# Addressing the problems of food waste generation in Malaysia

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A B S T R A C T

The main objective of this study is to investigate the impacts of government food waste policy on household food waste disposal and household's knowledge of environmental effects of food waste could be a panacea towards food waste reduction in Malaysia. The study was conducted in Selangor and Terengganu applying purposive random sampling with 333 respondents representing same number of households. 257 were from Selangor and 76 from Terengganu. The primary data was collected through structured questionnaire and was analyzed by descriptive statistics and logistics regression model. Findings has shown in percent Selangor, 41.6 respondents or households gives out their edible food waste to neighbours, while Terengganu had 63.2 percent who gives their edible food waste to neighbours rather than disposed it into the waste bins. The most frequent food waste by Selangor respondents were rice and fruits at 19.1 and 36 percent receptively. While Terengganu had 9 and 26 percent that frequently waste same composition of food waste. Knowledge of environmental effects of food waste on cost of waste management, its impacts to increase energy consumption, government policy on household food waste management and government creating awareness of the impact of food waste to the environment were significantly related to influence household's to reduce food waste.

## 1. Introduction

Malaysia is blessed with abundant food surplus which brought about 30 percent of Malaysians been obsessed according to reports (Jegathesan, 2014).This evident is made clear that the first thing a Malaysian will ask a friend is "sudah makan" meaning have you eaten, which shows how food is embedded in everyday life activities in the society. Twenty four hour (24 Jam) restaurants are located every nook and corner; you don't have to walk far distance before getting delicious food served to you at nearby restaurants. From the researcher's observation, it could be rightly say that, per capital consumption for food per day is higher in Malaysia than her neigbouring countries as food consumption is taken more times than the traditional three square meals per day. People tend to eat any time rather than the conventional breakfast, lunch and dinner pattern that is common in most developed and developing countries.

This is because according to Masilamany (2013) in his online news report, Malaysia could possibly be the only country around the globe where one could have food available in the street corners all the night, while people in other parts of the world are already sleeping. The "iphone" generation according to him has code-named this unsustainable eating habit as "mamak-ing" (eating behaviour) in reference to Indian Muslim restaurants that operates till day break. This findings is further confirmed because Qayyum and Navin (2014) reports that in under-developed countries each person produce around 300g of food waste per day, while in the developed nations, the figure is slightly higher at average of between 3-4kg, but in Malaysia this is about 1kg per person a day. This is a true statement as the economic boom for about two decades or more has brought about increased income and thus drastically changed the food consumption habits of Malaysians households. Furthermore, shopping malls are full to

capacity with households on daily basics and most at times during weekends buying different kinds of food stuffs for family consumptions. The Table 1 show data of food waste from various sources.

Malaysians are throwing away up to 930 tons of unconsumed food daily. This is equivalent to throwing away10kg bags of rice each day. Furthermore, Kamarul Zaman, President of Core Competencies found under-developed countries are generating around 300g of waste per person per day. Therefore, it could be rightly say that Malaysians do not have food shortage problem, but rather food waste problem. This is because the issue of treatment of food waste generated in Malaysia could be said to be still extremely limited, like composting or even for animal feed. With this situation almost all of the food wastes generated in Malaysia from different sources such as households, commercial, restaurants food courts and supermarkets and others from beverages industries are disposed of to the landfill. Moreover, wastage of unconsumed food

alone in Malaysia has doubled over the past three years; this does not even include leftover food. The unconsumed food mostly consists of expired bread, eggs and old or rotten fruit. For example, food waste is becoming a growing trend, that almost 50 percent of the 31,000 tons of the solid waste produced daily by Malaysians comprised organic kitchen waste such as leftover food. A municipal solid waste composition study by local authority from the year 2002 to 2010 found that food waste constitutes largest quantities of the solid waste generated for each year in question. In 2003 it had 56.3 percent of total waste generated.

According to Abdul Hamid et al. (2012) in a study of municipal solid waste generated in 2005, 7.34 million tons of waste were generated and is estimated that it will increase to 10.9 million tons in 2020. Out of these 7.34 Million tons of waste generated, food waste constitutes 60 percent of the total waste.

