

**INVESTIGATION AND QUANTIFICATION OF
FOOD WASTE GENERATED AT USMKK
CAFETERIAS**

by

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**A dissertation submitted in partial fulfillment of
the requirements for the
Degree of Bachelor of Health Sciences (Hons)
(Environmental and Occupational Health)**

JUNE 2014

CERTIFICATE

This is to certify that the dissertation entitled 'Investigation and Quantification of Food Waste Generated at USMKK cafeterias' is the bonafide record of research work done by Rafidah binti Md Daud, Matric Number 109521 during the period of July 2013 to June 2014 under my supervision. I have read this dissertation and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation to be submitted in partial fulfillment for the degree of Bachelor of Health Sciences (Hons) (Environmental and Occupational Health). Research work and collection of data belong to the Universiti Sains Malaysia.

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LIST OF ABBREVIATIONS AND SYMBOLS

a.m.	Ante Meridiem
ASTM Standards	American Society of Testing and Material standard
EPU	Economic Planning Unit
e.g	Exempli gratia (for example)
et al.	Et alia (and others)
FW	Food waste
GHG	greenhouse gasses
LAs	Local Authorities
MHLG	Ministry of Housing and Local Government
MOEJ	Ministry of the Environment Japan
MOH	Ministry of Health
MSW	Municipal Solid Waste
p.m.	Post Meridiem
PPSK	<i>Pusat Pengajian Sains Kesihatan</i>
SWM	Solid Waste Management
SPSS	Statistical Package for Social Science
USMKK	<i>Universiti Sains Malaysia Kampus Kesihatan</i>
US	United States
WRAP	Waste and Resources Action Programme
kg	Kilogram
%	Percentage
r^2	Coefficient of determination

PENYELIDIKAN DAN PENGIRAAN SISA MAKANAN YANG TERHASIL DI KAFETERIA USMKK

ABSTRAK

Kajian ini bertujuan untuk menyiasat dan menentukan kuantiti sisa makanan yang dihasilkan di kafeteria USMKK. Kajian ini telah dijalankan di kafeteria Nurani, Murni dan PPSK. Kaedah timbangan telah dijalankan setiap hari dan diulangi untuk kafeteria yang berbeza dalam tempoh lima minggu dengan menggunakan alat skala gantung mudah alih. Borang soal selidik telah diedarkan secara rawak dalam kalangan 369 responden yang merupakan pelanggan di kafeteria USMKK ini. Kajian ini telah dijalankan untuk mengkaji pendapat peserta yang terlibat dalam penyelidikan ini mengenai isu-isu sisa makanan di kafeteria USMKK. Temubual separa berstruktur telah dijalankan terhadap kakitangan kafeteria untuk menyiasat sikap dan tingkah laku mereka dalam mengurangkan pembaziran makanan. Bilangan pelanggan di kafeteria telah ditentukan dengan menggunakan senarai semak. Keputusan kajian ini menunjukkan bahawa kafeteria USMKK menjana jumlah purata sisa makanan yang dapat dielakkan dengan 71.78 kg dan sisa makanan yang tidak dapat dielakkan dengan 275.93 kg. Keputusan regresi ($p > 0.05$) juga menunjukkan bahawa bilangan pelanggan bukan faktor peramal yang signifikan untuk sisa makanan yang dihasilkan. Daripada analisis Kruskal Wallis, terdapat perbezaan dalam kuantiti sisa makanan yang dihasilkan di kafeteria USMKK ($p=0.001$). Tambahan pula, kajian menunjukkan terdapat perbezaan yang signifikan ($p=0.001$) antara kuantiti sisa makanan yang dapat dielakkan dan tidak dapat dielakkan di kafeteria Nurani, Murni dan PPSK hasil daripada analisis Mann-Whitney. Menurut kajian, faktor penting yang menyebabkan penghasilan makanan sisa makanan tidak diketahui. Punca yang mempengaruhi sisa makanan di kafeteria USMKK mungkin disebabkan oleh faktor-faktor lain. Dapatan kajian turut merangkumi senarai penentu yang mempengaruhi pelanggan dalam menentukan pilihan kafeteria (contohnya lokasi kafeteria, murah, kualiti makanan dan lain-lain). Kempen kesedaran boleh meningkatkan pengetahuan mengenai sisa makanan dalam kalangan pelanggan. Di samping itu, ia akan membantu pihak pengurusan untuk merancang program yang sesuai dalam mengurangkan penghasilan sisa makanan untuk menyokong persekitaran yang mampan.

