

## **WASTE GENERATION AND STUDENTS' PERCEPTION ON WASTE SEPARATION PROGRAM AT CAFETERIAS UKM BANGI CAMPUS**

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### **Abstract**

Increasing amount of solid waste is one of the most crucial environmental problems in Malaysia. Lack of segregation from the sources, lack of awareness and knowledge on proper waste management have only worsened the problem. The objectives of this study are to analyse the amount of solid waste generation from cafeterias at UKM, and further assessing the students' perception on the importance and constraints for waste separation after having meals at the cafeterias. There were two methods used in this study which were done through sampling and weighing of solid waste generated and using questionnaires distributed to the UKM students. Sampling and weighing of waste generated at cafeterias was done in two phases: a trial phase and evaluation phase. The trial phase was waste collection from ten cafeterias for problems identification at initial stage for waste sampling, while the evaluation phase concentrated at three cafeterias only. During the trial phase, results showed that the total food waste generated in a month were 689.7 kg and 101.6 kg for recyclable items generated by 11,288 numbers of students. For evaluation phase, food waste generated were 918.4 kg and 45.8 kg for recyclable items for a study period of a month by 2,487 numbers of students. Analysis of the questionnaires showed that 76% of students knew the importance of waste segregation, while 48% of students said their awareness had increase through the awareness campaigns that were being held around UKM campus. Among the constraints faced by the students were lack of facilities for waste separation bins and minimum practice on the food separation in everyday life. Based on this study, a proper waste management can be introduced to treat solid waste generated at the campus more efficiently.

Keywords: Waste generation, Waste separation, Food waste, Recyclable items, Environmental behaviour.

## **1. Introduction**

Global waste has increased approximately 28% from 5.6 million tons in 1997 to 7.65 million tons in 2007 and is estimated to further increase by 30% in 2020 [1]. According to the Department of National Solid Waste Management Malaysia in 2015 [2], the amount of solid waste generated in Malaysia is approximately 38,563 tons/day. Population growth, increasing of socio-economic status and lifestyle changes that are becoming more sophisticated, followed by the enhancement of the material domestic waste, businesses and factories are the major factors in the rising rate of the solid waste generation [3]. Solid waste management is one of the major issues being addressed by the government. According to the Department of National Solid Waste Management (JPSPN) [4], solid waste is defined as any material scrap or surplus substance other unwanted or rejected products arising from the use of any process or anything that is required to be disposed of as being broken, worn out, contaminated or otherwise damaged. The effectiveness of the integrated solid waste management is crucial in ensuring the quality of life and well-being of environmental harmony. Therefore, the National Strategic Plan for Solid Waste Management [5] has outlined some guidelines which are based on solid waste management hierarchy. This hierarchy consists of elements that began with the reduction, reuse, recycling, treatment and disposal of intermediate. This study focuses on the separation of solid waste generated by students at the university level. Solid waste separation is the process of separating solid waste generated by the composition of solid waste food waste and recyclable items such as paper, plastic, glass, tin, aluminum, iron and metal.

Separation of waste before the recycling process is essential to prevent the occurrence of residual contamination and impairment of a recycled material. The goal of the zero waste is not something that is impossible to achieve if there is the will power in our society. The composition of solid waste is influenced by several factors such as the level of economic development, culture, geography, energy resources and also the weather [6]. Solid waste needs be managed properly and failing to do so will attract other issues such as expensive operation costs, environmental pollution, land scarcity, etc. Recycling is one of the most effective methods used to reduce waste [7]. Every programme's success relies on the cooperation of the people and its community. For that, the active practice of waste separation behaviour among the community is one of the key ingredients in realizing the target set in Malaysia.

Solid waste is a major environmental problem in Malaysia. Increasing waste quantity can cause many problems if improper solid waste management practice is inefficient that leads to pollution, resource degradation and health problems to human and animals. Most Malaysian generates mixed waste, which means combining of organic and inorganic waste. Organic waste can be used as composting materials while inorganic waste can be used and sent for recovery and recycling [8]. Lack of awareness and knowledge about the solid waste separation and recycling among Malaysians can cause the problem even more harmful [9]. Therefore, the most appropriate solutions need to be identified and efforts should be increased to reduce the burden on the solid waste disposal methods available such as landfills [10]. The objectives of the study are firstly to analyse the amount of food waste generation from cafeterias at UKM Bangi campus, and secondly to assess students' perception on the importance of solid waste separation after having meals at the cafeterias.

