

Motivations and Barriers to Minimize Household Kitchen Waste in Kota Kinabalu City, Sabah: A Preliminary Study

Mei Xue Yap, Isaac Wayne Witus and Leong Wan Vun*

Faculty of Science and Natural Resources

Universiti Malaysia Sabah

88400 Kota Kinabalu

Sabah MALAYSIA



Abstract - Kitchen waste discarded from households contributes to the high proportion of organic waste that ends up in its designated landfills. This poses negative impacts to the environment, social and economy in the long run. To tackle this problem, efforts are needed to minimise kitchen waste generated from households. However, for this initiative to be successful, the residents play an important role. The main objective of this study was to identify the possible motivations and barriers of the residents in minimising household kitchen waste, and also to provide recommendations to further motivate and overcome the barriers in reducing kitchen waste. A combination of open- and close-ended questionnaire was used to conduct this preliminary survey. One hundred household residents staying in Kota Kinabalu City were randomly selected as the respondents for this study. The identified major motivations for the respondents to minimise kitchen waste were (1) personal habits of not wasting food, (2) financial concern, (3) being the right thing to do and (4) to avoid from attracting rodents, ants or cockroaches into the house. To minimise household kitchen waste in the study area, most respondents agreed to enforce household kitchen waste segregation, install kitchen grinder, participate in kitchen waste minimization campaigns, and wiliness to use composting materials made from kitchen waste. However, these efforts are not without prior conditions. In conclusion, to reduce the generation of household kitchen waste, suitable efforts are required based on the identified factors of generation of household kitchen waste in the study area.

Keywords – Household Kitchen Waste, Waste Management, Motivation and Barriers.

I. INTRODUCTION

Solid wastes are released into the environment through human activities. Solid wastes are usually found in solid form or semi-solid form which are no longer in used [1]. They ranged from heterogenous mass of garbage from urban communities to the more homogenous accumulation of unwanted residuals generated from agricultural, industrial and mining activities [2].

Generally, solid wastes can be classified into six major types namely residential, commercial, industrial, municipal services, agricultural and institutional [2], [3]. Municipal solid waste (MSW) includes decomposable wastes (food or kitchen wastes) and non-decomposable wastes (metals, glass, paper and plastics wastes) generated from municipal services within

a community and also include all categories stated above except industrial and agricultural wastes [4].

Kitchen or food waste is part of the MSW that is usually generated from household, food processing sectors, food service and catering sectors, markets and schools [5]. Kitchen or food waste has raised global concern nowadays. In some South East Asian countries such as Indonesia, Malaysia, Thailand, China, Cambodia and Myanmar, kitchen waste made up the highest percentage of MSW composition [6]. In Western countries such as the United Kingdom, the generation of household kitchen waste is high and most of it was avoidable [5].

To manage MSW through a sustainable approach with environmentally sound strategies, a waste management

hierarchy can be applied [7]. In the hierarchy, the preferences of waste management, from highest to lowest are, reduction, reuse, recycle and energy recovery. In contrast, the least preference method in MSW management is waste disposal into landfill.

Every country has its own methods in managing kitchen waste. Instead of direct disposal of kitchen waste into landfill, some advanced countries such as Germany and Korea minimise kitchen waste through alternative methods such as composting, food recycling, anaerobic digestion and dry or wet feed method [8]. Some countries such as Sweden, Australia and Germany practice source segregation of kitchen waste from household waste for later biological treatment, production of biofuel and fertilisers [9].

Kitchen waste has become a global issue because it can cause negative impacts to the environment, food security and sustainability, human health, and social economics [10], [11]. The disposal of kitchen waste into landfill may give rise to odour problem due to high moisture content, greenhouse gases emission and toxic leachate [12]. Improper disposal of household kitchen waste may attract rodents, flies and cockroach, which will then lead to environmental health issues [13]. In terms of social economics, the household kitchen waste can lead to increase in global food price, and thus reduction in the accessibility of food supply to the poor nation in both developed and developing countries [11].

In Malaysia, the MSW was dominated by household or kitchen waste, comprising of about 50% throughout year 1975-2011 [14], [15]. Kitchen waste in Malaysia were not segregated or separated before they are disposed into a landfill until September 2015 whereby segregation at source was enforced [8], [16]. However, this was not enforced throughout Malaysia and such efforts have also been criticised for its weaknesses and other issues [17]. The state of Sabah was not one of the states in Malaysia with such enforcement in 2015.

In Sabah, food or kitchen waste were also reported comprising the highest composition in its MSW as compared to paper, plastics, glass, and other type of solid waste generated [18]. Food segregation to help minimising kitchen waste is only compulsory for food-producing premises in its capital city, Kota Kinabalu, as required by its local authority [19]. To effectively minimise household kitchen waste, attitude and participation of residents are the key factors. The motivations and barriers of the people in household kitchen waste minimisation need to be known for the initiatives towards waste reduction to be successful [11].

The objectives in this preliminary study is to identify the possible motivations and barriers amongst Kota Kinabalu City

residents in their kitchen waste reduction efforts and to propose recommendations in minimising the household kitchen waste in the study area. This research targeted the residents around the area of Kota Kinabalu City, Sabah, to identify the possible motivations and barriers in the kitchen waste minimising efforts. "Household" in this study refers to a unit which is made up of "related and/or unrelated persons who usually live together and make common provisions for food and other essentials of living" [20]. On the other hand, "resident" is defined as a person who lives somewhere permanently or on a long-term basis [21].

Studies on the factors of household kitchen waste generations, motivations and barriers of household kitchen waste minimisation have been conducted in Western countries such as the United Kingdom. Malaysia, a country in South East Asia may have a different culture in eating habits and food processing methods. Thus, possibly the motivations and barriers in household kitchen waste reduction may be different. The identification of possible motivations and barriers in reducing household kitchen waste is important in the study of household kitchen waste management. As compared to restaurants, schools and hawkers, generation of kitchen waste from household is the most difficult to control because currently there is no specific enforcement that exists. Although the study has been completed in 2016, it may still be useful as a reference point for the local authorities, and government to introduce the suitable and effective waste management system, policies and programmes that will help to minimise household kitchen waste in the study area in the future.

II. METHODOLOGY

This preliminary survey was conducted in Kota Kinabalu City, Sabah, Malaysia from April to May 2015 and finalized in 2016. Kota Kinabalu is the capital of Sabah, which is located at the West Coast Division of Sabah. Figure 1 is a map showing the study area. The latest Population and Housing Census in 2010 reported the number of households in Kota Kinabalu, Sabah at 76088 [20].