**Table 1:** Food waste generated in Malaysia

| Estimated food waste generated in Malaysia | Generation rate | | |
|---|---|---|---|
| Sources of food | (tonnes/day) | (tonnes/year) | Percent |
| Households | 8,745 | 3,192,404 | 38.32 |
| Wet and night markets | 5,592 | 2,040,929 | 24.50 |
| Food courts/restaurants | 5,319 | 1,941,608 | 23.35 |
| Hotels | 1,568 | 572,284 | 6.87 |
| Food and beverages industries | 854 | 311,564 | 3.41 |
| Shopping malls | 298 | 108,678 | 1.30 |
| Hypermarkets | 291 | 106,288 | 1.28 |
| Institutions | 55 | 26,962 | 0.32 |
| Schools | 45 | 21,808 | 0.30 |
| Fast food/chain shops | 2521 | 808 | 0.26 |
| **Total** | **22,793** | **8,331,589** | **100** |

Therefore, it is estimated that the amount of food waste generated within that period in 2005 was 4.404 million tons and thus will likely increase to 6.54 tons in 2020. Furthermore, recent online news reported that Malaysians waste 8,000 tones or 8 million kilos of food per day. Prior to this, The Star reported food waste in Malaysia average around 450 tons per day in 2009, according to the report the number was double in 2011 and in 2013, and what that implies is that it has multiplied to about 15 times within four years. Malaysians are therefore throwing away 15 times more food and organic waste material as when compared to fours ago. The report is disturbing as these quantities of food waste could feed 7.5 million people of the country in a day (Qayyum and Navin, 2014). According to official report, about 15,000 tons of food daily are wasted, if 20 percent of this is saved, taking into account that most wastage were vegetables and fruits which are at the cheaper side rather than of meat and fish, which he estimated at RM3 per kilogram of food, that will amount to 2,400 tons of food waste into RM7.2 million, and in a year is about RM2.6 billion worth of food which could be save if adequate measures are taken. Fig. 1 shows the current food waste situation in Kuala Lumpur alone.

Emphasis on waste recycling is mostly concentrated on dry solid waste such as paper, aluminum metals etc., disposing of food waste on landfills still dominate a larger disposal channel for the mean time. Besides all these landfills are unsanitary landfills constituting nuisance to the communities where they are located (Jereme et al., 2013).

This is because according to National solid waste department, the treatment of food wastes generated in Malaysia is still very low, due to there is no proper innovative and strategies like in developed countries, for this reasons food waste treatment is still very limited and under-developed. However, a strategic plan that is particularly on food waste management is very crucial and is underway.

Such as establishment of an inventory for the purpose of household food waste generation; exploring the options for proper food waste management, which include the possibility of using anaerobic digestion technology; also the development of anaerobic digestion plant or other appropriate treatment technologies depending on the outcome of food waste study.

However, currently the focus on treatment of food waste in Malaysia is only for restaurants, wet

markets and food industries. Though, food wastes generated from households still remains main source of larger quantities of food waste generated

when combined together, but the facilities for households to engage in sustainable food waste management are not yet there.
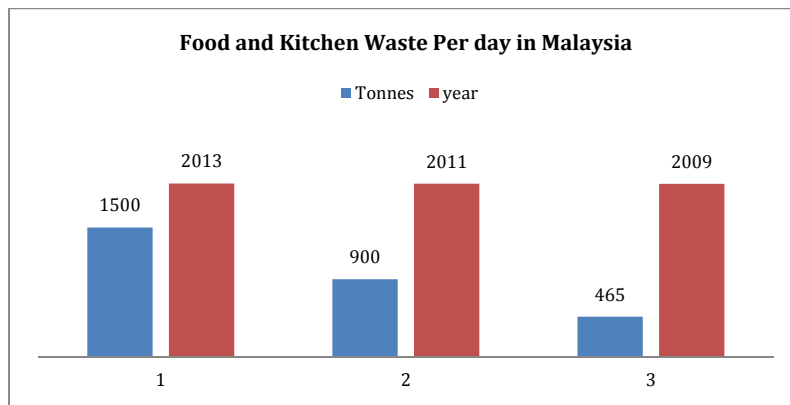


**Fig. 1:** Food and kitchen waste per day in Kuala Lumpur

More focused on food waste generated from households will be after that of restaurant and food industries 'macro food wasters' have taken a good shape. From the eastern coast which is part of the area of focus in this study show in Table 2, the current estimation of waste generation in Terengganu. Domestic waste with food waste

constitute highest is 169.60 tons/day. The lower quantities of household wastes compare to Kuala Lumpur is because of income disparities with regards to Kuala Lumpur being the old capital city with higher income and Terengganu a rapidly developing but under developed with most population residing in the rural areas.