## 2. Methodology

There were two steps used for this study. The first step was done through sampling and weighing of food waste generated at the cafeteria and secondly using questionnaires distributed to UKM students. The waste generation data was obtained by sampling and weighing of the solid waste collected from cafeterias at UKM Bangi Campus. Each cafeteria operators were required to separate the food waste and recyclable items into two bins. The Department of Services and Maintenance UKM (PRASARANA UKM) collected and weighted food waste and recyclable items separately. This study consisted of two phases which were the trial phase and then the evaluation phase. The trial phase involved the collection of food waste and recyclable items at ten cafeterias starting from 5<sup>th</sup> to 29<sup>th</sup> December 2016. The trial phase was done as a preliminary study to identify and overcome problematic situations during the data sampling process, and thus can be improved during evaluation phase. From the observation made during the trial phase, three cafeterias were selected for better representation of sampling.

For the evaluation phase, the data collection process had only involved three colleges, which were Ungku Omar College, Ibrahim Yaakub College and Burhanuddin Helmi College. The data collection was conducted for a month, continuously except for Saturdays and Sundays for the trial phase, while for the evaluation phase, solid waste were being weighted three times per week for a month period. Data collection for evaluation phase started from 6<sup>th</sup> to 30<sup>th</sup> of March 2017. The collection process was done 3 times weekly for a month. The wastes were collected and weighed on Mondays, Tuesdays and Thursdays every morning from 8.30 until 10.00 am. The solid waste was separated into three categories, which were food waste, kitchen waste and recyclable items by the café's workers and students themselves. Then the solid waste was weighed by using a 100 kg scale. The waste collected was then brought to the Composting Centre UKM to be composted.

The second step was conducting a self-administered questionnaire to assess the students' sources of knowledge, awareness, constraints and practices towards the segregation of food waste. In this study, a Likert scale of 1 to 5 was used. The questionnaires consisted of 40 items distributed into four categories: Section A - Students' background, Section B - Constraints for separating waste encountered, Section C - Level of awareness and Section D - Students' eating behavior. The number of respondents taken for this study was 100 students. Data was analyzed using Microsoft Excel and Statistical Package for Social Science (SPSS) version 22 software.

## 3. Results and Discussion

### 3.1. Solid waste generation during trial phase

Table 1 shows the data collection of food waste and recyclable items collected for a month. The total of food waste was 689.7 kg and 101.6 kg of recyclable items generated by 11,288 numbers of students. Thus, the average food waste generated in a day was approximately 43.1 kg. Ungku Omar College recorded the highest food waste generated which was 121.1 kg while Ibu Zain College recorded the lowest food waste generated at 13.9 kg. Keris Mas College dominates the production of recyclable items by producing 36.8 kg while Ibu Zain College

recorded the lowest generation at 4.2 kg. Some of the recyclable items collected were plastic bottles, boxes, tin and aluminum. The result shows that students have been practicing food waste separation at some cafeterias, even though the success rate was not encouraging. This study indirectly shows the importance of food waste separation in order to be treated or disposed properly for the amount of waste generated. Organic waste materials such as food leftovers and kitchen wastes can be processed to produce bioenergy generation using anaerobic digestion process or organic fertilizer production by composting [11]. The university should develop a policy that make compulsory for all cafeterias operating at the university to separate food waste and recyclable items [12].

**Table 1. Total waste generated (kg)  
at ten different cafeterias in UKM (December 2016).**

College	Food waste (kg)	Recyclable items (kg)	Number of Students
Keris Mas	99.2	36.8	2,630
Ibu Zain	13.9	4.2	405
Rahim Kajai	40.0	7.9	820
Dato' Onn	32.5	10.0	551
Tun Hussein Onn	45.5	7.3	600
Aminuddin Baki	49.6	8.6	970
Ungku Omar	121.1	5.3	957
Burhanuddin Helmi	110.3	5.1	780
Ibrahim Yaakub	90.3	4.9	750
Pendeta Zaaba	87.3	11.5	2,825
Total	689.7	101.6	11,288

### 3.2. Solid waste generation during evaluation phase

Table 2 shows the total amount of food waste generated during the evaluation phase was 918.4 kg and 45.8 kg of recycled materials taken for a period of one month by 2,487 numbers of students. Ibrahim Yaakub College recorded the highest amount of food waste generated of 343.6 kg, while Burhanuddin Helmi College recorded lowest amount, which was 268.9 kg. For recyclable items, Ungku Omar College recorded the highest amount of 15.5 kg and Ibrahim Yaakub recorded the lowest of 15.1 kg.

