Food Waste and Disposal Behaviour among University Students

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Abstract

Food waste is a crucial and persistent issue globally. The household food waste phenomenon in Malaysia has emerged as increasingly serious with the rapid rise in its generation by domestic households. This study explored youth behaviour toward food waste and its disposal behaviour among the university students of Faculty Business and Management, Universiti Teknologi MARA, Puncak Alam Campus. Factor analysis was applied to identify the underlying factors of food waste and disposal behaviour, while the independent t-test served to examine gender differences regarding the factors. In particular, Pearson's Chi-square Test of Independence was applied to examine the association between gender and food waste, food planning, and food recycling behaviors. To this end, a self-administrated questionnaire was used to collect data based on the convenience sampling method in which a sample size of 111 respondents were engaged with. Factor analysis successfully identified three factors as a result, namely food disposal, knowledge of food waste, and involvement in preventing food waste. The independent t-test also revealed significant gender differences among the students on food disposal behavior, whereas no significant gender differences were found with the factors of knowledge of food waste and involvement in preventing food waste. Additionally, there was no association between gender and food recycling, food planning, and food waster behaviours, respectively. As such, these findings can increase student participation and commitment to reducing food waste as it is fast becoming an issue for all.

Keywords: Food Waste, Food Disposal

1. Introduction

Food is an essential need for humans. In contrast, the food wasting issue is not an uncommon phenomenon in which it is an emerging problem faced by many countries worldwide. Unfortunately, some people are going through the scarcity of food, while others have too much of it for their consumption. Food waste refers to items that are fit for human consumption but are thrown away (Lipinski, Hanson, Lomax, Kitinoja, Waite & Searchinger, 2013). This is an extensive problem globally as it involves great financial, ethical, and environmental costs.

The global food waste amount is increasing with millions of wasted food being dumped daily in unsanitary landfills. The impacts of food waste include greenhouse gases (GHG) emissions and climate change, water footprint, nutrient loss, sanitation issues, ecological after-affects, and economic by-products. In particular, the issue of GHG generation and emission such as carbon dioxide (CO_2), methane (CN_4), and nitrous oxide (N_2O) has received much attention from various parties in the society as a result of food waste problem due to it contributing hugely to climate

change and global warming. For example, the United Nations Food and Agriculture Organization (FAO) has reported that global food wasted throughout the supply chain contributes 8% of total GHG emissions globally. Many may not realize that not only the food waste dumped in landfills release GHG; any leftover food kept in the refrigerator before being thrown or discarded also generates this as it is produced and emitted throughout food production until refrigerator safekeeping (Frischmann, 2018). Furthermore, growing concerns have been underlined on the economic and environmental feasibility of the current food waste disposal systems, as well as the consideration toward food waste as a resource input in agriculture (Jereme, Abdul Talib, Siwar, & Begum, 2013).

To this end, the Boston Consulting Group (BCG) has reported that the magnitude of global concerns regarding the food waste issue is incoherent and insufficient, whereby the problem is increasing at a worrying level. About 1.6 billion tonnes of food is wasted every year, which is approximately one-third of the food amount produced globally. Food waste occurs over the different stages of supply chain ranging from the primary stage of agricultural production to the final stage of consumer consumption. The waste is mostly seen in the consumption stage across medium- and high-income countries alike (Jereme et al., 2013).

Furthermore, food waste is a critical problem in Malaysia as public awareness of the issue is still relatively low even though the population's cognizance awareness has increased over time. However, perception of food waste disposal and treatment remains low among Malaysian households (Jaswa, 2017). The domestic households are the largest contributor to food waste in Malaysia by wasting around 17,000 tonnes of food every day, whereby food waste quantity increases by 15–20% during festive season (e.g. Ramadhan). Besides, about 50% of solid waste in local landfills consists of food waste, while the remaining percentage comprises of other wastes such as plastic, paper, etc. Accordingly, disposal of food waste at these unsanitary landfill sites is the largest contributor to GHG emission was reported by Ministry of Housing and Local Government Malaysia in year 2015. According to the Institute of Islamic Understanding Malaysia (IKIM), households are the major food waste contributor at 38% compared to wet markets (24%), restaurants (23%), and hotels (7%). Practically, a family of four members can generate and dispose of about 1kg of food waste daily ("Household generate the largest amount", 2019). Additionally, Malaysian households are typically not aware that food waste is recyclable and can be utilized as a resource in the production process.

