Knowledge and information should address the concerns regarding food wastage. For example, food waste is a waste of resources (money and edible food). Wasting food is not good in the moral aspect and yields feelings of guilt, and food waste negatively impacts our environment. From our study, most of the respondents indicated their concern and were willing to participate in food waste reduction programmes. The degree of involvement can be further improved by giving support, awareness and motivation, such as with skills, knowledge and facilities.

Because of the post-COVID-19 pandemic, food waste matters have gained more attention in recent years. More citizens, businesses, institutions and policymakers have made the step to participate in the programme. Reducing food waste will become an increasingly essential strategy in the future to help feed this growing population. Food security will soon become an issue if this matter is not taken seriously. Whilst food waste reduction programmes involve complex procedures, the government should take the lead in implementing, managing and controlling food waste-related programmes. Policies to prevent food waste should be addressed accordingly, addressing the behaviours for wastage, and households should make their best efforts to be involve in and support food waste reduction programmes.

7. Limitations and future study

One of the limitations of this study is that its sample size was relatively small. The number was only slightly higher than required. It was suggested that a bigger sample size be carried out in the future, and only focus on a specific area. Besides that, from our descriptive study, the respondents did not reflect the population in the area. In terms of gender, the female respondents carried bigger numbers. This study targeted people who were involved in home planning and food preparation. There might be a bias in the result, as an individual in charge of the household might have more awareness of food planning and waste control. Thus, it is advised to adopt findings from other countries and learn from the experience of the local and international communities. To better understand the behavioural intentions of households in the food waste reduction programme, we advise that a more detailed study be carried out locally, and with the support from the government, data collected can be carried out more smoothly and broadly.

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