Figure 1 shows the food waste collected for four weeks at three different cafeterias. For a month period, Ungku Omar College recorded the highest collection at 25.9 kg while 9.7 kg was recorded as the lowest generation at the third week. There was an increment in the second week at Ibrahim Yaakub College by 23.7 kg from 22.6 kg in the first week. However, during the third week, the weight of waste was slightly drop by 11.9 kg but increase again in the fourth week by 19.5 kg. The decreasing amount of waste collected in the third week was due to the heavy rainfall and some constraints faced during the

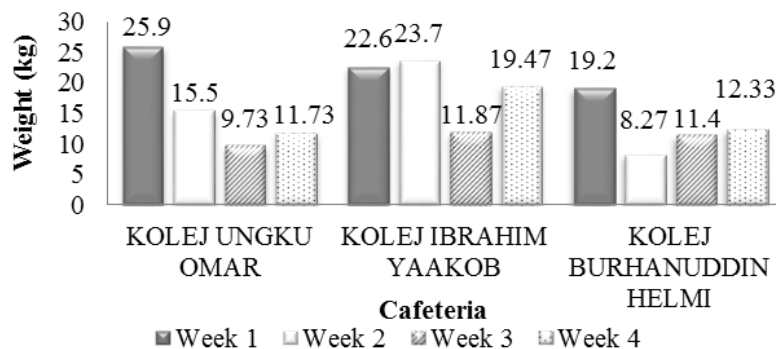
collection process. Burhanuddin Helmi College recorded the lowest collection compared to the others colleges. During the first week, the value recorded was 19.2 kg but decreasing in the second week by 8.3 kg. However, this college shows some improvement in the collection of waste in the third and fourth week by 11.4 kg and 12.3 kg respectively. Observations during the sampling showed that all customers who dine-in at the cafeteria must clean their own tables after they had completed their meals. All the left-over food was required to be thrown in a bin labelled “food waste” and the dishes must be placed in the respective containers.

Figure 2 shows that Burhanuddin Helmi College had the highest collection of kitchen waste in the first week by 15.4 kg and the lowest collection in the second week by 7.2 kg. For Ungku Omar College, the collection showed some improvement in the second and third week by 11.17 kg and 11.3 kg respectively compared to the first week by 7.3 kg. Meanwhile, Ibrahim Yaakub College decrement in the third and fourth week. Kitchen waste consisted mainly of processed kitchen waste such as meat and vegetables. All cooking activities were done at the cafeteria. Therefore, the raw materials such as meat and vegetables were processed there.

Figure 3 shows the amount of recyclable items collected within a month. The highest collection recorded over the past four week was 1.3 kg at Ungku Omar and Burhanuddin Helmi Colleges and 1.2 kg was the lowest. Recyclable items mainly consists of plastic bottles, fruit wrappers, egg cartons and mineral bottle boxes.

**Table 2. Total waste generated (kg)  
at three cafeterias in UKM (March 2017).**

College	Food waste (kg)	Recyclable items (kg)	Number of Students
Ungku Omar	305.9	15.5	957
Ibrahim Yaakub	343.6	15.1	750
Burhanuddin Helmi	268.9	15.2	780
Total	918.4	45.8	2,487



**Fig. 1. Food waste collected for four weeks.**

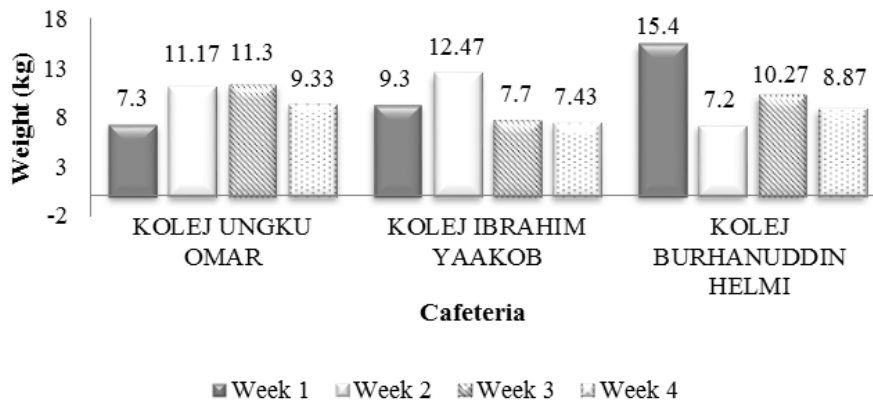


Fig. 2. Kitchen waste collected for four weeks.

