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Household Food Waste Behavior in Klang Valley, Malaysia, and Its Potential in the Circular Economy

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Abstract: Food waste is a problem that has resulted in a variety of situations in which it is one of the primary causes of food insecurity. Changes in household behaviors, such as overbuying, are important drivers of food waste, particularly following the emergence of COVID-19. Studies on what drives household consumer engagement in various food-waste strategies have been limited. Thus, this paper aims to study the factors that lead to food-waste behavior at the household level in the Klang Valley area. Out of the 431 questionnaires distributed, 404 were useful, and the respondents for this study were from various ethnicities. A quantitative design was employed in this study, with descriptive and inference statistics derived from the questionnaire, which was distributed via Google Forms. The data were analyzed using Statistical Package for Social Science version 26.0 and Smart PLS version 3.0, to test the reliability, validity, and hypotheses of this study. A significant relationship exists between food-waste behavior, namely food expenditure, and waste reuse, but food-waste behavior has no relationship with food choice. The study's conclusions highlight the significance of understanding and planning one's food-buying behaviors, to achieve benefits additional to simply lowering the number of those who are at risk of being hungry. The study also found that male respondents wasted more food than their female counterparts.

Keywords: food choice; food expenditure; food waste; waste reuse; waste-to-energy

1. Introduction

It is an immediate concern to the world to be able to supply food for its 9.1 billion individuals over the next 30 years [1,2]. Previous studies have stated that over 805 million people face daily hunger all over the world [3,4]. Numerous studies have determined that food security is at risk, and increased food production is no longer a desirable option, due to its consequences in terms of climate change, including environmental degradation, and loss of land, water, and energy resources [5–7]. Environmental awareness has increased due to concerns about pollution and climate change. This has prompted governments, particularly in industrialized countries, to create regulations to protect and preserve the environment [8,9].

According to Abdelradi [1], food waste, or food misfortune, is food that is not eaten. Food waste, or food misfortune, mostly occurs during the food-cycle in the processing system, on-site production, preparation, conveyance, retail, and utilization. Worldwide

food misfortune, or food waste, comprises up to 33%, or one third, of all food delivered. Food wastage has even become a threat to food security globally. According to the United Nations Food and Agriculture Organization (FAO) [4], food security is defined as a person without enough food, and with restricted access to sufficient safe and nourishing food for healthy growth and development, as well as for an active and fulfilling life. Without tackling the issue of food loss and waste, building a sustainable food system is impossible, according to the EAT–Lancet Commission's (2019) report [10]. Unfortunately, COVID-19 has created food-system disruptions, which comprise delays in transportation and harvesting, which have increased the loss of perishable goods. This has established a new standard, and a consumption pattern that may have an adverse domino impact on the food industry's ability to produce and consume food sustainably [11].

Food waste is a multifaceted problem, with many contributing factors [12,13]. Food that is initially produced for human consumption, but is later thrown away or is not consumed by people, is characterized as food waste by Thyberg and Tonjes [14]. Food waste is becoming widely acknowledged as a pressing issue among governments, businesses, other concerned groups, and the public, due to mounting evidence of the amounts of food wasted worldwide [13]. In response, the UN's Sustainable Development Goals (SDGs) call for responsible consumption and production (Goal 12). The Sustainable Development Goals (SDGs) cover a wide range of topics, including social issues (such as no poverty, zero hunger, good health and wellbeing, quality education, and gender equality), as well as environmental protection (such as clean water and sanitation, affordable and clean energy, climate action, and life on land) and economic development (such as decent work and economic growth, industry, innovation, and infrastructure, sustainable cities, and communities) [15]. This effort also heavily emphasizes multi-level cooperation, which comprises local, national, regional, and international cooperation, to create a worldwide partnership to address global concerns [16].