**Table 2:** Estimation of waste generation in Terengganu

| Type of waste (source) | Calculation at source | Total waste (ton/day) |
|---|---|---|
| Domestic Waste with household food waste | 353,000 people 1 kg @ people = 353 ton 60% urban population = 212 ton | 212 (80% disposed in PBT) = 169.60 |
| Shop lot/Restaurants | 2,000 units @ 30 kg | 60 (10% 3R) = 54 |
| Workshop | 300 units @ 60 kg | 18 (10% 3R) = 16.2 |
| Industry | 15 units @ 2,000 kg | 30 (20% 3R) = 24 |
| Hypermarket and Wet Market | 15 units @ 8 ton | 120 (20% 3R) = 96 |
| Others (Orchard waste, night market, carnival, sales, etc.) | 20 lorries @ 4 ton | 80 (20% 3R) = 64 |
| TOTAL | | 424 ton/day |

The situation is becoming alarming because resources to produce food are exhaustible. With population increase outgrowing food production, there is need to control food wastage so that what is already produced could be judiciously use for the well-being of humans. Therefore, this study primarily focuses on household food waste. The objectives is to assessed if government policy on households food waste management and consumer's knowledge of environmental effects of food waste could impact to reduce food waste disposal at household's levels and in general: to investigate the current pattern of food waste composition and disposal by respondents. Sustainable food waste management at households have been for long time neglected due to the erroneous perceive of small quantities of food waste generated per households' levels were seems small but large in volumes when combined together, as it generates far more food waste than other sources in Malaysia. As sustainable waste management therefore, has become a buzzword in this decade Jereme et al. (2013a), addressing the problems of food wastage at

households at this critical time countries are experiencing global economic problems which affect food security would be a timely call which needed serious attention.

## 2. Literature review

The reason we have current environmental problems is because people lack information and as well not conscious of the environment. This is because a person with no environmental consciousness does not understand that food wastage at home leads to food waste generation and impacts on the life of the people in the future. Adequate and sound environmental knowledge leads to reducing food waste generation as a result of understanding of its effects on the natural environment (Gökdere, 2005). Consumers understanding of environmental effect of food waste will go a long way in tackling the problem of food wastage at households. The ignorant of the after effects of this behaviour on the environmental are the reasons behind food waste increase yearly in any

waste composition studies. It is an accepted fact that when consumers don't have adequate knowledge of these effects consumers participation in recycling will be very difficult to develop and even effective and sustainable policies will be hard to achieve (Schultz et al., 1995; Clay, 2005; Latif et al., 2012). Hence, household's waste is the largest source of food waste at more than 30 percent of the total waste generated and at the same time contributes to the pollution from landfills. It is known facts that households are the largest source of waste in the whole food system, according to (Kantor et al., 1997), its accounts for about the 26 percent of all the edible food that are available.

Consumers are more aware of the economic consequences of food waste in their households but unaware of the environmental impact. This is because most of them think about the cost associated with food waste that are wasted rather than any other effect or even the social impact. This high awareness on cost is because it directly affects their budget but when it comes to the environmental effects the situation is different. From a study the percentages of people who believe that food waste has no environmental effects because it is biodegradable were 39 percent in his findings. While 73 percent others are of the view that packaging waste have far more environmental problem than food waste. In a nutshell it could be concluded that consumers do not associate food waste to environmental problems and this is the reason the unacceptable food waste disposal behaviour will continue to persist. Consumers that understand they have a role as stakeholders in controlling adverse effect of food waste do not show negative behaviour in their consumption.

## 2.1. Environmental impacts of food waste

The environmental impacts of food production at different stages of food chain have been considered as contributors of global warning. Moreover in the light of rapidly rising cost associated with energy supply and increasing public concerns with environmental quality degradation, conversion of food waste to renewable resources or utilizing it for animal feeding and agricultural purpose is becoming a more economical viable option to reduce food waste. According to the Ministry Natural of Resources and Environment of Malaysia, energy industries were the leading emitter of $CO_2$ (35 percent ), and landfills led in methane ($CH_4$) emissions (47 percent) while agricultural soils led in the emissions of $N_2O$ (60 percent). The environmental impacts of food production at different stages of food chain have been considered as contributors of global warning EPA Australia (2012). It found that food waste has an environmental impact caused by the loss of natural resources used to produce the food and the greenhouse gas emissions created during its production and disposal. In food production, energy and resources demand are require which results in

higher quantities of pollution been emitted into the environment. What this show is that food waste do not only impact on the environment during the stage of waste management but as well within the life cycle stages of food production.