INVESTIGATION AND QUANTIFICATION OF FOOD WASTE GENERATED AT USMKK CAFETERIAS

ABSTRACT

This study aims to investigate and quantify the food waste generated at USMKK cafeterias. This research sampling has been conducted at Nurani, Murni and PPSK cafeterias. The weighing methods were carried out daily and repeated for different cafeteria within five weeks using portable hanging weight scales. A survey was conducted using self-administered questionnaire which was distributed randomly among 369 respondents who are the customers at the USMKK cafeterias. This survey was conducted to investigate the opinions of the research participants on food waste issues within USMKK cafeterias. Semi-structured interview was conducted among cafeteria staffs as to investigate the attitude and behaviour of them in reducing the food waste. The number of customers at the cafeteria was determined using checklist. The results of this study indicated that USMKK cafeterias generates average amount of avoidable food waste with 71.78 kg and unavoidable food waste with 275.93 kg. The regression results ($p > 0.05$) also showed that number of customers is not a significant predictor factors for food wastes generated. From the Kruskal Wallis analysis, there was a difference in the quantity of food wastes generated at USMKK cafeterias ($p = 0.001$). Furthermore, the significant differences ($p = 0.001$) were found between avoidable and unavoidable food wastes quantities generated at Nurani, Murni and PPSK cafeteria as a result of the Mann-Whitney test analysis. According to the research, the predictor of food waste generation is unknown. The attributes influencing food to be wasted at USMKK cafeterias might due to other causes. Findings include a list of determinants that influence customers considered in determining their choice of cafeteria (e.g. location of cafeteria, cheap, food quality). Awareness campaign could increase the level of knowledge about food waste among customers. In addition, it would help the top management to plan suitable programme in minimizing the production of food waste as to support sustainable environment.

CHAPTER 1

INTRODUCTION

1.1 Background

Malaysia is a developing country with the total population of 28.3 million compared with 23.3 million in 2000 (Department of Statistics, Malaysia, 2010). Wan Azlina et al. (2013) stated that the total municipal solid waste (MSW) generation in 2005 was 19,100 tons. This amount is expected with assumptions of 36% growth to be 31,000 tonnes/day and the rate of average generation ranges from 0.5-0.8 kg/person/day to 1.7kg/person/day in major cities in 2020. The daily generation and volume rate of MSW was accelerates due to the economic growth, business activities and consumption rate.

Asmawati, Nor Ba'yah & Fatimah (2011) reported that the increasing number of students in the universities showed the escalating growing pattern in the amount of waste produced every day. The generators predominantly are students, staff, cafeteria staff and visitor. The overloaded bins and uncollected in waste bins have created a foul smell and insightful scenery. Solid waste is a major environmental problem just not only in the university but also in Malaysia as sometimes litter can be seen at the roadside, drains clogged up with rubbish and others. The generations of extremely great amount of waste ranging from biodegradable to synthetic waste have resulted from rapid development, population increase and changes in consumption pattern directly and indirectly.

Agamuthu et al. (2007) identified that organic matter is normally dominates the waste composition of most countries in the world followed by paper and plastics.

Approximately, 75% of the total waste stream is consisted of organic waste in Asian countries except Japan. In 1980s and the 1990s, the average composition of organic waste is approximately 50% and comprising a very high percentage of processed kitchen waste and food waste.

Zhang et al. (2006) identified that uneaten food and food preparation leftovers are the food waste that generates from residences, commercial establishments such as restaurants, institutional sources like school cafeterias and industrial sources. Jing-Yuan et al. (2006) found that the common methods for food waste management are landfill and incineration. However, food waste that disposed in the landfill requires large-scale areas and incineration method consumes a lot of energy. The environmental problems such as foul air, bad odour, and increases in the number of pathogens in soil and water were caused by the disposal of food waste at landfill.

Food waste production is a complex issue in cafeteria in which many respondents play a part in this study. A lack of effective feedback between students and staff and also the cafeteria staff will be some causes for food waste being generated in some cafeteria. The effective feedback from them has shown that food waste will be minimised and ensuring the cafeteria meals meet demand (Cordingley, Reeve & Stephenson, 2011).

1.2 Problem statement

Recent statistics showed about more than 40% of the total waste stream was dominated by organic waste (food waste) in Malaysia from 1975 to 2005 (Agamuthu et al., 2009). These food wastes (FW) are mainly from commercial restaurants, school cafeteria, residential homes and others (Musa et al., 2014). Local Authorities (LAs) are responsible for the waste collection, transport to disposal sites and the operation of some recycling centres. The Ministry of Housing and Local Government (MHLG), the Ministry of Health (MOH) and the Economic Planning Unit (EPU) are responsible for providing technical and financial assistance to local authorities. Currently, with municipal solid waste generation of 17,000 tonnes in Peninsular Malaysia daily, the amount is expected to be more than 30,000 tonnes in the year 2020 (Local Government Department, Ministry of Housing and Local Government, 2005).