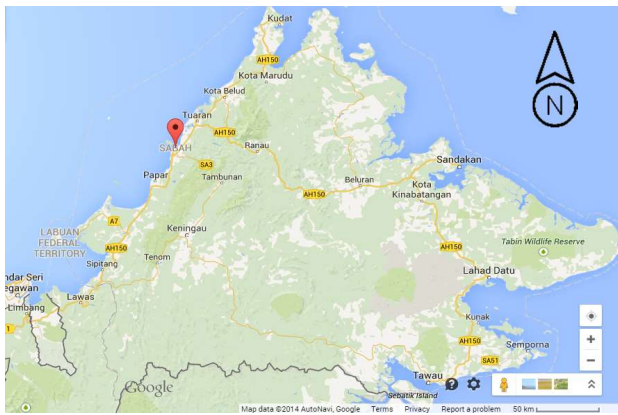


Figure 1. Location of study area on the map of Sabah (Google Maps, 2014)

A questionnaire was designed and used in this preliminary survey. The type of questionnaire used in this study consisted of open-ended and close-ended questions. The purpose of including several open-ended questions in this survey was to allow the respondents to express their opinions in answering the questionnaires and reducing the bias that may occur in closed-ended questions [22].

Likert scales was not used in this preliminary study it is usually used to evaluate the degree of agreement and preferences of respondents; thus, it is not appropriate in this preliminary survey. Another reasons for not using the Likert scale was to avoid “laziness” in answering the questionnaire, such as the tendency to select the first option of the answer scale or the same response for all questions in the questionnaire [23]. After data collection, Microsoft Excel was used for the analysis of descriptive statistics. Response percentages were calculated to show the frequency distribution of the results.

Before the questionnaire was designed, the target population and sample size of respondents were determined. To determine the number of respondents, the formula in Iarossi [24] was used. The confidence level and margin of error in this study were determined at 95% and 10%, respectively, while the z-score for 95% of confidence level was 1.96 [25]. The margin of error or confidence interval was acceptable within 10% [26]. Since there is no prior information for p, its value was set as 0.5 [27]. The given household population size is 76088. Thus, using the formula from Iarossi [24], the number of household respondents calculated was rounded off to approximately 100.

The questionnaire consists of three parts with 23 questions. The language used in this questionnaire is English. The first part of the questionnaire consists of questions on the demographic information of the respondents. The second part

includes questions to determine the composition of kitchen waste produced from the respondents’ home, to determine the awareness of the respondents on the kitchen waste produced and the motivations and barriers faced by the respondents in minimising kitchen waste at home. The last part of the questionnaire requires the participants to give their opinions on the suggested possible efforts that can be implemented to minimise household kitchen waste as well as their own opinion on the possible minimising efforts.

Pretesting study is a stage before main data collection, and it is important as it helps to test the initial designed decision [28]. In the pretest, 10 to 15 individuals are considered sufficient to provide data to assist in identifying the problems of the questionnaires [29]. In this stage, the questionnaire was reviewed by some experts in the relevant field and distributed to ten other people at random to check for suitability of the questions, understanding level of respondents, mistakes and to get feedback for improvement before the proper study was conducted. Revision and improvement on the survey questionnaire was then carried out before distribution to target respondents.

The respondents targeted in this preliminary study were the residents of Kota Kinabalu City. The questionnaire designed was distributed to household residents in the study area to obtain the information the relevant efforts in kitchen waste minimisation. The survey was conducted at the Kota Kinabalu Central Market and several other nearby areas from 6th April 2015 until 3rd May 2015. Random sampling technique was used in this survey. The respondents were first asked whether he or she is a resident staying in Kota Kinabalu City or its nearby area before the questionnaires were distributed to them. A brief explanation was given to the respondents before the start of the survey. Besides that, the questionnaire was also distributed online to reach out to more residents of Kota Kinabalu City. After collecting the answered questionnaires, data interpretation and analyses were carried out. Microsoft Excel 2013 was used to provide the statistical description of the data for further analyses.

III. RESULTS AND DISCUSSIONS

The first part of the study shows the general demographic information of respondents and are shown in Table 1. There were 100 respondents in this study consisting of 76% females and 24% males. About half or 51% of the respondents came from those aged 21 to 30 years old. This is followed by those aged 51 and above at 23%. In term of ethnicity, 49% of the respondents were Chinese, followed by Bajau, Peranakan Jawa, Rungus, Bisaya, Brunei and Sinokadazan at 24%. The

Kadazandusun, Malays and Indians made up 14%, 9% and 2%, respectively, of the total respondents.

A few questions regarding the background information of the respondents were included and the results are tabulated in Table 4.2. Many of the respondents, around 77%, live in a household with four or more family members. Terrace house, semi-terraced or bungalow are the most common type of house of the respondent at 65%, followed by those staying in a flat, apartment or condominium at 35%. Among the respondents, a majority of 75% prefer eating home-cooked meals instead of eating out.

Table 1. Demographic information of the study

Demographic Information		Quantity (person)
Gender	Male	24
	Female	76
Age (years old)	19 to 20	11
	21 to 30	51
	31 to 40	9
	41 to 50	6
	51 to 60	18
	≥ 61	5
Race	Malay	9*
	Chinese	49
	Indian	2
	KadazanDusun	14
	Others	24
Highest education qualification	Primary school	3
	PMR	2
	SPM	22
	STPM / A-level /	22
	Diploma / equivalent	43
	First degree	43
	Postgraduate degree	8

*2 with missing data.

In Malaysia, kitchen waste generated from household was the highest among other generators of kitchen waste such as markets, hotels, food courts and restaurants in which there's a worrying trend in the disposal of leftovers and unconsumed food [30], [15]. Different lifestyle, culture and dietary consumption patterns have their roles in the differences of household kitchen waste generated between places. For example, Watanabe *et al.* [31] found that local fruit peels were the most common kitchen waste generated in residential area in Bangi, Selangor while in western countries such as Australia, unconsumed food in unopened packaging and partly

used food is generated in a higher rate than leftovers such as cooked rice and vegetables [32]. In contrast, China discarded high proportions of unconsumed rice, vegetables and dairy products from their household [33].

In this study (Figure 2), the most common type of kitchen waste disposed from household were inedible, such egg shells, bones and seafood shells at 23% and closely followed by fruit skin, peels and seeds and inedible part of vegetables at 22%. These are followed by expired bread or cakes and dairy products at 15%, food residues at 14%, unfinished rice or noodles at 12% and teabags at 8%. The least thrown type of waste were uncooked vegetables and meat at 6%.