New concepts and alternative economic models have been promoted to aid the shift to sustainable development. One of the well-liked strategies for promoting sustainable development initiatives is the circular economy (CE). The global community is moving to a sustainable model due to environmental GHG emissions, and the harm that linear economies cause to biodiversity and water demand [17]. The "Production–Consuming–Recycling" cycle of sustainable development is favored by the new circular economy model [18,19]. By 2030, it is intended that food waste will be reduced by one half [20]. Along the food supply chain, private households are some of the largest sources of food waste [21,22]. In addition to being a significant environmental issue, food waste has social repercussions, because the lost food could have fed one in nine hungry people on the planet [23,24]. Food waste disregards the needs of the current generation, and jeopardizes the needs of future generations. Consequently, food waste is one indicator that the feeding of the human population may not be able to continue [25]. Food waste by consumers, or at the end of the food supply chain, also wastes the natural and financial resources that have been donated at earlier stages of the chain, leading to detrimental economic effects [26,27].

This study focuses on the urban territory of Klang Valley, specifically its households. It is one of the most populated areas in Malaysia, with a population size of 29.4 million in 2019, wherein 72.04% is urbanized [28]. The Ministry of Housing and Local Government Malaysia (MHLG) estimates that the quantity of food waste generated by households alone may reach 8745 tons per day or 3,192,404 tons annually [29]. The detailed breakdown shows that more than 38.32 percent of total garbage is produced by households, compared to restaurants, which produce 941,608 tons of garbage yearly, or 23.35 percent. Currently, only a few of the studies on waste measurement available at the national level have been focused on food waste. Both quantitative and qualitative research has been conducted on food-waste management in Malaysia, related to environmental consciousness [30], how psycho-social factors influence intention [31], green purchase behavior [32], household intention [33], food-waste separation intention [34], and zero-waste pro-environmental

behavior on a university campus [35]. However, there is still a lack of data on food expenditure, choices, and reuse of food-waste behavior.

This study aims to investigate the relationships between food expenditures, food choice, and waste reuse; and food-waste behavior. Food expenditures in this paper are characterized as the acquisition of food at supermarkets, and other food stores where the end-user is the customer. Waste reuse implies any activity by which items or products are not wasted, and are reutilized for a similar purpose to that for which they were designed. On the other hand, food choice is how individuals choose what to purchase and eat. An unpredictable arrangement of factors transferred from one individual to another, such as culture, legacy, and upbringing, impact one's food decisions. This study contributes to the findings in correlating people's food waste conduct with these discernments, as well as adding to the small volume of literature exploring food waste at the family-unit level in Malaysia's metropolitan region.

2. Hypothesis and Methods

2.1. Hypothesis Development and Framework

2.1.1. Relationship between Food Expenditure Behavior and Reducing Food Waste

Food waste is a multifaceted issue, with numerous variables. Food waste is defined as food that is qualified for safe consumption, but is discarded due to spoilage [36]. Food expenditure is one of the factors contributing to food waste. According to Abdel-radi [1], the amount of food waste at the consumer level in industrialized countries is equal to the total food production in sub-Saharan Africa, with over 40% of food waste occurring at household and retail levels. Another 60% comes from private households [37]. The amount of food waste in industrialized countries is 222 million tons, while the total food production in sub-Saharan Africa is 230 million tons. Furthermore, the combination of increasing social media usage, particularly during the pandemic [11,38–40], and new food-producer marketing patterns, may be resulting in further impulse-purchases of food products [41]. Due to the inability to shop normally, there has been a considerable increase in food expenditures made online, resulting in food waste. The food waste produced by households is the result of poor planning, and lack of discipline in routine spending [1]. A study conducted by Stefan et al. [42] shows that planning during shopping and the shopping routine is one of the contributing factors to food-waste behavior in Romania.

Ananda et al. [43] revealed that food-storage practices, leftover-cooking skills, dining-out behavior, grocery spending, and the frequency of grocery shopping are the main determinants of food waste at the household level. The study concludes that household food-waste reduction strategies should focus on routinized food-related behaviors and initiatives, to improve overall food-management skills, in order to reduce food waste effectively. Understanding purchasing behaviors, expenses for food purchases, and the attitudes toward waste by consumers, has become critical [36,44–46]. Previous studies indicate a vast portion of household respondents that plan and use a shopping list for their food purchases. According to previous studies (Bravi et al. [44], and van Herpen et al. [47]), purchase-planning has been shown to prevent overbuying, and is also associated with good housekeeping practices. Moreover, purchase-planning and using a shopping list led to responsible consumption [48–51]. Thus, the following hypothesis is followed:

H1. *The more the respondents are concerned about their food expenditures, the less food waste is produced.*

2.1.2. Relationship between Waste Reuse Behavior and Food Waste Behavior

Unused food is usually one of the major contributing factors to food-waste behavior. This is because the reuse of this food requires high flexibility in menu planning [37]. According to Porpino et al. [52], this is usually because individuals are psychologically opposed to the concept of pollution, or due to the tendency of individuals to exhibit to others that they can afford to consume fresh food. However, Stancu et al. [22], and

Stefan et al. [42] argued that the reuse of food waste is one of the important factors in reducing food waste. Thus, a research study has investigated strategies for recovering and reusing food at the consumer level (Quested et al. [53], and Leverenz et al. [54]). The study has revealed positive influences from several aspects, including good freezing practices and cooking skills. Thus, an assumption can be made that the reuse of food waste contributes to a reduction in food-waste levels (Stefan et al. [42], Bell et al. [55], Brook [56], Principato et al. [57]). The following hypothesis is thus followed:

H2. *The more concern the respondent has about waste-reuse behavior, the less food waste is to be expected.*

2.1.3. Relationship between Food-Choice Behavior and Reducing Food-Waste Behavior

Food waste is increasing due to overspending, which means that products expire before consumption [58]. In response, the United Nations has incorporated responsible consumption and production (Goal 12) into its Sustainable Development Goals (Aman et al. [59], Paulson et al. [60]). The goal is to cut current food waste in half by 2030. Therefore, previous studies have recommended several characteristics in choosing food to avoid food waste, as food choice is one of the major contributing factors to food waste. According to Aschemann-Witzel et al. [6], food choice is a selection of either normal or optimal products based on three characteristics. The first is based on the selection of a standard appearance, measured by weight, shape, or size. The second is based on the labeling of the date-of-use of the product, i.e., choosing a product that does not deviate from the best-by date. The third is based on the packaging of the food or the product, and relates to good packaging, or the surface still being good in canned food products, and choosing foods that do not deviate from quality or safety.

Quested et al. [53] found a significant link between food waste and other food issues, such as healthy-food selection and safe-food selection. According to Abdelradi [1], individuals who are concerned about healthy and safe food choices will produce more food waste. Iori et al. [61] reported that smart diets are associated with higher values of food waste in Canada, Spain, the UK, and the USA. Vegetarian diets are associated with lower food waste values in China, Germany, the UK, and the USA, but not in Italy, Russia, and Spain. The share of the population adopting a smart diet was 2.7% of the sample on average; therefore, interventions for food waste reduction should focus on these specific types of consumers, who are often associated with larger amounts of food waste. The following hypothesis is thus followed:

H3. *The more concern the respondent has about food choice, the more food waste will be produced.*

Based on our discussion of the literature review in the first part of the paper, we concluded that there are links between the independent variables of food expenditure, waste reuse, and food choice; and the dependent variable of food waste, as shown in Figure 1. It is hoped that the current study will strengthen the existing theory, and provide a greater understanding of the relationship between the tested variables. The relationship between food expenditures, food choice, and waste reuse is posited to food waste behavior within the Klang Valley area.

2.2. Quantitative Research

This study used a quantitative design that comprised the collection of primary and secondary data. Primary data collection is the method by which information is directly obtained and gathered from respondents through questionnaires. The secondary source refers to the research problems or situations that are present within the data that have previously been collected from others and compiled into one set of data [62].
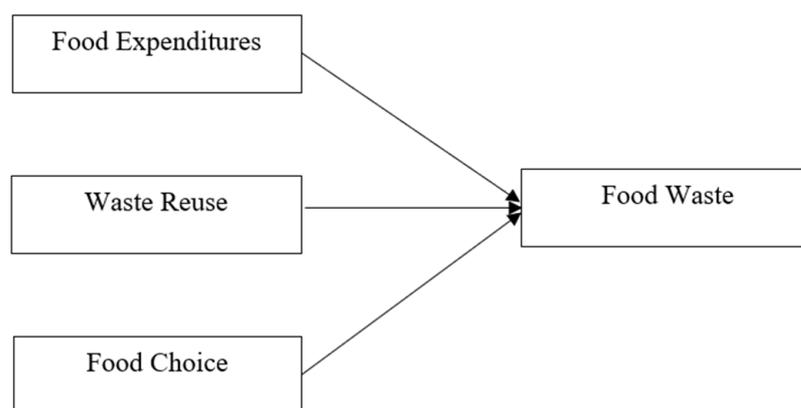
Figure 1. Proposed Food-Waste Framework.