According to Economic Planning Unit (2010), the important issue of public health is the solid waste disposal and collection. In the Tenth Malaysia Plan 2011-2015, Federal Government are responsible for the solid waste management and public cleansing by providing support to local authorities, delivering comprehensive and sanitary services and ensuring waste management in a sustainable manner. The existing 112 unsanitary landfills will be rehabilitate and some of them are upgrade to sanitary landfills. In addition, the government will built transfer stations, integrated material recovery facilities, sanitary landfills and other disposal and treatment facilities during the Plan period. Bulky waste, garden waste and recyclables will be collected separately as to facilitate recycling and waste recovery.

Azlina, Anees, Mahamad & Nik (2012) reported that even though food waste issue is critical as municipal solid waste issue, the system of municipal solid waste management systems in Malaysia are also very poor. Presence of food waste will

cause contamination of other waste components including the recyclable materials especially paper and cardboard and it could reduce their value for recycling. The biodegradable wastes such as food waste will almost immediately start to undergo microbiological decomposition as a result of the growth of bacteria and fungi. Efficient waste management is not impossible to be conducted. For this reason more generalized field procedures, based on common sense and random sampling technique have evolved for determining composition (Tchobanoglous, Theisen & Vigil, 1993).

According to Malakahmad, Muhammad, Shamsul Rahman & Mohammed (2010), the scenario of food waste will get worse in humid and high temperature environment of tropical countries like in Malaysia. In addition, it could lead to cross contamination, value drop, flies can start to breed and odorous compounds can develop if wastes are allowed to remain in storage containers which were open for extended period of time. The most encouraging way in separating the amount of food waste is through separate collection of food waste in food waste bins. It would increase perception about the participation which in turn may encourage the involvement in food waste separation. However, it is less encouraging approaches to separate food waste at home by the food waste collection centres and composter units provided to each household. The main predictor towards waste separation is the attitude towards waste separation. The situational factor in turn could be an insignificant predictor of the food waste separation behavior (Wan Azlina et al., 2013).

1.3 Research objectives

1.3.1 General

To analyse the food waste generation at USMKK cafeterias

1.3.2 Specific

- 1) To determine the quantity of food waste generated in USMKK cafeterias
- 2) To compare the quantities between avoidable and unavoidable food wastes generated at each cafeteria
- 3) To determine the relationship between the number of customers at the cafeteria and the amount of food waste generated
- 4) To identify the factors that influence the generation of food waste in USMKK cafeterias

1.4 Hypothesis

Alternative Hypothesis

- 1) The amount of food waste generated for each cafeteria is high daily
- 2) The amount of unavoidable food waste generated for each cafeteria is high
- 3) The higher the number of customers, the higher amount of food waste will be generated
- 4) The cause of generation of food waste is the quality of food/ taste

1.5 Definition of term

1.5.1 Food loss

It means any decrease in edible food mass at the production, post-harvest, processing and distribution stages in the food supply chain. The food loss are mainly caused by inefficiencies in the food supply chains, lack of technology, insufficient skills, knowledge and management capacity of supply chain actors, no access to markets and natural disaster (Food and Agriculture Organization of the United Nations, 2012).

1.5.2 Food waste

It refers to the amount of food which is fit for consumption which is thrown away as a result of human action or inaction (Priefer, Jorissen & Brautigam, 2013).

1.5.3 Waste Management

Waste management was a social phenomenon in that those who engage in waste management were more likely to be concern with the impact of environmental issues on the environment and other people (Tonglet et al., 2004).

1.6 Significance of study

This study is to determine the quantities of food waste being generated at *Universiti Sains Malaysia Kampus Kesihatan (USMCK)* cafeterias and to know the causes of its generation. Thus, this can be used as an additional knowledge about the effects of the improper handling of food waste on the human health and environment especially to cafeteria workers. The findings could also help the top management to plan suitable programme in minimizing the production of food waste as to support towards sustainable environment.

CHAPTER 2

LITERATURE REVIEW

2.1 Food waste

Food waste is part of the solid waste generated. Waste occurs along the entire food chain, from farmers and manufacturers down to supermarkets, restaurants and consumers. Sources of food waste vary including food industry, retail, restaurant, hotels, catering, canteens and households (Katajajuuri et al., 2012). Waste in the food service industries occurs in restaurants, hotels and institutions (such as school, hospitals and penitentiaries). It is largely attributable to quality standards and over-serving which referred to as "plate waste" (George Morris Centre, 2012). On average, United State (US) diners leave 17% of uneaten meals (Gunders, 2013). Most of the food in the cafeteria is served in buffets. This might lead to overtaken of the food and high possibilities of not finishing the meals.