Indeed, food waste is a problem resulting in various environmental impacts and economic externalities. Therefore, this study is aimed at exploring the socio-demographic characteristics of gender differences in food waste and disposal behaviour at the consumer level among university students. Understanding these food consumption disposal behaviours are important to reduce the food waste amount in Malaysia. To this end, the first section provides an overview of the food waste issue in Malaysia, whereas the second section then presents a review of previous studies on the topic. Following this, the third section details the research methodology carried out in this study, while the results and discussion are presented in the fourth section. The final section underlines the conclusion of the study concisely.

2. Literature Review

Food Waste Management

A study carried out by the National Solid Waste Management Department (2012) has reported that food waste is the most prevalent type of waste produced in Malaysia, with its households generating about half of the total amount. A majority of the public is not conscious of the quantity of food they discard (Jarjusey, 2017). Moreover, Lim, Chin, Yusof, Yahya, and Tee (2016) have asserted that waste management and policy for food waste treatment are deliberately inefficient in this country due to insufficient fund allocation for the cause.

Regardless, the Food Waste Management Development Plan for Industry, Commercial, and Institution Sector (2016–2026) has been developed to manage food waste efficiently and effectively. Its objectives include to provide specific strategies toward effective food waste management in every stage spanning from waste generation to waste disposal and to achieve a 40% reduction in carbon emission by 2020, which is in line with the National Solid Waste Management Policy in year 2006. Such policy emphasizes on comprehensive, cost-effective, and sustainable conservation of public health and the waste hierarchy via 3R (reduce, reuse and recycle). However, food waste management in the household perspective has not been included in the development plan.

Disposal practices such as recycling and composting food waste often motivate people to prevent themselves from generating more food waste (Cecere et al., 2014; Tucker & Farrelly, 2016). According to Gaiani, Caldeira, Adorno, Segrè, and Vittuari (2018), a majority (90%) of the Swedish population is concerned about food waste issues and 78% is worried about the food waste problems. They are conscious about food wastes but not firmly behaving favorably on food waste problems. In particular, the most common method to dispose of food waste among the Swedish is by throwing the wastes into the bin (59.4%), followed by treating as animal feed (30.5%), and composting (28.8%).

Moreover, Jereme, Siwar, Ara Begum, and Abdul Talib (2016) have claimed that a persistent and improper food waste disposal behaviour is present among Malaysians in which it is found that consumers typically fail to relate food waste with environmental problems. However, the implementation of strict regulations in South Korea on food waste recycling and the expansion of food waste-to-energy facilities efficiently increased its recycling rate from 45.1% in 2002 to 81.3% in 2004 (Low & Aw, 2010). Similar efforts on recovering food waste are negligible in Malaysia, however (Jereme et al., 2013). Therefore, a sufficient food waste disposal behaviour is contributory toward good food waste management practices.

Knowledge of Food Waste Management

Zero environmental consciousness among households toward food wastage leads to considerable food waste generation (Jereme et al., 2016). Sufficient and sound environmental knowledge is crucial and effective to lower food waste generation as consumers will have a better understanding of its negative impacts on the environment (Gökdere, 2005). Richter (2017), in particular, has

found that the knowledge and perception of food waste among German consumers are significantly associated with food waste management behaviour.

Using the logistic regression model, Jereme et al. (2016) have found that environmental knowledge on food waste has a significant influence on food waste reduction among Malaysian households. Similar to this, Cox, Giorgi, Sharp, Strange, Wilson and Blakey (2010) have asserted that establishing the awareness and understanding among households regarding food waste impacts on the environment can effectively change consumer's behaviour toward ensuring sustainable food waste disposal behaviour.