The production of food is a highly water-consuming activity. So many volumes of water are transformed into vapor during the production process, both as plant transpiration and evaporation from the fields, canals, reservoirs and high water tables. For the past decades, the increase in food production has outpaced population growth which is a worrying situation. With global warning in the horizon, most of the world is simply running out of water for more production and the context for production is changing. The consumption pattern and life style of humans which has increased consumer preferences and purchasing power tend to drive production patterns.

Furthermore, the very high concern with food waste going to landfill is that when organic waste (including food waste) breaks down it results in the production of methane, a greenhouse gas 25 times more potent than carbon dioxide. In Australia a National greenhouse inventory data suggests that landfill contributes two percent of Australia's total greenhouse gas emissions. For every tone of food waste not sent to landfill, 0.9 tons of carbon dioxide emission is saved. Food supply chain is responsible for approximately 23 percent of Australia's total greenhouse gas emissions, second only to coal fired power stations (EPA Australia, 2012). To reduce environmental impact, food waste need to be targeted to reduce the wastage of water, given that large quantities of water are used to produce the food that were lost. What this analysis shows is that when consumers understands that food wastes has effect on the natural environment and water usage, it could have a significant impact in their consumption behaviour to reduce food waste generation. Therefore, reducing quantities of food waste generated at households means more available water for other water related activities for human sustenance and less cost of waste management, when food waste are reduced by households in their consumption behaviour.

ii. Social impact of food waste: Social impacts of food waste stern on what moral justification of such action while it is stated that we should be our brother's keeper for mutual existence. The fact that foods are wasted while there is people in need means it also has a social impact. The social impact of food waste on food security is enormous as this has brought misery to households as it does reduce quantities of available food for consumption. Furthermore, these impacts come in many fold, such as socio, economic, and environment which all affect the food security. The social aspect is the immoral acts of food wastage in the societies while in 2006 MSNBC reported global estimate of about 800 million being undernourished, and that the world need estimated 50 percent more food by 2030 to feed the growing world population with evolving

diets. Human effort in terms of social cost affects food security as this could have been channel for other useful purpose which could help reduce waste and boast food security. When households and even restaurants and food producing companies dispose edible food waste unsustainably, it erodes their social responsibility of helping those in food insecurity which does not tell well of their image.

## 2.3. Government policies on household food waste management

In some cases government policy on household's food waste management might indirectly reduce quantity of food waste disposal from households. This is because, according to a report from the city of Milwaukee, through regulation on food waste management by local authorities, more than 7,000 cities and counties in the United States encouraged households to reduce the quantity of waste by imposing higher tax for more larger quantities of waste generated at home described as Pay-as-you-throw (PAYT) program. According to this program, the average waste disposal was 20 percent less in PAYT communities than non-PAYT communities (Reschovsky and Stone, 1994). Furthermore, in South Korea, the food waste recycling rate increased to 81.3 percent in 2004, from 45.1 percent in 2002 after the implementation of strict policy regulations on food waste recycling and expansion of waste to energy facilities.

In another finding from Sweden, the regulation on Pay-as-you-throw (PAYT) away motivated households in these counties to increase their food separation activities (Dahlén and Lagerkvist, 2010; Dahlén et al., 2009). Moreover, the policy regulation on waste disposal even helped households to understand the need for waste separation and saved cost of disposal for local authorities. Though, barriers such like lack of facilitates were put in check by making it available and creating awareness of the benefits of food waste separation and composting. This made the policy a success and embraced by almost all households which thus led to reduction of food waste generation. Furthermore, in another survey in Oostzaan Netherlands, policy by local council on weight-based pricing for household's waste disposal saw annual household waste collection dropping to 42 percent, non-recyclable waste by 56 percent. It is therefore concluded that Oostzaan policy appears to be cost effective and also produced significant social benefit to the community which leads to reduction high food waste generation (Linderhof et al., 2001).

In developing household's food waste management programs government needs to focus on minimizing barriers to implementing sustainable food waste programs; this is when such programs will be a success in the local community. This could encourage more households embracing ecologically desirable methods of food waste as it made accessible for them to participate (Kwon et al., 2012; Timlett and Williams, 2008). Furthermore, the imposing of Pay-as-you-throw (PAYT) program, the fear of not wanting to pay higher disposal cost prompted households to start engaging in food waste reduction in different ways as it deem convenient to them. This led households in these areas avoiding food items not needed and not been tempted by "buy one free one and discount promotions sales. This show government policy formation has strong effect towards reducing food waste generated at households. This is because consumers who don't understand the implications of negative environmental behaviour will lead to more incurring paying more charges to local authorities because of large quantities of food waste that could likely be generated from their households. Some studies have even suggested raising food price as food is cheap because it is one of the reasons household's waste lots of edible food. However, this should not be encouraged as it will lead to more food insecurity especially in developing country like Malaysia.