The target population of this study comprises individuals aged 18 years and above in Klang Valley. Klang Valley was chosen because the area has a big population, estimated to be around 7 million people, who are living in its six districts and one Federal Territory. The six districts that represent the Klang Valley are areas within Selangor, Kuala Lumpur, and Putrajaya. Based on this population, the sample size was determined according to the method of sample-size determination as Krejcie et al. [63] recommended, in which at least 384 samples are used for a population exceeding 1 million. All constructs in this study were measured using the 5-point Likert scale, which ranges from (1) strongly disagree, to (5) strongly agree.

The questions in the survey for this study were adopted and adapted from previous studies related to the independent variables and dependent variables of this study. All questions were modified and selected to fulfill the aim of this research. The food-expenditure variable was measured by using 10 items in the present study which were adopted, adapted, and modified from the work of Abdelradi [1], Bravi et al. [44], and Visschers et al. [64]. The waste-reuse variable was measured by using 10 items from the work of Bravi et al. [44], and Bassi et al. [65]. In addition, the food choice variable was measured by using 10 items in this study which have been modified from the survey by Abdelradi [1], and Visschers et al. [64]. The variable of food waste was also measured using 10 items that were adopted, adapted, and modified from Bravi et al. [44], and Amirudin et al. [66].

The pilot study was conducted before the main study. This approach was designed to gain access to, and eliminate, any doubts about the instruments' reliability and validity. As a result, 20 questionnaires were delivered at random through personal visits, as suggested [67]. Then, the final research questionnaires comprised the suggestions obtained from the pilot study, and revisions to all the items where necessary. Out of the 431 questionnaires distributed, 404 were useful, while the remaining 27 were incomplete. However, the response rate was approximately 93.7% due to dissemination and personal receipt via convenience sampling techniques. Only members who were easily accessible to the researcher, with their consent given for data collection, were selected [68]. The data collected were then interpreted and analyzed using Statistical Package of Social Science (SPSS) version 26.0 and Smart Partial Least Square (SmartPLS) version 3.0.

3. Results

3.1. Demographic Profile of the Respondent Analysis

3.1.1. Descriptive Analysis

Table 1 displays the demographic profiling of the respondents. It shows that most respondents (52.7 percent) were female, while 47.3 percent were male. In terms of ethnic groups, the highest percentage group was Malay (40.1%), followed by Chinese at 33.2 percent, Indian at 8.3 percent, and others at 1.8 percent. The quota requirement for ethnicity was not fulfilled because the researcher could not completely control the enumerators while they were in the field. Consistent with the ethnicity analysis, Islam dominates with 42.8%,

followed by other religions. The respondents varied in age, ranging from 18 years old to over 65 years old. The smallest proportion of the respondents fell into the "More than 65 years old" age group. They accounted for 2.2 percent of the total respondents. This was followed by the "18–34 years old" age group (45.0 percent), the "35–49 years old" age group (43.3 percent), and the "50–64 years old" age group (9.4 percent). The highest education level for the respondents came from the "Degree" group (55%) followed by "Diploma" and "SPM/SVM", with 39 percent respectively. The remaining respondents were from the "Certificate" group (7.9 percent), "STPM" (5.2 percent), and "PMR" (4.2 percent).

Table 1. Participant Characteristics (N = 404).