Involvement in Preventing Food Waste

Typically, consumer awareness of food waste issues may encourage their stance to minimize the food waste amount (Abd Razak, 2017). Campaigns and enlightenment programs creating awareness about food waste recycling are deemed effective in reducing the projected waste up to 50kg per day (MPSJ, 2009). Furthermore, the public found to react positively toward food waste issues are seemingly changing their behaviour by involving in food waste prevention as facilitated by food waste reduction campaigns (Abd Razak, 2017). In fact, Renn, Webler, and Wiedemann (1995) have argued that public involvement is important to support government efforts in implementing a certain policy. Therefore, O'Faircheallaigh (2010) has also proposed that public involvement improves the quality of engagement and contributes to the success of policy implementation.

In contrast, no consensus has been reached with regard to empirical findings on gender behaviour and attitudes toward food waste. Some studies have found that women are less likely to waste food than men (Barr, 2007; Secondi, Principto, & Laureti, 2015; Visschers, Wickli, & Siegrist et al., 2016). Conversely, other works have yielded contradictory results in which single women produce more food waste compared to single men (Silvennoinen, Katajajuuri, & Hartikainen., 2014; Koivupuro Hartikainen, Silvennoinen, Katajauuri, Heikintalo, Reinikainen, & Jalkanen, 2012). Meanwhile, Principato, secondi, and Pratesi (2015) have revealed that the amount of food waste generated by young females is the same as a young male.

Women are typically accountable for grocery shopping (McCarthy & Liu, 2017) and meal preparation for the family (Koivupuro et al., 2012). Following this, Koivupuro et al., (2012) and Silvennoinen et al. (2014) have found that families with women or having both men and women being in charge of grocery buying tend to generate more food wastes than those with men in charge of the task. This is due to women typically carrying out the responsibility of preparing food for the family. Some studies have revealed that they tend to feel guilty about food waste (Lyndhurst, 2007), whereas Qi and Roem (2016) also noted women to be more likely to feel guilty toward their actions when throwing away food into the trash.

Meanwhile, findings on gender-based attitude and behaviour on food recycling are mixed when looking at past studies. For example, Cappellini and Parsons (2012) have found that women are more intended to thrift and recycle food leftovers, while Lee and Paik (2015) indicate that gender does not influence the food separation tendencies of recycling behaviour. Besides, Graham–Rowe, Jessop, and Sparks (2015) have yielded findings revealing that women show a higher concern for

reducing the number of fruits and vegetables wasted by their families. However, Cantaragiu (2019) has found no significant difference between young males and females in the context of food waste amount generated. Additionally, the findings yield no difference in perception toward food waste for young adults aged below 20 years, while women in the age range between 20- to 30-years old tend to feel guiltier than men of the same age range when wasting food.

3. Methodology

The study was conducted among university students hailing from the Faculty of Business Management, Universiti Teknologi MARA, Puncak Alam Campus to explore their food waste management and disposal behaviour. A sample size of 111 respondents was engaged and their questionnaire responses were collected accordingly.

Data were collected via online and self-administered questions with a measurement of 5-point Likert scale (5-point measures strongly agree and 1-point measures strongly disagree). Collection was done using the non-probability convenience sampling method and the administered questionnaire comprised of socio-demographic information and questions regarding respondent attitude and behaviour with food waste and food disposal.

This study investigated whether statistical differences of gender and socio-demographic factors were present on food waste management and disposal for the constructs of food disposal behaviour, knowledge of food waste, and involvement in preventing food waste. Therefore, the statistical analysis methods applied included the exploratory factor analysis (EFA), independent t-test, and Pearson's Chi-square test of independence. EFA is a multivariate analysis geared to reduce measured items based on the number of basic factors in order to group numerous variables. Meanwhile, inferential statistics of independent t-test and Chi-square test were applied to assess the significance of variables employed in the study. In particular, Pearson's Chi-Square test for independence was used to examine the association linking gender with food planning and food recycling behaviour among students. To this end, SPSS version 25 was utilized for all tests conducted on the variables and hypotheses designed in the study.