Food waste is a waste composed of raw or cooked food materials. It includes food materials discarded at any time relating to food waste generated before, during or after food preparation such as vegetable peelings, meat trimmings, and spoiled or excess ingredients or prepared food. Food waste can be categorized as either avoidable or unavoidable. However, food waste can be both edible and inedible. Edible food waste is considered avoidable, although Waste and Resources Action Programme (WRAP) describes some of this as "possibly avoidable", given certain foods that are not unanimously considered edible. Avoidable food waste consists of products that could have been eaten such as leftovers, food left to go bad and food past its sell-by date. Unavoidable food waste consists of non-edible waste such as

peels, bones, shells and coffee grounds as well as any fat or moisture lost in cooking. The distinction is clarified in the Table 2.1 (WRAP, 2012).

Table 2.1: Edible and inedible food waste

Edible food waste	
Avoidable food waste	It means the food that is thrown away at some point prior to disposal or edible in the majority of situations (e.g. slices of bread, apples, meat)
Possibly Avoidable food waste	It defines as food that can be eaten by some people and others do not (e.g. bread crusts) or food that is prepared in one way but not in another (e.g. potato skins)
Inedible food waste	
Unavoidable food waste	Any waste from food preparation that cannot be eaten under normal circumstances (e.g. bones, egg shells, pineapple skins)

Source: based on Quested et al. (2012)

Gustavsson et al. (2011) reported that one-third of all food produced for human consumption is lost or wasted globally amounting to as much as 1.3 billion metric tonnes annually. Food waste is an issue in all of the major economies in the world and it is a global problem of staggering proportions but the underlying reasons differ between countries. Due to spoilage in warm and humid climates resulting from the lack of modern transport and storage infrastructures, developing countries have high losses at the post-harvest and processing stages while food waste in industrialized countries is dominated by retail and consumer waste.

2.2 The contributing factors to the generation of food waste

Food service in Malaysia universities have been providing day-to-day variety food options for their students and staff (Nadzirah, Othman, Ab Karim & Ghazali, 2012). In addition, according to Lee (2000), many of the foodservice at universities and colleges provide many variety meals options and delivering fresh, healthy and tasty ingredients as customers' needs are concerned. Some of the university and college have different type of foodservice operations in which the concept representing a franchised restaurant brands or a self-branded restaurant concept.

Cordingley et al. (2011) studied the nature and types of food waste in schools, the reasons of food are wasted in schools and the impact of interventions developed to reduce the food waste. The reasons identified related to food being wasted were grouped into three categories which are operational, situational and and behavioural. Operational reasons for food waste relates to catering policies on meals and the system. Situational not directly connected to food but to broader issues such as rushed lunch hours or the canteen environment while behavioural relating to individual choices and preferences. However, there may have been an increase in food waste due to nutritional value and food quality that could affect customer satisfaction (WRAP, 2007/08).

The amount of food waste generated is influenced by a variety of interlinked factors. Based on two comprehensive UK-based studies (WRAP, 2007a; WRAP, 2007b), the food waste patterns also influenced by a routines which are actions and behaviours that tend to repeat over time. This set of habitual actions are pre-shopping, shopping and post-shopping routines (Malinchev, 2014). According to WRAP (2007a), individual with consistent pre-shopping routines such as checking before shopping, planning and making a written shopping list tend to waste less food. Besides that,

unused food is often discarded due to consumers are incapable to determine the exact amount of food required for consumption.

Creedon, Cunningham and Hogan (n.d) stated that food preparation residues (eg vegetables peelings, meat trimmings), over-preparation of items in the kitchen (eg prepared food portions that cannot be reused/ frozen) and over-sizing of food portions are the reasons of food waste is produced. WRAP (2007a) also identified that cooking too much at the preparation stage is the possible food can be wasted. According to Glanz (2008), personal attitudes towards edibles, cooking and eating habits, shopping behaviour and storage of edibles have been identified as relevant factors for the arising food waste. The amount of food waste generated is influenced by consumption behaviour. In context of food consumption, preferences, taste, time constraints and prices are the decision criteria that influence the food consumption on an individual level (Reisch, Eberle & Lorek, 2013).