Participant Characteristics	Sub Profile	Percentage
Gender	Male	52.7
	Female	47.3
Race	Malay	40.1
	Chinese	34.4
	Indian	25
	Iban	5
Religion	Islam	42.8
	Buddhism or Taoism	21.8
	Hinduism	18.1
	Christianity	17.3
Age	18–34	45
	35–49	43.3
	50–64	9.4
	More than 65	2.2
Highest Education	PMR	4.2
	SPM/SVM	13.9
	STPM	5.2
	Certificate	7.9
	Diploma	13.9
	Degree	55
Monthly Income	B40	32.7
	M40	42.3
	T20	25
Occupation	Employee	47.3
	Self-employed	24.8
	Unemployed, pensioner, housewife etc.	4.7
	Student	23.3
Marital Status	Single	42.3
	Married	57.7
Household	Less than and equal to 2 people	0
	3–5 people	60.9
	6–7 people	31.7
	8–9 people	5.2
	More than 9 people	2.2
Children	None	29.2
	1 child	27
	2 children	28
	3 or more children	15.8

In terms of monthly income, the researcher found that the majority came from the "M40" income group, with 42.3%, while another 32.7% represented the income group of "B40", and 25.0% were from the income earners of "T20". The occupations of the respon-

dents comprised four categories. About 47.3 percent were employees, while 24.8 percent were self-employed, and 23.3 percent were students. The remaining 4.7 percent were in the category of unemployed, pensioner, housewife, etc. With regard to the data provided, most respondents were married (57.7%), with household sizes ranging from three to five people (60.9%), six to seven people (31.7 percent), eight to nine people (5.2 percent), and more than nine people (2.2 percent). The household size "less than and equal to 2 people" has no recorded respondents, even though the respondents' household comprised a majority with no children (29.2). They are possibly staying with their own parents. The next minority of respondents' households is two children (28.0 percent), followed by one child (27.0 percent), and then three or more children (15.8 percent).

3.1.2. Demographic Aspect (Gender) Comparison of Food Waste

Table 2 shows the results of the independent sample *T*-test for demographic variable (gender) and dependent variable (food waste). With respect to the dependent variable (food waste), results show that it was significant (t = 2.113, p = 0.035). The male respondents appear to have a higher mean than the female respondents, indicating that males were more inclined toward food waste than their female counterparts.

Table 2. Independent Sample *T*-test—Demographic Variable (Gender) and Food Waste.

Variable	Gender (Mean)		t	Sig.
	Male	Female		
Food Waste	3.0912	2.8936	2.113	0.035

3.1.3. Instrument Reliability

The reliability of a measure shows the extent to which it is without bias, and hence ensures consistent measurement with the instrument across time and various items [69]. This study will measure the reliability of the instrument by using Cronbach's alpha value. Results show a decent unwavering quality, and each of the Cronbach alpha values for four constructs ranged from 0.947 to 0.975 above the suggested estimate of 0.70 [70]. Thus, this result further confirms that all constructs have satisfactorily fulfilled the criteria of reliability analysis, as shown in Table 3.

Table 3. Results of Reliability.

Variables	Number of Items	Cronbach Alpha Value
Food Expenditures	10	0.947
Waste Reuse	10	0.869
Food Choice	10	0.975
Food Waste	10	0.925

3.1.4. Convergent Validity

Table 4 shows that the relationship between items and constructs had loadings greater than 0.70 and values of indicator reliability (IR) greater than 0.5, as well as all constructs, which had values of average variance extracted (AVE) greater than 0.50 [70]. However, 12 items were deleted due to low loadings. The table below demonstrates that the constructs fulfilled the standard of convergent validity analysis.

Table 4. Results of Factor Loadings and AVE Analyses.