4. Analysis and Findings

In total, 111 students from the Faculty of Business and Management successfully participated in this study. A demographic analysis of the sample size is shown in Table 1. Collectively, 29 male (26.1%) and 82 female (73.9%) students were involved in the survey of age ranges spanning from 20 to 24 years, with a majority of them were staying on-campus (66.7%). Furthermore, more than half (53.2%) of the respondents spent around RM51–RM199 per month on food, while the remaining 37.8% spent less than RM50 and only 9% spent more than RM200 per month on food.

Table 1: Demographic Analysis

Item	Frequency	Percentage
Gender:		
Male	29	26.1
Female	82	73.9
Age:		
20 years old	21	19.2
21 years old	14	11.9
22 years old	56	51.8
23 years old	16	14.0
24 years old	4	3.1
Stay:		
On-campus	74	66.7
Off-campus	37	33.3
Monthly food budget:		
Less than RM50	42	37.8
RM51–RM199	59	53.2
RM200 and above	10	9.0

Five questions were included in the questionnaire used to assess the students' behavior in managing food waste. The results are presented in Table 2.

Table 2: Behavior toward food waste management

Item	Male		Female		Total	
	Frequency	%	Frequency	%	Frequency	%
Food waste behavior						
Have you ever wasted your food?						
I never waste food	8	27.6	19	23.3	27	24.3
I rarely waste food	20	69.0	59	72.0	79	71.2
I usually waste food	1	3.40	4	4.9	5	4.5
How much food do you waste in a day?						
Very little amount						
Small portion/amount	23	79.3	60	73.2	28	25.2
A large amount	6	20.7	22	26.8	83	74.8
	0	0.0	0	0.0	0	0
Food recycling						
How much food waste do you recycle?						
None	18	62.1	45	54.9	63	56.8
Some	8	27.6	29	35.4	37	33.3
All or most	3	10.3	8	9.8	11	9.9
Managing food waste						
How do you manage your leftover food?						
I keep them in the refrigerator before discarding.	9	31.0	12	14.9	21	18.9
I separate the liquid and solid food wastes before discarding.	11	37.9	31	37.8	42	37.8
I do not separate food waste before discarding.	9	31.0	39	47.6	48	43.2
Food planning						
I do planning for my food preparation/ purchasing.						
No	8	27.6	17	20.7	42	37.8
Rarely	12	41.4	33	40.2	39	35.1
Yes	9	31.0	32	39.0	30	27.0

In the context of food waste, most of the students would rarely waste their food (71.2%), while almost three-fourth of them would waste a small portion of food daily. Moreover, more than half of the students did not recycle their food, which might be due to the lack of facilities to do so as

most were staying on-campus and thus their intention to recycle food was limited. Meanwhile, 43.2% of the students did not separate their food waste before discarding, while 38% would separate the liquid and solid food wastes before discarding, which was probably upon the request and following the rules stated by the university cafeteria. Additionally, a majority (73%) of the students did not or rarely plan their food preparation and purchasing decisions.

Regarding food planning, EFA was conducted on all 15 questions regarding food waste management and disposal behaviour as answered by 111 respondents in order to determine the latent variables. Factor analysis by using Principal Component Analysis (PCA) with a Varimax (Orthogonal) Rotated Component Matrix was applied to yield the factor component. The results of the orthogonal factor analysis rotation are shown in Table 3. The analysis produced three construct matrixes with factor loadings more than 0.40 (Comrey & Lee, 1992) containing items regarding managing and behaviour with food and food waste, which were food disposal behaviour, knowledge on food waste, and involvement to prevent food waste.