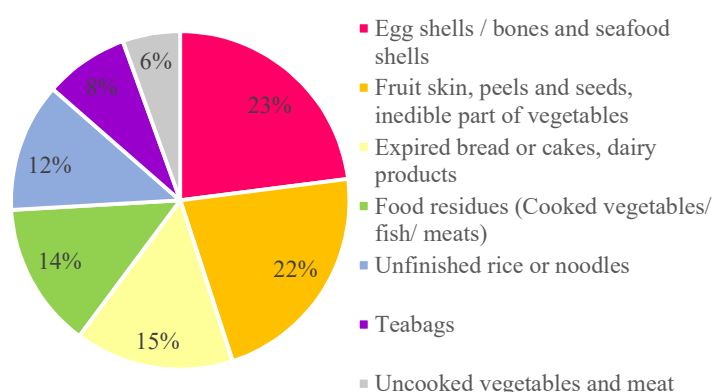


Figure 2. Composition of kitchen waste usually being discarded from households in Kota Kinabalu City

Studies in the United Kingdom found that the likelihood of an increase in generation of kitchen waste is usually a result of multiple behaviours of consumers or some other external factors [34]. The common possible reasons of kitchen waste disposal can be due to purchasing behaviour, storage of food, meals preparation, dietary consumption pattern and a sense of dissatisfaction with the taste of food [35].

Based on Figure 3, the main reasons for the disposal of household kitchen waste are the inedibility of the remaining parts of foods and the expiration or spoilage of food. The former suggests these inedible and remaining parts of food to contribute to the highest percentage of disposed kitchen waste. The latter suggests the disposal of expired products. The disposal of household kitchen waste is also due to over purchasing of food products at 13%. Overcooking is another reason for the disposal of household kitchen waste at 6%, however, there is a trend of refrigerating leftovers for later consumption [30]. Consequently, these three factors can cause the generation of avoidable waste such as expired food items and food residues. As a comparison, the study in United

Kingdom share about the same trend where avoidable kitchen waste was dominant due to these possible factors [36].

The households in Kota Kinabalu City have different methods of managing their kitchen waste as shown in Figure 4. Based on the figure, 42% of the respondents usually throw away their household kitchen waste together with household rubbish. In Kota Kinabalu City, organic waste was the highest proportion compared to other types of municipal solid waste suggesting that direct disposal of household kitchen waste together with other types of household kitchen waste as part of the reason for its high generation of organic waste [18]. On the other hand, 32% of the respondents utilized their kitchen residues as animal feed for domestic pets. Apart from this, 21% of the respondents manage their household kitchen waste in ways that help to minimise the amount of kitchen waste that can directly end up in the landfill. For example, 13% of them utilized fruit skins and remaining parts of uncooked vegetables as garden fertilizers or home composting.

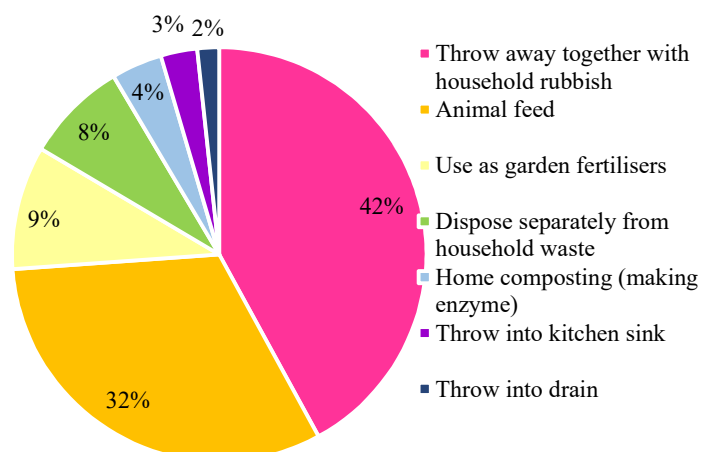


Figure 4. Types of kitchen waste handling methods by household residents in Kota Kinabalu City

Figure 5 reflects the perception of respondents on whether kitchen waste can cause environmental and hygiene problems around their housing area of which 70% of the respondents agreed that household kitchen waste can lead to both environmental and hygiene problems respectively within household area. The consequences of improper disposal of kitchen waste can cause unpleasant smell, attracts rodents and animals, and affects the aesthetic view in residential area. However, this result may be overstated as a previous study shows that households generally have the knowledge and awareness of their responsibility towards the environment, but these are not translated in their real life behaviour [37]. As for the minority respondents that did not view environmental and hygiene problems as being caused by the disposal of household kitchen waste, it can be inferred that the disposal of kitchen waste was minimum or under control within their residential area or due to a lack of priority and environmental concern among the respondents [11]. Probably it would be important to introduce the idea of mutual sustainable development among the communities so that they can see that people are a part of the environment [38].

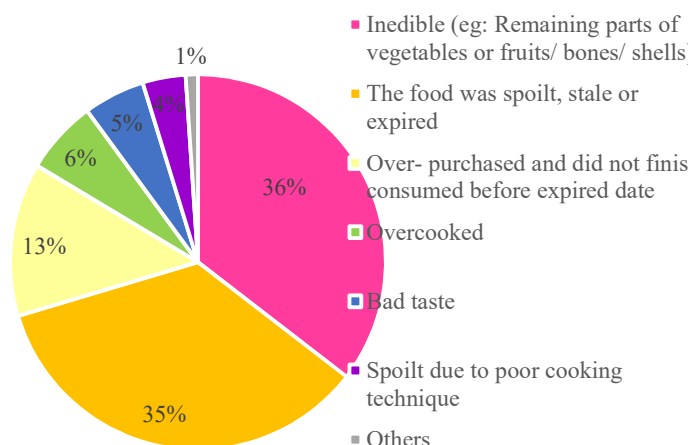


Figure 3. Reasons of household residents in Kota Kinabalu in kitchen waste disposal

The remaining 8% of the respondents claimed that they disposed kitchen waste separately from household waste by putting them in different carrier plastic bags to avoid bad smell and moisture that can attract rodents and flies. Although this habit is common among Malaysians in handling kitchen waste, it can however, increase the moisture content of wastes in the plastic bags that are disposed into landfill or sorted for recycling purposes [31]. The least preferred methods of managing household kitchen waste among respondents was its disposal into kitchen sink or drain which may cause environmental problems.