Construct	Food Expenditure	Food Choice	Waste Reuse	Food Waste	AVE
Food Expenditure					0.675
Price of food is very important to me at the time of purchase.	0.837				
For me, it is important that the food we consume is economic	0.791				
I compare price, quality, and quantity of food before buying.	0.867				
I always buy food that is on sale.	0.847				
I spend according to my desires especially when the offer season arrives.	0.762				
Waste Reuse					0.749
I store leftover condiments in the fridge for use in other dishes.		0.873			
I reuse water for agriculture.		0.828			
I am not sure about the safety level of water reuse.		0.895			
Food Choice					0.670
I realized the importance of eating foods rich in vitamins and proteins during the outbreak.			0.795		
I realize that low fat diet is important.			0.825		
For me, it is important that the food we consume contains no toxic ingredients.			0.834		
I am aware of food that contains substances such as dioxin, insecticides, residues are dangerous.			0.870		
I am concerned about food safety.			0.828		
I believe that the risk of becoming ill as a result of eating food past its use-by date is high.			0.786		
I always try to eat all purchased foods.			0.839		
I am not worried that eating leftovers results in health damage.			0.800		
I think that consuming leftovers is harmless.			0.786		
Food Waste					0.658
I noticed there was leftover food on the plate after I ate.				0.765	
I cooked more than needed.				0.800	
I kept the food and I ended up not eating it.				0.805	
At home there are products that have been opened such as canned foods, sauces and flour but have yet to be used.				0.774	
At home I have food that has expired.				0.802	
At my house there are ingredients that are spoiled and can no longer be used.				0.737	
I will not eat the food if I do not like it.				0.725	
The meal I cooked was not as successful as I would like for example. The cake was too mushy, the soup was too salty, and so on.				0.767	
I keep the package food outside the fridge.				0.732	
I noticed there was a waste of edible or inedible food like bone in my plate.				0.791	

3.1.5. Discriminant Validity

Table 5 displays that all constructs had heterotrait–monotrait ratio (HTMT) of correlation values lower than 0.90, while the values of the confidential interval shown in the parenthesis were lower than 1.0 [70], signifying that the constructs fulfilled the criteria of discriminant validity analysis. Thus, the values of composite reliability for all constructs were higher than 0.80, signifying that the constructs had high internal consistency [71].

Table 5. Results of Discriminant Validity and Composite Reliability Analyses.

Construct	Heterotrait–Monotrait Ratio of Correlation				Construct Reliability
	Food Expenditure	Waste Reuse	Food Choice	Food Waste	
Food Expenditure		0.511	0.550	0.525	0.912
Waste Reuse			0.479	0.646	0.900
Food Choice				0.239	0.948
Food Waste					0.951

3.1.6. Hypotheses Testing

Table 6 shows that food expenditure contributed 33.9% of the variance in food waste, and waste reuse contributed 0.487% of the variance in food waste, which was larger than 0.26 [72], demonstrating that the direct-effects model has a substantial effect. Further outcomes of testing the research hypotheses showed two essential findings: first, the more the respondents are concerned about their food expenditures, the less food waste is produced ($\beta = 0.348$; t = 5.568). Thus, H_1 is supported. Second, the more positive the respondent is about waste-reuse behavior, the less food waste is to be expected ($\beta = 0.483$; t = 8.090). Thus, H_2 is supported. This demonstrates that food expenditure and waste reuse act as essential determinants of food waste. However, H_3 is not supported. This hypothesis is rejected in this study, due to the behavior itself providing comfort and predictability to the respondents.

Table 6. The Outcomes of Testing Hypotheses 1, 2, and 3.

Hypotheses	Beta Value	t-Value	R^2	Decision
H1. The more the respondents are concerned about their food expenditures, the less food waste is produced.	0.348	5.568	0.339	Substantial effect
H2. The more concern the respondent has about waste-reuse behavior, the less food waste is to be expected.	0.483	8.090	0.487	Substantial effect
H3. The more concern the respondent has about food choice, the more food waste will be produced.	0.139	2.707	0.142	Rejected

4. Discussion

The consumers' behavior toward food waste was also found to differ according to gender, age, and income. The motivation to reduce food waste contrasts with earlier research about actual or self-reported consumer behavior around food waste. For instance, whereas a study found that women were more prone to reduce food waste than men, some studies have found that female respondents were more likely to report generating food waste (Visschers et al. [64], Vasko et al. [73]), whereas other studies have found that men waste more than women [74,75]. The present research findings indicate that male respondents were prone to food waste compared to female respondents.

