WASTE AUDIT AND AWARENESS LEVEL ON RECYCLING PROGRAM: A CASE STUDY IN UNIVERSITI MALAYSIA SABAH (UMS), MALAYSIA

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ABSTRACT. *A waste audit was carried out in Universiti Malaysia Sabah on-campus residential colleges (AB, CD and E) from 8 to 22 March 2006 involving 1323 students. The waste audit was conducted to identify the total waste disposed by students and to determine the percentage of waste that can be recycled based on six categories : organic waste, plastics, paper, aluminum, glass, and others. The audit found that the organic waste has the highest percentage, while glass is the lowest percentage thrown by the students. Recycling and composting could greatly enhance the solid waste management in UMS, whereby UMS can reduce up to 85% of its solid waste from being sent out to the landfill. A survey was also conducted among 440 students from the waste audit participants, on their awareness level in recycling program, composting, role and responsibilities of students. The partial correlation analysis on the survey responses revealed that the students only understand the basic recycling program. This indicates that the solid waste campaign and approach design has to be more practical to increase the students' knowledge and attention on the above matter. Nevertheless, this study has given an impact to the students about the consequence of recycling and composting, and the importance of their participation and support in helping the government to overcome the management and disposal of solid waste in Malaysia.*

KEYWORDS. Waste audit, Recycling, Composting, Awareness level, Solid waste

INTRODUCTION

The production of solid waste is influenced by rapid economic growth as well as development and urbanization due to an increase in consumer goods and population (Agamuthu, 2001; DEAT, 2002). Study by Luu (2006) revealed that the total estimation of total solid (kg/ capita/ day) of Kota Kinabalu population from 1997 to 2010, based on formula introduced by Pellowitz (2003), will increase from 0.20 kg/ capita/ day in 1997 to 0.90 kg/ capita/ day in 2010. The increase in total solid waste production puts a pressure on, and shortens the duration time of, the existing landfill. Therefore, a systematic and well organized waste management system is a vital step in order to avoid health effects and environmental pollution such as groundwater contamination, river and soil pollution (Fazil Haji Othman, 1993; Tchobanoglous & Keith, 2002).

This paper presents findings on a survey of solid waste and alternative of solid waste management based on type and total solid waste at residential college of UMS. It points out aspects that can be addressed to improve UMS solid waste management. Besides that, this study also focuses on awareness level of the students on recycling

program, compositing, their role and responsibilities in solid waste minimization program.

Universiti Malaysia Sabah (UMS) established in 1994, is the ninth of 18 government-owned higher learning institutions. UMS covers an area of 999 acres with three on-campus residential colleges which are AB, CD and E, and two off-campus residential colleges which are Indah Permai and Kingfisher. The AB, CD and E residential college can occupy up to 6000 students per semester. In every semester the students produce amounting of waste in the college. Therefore it is important to educate and expose them to waste management and the importance of recycling and composting and their role in waste minimization.

MATERIALS AND METHODS

The study was conducted from 8 to 22 Mac 2006 involving 2 phases. The phase one was the waste audit of 1323 students whilst the phase two involved a survey involving 440 students from the first phase. In the first phase, the student has to segregate his/ her waste into six categories (organic waste, plastic, aluminum/tin, glass, paper and other) in rubbish bins provided at the college. A weighing balance with a capacity up to 20 kg was used to weight each of the waste categories. Finally, the waste was separated and weighted again based on recyclable and non-recyclable categories. The questionnaire from the second phase was circulated among 440 students who were randomly chosen from the first phase. The feedback provides information on their awareness level and knowledge on recycling.

RESULTS AND DISCUSSION

Results from Waste Audit
A total of 1106.42kg waste was collected from the 1323 students (Table 1). The segregation shows that the organic waste represented the largest percentage (53%) followed by plastic (24%), paper (15%), aluminum/tin and other (3%) and the lowest percentage was the glass (2%). Table 1 show that only 356kg or 32% from 1106kg of the total waste produced by the students can be recycled.