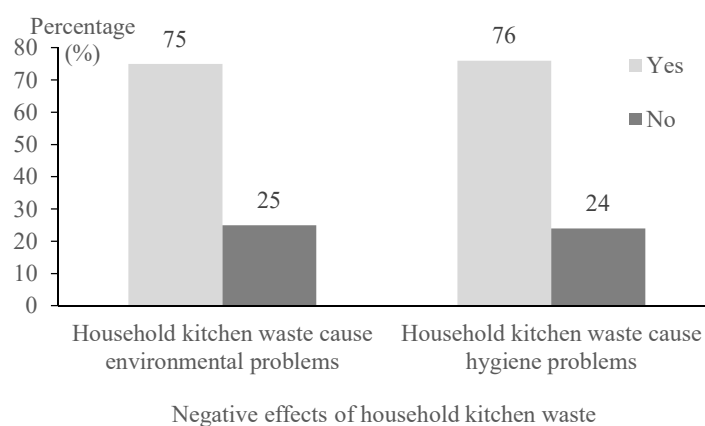


Figure 5. Perception of respondents on negative effect of kitchen waste in their respective residential area

Based on the samples studied, 76% claimed that they did try various methods to minimise kitchen waste generated from their household. The kitchen waste management methods used by respondents who claimed that they practice kitchen waste minimisation at home is shown in Figure 6. For the minimisation of household kitchen waste, the top three common methods among respondents, in a descending order are, avoidance of food leftovers, ensuring foods are in good conditions at purchasing stage, and also for animal feeding. In contrast, the less preferred methods among respondents to minimise household kitchen waste include using waste as fertilizers, home-composting, and preference on eating out rather than cooking at home.

Generally, to minimise household kitchen waste generation, the methods used can be divided into pre-consumption, consumption and post-consumption stages. Food management can be a factor facilitating the minimisation of kitchen waste at home [11]. At pre-consumption stage, kitchen waste can be reduced by avoiding excessively prepared foods, proper storage of fruits and vegetables to prolong their shelf life, avoiding excessive purchase of food and lastly, checking the expiration date of food when purchasing canned or packaged food. Among those who try to minimise their kitchen waste, more than 50% of the respondents check the details during food purchasing, avoid extra purchase of food, and cooking excessively. About 68.4% of the respondents in this study claimed that they always avoid leftover of food by consuming all of the food prepared which can minimise the post-consumption kitchen waste generation and it is gradually promoted by non-governmental organisations in local and also foreign countries such as China through campaign called “Clear Your Plate” [39]. Post-consumption stage of kitchen waste generally refers to edible food that have been purchased and collected but not used due

to an excess of consumed food. Instead of directly disposing kitchen waste at this stage into landfill, it can be utilised by turning them into garden fertilizers or compost. However, instead of turning waste into fertilizers or compost, 57.9% of the respondents preferred feeding leftovers to animals.

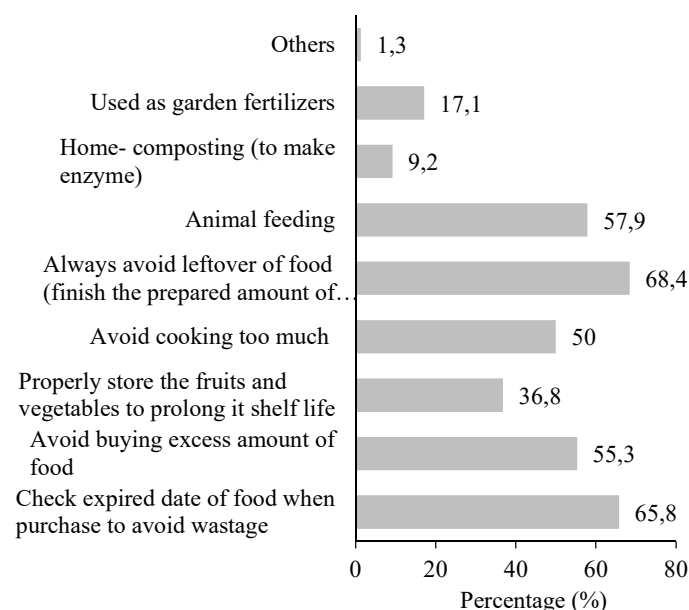


Figure 6. Methods used by respondents to minimise household kitchen waste

Figure 7 represents the motivations of respondents of Kota Kinabalu City in minimising household kitchen waste. In this study, 76% of the respondents put efforts in minimising household kitchen waste. It was found that there were several motivations for the respondents in minimising their kitchen waste in their home. The major motivations for the minimisation of kitchen waste among the respondents as agreed upon by more than 50% of the respondents were, in a descending order, personal habits, financial concern, and the perception that minimisation of kitchen waste is the right thing to do. Personal habits, the most common motivations, may influence the behaviours of consumers in minimising kitchen waste [34]. Based on the responses given by the residents, these habits included food purchasing behaviours, ensuring prepared food are finished and avoiding excessive cooking of food.

For 64.5% of the respondents, the desire to avoid wasting food due to financial concerns was viewed as a strong motivator to keep household kitchen waste to a minimum. The study of Graham-Rowe *et al.* [11] also found that financial waste concern was the priority before environmental concern. The respondents also mentioned during the survey that wasting food was a waste of money. Kitchen waste can be

generated if foods are purchased uncontrollably, improper storage of fruits and vegetables, and over-preparation of meals [34]. Some of the respondents thought that discarding the food due to the mentioned possible factors is a waste of money because they have already paid for it. To avoid or minimise leftover meals, some of the respondents usually keep them in the fridge and reheat them as meals for the next day. These explanations reflected that they want to save money as the foods are still edible and throwing it away would be a waste of money. Besides that, there were a few respondents who practice proper planning when buying food by preparing shopping list when going to the market. This could help prevent over-purchasing of food products.

About 53.9% of the respondents in this study seem convinced that minimising kitchen waste at home is a good idea and that it is a right thing to do. Study found that the behaviours of some consumers in kitchen waste matters are guided by a sense that by doing so it feels just “right” [11].

There were a few respondents in this study that sees kitchen waste as an ethical issue. Furthermore, some of them mentioned that they feel guilty and that money is wasted if there are leftover foods as these foods can actually be avoided. In a previous study, households in the United Kingdom also had the same feelings concerning kitchen waste [35]. Thus, they try to feed their home pets or some other stray animals with those leftovers instead of directly disposing the waste into the rubbish bin. On the other hand, there were respondents that linked kitchen waste with hygienic issue in their household area. As shown in Figure 4.6, 48.7% of the respondents thought that kitchen waste disposed together with other types of household solid waste may create hygienic problems. This is because kitchen waste, which have high moisture content, can attract rodents, ants and flies which can lead to environmental health problems [13].

Although there were opinions that kitchen waste from household should be kept at the minimum as it may bring negative consequences to the environment, the intention to reduce environmental impact is not the motivator that is most frequently selected by the respondents. Compared with financial concern, environmental concern was less of an issue for the respondents in this study. Besides that, only 23.7% of the respondents tried to avoid from generating kitchen waste because they sympathise people suffering from starvation in the deprived parts of the world.

In contrast, news, television program, social media, education, friends, family members, neighbours, and NGOs, were not the main motivations for the respondents to practice better household kitchen waste management. This result

contradicts the findings of a study conducted in Klang in which neighbours play a significant role in motivating the surrounding residents towards better kitchen waste management such as making compost using fruit peels [30].