This study examined the relationships between the dependent variable (food waste) and the independent variables (food expenditures, waste reuse, and food choice). The relationships between the dependent variable and independent variables are shown in Hypotheses 1 to 3. The results of the coefficient analysis have shown that two of the three hypotheses are accepted. Based on the results of Hypothesis 1, the relationship between food waste and food expenditures is confirmed. A positive relationship indicates that those who are more concerned about food expenditures will produce less food waste. The result of Hypothesis 1 confirms the previous study, that food waste occurs because of poor planning and discipline in buying household necessities [1]. This indicates that food expenditures can lead to food waste. As mentioned earlier, after the emergence of a coronavirus disease (2019-nCoV) in December 2019, the whole world entered a state of chaos (Aqeel et al. [76]; Nejhaddadgar et al. [77]), and this changed consumers' behavior in

their purchasing and eating habits. They spent more than usual during the lockdown [76], due to the fear, anxiety, and stress of being infected when going outside of the home [78], and panic-buying without proper planning, which causes bulk-buying. If consumers tend to buy household items without planning, they may spend more than they need. When consumers buy more than what they need, this will lead to food-waste behavior. Having a planning routine, such as prior meal planning and inventory checks, may help households to reduce food waste, by reducing the possibility of inventory underestimation, and the purchase of leftover stock, as well as contributing to improved reuse routines (Stancu et al. [22], Visschers et al. [64]).

Hypothesis 2 is tested for the relationship between waste reuse and food waste. The result for H$_2$ has shown that the more positive the respondents are about reuse behavior, the less food waste behavior is to be expected. Initiatives to improve waste reuse (e.g., leftover reuse) patterns may have the greatest impact on food waste, even though food expenditures have a large potential. The result was supported by the previous study, that suggested that waste reuse such as freezing methods and cooking skills can reduce food-waste behavior (Stancu et al. [22], Leverenz et al. [54]). Furthermore, there could be a focus on improving subpar culinary abilities that may result in food waste (food burned during cooking), avoiding preparing more food than is necessary, and enhancing one's capacity to transform leftovers into good new meals (e.g., leftover rice transform into fried rice).

Hypothesis 3 is not supported, which hypothesized that the more concerned the respondents are about food choice, the more food waste will be produced. Food choice and eating preferences are tied to the moral and health elements of eating, and influence subsequent food-purchasing decisions [79]. Those who promote healthy eating may reduce food waste, but they are also among the causes of increased food waste and throw away more food when more criteria are used to differentiate between edible and non-edible food [66]. Therefore, negative impact exists on food choices about food waste. The previous study also stated that food choice does not affect food waste, as the behavior itself provides comfort and predictability toward the respondents' psychological reflection on what they are buying or eating [22]. This indicates that when a respondent has a high awareness of household food choices, they can decide what they want, which may reduce the potential for food-waste behavior to occur.

5. Limitations

Some limitations to our study should be highlighted, such as the fact that our results are based on households in the Klang Valley area only. Thus, future studies could use this study as a source, but cover a larger area, such as the whole of Malaysia. This will allow us to improve, and to obtain more accurate data. Future studies could also compare food-waste behaviors in two different countries (i.e., Malaysia and Singapore), which have different economic and cultural backgrounds. The present study may also be limited in terms of the theory, which only focused on direct relationships. Behavior, in the context of food waste, is dynamic, and its drivers can shift. Consequently, future research should include food expenditures, waste reuse, and food choices, to gain a better knowledge of food waste. Future studies could replicate this study by adding mediating variables (i.e., technology innovations), or add further challenge by adding moderating variables (i.e., income) that may further enhance findings.

Because this study was entirely quantitative in nature, certain constraints surrounding survey-based data collection were in place; therefore, additional research should be conducted using alternative methodological techniques, such as mixed-methodology and qualitative approaches. Although this research was conducted during the pandemic, future studies focusing on food-waste-avoidance behavior will be beneficial. As society adapts to COVID-19, sustainable consumption could be corrected and adjusted to a new norm, and the long-term impact could play a major role among consumers.

6. Conclusions and Recommendations

This study aimed to validate the framework based on the literature on food-waste research. The outcomes of the measurement scales in this research convincingly fulfilled the standards of reliability of the analysis. In two out of three of the hypotheses presented, the independent variables displayed a positive relationship with the dependent variables, which may lead to the sustenance and validation of the FAO's objective to decrease the volume of food waste and to avoid future starvation. However, one of the three hypotheses was not accepted, because respondents showed a negative behavior in food choices about food waste. Overall, this study achieved most of its objectives, which were the critical factors proposed in this research.