The level of customer satisfaction may be identified by various determinants from internal and external factors. Md. Abdullah (2012) reported that poor sanitation, poor food quality, insufficient facilities, poor food choice and service quality have effects on customer satisfaction. Shanka & Taylor (2005) indicated the most important determinants students would be considered in choosing a particular cafe on campus were significantly quality, price and service. These determinants of customer's satisfaction towards cafeteria could influence the generation of food waste.

Hwang (2010) studied the factors influencing customer satisfaction or dissatisfaction in the restaurant business and the findings indicated that customers most satisfied on good quality, tasty food, and restaurant cleanness. However, good value, tasty food and employees' knowledge of menu most affect customer dissatisfaction. It is important to pay a lot of attention to taste in relation to waste reduction. Therefore,

some food services pay attention to improving the quality of the food they serve and to adapt it to the customer needs (European Federation of the Associations of Dietetians, 2012). According to (WRAP, 2007/08), uneaten food was resulted from the food that are not the choice of meal option among customer. The food that being served are food that they have not chosen and they do not like.

Slow service in preparing and serving the food may affect lack of confidence among individual in the catering service to deliver additional or alternative food items at short notice. This may affect individual satisfaction and have a negative effect on the amount of food eaten (NHSE Hospitality, 2005). Aigbedo & Parameswaran (2004) stated that it is important for the management to provide goods or services in a way that pleases the customers. Commitment from workers and support from the management is necessary in order to achieve a quality service organization. Foodservice managers must be knowledgeable of expectations and perceptions of service quality and satisfaction among the students. Hence, it is important for college and university foodservice providers to measure services provided that affect students satisfaction (Estepa, Shanklin & Back, 2005).

According to NHSE Hospitality (2005), environmental reasons such as unpleasant smells, excessive or intrusive noise may reflect individual satisfaction and have a negative effect on the amount of food eaten. Andaleeb & Caskey (2007) had studied about satisfaction with food services: insights from a college cafeteria. This study was carried out to determine college students' satisfaction with their food service establishments. Result shows that atmosphere, responsiveness and cleanliness are the significant variables that explain student satisfaction. Lee (2000) also deduced that college students' satisfaction levels were influenced by cafeteria environment, employee competency, price and nutritional information.

2.3 Food waste management in Malaysia

According to Ministry of Housing and Local Government (2011), the largest source for emission of greenhouse gasses (GHG) is the food waste that was disposed at the landfill sites. In addition, solid waste in Malaysia comprises of 50% of food waste at source and 70% of disposal of food wastes at the landfill sites. The treatment of generation of food waste at Malaysia is extremely limited. The innovative strategies are still very limited and under-developed for proper food wastes management. The possible solution to deal with the challenge of the overall waste management is a strategic plan primarily focused on food waste management that emphasizes the concepts of 3R (Reduce, Reuse and Recycle).

In 1987, the Malaysia Government requested the Japan Government to assist in improving the entire waste management especially at the disposal sites. The upgrading and effective management of landfill sites are significantly contributed by transfers of knowledge from Japan to Malaysia for the past 25 years. The objective of Technology Development and Transfer project has been achieved. However due to various local constraints, there are still lacking in terms of "duplication" (Theng, 2004).

Based on the Collaboration Project between the Ministry of Housing and Local Government Malaysia (MHLG) and Ministry of the Environment Japan (MOEJ), the government summarizes the strategies into six strategies (refer Figure 2.1): which are collection of baseline data, establish "Food Waste Recycling Regulation", minimize at source, treatment at source, centralized food waste treatment facilities and final disposals. Strategy 1 and 2 focus on data collections which set up regulations and provide incentives. Strategy 3 aims at minimizing at source which causes less food waste to manage. Strategy 4 is turning the food waste into resources at source as the waste generators to minimize for proper treatment and achieve the targets. Strategy

5 will establish more centralized facilities for food waste treatment as to provide alternatives. Last strategy is an appropriate final disposal with energy recovery as to minimize the impacts from the food waste (Ministry of Housing and Local Government, 2011).