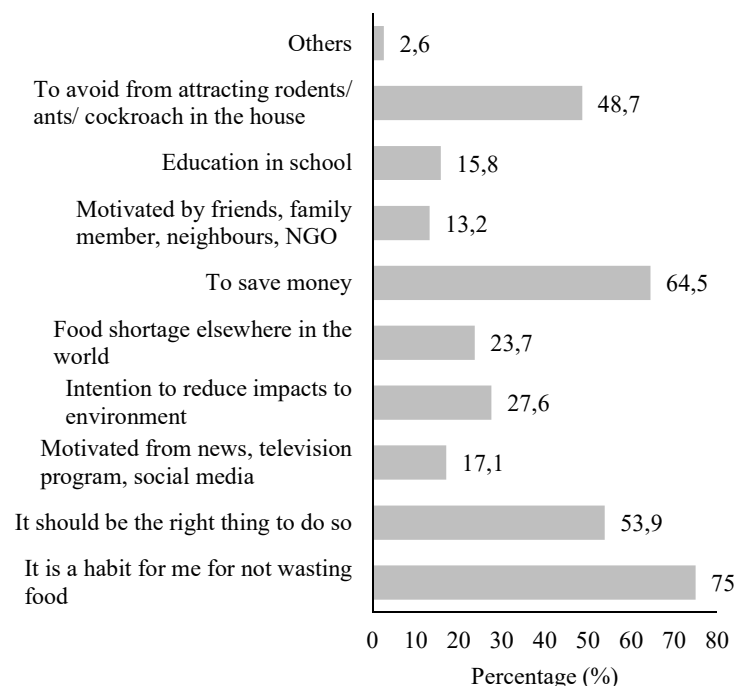


Figure 7. Motivations of residents in Kota Kinabalu City in minimising household kitchen waste

There were 24 out of the total 100 respondents in this study who did not try any method to reduce household kitchen waste. This is due to several barriers as shown in Figure 8. Time constraint was found to be the main barrier for post-consumption stage kitchen waste minimisation. About 45.8% of the respondents claimed that the lack of time as the main reason for them to not put any efforts in reducing kitchen waste at home. Time constrain in their daily schedule did not allow them for any practice of kitchen waste reduction.

Another barrier in minimising kitchen waste was the lack of idea on how to minimise kitchen waste at home as agreed upon by 37.5% of the respondents. Meanwhile, 33.3% of the respondents sees kitchen waste as a non-issue. It can be supported by the evidence from a previous study in which the lack of food management skills and knowledge about food storage and hygiene safety limit the intention of households to minimise the generation of kitchen waste [11]. Thus, it also reflects the inadequacy of respondents in their handling of kitchen waste upon generation through their dietary habits or meal preparation. As a result, some of the respondents in this study has the habit of simply throwing away their kitchen waste from home together with other types of household

kitchen waste. Furthermore, Agumuthu *et al.* [40] found that Malaysians have low awareness in matters related to waste generation and at the same time demand is low on products made from kitchen waste such as compost. This explains why some of the respondents did not treat kitchen waste generation as an issue to them.

Some of the respondents believed that kitchen waste will degrade by itself in the environment and hence there is no need to put environmental concern as a priority issue. In fact, kitchen waste has significant contribution to the portion of waste in municipal solid waste composition in Kota Kinabalu, which will eventually end up in landfill leading to an increase of the moisture content [18]. Moreover, some of the respondents may not feel that their own behaviour can contribute much to the negative consequences of kitchen waste as it is considered a social norm and that kitchen waste is something that is inevitable [11].

Situational factors such as limited space, time and cooperation are also considered as the barriers for source-separation of kitchen waste at home [41]. Similarly, although Sweden enforces source-segregation system for kitchen waste, it also faces this sort of problems [42]. In this study, 29.2% of the respondents treated space limitation as a barrier for them to perform source-segregation of kitchen waste.

A previous study mentioned that perception is usually a much stronger barrier than actual experience for people to participate in waste minimisation practice [43]. Thus, another factor that appeared to stand out as a potential barrier to minimise household kitchen waste was the individual perception that it is dirty and troublesome to segregate kitchen waste or to do composting at home.

About 25% of the respondents admit that they did not try out any kitchen waste minimising method at home because of their lack of interest in such efforts, and the feeling that it is energy and time consuming. In addition, kitchen waste matter was not an issue of concern for 12.5% of the respondents because there is no mandatory requirement for them to segregate household kitchen waste at source at this moment. However, the government has recently announced to make it mandatory for households to practice source-segregation of kitchen waste from September 2015, but this is only applicable in Peninsula Malaysia and the information is still not clear to the public at the time of the research [44]. It is interesting to note that none of the respondents chose the absence of law enforcement as barrier for them to minimise kitchen waste at home.

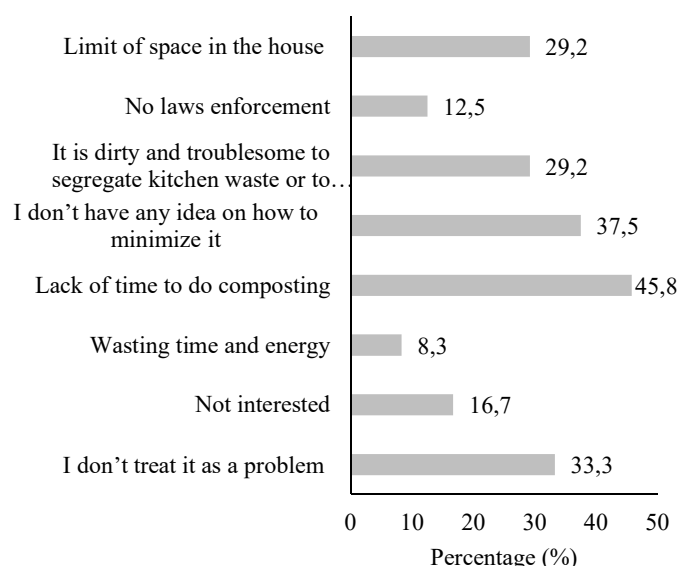


Figure 8. Barriers of residents in minimising household kitchen waste in Kota Kinabalu City

Respondents who admitted that they did not try any method in minimising household kitchen waste (24 respondents) were questioned on whether they will be involved in such efforts in the future. Based on Figure 9, more than half of the respondents think that they might get themselves involved in minimising household kitchen waste in the future. Meanwhile, 42% of the respondents will most likely participate in minimising household kitchen waste in the future. It can be suggested that those who answered “maybe” and “yes” are facing barriers such as lacking in knowledge on minimising kitchen waste and are constrained by time and space availability. Any future laws requiring the practice of keeping household kitchen waste minimum and its importance may also cause them to want to be involved in the future. Only one respondent would not participate in the future as the respondent deemed kitchen waste as a non-issue.