## 2.4. Sustainable Food Waste Management Program

A sustainable food waste management system could be said to be a collaborative network that integrates different components so as to enhance a community's environmental, economic and social well-being. This principle is built that further ecological, socio and economic values of a community and region is not jeopardized in future (Pothukuchi and Jufman, 1999). On the other hand (EPA, 2010) defines it as an approach of using resources in the most efficient and sustainably throughout their lifecycles. It seeks to minimize material use and all associated environmental impacts. It reduces the amount of food waste that is generated each year by consumers and producers without compromising the future needs and to recycle or otherwise gain value from waste that does arise. Some possible way of achieving this according to EPA (2010) is through implementation of sustainable food waste management program through the waste hierarchy pyramid model: feed the people, feed animals, industrial use and compost Incineration and Landfill.

## 3. Methodology

The study location was at Selangor and Terengganu consisting 333 respondents. Of this 257 were from Selangor and the rest from Terengganu. The study applied purposive -random as the target were respondents within specific age limit of from 18 years and are involve in food related matters. The reason being since the main objective is to achieve sustainable food waste they stand to give responds to the structured questionnaire as to what will motivate them to engage in any measure to reduce food waste at home.

## 3.1. Statistical analysis

Data was analyzed with SPSS version 22.0.1 Inc, Chicago, IL, 2013 by applying descriptive and logistic regression model analysis. Prior to the analysis missing values, outliers, normality, and linearity were analyzed. Cronbach alpha values had reliable values for the logistic regression analysis. Logistic regression model is always based on the cumulative logistic probability function and is represented in this formula:

$$P_i = F(Z_i) = F(\alpha + \beta X_i) = \frac{1}{1+e^{-z}} = 1^{+e-(\alpha+\beta X_i)}$$

From the above expression, e is representing the base of natural logarithms. $P_i$ is the probability that the individuals will have to make a certain choice, given knowledge of $\times_i$. F is the cumulative probability function and $\dot{Z}_i$ is a theoretical index $\dot{Z}_i$ is assumed to be a continuous variables which is random and is normally distributed.

## 3.2. Results and discussion

### 3.2.1. Characteristics of respondents

The results of the descriptive analysis show 33.3% of the respondents were men while 67.7% are women. On ethnicity level, out of these respondents the Melayu were 64.9%, Chinese 22.8%, Indians 7.2% and the rest of other respondents were 5.1%. Those who are married among the respondents were 59.2%, single 30.5% and others 3% respectively.

### 3.2.2. Composition of food waste generated at home

Literatures suggest households have different composition off food waste items more than others as it's the most commonly eaten food in their households. According to Wenlock and Buss (1980), this could either be due to culture or geographical location. Therefore, in these question, respondents from both Selangor and Terengganu where asked to indicate the composition of food waste they generates most frequent, frequently and less frequent as food waste in their individual households. The results shows that in Selangor 36.2 percent generate fruits frequently, while 19.1 percent most frequently generate rice food waste. 37.4 percent generate less frequent vegetables and 7.4 percent none. On the other hand, Terengganu 11.8 percent most frequently generate rice and 34.2 fruits frequent. While 44.7 percent generate less frequent vegetable and 9.2 percent none of the above.

The differences in composition of food waste per state could be due to location. Terengganu where most of the respondents resides in the rural areas and underdeveloped state they have alternative food items from farms, thus generate less of rice unlike Selangor which is a big city where stable food is most likely rice. The possible reasons Terengganu respondents generate less vegetable could be living in the rural areas they have availability of freshly harvested vegetables while in the city it could be kept for use the other days in the process damaged. Table 3 shows the results from the field work how they fared.