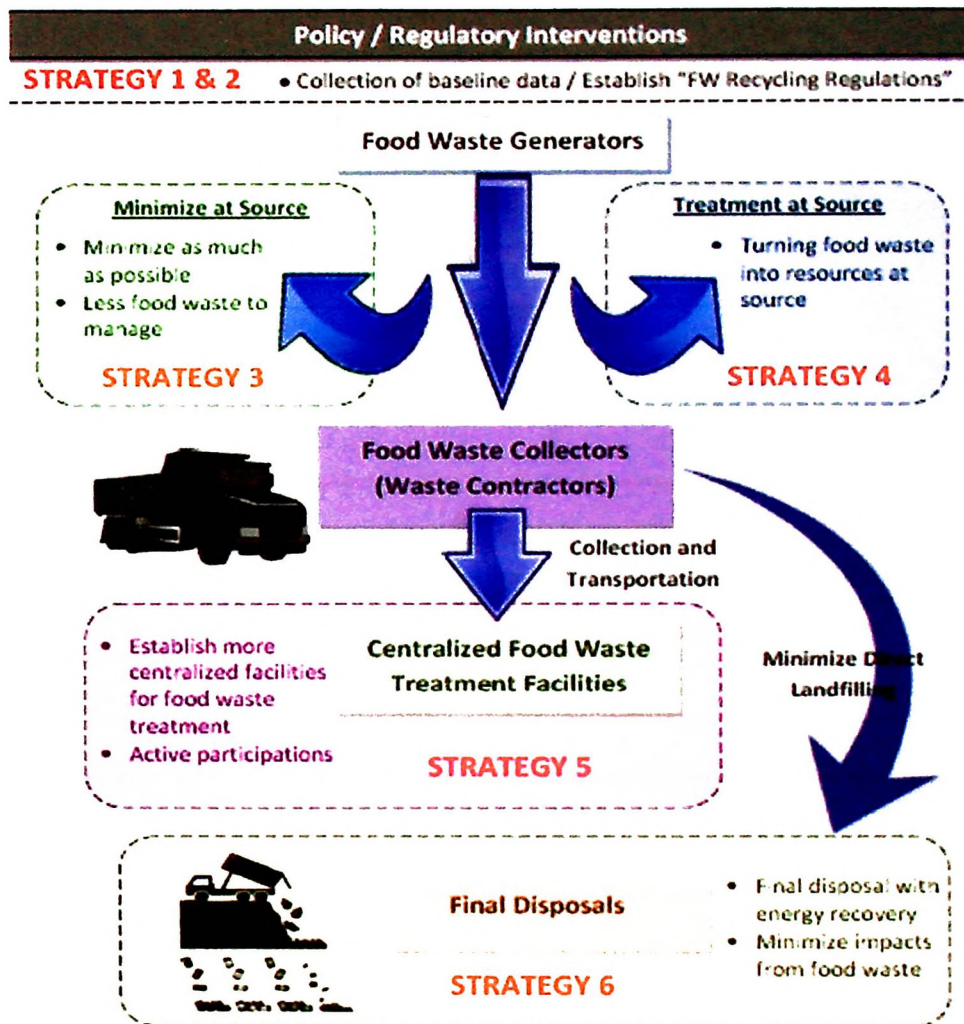


Figure 2.1: Summary of Strategies

Source: (MHLG, 2011)

However, the management of food waste suitability is highly dependent on the costs of setting up and running the system. Based on the hierarchy shown in Figure 2.2, to set up highly advanced facility for recycling, recovery and safe disposal is normally the most expensive part of waste management. However, the first and second

priorities which are waste prevention and reuse are the least cost (Azlina et al., 2012).



Figure 2.2: Hierarchy of waste management option

Source: From "Food Waste Management in Malaysia- Current situation and future management options" by Azlina, A.H. et al., 2012, *Journal of Industrial Research & Technology*, 2(1), p. 36-39

According to Syed Azwan (2009), immediate action and improvement of garbage disposal management is needed for several issues in Malaysia. In Malaysia, there is no segregation of food waste at source nor separated from other solid wastes at landfill sites before disposal. At present, only seven of the 289 landfills in Malaysia are environmental-friendly sanitary sites.

2.4 Customer attitude and behavior towards generation of food waste

According to Graham-Rowe, Jessop & Sparks (2014), food waste behaviour among some people was guided by a sense of what they felt was 'right'. To keep food waste to a minimum, they should have a higher level of concern for the negative consequences of food waste. Motivation to minimise food waste due to the environmental concerns under such conditions might be less likely to be volunteered spontaneously among participants (Doron, 2013). Some participants did not concern the link between these behaviours and a reduced environmental impact. There should be an educational program and continuous policies for enhancing sustainable proenvironmental attitudes as to minimise food waste. The concern the environment's potential to be a trigger of behaviour change is inconclusive. This is because consumers have so far failed to make any connection between food waste and environmental impact. There is widespread belief that food waste has no environmental impact whatsoever because it is biodegradable and the consumers unreservedly believe that packaging waste is a greater environmental issue than food waste. The potential for an environmental message is unclear because consumers have yet to make any link between food waste and the environment even those who are environmentally conscious (Brook Lyndhurst, 2007).