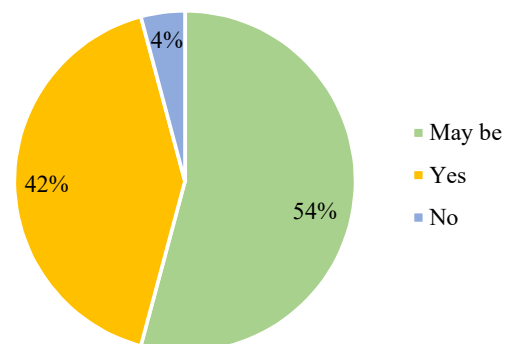


Figure 9. Opinions of the 24 respondents in future involvement in minimizing kitchen waste effort.

The final part of the questionnaire requires the respondents to give their opinions on the suitable efforts that can be implemented to minimise household kitchen waste. The results obtained are summarised in Figure 10. In this study, some of the possible efforts that can be implemented to minimise household kitchen waste included enforcement of household kitchen waste segregation system, installation of kitchen waste disposal unit (kitchen grinder), participation in related awareness activities or campaigns, implementation of the PAYT system and practicing home composting or using composting products made from kitchen waste.

Figure 10 summarises the opinions of the 100 respondents in the suggested possible efforts that can be implemented in the future to minimise household kitchen waste. The respondents were questioned on whether they agree with these suggestions and to provide reasons for their answer.

In some countries, kitchen waste is segregated at home which will then be treated biologically by composting or anaerobic digestion [9]. For example, to motivate households in segregating household kitchen waste, China, in a pilot study, provided waste containers, facilities and guidance with the help of separation instructors to households in Beijing [45]. The availability of waste facilities is found to encourage households in Malaysia to get involved in kitchen waste separation at home as well [41].

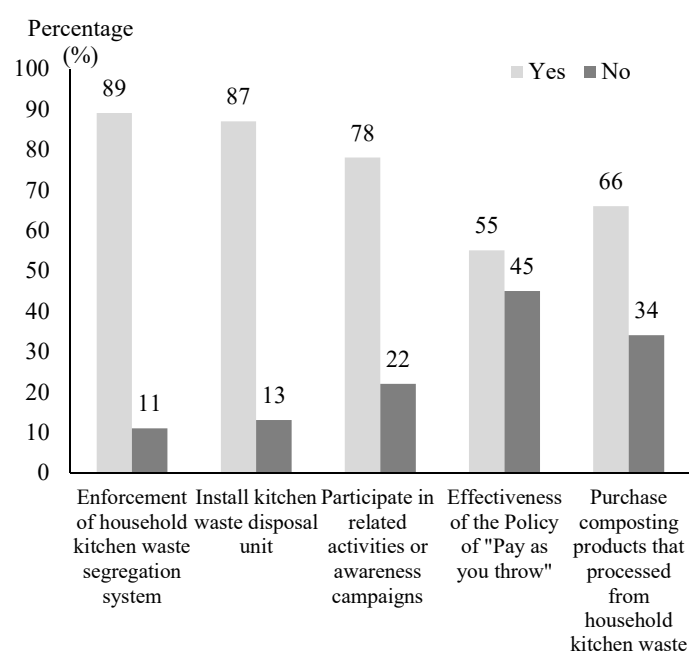


Figure 10. Responses from respondents for the possible efforts to be implemented in minimising kitchen waste

The enforcement of household kitchen waste segregation system was supported by 89% of the respondents. The reason given was that the environment will be cleaner when the wet kitchen waste is segregated from dry household waste. In contrast, the 11% that do not agree with this effort mentioned inconvenience, tiresome and impractical in a society with low awareness on this matter as the reasons.

Another practical way to overcome the barriers for source separation of kitchen waste without increasing the need for waste transportation which can avoid the problems such as bad odour and reduce the use of waste bins is through the usage of kitchen waste disposer [46]. On whether or not the participant were willing to install kitchen waste disposal unit (kitchen grinder) in every household in the future, 87% of the respondents agreed with the condition that the cost and maintenance fees of the kitchen grinder will be borne by the government. With the installation of kitchen grinder in every household, residents' inconvenience in segregating or composting kitchen waste can be reduced. Another reason for the willingness to install kitchen grinder is that it could help avoid blockage of kitchen sink caused by the disposal of kitchen waste directly into the sink. Those who were not willing to install kitchen grinder gave the reason that it is better to turn the waste into fertilizer or animal feed.

Campaigns with follow up actions and guidance can help the consumers to have better food management and increase awareness on the cost that can be saved by avoiding food waste [47]. Moreover, for waste minimisation programs, awareness campaigns or related activities to be successful, public participation is very important [15]. In this study, about 78% of the respondents claimed that they are willing to participate in these related activities organized by the government or NGOs to gain information in kitchen waste management. A few young respondents aged 21 to 30 years mentioned that they are willing to join the related activities to better understand kitchen waste minimisation provided that the location of activities is within their means and if they have spare time. However, study often mentioned that respondents tend to over-claim in participation when answering questionnaire [43].

Some of the older respondents aged 51 years old and above did not agree that such activities, programs or campaigns are effective in motivating people to reduce household kitchen waste. One of the reasons given was that such activities are not fruitful as there may not be any follow up actions such as monitoring whether or not the public are still continuing to practice the ways of minimising wastes or that if kitchen waste was effectively being reduced. Other reasons given were time

constrain and lack of interest. Thus, it is important to identify the motivations and barriers of the people when organising awareness activities to change households' behaviour in kitchen waste matters [47].

The PAYT system will be able to motivate households to change their disposal and recycling behaviour which will consequently reduce the amount of waste being disposed [48]. In Malaysia, Agamuthu *et al.* [49] found that Malaysians agreed that PAYT is a fair system that could help to minimise solid waste generation, but a majority deemed it as unsuitable for implementation in our country. Barely half of the respondents agreed with the implementation of the PAYT system as it can motivate residents to minimise kitchen waste at home to incur less expenses. However, the remaining respondents disagreed with the implementation of this system because it would be a financial burden and may cause illegal disposal of kitchen waste to avoid payment. There were those who mentioned that the PAYT system should only come into play once awareness among the public increases and sufficient waste facilities are supplied by the authority.

Composting is a beneficial approach in recycling kitchen waste because it reduces the composition of organic waste that ends up in landfill and it also yields environmentally friendly products which can be used for soil amendment and mulching [50]. However, composting rate is developing in a disappointed progress in Malaysia [51]. Composting is another suggested effort to reduce the generation of kitchen waste coming from households. Based on Figure 4.9, 66% of the total respondents mentioned that they will use or buy composting products in the future if it is needed. Those who supported purchasing composting products mentioned that those products are environmentally friendly, less toxic and that they recognize the benefits of using the products as they have used it before. For those who do not agree on the purchasing of composting products, they have the opinion that they will not be using the products, they have some concerns on the hygiene issues that may be brought upon by the products and the non-existence of a profitable market for the products as they can be made on their own.