Table 3: Explanatory Factor Analysis

Items	**M**	**SD**	**Component**		
			1	**2**	**3**
Food Disposal Behaviour					
I manage my food disposal activity once a week.	3.414	1.198	0.767		
I am in charge to dispose of garbage at home.	3.460	0.961	0.724		
I always prepare the right portion of food for my meal.	3.883	0.839	0.690		
I always buy the exact amount of food I need.	3.802	0.840	0.633		
I have a container in my house to collect garbage.	4.243	0.823	0.615		
I often leave food on my plate.	1.891	0.985	0.490		
I always separate food waste and non-food waste before throwing it into the bin.	2.982	1.198	0.482		
I often throw my leftover food in the bin.	3.964	0.904	0.458		
Knowledge of Food Waste					
There are many people hungry in the world.	3.252	1.167		0.819	
Food waste is the main cause of issues related to landfills.	3.423	1.066		0.755	
Food waste is associated with a large emission of greenhouse gases.	3.469	1.190		0.752	
Excess greenhouse gases are causing global warming and climate change.	3.955	1.107		0.508	
Malaysian households throw away much food every year.	3.676	1.207		0.508	
Involvement in Preventing Food Waste					
I always plan ahead for my meals.	3.550	1.025			0.687
I often plan what to eat.	3.171	1.143			0.564
I always make a shopping list when I buy food products.	3.604	1.064			0.470
I always check food storage and refrigerator before shopping for food products.	3.757	1.011			0.465
% of variance			24.196	13.293	7.947
Total of Eigenvalues			4.113	2.260	1.351
Cronbach's Alpha			0635	0.717	0.621

Next, Bartlett's Test of Sphericity was significant ($p<0.000$) and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (KMO = 0.746) supported the factorability of the correlation matrix

(Tabachnik & Fidell, 2007). The EFA analysis revealed that all three constructs had eigenvalues exceeding 1, thereby explaining 24.196%, 13.293%, and 7.947% of the variance for the constructs of food disposal behaviour, knowledge on food waste, and involvement in preventing food waste.

As shown in Table 3, the rotated factor matrix of the items for all three factors loads significantly, with factor loading values of at least 0.4. Factor 1 (i.e., food waste disposal behavior) comprised of eight items, with factor loadings ranging from 0.767 to 0.458 and an eigenvalue of 4.113. Meanwhile, five items were included in Factor 2 (i.e., knowledge on food waste), with factor loadings ranging from 0.819 to 0.508 and an eigenvalue of 2.260. Finally, Factor 3 (i.e., involvement in preventing food waste) contained four items with factor loadings ranging from 0.687 to 0.465 and an eigenvalue of 1.351.

In general, the value of Cronbach's Alpha is recommended to be > 0.7 (Nunally, 1978). Here, the values for the three constructs of food disposal behaviour, knowledge of food waste, and involvement in preventing food waste were 00.635, 0.717, and 0.621, respectively. Despite the smaller Cronbach's Alpha value for the constructs of food disposal behaviour and involvement in preventing food waste, they might influence food waste behavior regardless (Richter, 2017).

This study investigated the social-demographic differences of gender and the constructs of food disposal behaviour, knowledge of food waste, and involvement in preventing food waste. Accordingly, normality of data distribution was assessed using the Kolmogorov-Smirnov test, whereby the data significantly deviated from the normal distribution ($p<0.05$). Since the assumption of normality was not met, bootstrapping independent t-test with a 95% bias corrected confidence interval based on 1000 replications was applied for the robustness of the sample. Table 4 presents the results of the bootstrapped independent t-test on gender differences.

Table 4: Gender differences in the constructs of food waste management and disposal behavior

Construct	**Male**	**Female**	**Statistical Comparison**		**BCa 95% CI**
			t-test(df)	**p-value**	
Food disposal behavior	3.608 (0.393)	3.401 (0.544)	2.187 (67.906)	0.032	0.021, 0.369
Knowledge on food waste	3.331 (0.871)	3.634 (0.749)	-1.794 (109)	0.076	-0.665, 0.049
Involvement in preventing food waste	3.566 (0.863)	3.534 (0.608)	-0.427 (38.288)	0.672	-0462, 0.310

Next, the Levene's test was found to be significant for the constructs of food disposal behaviour ($F=4.269$, $p<0.05$) and involvement in preventing food waste ($F=4.259$, $p<0.05$), thereby indicating that the female and male genders were not of equal variance. Conducting the test for the construct of knowledge on food waste ($F=1.423$, $p>0.05$) yielded an outcome that was not significant, suggesting that the female and male genders were of equal variance.