According to Refsgaard & Magnussen (2009), the formal rules and legislation will have impact on environmental or success of the system concerning who are responsible on sorting out the food waste. In addition, attitudes to recycling of food waste may be affected in a positive way if there are system of sorting out food waste and efforts of sorting are followed up by others. However, the incentives for recycling can change behaviour if the extra effort or cost of recycling match with these benefits. Separation at source depends on individual participation. Therefore, the success of recycling will be affected by the individual behaviour and attitudes. In Malaysia, the

environmental awareness is low. Furthermore, due to the lack of awareness and knowledge among Malaysian community about solid waste management (SWM) issues and being ignorant about the effect of inappropriate SWM, it has definitely worsened the problem (Asmawati, Nor Ba'yah & Fatimah, 2012).

CHAPTER 3

METHODOLOGY

3.1 Study design

This was a cross-sectional study to investigate the food waste quantities generated from cafeteria in *Universiti Sains Malaysia Kampus Kesihatan (USMKK)* contributed by consumer and cafeteria staff in a randomly selected and representative sample of research participants. This study was used to answer descriptive questions and the information was collected from the participants at a single point in time (Katz, 2006).

3.2 Study location

This research has been conducted at USMKK cafeterias which were Nurani, Murni and PPSK cafeteria. These cafeterias were selected because they provide the service of meals to the USMKK's students and staff. These cafeterias operated from 7 am until 7 pm every day. USMKK's students and staffs preferred to come to these cafeterias because the location of the cafeteria is strategic as it is near to the office, campus and hostel.

3.3 Methods of study

3.3.1 Weighing method

a) Instrument

The portable hanging weight scale with capacity of 5 kg and 50 kg was used for weighing the avoidable and unavoidable food wastes (Figure 3.1). These scales are extremely useful because of their portability, precision and durable design.



Figure 3.1: Portable hanging weight scale
(Left) Capacity: 50 kg (Right) Capacity: 5 kg

b) Data collection

This study involved the weighing method which took place over a period of five weeks starting from 15th December 2013 until 16th January 2014 which ended before PPSK student's semester break. In this study, the wastes at the cafeteria were collected and sorted daily during this period. The method for measuring the quantification of food waste by employing manual sorting was referred to the American Society of Testing and Material standard (ASTM Standards, 2003) where food wastes are sorted into two main groups; avoidable and unavoidable food waste.

Based on this method, each food waste was sorted into the following main components which are avoidable wastes (e.g.: spoiled products and overproduction) and unavoidable wastes (e.g.: vegetable peels and bones). After the food wastes had been sorted, the food wastes had been weighted using portable weight.

The samples on the composition and quantities of food waste being generated in USMKK cafeterias was measured by using portable weight scale. The food waste

was collected at the cafeteria area. The waste was sorted into different categories. The food waste was collected simultaneously at the ends of the cafeteria operation times. Then, the waste was weighted and the weight reading was recorded. After that, the food waste was collected into plastic bag and was located at one place and waste truck will pick up the waste. This process was repeated daily for each cafeteria.

The wastes at the cafeteria were collected



The food waste was manually separated



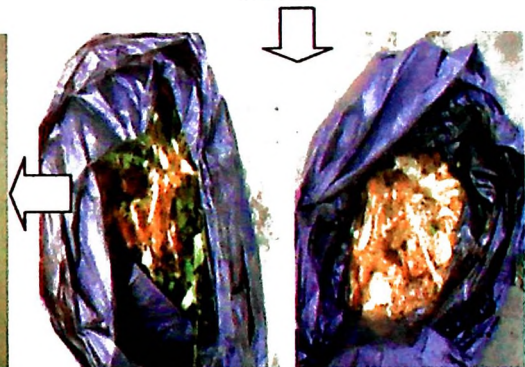
The food wastes had been weighed using of portable weight



Capacity: 50 kg Capacity: 5 kg



Each food waste was sorted into avoidable wastes and unavoidable wastes



After the waste had been weighed, the waste was placed at point of collection



Figure 3.2: Weighing method process flow

3.3.2 Questionnaire

a) Sample size calculation

Study participants consisted of USMKK cafeterias' customers who are students from three schools in Universiti Sains Malaysia Health Campus, staff, other customers who eat at the cafeteria and cafeteria staff. 369 questionnaires were distributed among the 8696 of USMKK population. The sample size was determined by using Cochran's formula and referred to Krejcie & Morgan's sample size table. These sample sizes that were selected were considered to be representative of the USMKK cafeterias' customers.