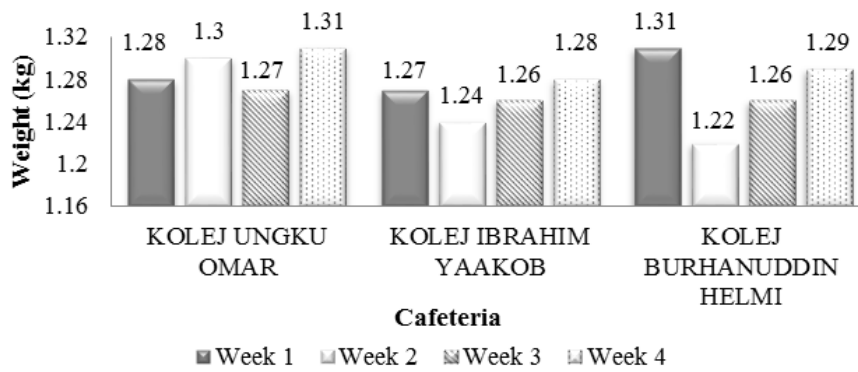


Fig. 3. Recyclable items collected for four weeks.

Table 3 shows the comparison of average weekly waste generated at three cafeterias during both phases. Food waste collected during evaluation phase demonstrated some increment in all cafeterias. The collection for the both phases was in the range of 11.0 kg to 16.0 kg in a week. This was a good progress shown by the students who actually did food waste separation at the cafeteria. Whereas, the amount for the kitchen waste reduced to 9.2 kg at Ibrahim Yaakub College, but considered satisfactory because there were no significant differences for both phases. The average amount for the recyclable items showed a good improvement by the students in recycling practice. Average result for Ibrahim Yaakub and Burhanuddin Helmi Colleges cafeterias showed approximately 1.3 kg per week for both phases. It can be said that the students were practicing the separation of waste in the cafeterias even though there was not much campaign being held in March 2017.

**Table 3. Comparison of waste generated at three cafeterias (December 2016 and March 2017).**

Cafeteria	December 2016			March 2017		
	Food waste (kg)	Kitchen waste (kg)	Recyclable items (kg)	Food waste (kg)	Kitchen waste (kg)	Recyclable items (kg)
Ungku Omar	15.43	14.85	1.3	15.72	9.78	1.3
Ibrahim Yaakub	12.0	10.58	1.1	19.4	9.23	1.3
Burhanuddin Helmi	15.55	12.03	1.3	11.73	10.44	1.3

### 3.3. Students' perception on waste separation program at cafeterias

Most of the respondents were undergraduate students (89%). The majority of the respondents were within age group between 19 to 25 years old (88%) with almost 75% were female and the remaining (25%) were male students. The questionnaires were pre-tested among the 100 students to establish its validity and reliability. The pre-test revealed the reliability of items for each section in the questionnaire which was evaluated using internal consistency approach Cronbach's Alpha. Table 4 shows the reliability test for each section in the questionnaire. From the analysis, the results show that the reliability for the main sections, which were Section B and Section C were above 0.7 indicated that the questionnaire was reliable.

**Table 4. Reliability test among the students.**

Section	Cronbach's Alpha	No. of items
A	0.342	8
B	0.865	13
C	0.908	11
D	0.478	8
Overall	0.746	40

The study showed that easy accessibility to recycle bins was important for the students for waste separation practice. The proximity of recycle bins has a great influence on food waste separation and recycling that encourages students to participate in recycling and waste separation practice. Lacking of recycling bins was acknowledged as one of the factors that restricted the recycling and separation behavior. Based on the statistical analysis, 74% students agreed that lack of the recycling bins affected their behavior toward practicing waste separation. Recycling bins should be easily accessed at locations where there are higher generation of waste.