This study is important for us to further understand how food waste could be affected by two factors: food expenditures, and waste reuse. To achieve the goal of reducing global food waste, special attention needs to be paid to individual households. Thus, this study can educate Malaysian households on how to control their expenditure, and raise awareness about waste reuse for minimizing food waste, which can improve their quality of life. Although this study was limited to households, it can still be useful to marketers. Practicing socially responsible marketing by considering what is best for society and a sustainable future, rather than carelessly pushing the excessive purchase of items that will ultimately be wasted, is critical for marketers. Thus, this study can urge marketers to be more creative in developing consumer-targeting strategies, such as portraying their brands as purpose-driven in their efforts to combat food waste.

Proper food-expenditure management can reduce food waste, based on the present findings. Thus, policymakers can use the results to build awareness and improve current policy regarding individual responsibility in food-waste management in Malaysia in the future. For instance, various media and public-awareness efforts should relate the negative outcomes or repercussions of wasteful conduct, in order to raise consumer knowledge of the damaging implications of excessive food expenditure, and the importance of waste reuse. Fostering a sense of community among community members motivates consumers to contribute toward decreasing food waste. Thus, the views of governments can exert a powerful impact on home consumers to engage in better food management. Social media platforms such as Facebook, Instagram, and YouTube can also be used to promote the views of governments and other influencers in encouraging food-waste-reduction behaviors.

This study revealed the importance of an individual understanding and planning his food-shopping behavior, and how this could have further benefits besides reducing the number of people that face starvation. The results of the current study show that male respondents wasted more food than their female counterparts. This is possibly due to the limited involvement of males in groceries shopping and food preparation, compared to their counterparts. Previous research conducted by Muhammad Najib and Majid [80] in Malaysia showed that the income of female workers, on average, is lower than that of male workers. Therefore, there is a high possibility that males have a lower involvement in grocery shopping due to their work commitments. In this sense, we recommend that an in-depth study on gender involvement in food waste in Malaysia's context should be explored in the future.

Food waste has been a serious problem for certain private organizations such as the FAO of the UN, as they are concerned about the number of people facing starvation, which has increased exponentially. The information which can be derived from this investigation may also educate society on the disastrous effects of food waste on our environment. Thus, suitable actions or policies can be taken and formulated to combat the problem of food waste. Furthermore, food waste is not limited to consumers when they throw food items away. The rejected items, which comprise food products from farmers or suppliers as well, also contribute to the mass production of food waste in landfills. Indirectly, the value chain effect of food waste may involve consumers to public authorities in handling the waste before it is classified as food waste in landfills. The handling of food-waste management

can follow green and lean practices for solid waste management, which have been proven by many researchers to be able to reduce waste efficiently and effectively [81].

A circular economy in the food supply chain means reducing the amount of waste generated in the food system, reuse of food, utilization of by-products and food waste, nutrient recycling, and changes in diet toward more diverse and more efficient food patterns. Alongside this, the government should take more strategic action in food security, when food loss and waste have risen by 30–40% over the last 10 years [82]. The authors would recommend the recent approach of circular economy through waste-to-energy (WtE) generation, which is focusing on cleaner technology [83,84]. Possible alternatives are available, including anaerobic digestion (Pramanik et al. [85]), gasification, incineration (Zamli et al. [86]), and landfill gas (LFG) recovery waste.

This study's results significantly contribute to the United Nations Sustainable Development Goals (SDGs) that are part of the UN's 2030 agenda and plan of action for sustainable development (Aman et al. [59], Paulson et al. [60]), which aims to influence responsible consumption and production. With an emphasis on responsible resource usage, production, and consumption, including waste management, the SDGs play a crucial role in Malaysia, to be achieved by 2030. The government may consider the WtE generation, in this case, to fulfill the goal. The government can also integrate the Internet-of-Things (IoT) tools for monitoring waste management at all levels, improving productivity, and providing economic solutions [87].

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