**Table 3:** Composition of food waste generated at households

| State | Most frequent (Rice) | Frequent (Fruits) | Lest frequent (Vegetables) | None of the above | Total |
|---|---|---|---|---|---|
| Selangor No | 49 | 93 | 96 | 19 | 257 |
| % | 19.1 | 36.2 | 37.4 | 7.4 | 100 |
| Terengganu No | 9 | 26 | 34 | 7 | 76 |
| % | 11.8 | 34.2 | 44.7 | 9.2 | 100 |
| Total | | | | | 333 |

### 3.2.3. Respondents pattern or method of disposing edible food waste

Quantities of edible food waste are disposed into landfills in Malaysia while many are living in food insecurity most especially those with low income and as well living in slums and squatters areas of the urban cities. However, despite that there are many living in food insecurity; wastage of edible food is still very most common among affluence families (Skourides et al., 2008). This problem is also common with individual households who are tempted by "buy-one-free-one" sales promotion. This adds to the quantities of food which they buy leading to wastage. Furthermore, other reasons according to Rogers and Bazerman (2008) and Milkman et al. (2010) is household's quest for purchase of fresh food for their families in order to have a healthier and balance diet for their families.

Therefore, individuals' households were asked to indicate how they disposed their edible food waste in the question No 52. They were asked to choose between Prayer house, NGO, Social welfare, neighbour and none of the above. The results show in Selangor 6.2 percent and Terengganu 10.5percent gives out their unused edible food waste to prayer houses. While in Selangor 4.3percent gives their unused edible food waste to None Government Organization (NGO) while Terengganu had none who disposed their edible food through NGO. Social welfare had 13.2percent in Selangor who disposed their edible food by sending it to them, while Terengganu had same figure 13.2 percent. Giving neighbours edible food waste has 41.6 percent households in Selangor exhibiting such behaviour and Terengganu had 63.2 percent who gives their edible food waste rather than disposed it into the waste bins.

Households who have other patterns to dispose their edible food waste were 34.6 and 13.2 percent respectively for both Selangor and Terengganu. In Terengganu more households gives out their edible food waste to neighbour which shows spirit of brotherhood in their community than households in urban cities in Selangor where everybody lives for self as some don't even know who are their neignbours, self-centered life style or "mind your own business" kind of behaviour. However, it seems Terengganu households on the other hand are not aware of the responsibilities of NGO who cares for the less privileged as the results show none of the households takes their edible to them. It could be households are used to giving out edible food to neigbours rather than through charity organization (NGO) or they have not made their presents known by engaging in more social activities in their local areas or such does not exit there yet. However, Selangor households' gives out their edible food waste more than Terengganu to NGO most likely for the availabilities of their services here through charities homes. Giving out edible food waste to those who are in need of it is one way of reducing food waste and also its impact on the environment. It saves local authorities millions of Ringgit used in disposing waste there by reducing cost of waste management. Table 4 shows the result of the survey.

**Table 4:** Household's pattern or method of disposing edible food waste

| State | Prayer house | NGO | Social welfare | Neighbour | None of the above | Total |
|---|---|---|---|---|---|---|
| Selangor No | 16 | 11 | 34 | 107 | 89 | 257 |
| % | 6.2 | 4.3 | 13.2 | 41.6 | 34.6 | 100 |
| Terengganu No | 8 | 0 | 10 | 48 | 10 | 76 |
| % | 10.5 | 0.0 | 13.2 | 63.2 | 13.2 | 100 |
| Total | | | | | | 333 |

### 3.2.4. Assessing positive impacts of consumer's environmental knowledge of food waste effect and government policy toward participation in sustainable management food waste program

Logistic regression model was applied to assess the level of awareness of consumer's knowledge on environmental effects of food waste and positive opinion on government policy to influence behaviour towards participation in government sustainable food waste management program. Furthermore, this study looks at how their understanding of these variables of food waste effects with government policy regulation on food waste management could leads to consumer's change of perception in sustainable food waste management programs to reduce food waste generation at households in Malaysia. If the consumers have knowledge on environmental effects of food waste and as well believe that with government policy on sustainable food waste management could help reduce food waste or not, it is assume to be positive or negative. On the other hand it is significant or not significant to influence their behaviour towards the issue of household food waste reduction. The dummy dependent variable of sustainable food waste management was regressed with some related variables; food waste pollutes environment, Food wastes contributes to water wastage and government policy will reduce food waste, government to educate local people how to reduce food waste, government policy will reduce food waste. The dependent variable in this model was therefore designed to be a dichotomy variable such that consumer's positive behaviour on sustainable food wastes management is positive.