Incentives motivate students to do better and encourage the students to practice the desired behavior. 31% of students agreed that by giving an incentive will increase their behavior to do the segregation of waste. However, 44% of students did not agree that given an incentive is needed to encourage students to practice the separation of waste. According to [13], incentives provide the initial

motivation for a sustainable activity. Once the activity becomes part of their daily life, they will continue their habits even without the intrinsic motivation [14].

Information to segregate waste means clear command on how to separate waste correctly and feedback information is required regarding the total waste separated on campus. Based on Table 5, more than half of the respondents (52%) said that the instruction for waste separation provided by the cafeteria's owner was unclear and confusing. This situation will not encourage students to perform waste separation at the cafeteria.

**Table 5. Factors that affect the separation of waste.**

No.	Factors	Percentage (%)		
		Agree	Not sure	Disagree
1	Lack of recycling bins	74%	12%	14%
2	No incentives to separate waste	31%	24%	44%
3	Unclear instructions on how to separate waste	52%	28%	20%

Based on Table 6, 48% of students agreed that their level of awareness concerning separation of waste had increased through the awareness campaigns, flyers and posters. The individual behaviour to separate the waste can be influenced through awareness campaigns due to their environmental concern and participation to overcome the associated issues [15]. Majority of the students agreed that solid waste management program should be implemented in the school curriculum and at university foundation programmes to encourage students to do waste separation, while 7% of the students disagreed with the suggestion. Thus, this study suggested that implementing solid waste management courses will increase student's knowledge and level of awareness to separate the wastes.

Majority of the students (79%) agreed that they will give their best cooperation to the university management to increase the practice concerning separation of waste in the campus. Even though some students were unaware about the separation program, some of them showed their determination to preserve the environment by involving in the separation of food waste programs. Based on the analysis, 76% of students knew about the importance of solid waste separation while only 4% of them were ignorant. Even though the number of students having awareness on the importance of food waste separation was relatively high, there is still a need to educate students on solid waste environmental issues as this can help in raising their awareness level and further support the management in ensuring sustainable environment at the university [16].

Regarding eating culture of the students, this study showed that the amount of food waste generated depended on the students eating culture. 74% of students ate at the cafeteria frequently, while 13% were not. Majority of the students (63%) finished up their meals every time they ate at the cafeteria, while only 8% of students were not. Students should only take the amount of food that they could afford to finish and do not exceed their own limit. This was a good practice shown by the students in reducing the food waste generation at the cafeteria that can help to reduce food waste generation [17].



**Table 6. Student's awareness concerning waste separation at cafeterias.**

No.	Awareness	Percentage (%)		
		Agree	Not sure	Disagree
1	Level of awareness concerning separation of waste increased through the awareness campaign, flyers and awareness posters.	48%	28%	24%
2	Implementing solid waste management courses in school curriculum and as a university foundation courses	82%	11%	7%
3	I will give my cooperation to increase separation of waste practice in campus	79%	17%	4%
4	I know the importance of separation of waste	76%	20%	4%

#### 4. Conclusions

This study showed that food waste generation for a month period was 689.7 kg and 101.6 kg of recyclable items generated by 11,288 numbers of students during the trial phase. The food waste generation was 915.6 kg per month by 2,487 numbers of students during the evaluation phase. The average weekly food waste collected during evaluation phase was in the range of 11.0 kg to 16.0 kg. This was a good progress shown by the students who actually did food waste separation at the cafeteria. The amount for the kitchen waste collected was approximately 9.2 kg in a week for both phases. The average amount for the recyclable items showed approximately 1.3 kg weekly for both phases.

This study also determined students' perception on waste separation program at cafeteria that 76% of students knew the importance of waste segregation, while 48% of students said their awareness had increase through the awareness campaigns that were being held around UKM campus. Among the constraints faced by the students were lack of facilities for waste separation bins and minimum practice on the food separation in daily life. The study also showed that most of the students are interested in practicing food waste separation as they value the cleanliness at their surrounding and they are concern on possible disease occurrences due to improper waste management practice.

Furthermore, a carefully waste education and awareness strategy should be developed in order to change students' habits on waste generation at cafeterias. Through an intensive awareness programs, a community can be sensitized and educated on best practices to espouse so as to ensure that everyone is carried along in issues concerning solid waste management. Finally, the university authority should arrange training for its staff and students on various waste

management programs to increase the level of awareness targeting on an environmentally sustainable university campus.

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