Yet, the organic waste is the highest waste produced in this study which is 586.18kg or 53% form the total waste. This waste is more suitable for compositing instead of recycling. Compositing is a degradation of organic waste by aerobic microorganisms. There are many ways to conduct compositing such a using plastic bags, pots, wire or compositing in soil.

The 356kg recyclable waste produced consist of 47% of paper, 39% of plastic, 8% of aluminum and 6% of glass (Figure 1).

If the 53% of the organic waste was composed and the 32% of the recyclable waste was sent to the recycling center, UMS could reduce its waste output by up to 85%. In another words, only 15% of total waste left would need to be disposed in the landfill. This presents a corresponding potential saving in landfill space as well as in collection and transportation costs (Mbuligwe, 2002). Furthermore the recovered of organic waste

from composting can be used as animal feed and natural fertilizer for gardens around UMS.

Table 1. Waste Audit Data

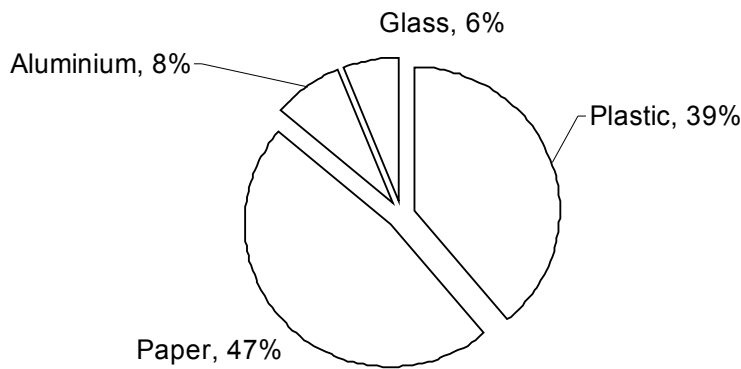| Waste Category	Total Waste Produced (kg)	% of Waste Produced	Recyclable Waste (kg)	Composting (kg)	Non-recyclable waste (kg)
Organic	586.18	53	-	586.18	-
Plastic	265.44	24	139.26	-	126.6
Paper	165.90	15	165.90	-	-
Aluminum	33.18	3	28.98	-	4.2
Glass	22.12	2	21.86	-	0.26
Other	33.18	3	0	-	33.18
TOTAL	**1106.42**	**100%**	**356 (32%)**	**586.18 (53%)**	**164.24**

Figure 1. The percentage of waste which can be recycled

Results from survey

Data obtained from the survey demonstrated that the majority of the students gain information's about recycling through printed media (PM) such as newspapers and magazines, electronic media (EM) through radio and television, campaign (C), lectures (L) and friends (F) (Figure 2). Electronic media and printed media play an essential role in giving information about recycling.

However, the score analysis for the survey (Figure 3) illustrated most of the students only recognized the basic concept of recycling where plastic, paper, aluminum, tin and glass can be recycled. They are not sure about the fact that there are some of the papers, plastics and glass that cannot be recycled. Only 10 (7.5%) of the 440 students are fully understood recycling and answer the questions correctly with a score within 17 – 23. The 63.6% of the students only partly understand with a score within 9 – 16 while the rest (28.9%), they don't understand at all about the program (score 1 – 8). In addition,

the survey has elaborated that the UMS students did not take any initiative in order to understand recycling in detail.
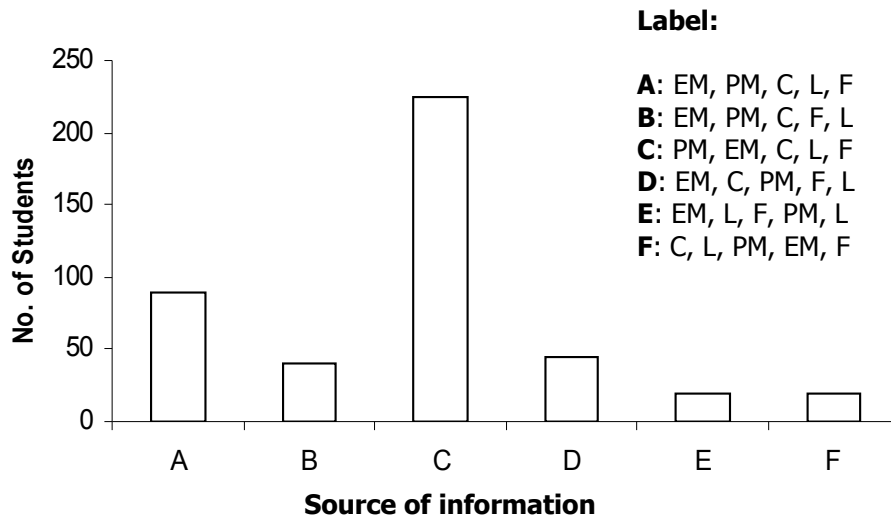