Furthermore, the dependent dummy variables, *sustainable food waste management program will give us a better reputation* was re-coded as (1 if positive opinion) and otherwise 0. The dependent variable SFWM was designed as a dichotomous dummy to understand if consumers have positive or negative behaviour towards sustainable food waste management. The SPSS data was re-coded to meet the assumption of logistic regression hence the main data from the questionnaire was in 4 point-Likert scale items used for SEM analysis but not suitable for logistic regression (Eq. 1).

$$\text{Log } P_i/(1-P_i)=Z= \beta_0+ \beta_1 X_1+ e \qquad (1)$$

Where,
$P_i$ =1 if consumers awareness towards sustainable food waste management is positive or negative
$P_i$ = 0 for otherwise
$X_1$= Independent variables
$\beta_0$ = Constant term
$\beta_1$ = Coefficient of independent variables
e= The error /disturbance term
X= 1, 2, 3, , ,n
From the above exhibited equations therefore, $\beta_1 X_1$ can then be interpreted as the following (Eq. 2);

$$\beta_1 X_1+ \beta_2 X_2+\beta_3 X_3+ \beta_4 X_4+\beta_5 X_5+ \beta_6 X_6+.\beta_7 X_7 \qquad (2)$$

The independent variables are:
Constant $\beta_0$

1. Food waste increase cost of waste management $X_{.1}$ (awareness)
2. Food waste consumes much energy which thus affects environment $X_2$ (awareness)
3. Waste foods contribute to cause health problems if it is not disposed well $X_3$ (awareness)
4. Government policy on sustainable food waste management will help reduce food waste $X_4$ (opinion)
5. Government should educate the local people on what is sustainable food waste disposal and consumption $X_5$ (opinion)

6. We need more government regulations to force people to practice sustainable life style for sake of the environment $X_6$ (opinion)

7. I understand what sustainable food waste management means $X_7$ (opinion)

A logistic regression was performed to assess the positive impact of consumer's environmental knowledge of food waste effect and government policy regulation on food waste management to influence their participation in sustainable food waste management program. The results was satisfactory as the predicted percentage of the full model with all the predictors were statistically significant at $X^2$ (5, N=333)=85.6, p < 001, what this indicated was that the model were able to distinguish between consumers who had positive opinion towards participating on sustainable food waste management program as means of reducing food waste and those who were not.

The Cox and Snell $R^2$ prediction was .104 which was satisfactory and the Negelkerke $R^2$ was as well 0.185. The Hosmer and Lemeshow Test Chi-Square was 9.700 indicating the rejection of null hypothesis at non-significant level of .287 which shows the model adequately fits the data reasonable well. Predictors' variables were tested for multicollinearity' with regression model, collinearity' diagnoses test show variance inflation factor (VIF) for all the predictor variables were less than 10.00 (<10.00 acceptable)and tolerance values more than> .10 is acceptable level Gujarati, (2003), which implies there was no multicollinearity problem and violation of assumption governing logistic regression model. Therefore logistic regression analysis was appropriate in this case. The results of the logistic regression are shown in Table 5 and the SPSS full output and the Multcolinearity text are shown in Appendix L and C (Eq. 3).

$$LnP_i/(1-P_i)=-6.334+0.514X_1+0.451X_2+0.289X_3+0.629X_4+0.405X_5+0.129X_6+0.293X_7 \qquad (3)$$

**Table 5:** Logistic regression model on positive impact of consumer's environmental Knowledge and Government Policy towards participation in Sustainable Management Food Waste

| The Variables | Estimated coefficient (B) | S.E | Wald | Sig | Exp (B) |
|---|---|---|---|---|---|
| Costant | -6.334 | 1.519 | 17.381 | .000*** | .002 |
| Food waste increase cost of Waste management | 0.514 | .235 | 4.775 | .029** | 1.672 |
| Food waste and energy | 0.451 | .223 | 4.081 | .043** | 1.570 |
| Food waste causes health problems | 0.289 | .250 | 1.340 | .247 | 1.336 |
| Govt policy on sustainable SFWM | 0.629 | .244 | 6.625 | 0.10* | 1.876 |
| Govt to educate local people | 0.405 | .245 | 2.731 | 0.098* | 1.499 |
| Govt regulations | 0.129 | .242 | .284 | .594 | 1.138 |
| Understands SFWM meanings | 0.293 | .248 | 1.400 | .237 | 1.13 |

No of Observation 333, Df  8, Chi- Square       9.700, Cox and Snell R Square  0.104, -2 Log Likelihood 238.134
Nagelkerke R- square 0.185, Hosmer and Lemeshow Test at 0.278,
**Significant level at .05 and at the 0.10* level