Some suggestions that were provided by the respondents were: disseminating awareness among households or relevant authorities to provide incentives for those making home composts and sharing of information on making composting products from kitchen waste through non-government sectors or mass media. Sharing of information would be the way forward for mutual sustainable development [52]. Recent studies also stressed that knowledge plays an important role in household waste prevention [53], however this is just part of

the whole puzzle. All aspects need to be pieced together to create a mutual sustainable generation.

IV. CONCLUSIONS

This preliminary study managed to identify the motivations and barriers in minimising household kitchen waste in Kota Kinabalu City, Sabah. Most of the household residents in Kota Kinabalu City minimise their kitchen waste at home through various methods. The top three possible motivations encouraging the respondents to minimise kitchen waste were personal habits, financial concern, and the perception that it should be the right thing to do. This study also revealed that financial factor was a more important factor than food security and environmental issues in motivating the respondents.

On the other hand, the top three underlying barriers in minimising kitchen waste were time constrain, lack of knowledge on kitchen waste management and lack of awareness of this being a problem. These barriers discouraged the respondents from practicing kitchen waste minimisation at home.

The recommendations on minimising household kitchen waste based on the feedback from the respondents have been provided at the end of this study. Source-segregation of kitchen waste from household waste at home could be a good start. Nevertheless, the authority needs to have a strategic plan to implement this system. Through campaigns and awareness activities, knowledge and skill on food management can be disseminated among household residents. In a nutshell, suitable approaches should be introduced to motivate and overcome the constraints for household residents in Kota Kinabalu City to minimise kitchen waste.

Though the study has completed in 2016, the findings are still relevant as minimising waste will help to accomplish the Sustainable Development Goals (SDGs) on Responsible Consumption and will help to create a green community in the city.

REFERENCES

- [1] Hosetti, B. B. 2006. *Prospects and Perspective of Solid Waste Management*. New Age International Publishers, New Delhi, pp 1-2.
- [2] Uriarte, F.A. 2008. *Solid Waste Management: Principles and Practices: An Introduction to the basic functional elements of solid waste management, with special emphasis on the needs of developing countries*. The University of the Philippines Press, Philippines, pp 2-3.

- [3] Naimpally, A. & Rosselot, K. 2013. *Environmental Engineering: Review for the Professional Engineering Examination*. Springer, New York, pp 99-114.
- [4] Reddy, P.J. 2011. *Municipal Solid Waste Management: Processing Energy Recovery Global Examples*. BS Publications, India, pp 4-6.
- [5] Nahman, A., Lange, W., Oelofse, S. & Godfrey, L. 2012. The cost of food waste in South Africa. *Waste management*, **32**: 2147-2153.
- [6] Borongan, G. & Okumura, S. 2010. *Municipal Waste Management Report: Status- quo and Issues in Southeast and East Asian Countries*. AIT/UNEP Regional Resource Center for Asia and the Pacific (RRC.AP).
- [7] Agamuthu, P. & Fauziah, S. H. 2014. Sustainable 3R Practice in the Asia and Pacific Regions: The Challenges and Issues. In: Agamuthu, P. & Tanaka, M. (editors) *Environmental Science and Engineering*. Springer-Verlag Singapore, Singapore, pp 15- 40.
- [8] Azlina, A. H., Anees, A., Mahamad, H. I. & Nik Norulaini, N. A. R. 2012. Food Waste Management in Malaysia- Current Situation and Future Management Options. *Journal of Industrial Research & Technology*, **2** (1): 36- 39.
- [9] Bernstad, A. & Jansen, J. C. 2012. Separate collection of household food waste for anaerobic degradation– Comparison of different techniques from a systems perspective. *Waste Management*, **32**: 806- 815.
- [10] United Nations Environment Programme (UNEP). 2013. *WED THEME*. At: <http://www.unep.org/wed/2013/theme/>. (Accessed 18 September 2014).
- [11] Graham- Rowe, E., Jessop, D. C. & Sparks, P. 2014. Identifying the motivations and barriers to minimising household food waste. *Resources, Conservation and Recycling*, **84**: 15- 23.
- [12] Lee, S.H., Choi, K.I., Osako, M. & Dong, J. 2007. Evaluation of Environmental Burdens Caused By Changes of Food Waste Management Systems in Seoul, Korea. *Science of the Total Environment*, **387** (1-3): 42- 35.
- [13] Schott, A. K. E. B. S. 2012. *Household food waste management: Evaluation of current status and potential improvements using life-cycle assessment methodology*. PhD Thesis. Lund University, Sweden.
- [14] Chua, K.H., Endang Jati, M. S. & Leong, Y.P. 2011. Sustainable Municipal Solid Waste Management and GHG Abatement in Malaysia. *Green & Energy Management*, **4**: 1- 8.
- [15] Agamuthu, P. 2014. MSW Management in Malaysia- Changes for Sustainability. In: Agamuthu, P. & Tanaka, M. (editors) *Municipal Solid Waste Management in Asia and the Pacific Islands, Environmental Science and Engineering*. Springer- Verlag Singapore, Singapore, pp 195- 232.
- [16] KPKT (Ministry of Housing and Local Government, Malaysia). 2020. What Needs to be Separated at <https://www.kpkt.gov.my/separationatsource/en/> (Accessed 02 Jan 2020).
- [17] FMT (Free Malaysia Today). 2019. Garbage separation drive turning out to be a wasted effort? At <https://www.freemalaysiatoday.com/category/nation/2019/01/06/garbage-separation-drive-turning-out-to-be-a-wasted-effort/> (Accessed 02 Jan 2020).
- [18] Fatma, S. A., Latifah, A. M., Mariani, H. N. O. & Sabrina, J. H. A. 2013. Overview of Municipal Solid Waste Management Practices and Challenges in Sabah: A Review Paper. *Borneo Science*, **33**: 23-30.
- [19] Dewan Bandaraya Kota Kinabalu (DBKK). 2014. *City Hall to Make Food Segregation Compulsory*. At: <http://www.dbkk.sabah.gov.my/en/content/news/more/654>. (Accessed 20 September 2014).
- [20] Department of Statistics Malaysia. 2010. *Population and Housing Census of Malaysia: Preliminary Count Report*, 2010.
- [21] Oxford University Press. 2015. *Resident*. At <http://www.oxforddictionaries.com/definition/english/resident>. (Accessed 23 May 2015).
- [22] Kumar, R. 2014. *Research Methodology: A Step-by-Step Guide for Beginners*. 4th edition. SAGE Publications, Croydon.
- [23] Qing, L. 2013. A novel Likert scale based on fuzzy sets theory. *Expert Systems with Application*, **40**: 1609- 1618.
- [24] Iarossi, G. 2006. *The Power of Survey Design: A User's Guide for Managing Surveys, Interpreting Results, and Influencing Respondents*. World Bank Publications, Washington, pp 95- 96.
- [25] Healey, J. F. 2012. *The Essentials of Statistics: A Tool for Social Research*. Cengage Learning, USA, pp 144- 147.
- [26] Rea, L. M. & Parker, R. A. 2005. *Designing and Conducting Survey Research: A Comprehensive Guide*. John Wiley & Sons, San Francisco.
- [27] Johnson, R. & Kubly, P. 2012. *STAT 2*. Brooks/ Cole Cengage Learning, USA, pp 192-195.
- [28] Czaja, R. & Blair, J. 2005. *Designing surveys: A guide to decisions and procedures*. Sage Publications, USA, pp11- 27.
- [29] Leon, J. J., Brown, W. C., Ruch, L. O. & Johnson, T. E. 2003. *Survey Research: In-person, Mail, Telephone and Web Methods*. Streamline Surveys, Honolulu, pp 74-76.