Furthermore, a significant difference was found between the female and male genders for the construct of food disposal behavior, $t(67.906) = 2.187$, $p<0.05$, $r = 0.257$ (M Difference = 0.207, BCa 95% CI [0.021, 0.369]). The bootstrap confidence interval also confirmed the analysis result. This study found that male students tended to be more responsible for food disposal behaviour compared to female students ($M_{male}=3.608$, $M_{female}=3.401$, $p<0.05$). This might be due to male students displaying better behavior toward food waste by producing less food; in this study, more male students (79.3%) wasted a little amount of food than the female students (73.17%). This supports the findings by different studies stating that single women produce more food waste than

single men (Silvennoinen et al., 2014; Koivupuro et al., 2012; Principato, secondi, & Pratesi, 2015). Meanwhile, this study found no significant difference between the female and male genders on the constructs of knowledge on food waste, $t(109) = -1.796$, $p<0.05$, $r = 0.170$ (M Difference= -0.303, BCa 95% CI -0.665, 0.049]) and involvement in preventing food waste $t(38.288) = -0.427$, $p<0.05$, $r = 0.069$ (M Difference= -0.074, BCa 95% CI [-0462, 0.310]). The insignificance outcome between gender and involvement in preventing food waste confirms Cantaragiu's (2019) findings, which have noted no significant difference between young Romanian males and females in the context of food waste amount generated as they are not actively involved in reducing the food waste. Additionally, the size effect for food disposal behaviour was considered medium and small for the components of knowledge on food waste and involvement in preventing food waste, respectively.

Pearson's Chi-square test of independence was carried out to determine the association between gender and food waste management behavior, specifically food planning and food recycling. The results are presented in Table 5.

Table 5: Pearson's Chi-square test of independence

	Chi-Square Test of Independence		
	Food Planning	**Food Recycling**	**Food Waste**
Gender	$\chi^2 = 0.824$ $p > 0.05$ Phi = 0.086	$\chi^2 = 0.592$ $p > 0.05$ Phi = 0.073	$\chi^2 = 0.296$ $p > 0.05$ Phi = 0.052

The Chi-square test revealed no significant association between gender and food recycling ($\chi^2(2) = 0.592$), $p > 0.05$, *Phi* = 0.073) and with food planning ($\chi^2(2) = 0.824$), $p > 0.05$, *Phi* = 0.086) accordingly. These outcomes are consistent with Lee and Paik's (2015) findings, whereby gender does not influence the food separation behavior or recycling behaviour as no significant difference is present between female and male students' involvement in preventing food waste in the study. Moreover, the test yielded no significant association between gender and food waste as well ($\chi^2(2) = 0.296$), $p > 0.05$, *Phi* = 0.052).The effect size of the association between gender and food planning, food recycling, and food waste was small, following Cohen's (1988) criteria of 0.10, 0.30, and 0.50 for a small, medium, and large effect, respectively.

5. Conclusion

Three constructs of food waste and disposal behavior were identified in the current study, namely food waste disposal behaviour, knowledge of food waste, and involvement in preventing food waste. It also determined the socio-demographic characteristics of gender differences on these three constructs among the students of the Faculty of Business Management, UiTM Puncak Alam Campus. Out of the three constructs, this study found that only the waste disposal behaviour differed between the female and male students, whereas no difference was noted in the constructs of knowledge on food waste and involvement in preventing food waste. Furthermore, this study revealed no significant association between gender and food planning, food recycling, and food waste behaviors among students. Therefore, these findings show that there is no significant impact of gender on food waste and disposal behaviour, rendering food waste a crucial issue for all. Development and enhancement of public awareness and engagement toward food waste problems can thus be promoted further through educational programs and awareness campaigns.

Additionally, involvement and knowledge of food waste and food disposal behaviour are crucial aspects of the issue, requiring a proper food disposal behaviour on food waste separation, which can be enhanced more through regulatory enforcement.

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