$$n = \frac{n_0}{(1+n_0/N)}$$

$t = 1.96$ - t value for $\alpha = 0.05$ $N \geq 60$ population
 p and $q = 0.5$ - the maximum ratio may produce maximum sample size
 d = an acceptable margin of error for the estimated portion is 0.05

$$n_0 = \frac{(t^2)(p)(q)}{d^2}$$
$$n_0 = \frac{(1.96^2)(0.5)(0.5)}{0.05^2}$$
$$n_0 = 384.16$$

$$n = \frac{n_0}{(1+n_0/N)}$$
$$n = \frac{384.16}{(1+384.16/8696)}$$
$$n = \frac{384.16}{1.04}$$
$$n = 369.38$$

Thus, the required sample size is 369 with a 90.9% response rate (refer Appendix H).

b) Composition of questionnaire

The questionnaire was provided in bilingual which were English and Bahasa Malaysia. The questionnaire consists of eight questions with close-ended format. The questionnaire form was divided into two parts which are Part A and Part B. In Part A, the respondents were asked about the demographic background such as gender and ethnic. The second part of the questionnaire (Part B) is about the attitude and behaviour towards generation of food waste at the cafeteria.

The questionnaire itself consisted of both multiple choice answer and likert-scale types questions. This was appropriate for the purpose of this project because multiple choice answer questions ensured that it would receive answers in regards to specific variables while the likert-scale type's questions gave the cafeteria's customers the opportunity to express their thoughts on this research project openly. The likert-scale types of questions can help to ascertain how strongly the participants agree or disagree with a particular statement. Furthermore, proposing both types of these questions increased the reliability and validity of the data. The questions were derived and modified from multiple sources (Gunders, 2013; Abeliotis *et al.*, 2012; Katajajuuri *et al.*, 2012; Monier *et al.*, 2011; Budgell *et al.*, 2007). The translation of the questionnaire was checked by English teacher from School of Languages Literacies and Translation of Universiti Sains Malaysia Health Campus.

c) Data collection

The purpose of the questionnaire was to investigate the opinions of the research participants on food waste issues within USMKK cafeterias. The questionnaire was self-administered at Nurani, Murni and PPSK cafeteria starting from 1st January 2014 until 16th January 2014. The research participants consisted of individuals who eat at these cafeterias and were primarily USMKK's students and staff. A grab sampling technique was used for the questionnaire. The participants were given as much time as they liked to complete the questionnaire. The questionnaire were collected back right after the respondent complete it. Once completed, the questionnaire was placed directly into an envelope for confidentiality purposes.

Prior to this research, the questionnaire were pre-tested. Questionnaire design was screened to check out any fundamental problems to respondents during fulfil the questionnaire form. This pre-tested involved 12 people of USMKK cafeterias' customers who were selected randomly. The pilot study was carried out in the month of November 2013 in order to check the reliability and validity of the questionnaire prepared. Validity was ensured by obtaining the cronbach alpha value through the validation analysis. The questionnaire was reliable and valid as the cronbach alpha value are 0.721 for likert-scale questions and 0.709 for multi-choice answer questions. According to Saunders et al. (2009), values within the range of 0.7 and 0.95 are generally accepted as an indication of a strong internal consistency.

A questionnaire was chosen in this research because it allows the researcher to gather information about the ideas, knowledge, feelings, opinions and behaviours of research participants (Phellas, Bloch & Seale, 2011). Through a questionnaire, the researcher can study the participants' thoughts about the food waste issues within

USMKK cafeteria and their attitude and behaviour towards generation of food waste at the cafeteria.

3.3.3 Checklist for counting number of customer

The checklist consisted of square/ space that require the USMKK cafeterias' customers to tick in the appropriate column (refer Appendix G). This method was carried out to determine the number of customers who came to Nurani, Murni or PPSK cafeteria. This checklist had been put on the cashier table and at each stall at the cafeteria.

3.3.4 Semi-structured interview

Semi-structured interview was conducted among cafeteria staff as to investigate the attitude and behavior of them in reducing the food waste. Interview questions consisted of five questions with open-ended format. This semi-structured interview allowing the cafeteria staff's to give their opinion regarding the food waste management. It is also allow a focused, conversational and two way communications. Moreover, this semi-structured interview can be used to give and receive information. The time of interview session was conducted when the cafeteria staff was free. During this interview session, there was no tape-record interviews as there was possible to jot notes to capture cafeteria staff's answers.

In total of six cafeteria staffs were interviewed. These interviews were conducted as informal and a guide was used with questions and topics. However, in semi-structured interviewing, the questions are standardized to ensure that the correct material was covered (Harrel & Bradley, 2009).