- [30] Jereme, I. A., Talib, B. A., Siwar, C.S. & Begun, R. A. 2013. Household food consumption and disposal behaviour in Malaysia. *The Social Sciences*, **8** (6): 533-539.
- [31] Watanabe, K., Fukuoka, M., Ahmad Fariz Mohamed & Noor Ezlin Ahmad Basri. 2011. Assessing the Potential of Reduction and Recycling of Household Waste in Malaysia. In: Edmonton Waste Management Center of Excellence (ed.) "Waste- The Social Context" Conference 2011 Proc., May 2008, Edmonton, Alberta, Canada.
- [32] Schneider, F. 2008. Wasting Food– An Insistent Behaviour. In: Edmonton Waste Management Centre (ed.) "Waste- The Social Context" Conference 2011 Proc., May 2008, Shaw Conference Centre, Edmonton, Alberta, Canada: X1- 10.
- [33] Song, G., Li, M., Henry, M. S. & Zhang. S. 2015. Food Consumption and waste and the embedded carbon, water and ecological footprints of households in China. *Science of Total Environment*, **529**: 191- 197.
- [34] Quested, T. E., Marsh, E., Stunell, D. & Parry A. D. 2013. Spaghetti soup: The complex world of food waste behaviours. *Resources, Conservation and Recycling*, **79**: 43- 51.
- [35] Lyndhurst, B. 2007. *Food Behaviour Consumer Research: Quantitative Phase*. WRAP, United Kingdom.
- [36] Quested, T. & Johnson, H. 2009. *Final Report: Household Food and Drink Waste in the UK*. WRAP, UK.
- [37] Moh, Y. C. & Abd Manaf, L. 2014. Review Overview of household solid waste recycling policy status and challenges in Malaysia. *Resources, Conservation and Recycling*, **82**: 50–61.
- [38] Vun, L.W. & Witus, I.W. 2018. Thinking of "Home" for a Mutual and Sustainable Development for the Future: A Look into Aquaculture Activity as an Example. *International Journal of Management and Applied Science*, **28**: 26-28.
- [39] Celia, H. 2013. Operation Empty Plate: China's food waste campaigner. *BBC News*, 9th March. At: <http://www.bbc.com/news/world-asia-china-21711928>. (Accessed 26 May 2015).
- [40] Agamuthu, P., Fauziah, S. H., Khidzir, K. M. & Aiza, N. 2007. Sustainable waste management- Asian perspective. In *Proceedings of the International Conference on Sustainable Waste Management*, India, pp 15- 26.
- [41] Wan Azlina, Wan Ab. Karim Ghani, Iffah Farizan Rusli, Dayang Radiah Awang Biak & Azni Idris. 2013. An application of the theory of planned behaviour to study the influencing factors of participation in source separation of food waste. *Waste Management*, **33**: 1276-1281.
- [42] Dahlén, L. & Lagerkvist, A. 2010. Pay as you throw Strengths and weaknesses of weight-based billing in household waste collection systems in Sweden. *Waste Management*, **30**: 23– 31.
- [43] Lyndhurst, B. 2009. *Enhancing Participation in Kitchen Waste Collections*. Defra Waste & Resources Evidence Programme Final Project Report, Defra.
- [44] Bernama. 2014. Govt to gradually introduce mandatory waste separation from Sept 2015. *The Star Online*, 15th November. At: <http://www.thestar.com.my/News/Nation/2014/11/15/waste-sorting-mandatory-sept-2015/>. (Accessed 18 May 2015).
- [45] Yuan, Y. & Yabe, M. 2015. Residents' Preferences for Household Kitchen Waste Source Separation Services in Beijing: A Choice Experiment Approach. *International Journal of Environmental Research and Public Health*. **12**: 176-190.
- [46] Bernstad, A., Davidsson, Å, Tsai, J., Persson, E., Bissmont, M. & Jansen, J. C. 2013. Tank-connected food waste disposer systems – Current status and potential improvements. *Waste Management*, **33**: 193- 203.
- [47] Business for Social Responsibility (BSR). 2012. *Household Food Waste: Opportunities for Companies to Provide Solutions*. At: http://www.bsr.org/reports/BSR_Reducing_Household_Food_Waste.pdf. (Accessed 20 May 2015).
- [48] Folz, D. H. & Giles, J. 2002. Municipal Experience with "Pay As You Throw" Policies: Findings From a National Survey. *State and Local Government Review*, **34** (2): 105- 115.
- [49] Agamuthu, P., Chenayah, S., Hamid, F. S. & Victor, D. J. 2012. *3R Policy Implementation in Malaysia: Strategic Gap Analysis & Recommendations*, IGES. Hayama, Japan.
- [50] Badgie, D., Mohd Armi, A. S., Latifah, A. M. & Azizi, B. M. 2012. Assessment of Municipal Solid Waste Composition in Malaysia: Management, Practice, and Challenges. *Polish Journal of Environmental Studies*, **21** (3): 539- 547.
- [51] Md. Abdul Jalil. 2010. Sustainable Development in Malaysia: A Case Study on Household Waste Management. *Journal of Sustainable Development*, **3** (3): 91- 102.
- [52] Vun, L.W. 2015. Letter to the editor: 4Ss for sustainability. *International Journal of Environmental Studies*, **72**(4): 599-600.

- [53] Syahirah A.R., Siti Wahidah A.G., Nur Aida M.P., Aniadila K., Nurzafirah M.Z., Mahani S. and Ainu Husna M.S. S. 2018. Household food wastage prevention in Malaysia: An Issue Processes Model perspective. *Economic and Technology Management Review*, **13**: 51 – 62.