The results of the logistic regression model have revealed four variables which are; Food waste increase cost of Waste management ($X_1$), (Food waste and energy($X_2$), Government policy on sustainable SFWM($X_4$) and Government to educate local people ($X_5$) are significantly related with sustainable food waste management. Food waste increase cost of Waste management (variable $X_1$) has proved to be the main determining factor that could influence consumer's positive behaviour towards participation in sustainable food waste management at households' at.029. The researcher is of the opinion as this is related to cost which involved consumers could be the main reason for this awareness. This is because similar result by McCosker (2006) has proven that 'Pay-As-You-throw (PAYT) away has been the factors that motivates consumer to reduce households waste in Athens, USA. The exponential beta coefficient result, Exp(B) as well indicates that consumers who have positive opinion on sustainable food waste management are 1.672 times more likely to participate in sustainable food waste management at households than those who are not.

Food waste and energy ($X_2$) also was positively related to sustainable food waste management with estimated coefficient of 0.451. The exponential coefficient, (Exp)B in the model is 1.570. The results indicates that consumers who have positive opinion on the impact of food waste in energy consumptions will most likely participate in reducing food waste 1.570 times through sustainable food waste management than those who do not realize its negative impact of food waste on energy consumption. Government policy on SFWM ($X_4$) and government to educate the local people ($X_5$) were also significantly related to sustainable food waste management at 0.10 and 0.098 levels respectively with (Exp)B of 1.876 and 1.499.Government enlightenment campaign through the information could educate local people by creating awareness on the danger of food wastage on the economy as well the environment. This is because educating consumers through information has significant impact towards attitude change on food related issues. These results are supported with similar studies from (De Young 1993; Gökdere, 2005). The government should not underestimate the role and power of information can play on awareness to change behaviours on environmental issues. However, the other three variables which were not significantly related to sustainable food waste

management in the model were; Food waste causes health problems ($X_3$), Government regulations ($X_6$) and understands meaning of SFWM ($X_7$). These variables had no impacts in influencing consumer's behaviour towards participating in sustainable food waste management at households from the results of the model. The reasons for the non-significant effects on these variables could be due to lack of awareness or information on environmental problems especially on food waste causes health problems and understanding meaning of SFWM.

## 4. Conclusion

The main aim of this study was to assess the impacts of these variables, waste reduction polices on households and consumers' knowledge of environmental effects of food waste to reduce food waste at households, and also their food waste disposal behaviour in order to achieve a sustainable food waste. Government policy on household waste was seen to have strong impact to reduce food waste generation. This is similar to the findings of policy as pay-as-you-throw (PAYT) away in Athens and Sweden prompted households to change their behaviours on household waste in general. Though, this is not a call to increase fees on waste disposal for households considering the current economic situations and again the income disparities between these countries where this kind of policies have brought down quantities of food waste at homes and waste in general. However, in nearby South Korea, the food waste recycling rate increased to 81.3 per cent in 2004, from 45.1 per cent in 2002 as seen from the review, after the implementation of strict household's food waste policy regulations on food waste recycling and expansion of waste to energy facilities the same with Taiwan. What this finding indicates is that strong government policy on food waste reduction and campaign will change behaviours of households to see the issue of food waste as unacceptable behaviour.

Environmental knowledge on food waste effect has shown strong effect to reduce food waste. According to De Young (2003), nobody engages in activities he or she does not understand or the reason they should change their behaviour such as in food wastes. If households understand that food waste leads to increase cost of waste management, water shortage, energy and impact food security, this knowledge will compel them to change behaviour on their consumption lifestyle. According to Cox et al. (2010) creating awareness among households and making them to understand the food waste impacts on the environment is an effective component for behaviour change towards sustainable food waste disposal. Furthermore, enhancing knowledge on environmental education on households could start from preschool children, inculcating in them to understand their responsibilities as environmental stakeholder and making them to know they have responsibilities and roles to play to reduce wastage in their consumption behaviour. As they grow up with this understanding, food waste will be seen as unacceptable social behaviour in their adulthood, thereby avoiding wastage in their consumption both at home and in schools. This is because environmental education is a way to create public awareness both for younger generation and as well for adults on the environmental consequence of our everyday actions at home and outside homes. Food waste disposal varies depending on location and incomes from Selangor and Terengganu, though Selangor is on the higher side due to higher income at their disposal. The reasons for the current environmental problem were because of lack of environmental consciousness and its impacts in the lives of people in the future. However, policies that suits local environment should be considered in this regards so that sustainable food waste management will be achieved in Malaysia.

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