Label:

A: EM, PM, C, L, F
B: EM, PM, C, F, L
C: PM, EM, C, L, F
D: EM, C, PM, F, L
E: EM, L, F, PM, L
F: C, L, PM, EM, F

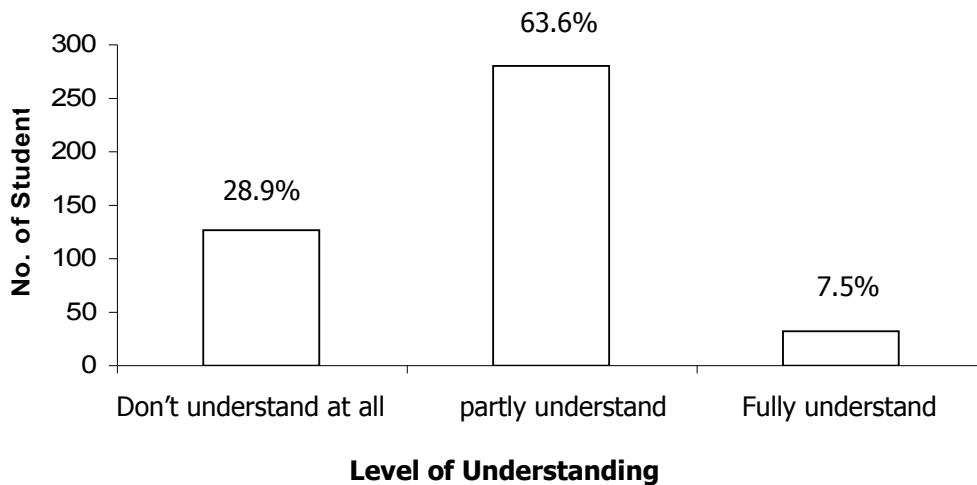**Figure 2. Source of information on recycling among students**

Figure 3. Level of understanding about recycling among students

Statistical Analysis of results

The statistical analysis using partial correlation of the postal questionnaires were found insignificant relationship (p>0.05) between the source of information, their understanding and the awareness level of the students towards recycling (Table 2).

This gives a general view that sources of information (electronic media, campaigns, lectures, family and friends) do not play a strong influence on the

understanding and awareness level of the students about recycling program. This point up that the information about recycling in Malaysia are still not very efficient in providing the facts about recyclable and non-recyclable items to the public. The current recycling program approach is more focused on four basic categories (paper, plastics, aluminum/ tins and glass). This gives an inaccurate perspective to the public that materials such as stryofoam, battery, paint, tin can be recycled. As a result, the public are not aware about the impact of these non-recyclable items.

Furthermore, the way recycling is approached; information in recycling promotion, and the explanations about recycling programs should be modified so that it is suitable for the public. The production and management of solid waste can be minimize with the establishing of 3R (Reuse, Reduce and Recycle). As an example, steps taken by University of Standford, California where the recycling program has been started since late 70's, won "National Recycling Coalition's Outstanding School Program Award" in September, 2002. The university has created a comprehensive recycling program which involves the whole student community through recycling centers provided on campus which includes collection, processing and marketing of recycling goods (www.recycling.standford.edu).

Table 2. The partial correlation analysis result

	Awareness of recycling	Source of Information	Level of Understanding
Level of Understanding	- 0.156	- 0.325	1.00
Source of Information	- 0.102	1.00	
Awareness of recycling	1.00		

(p significant at < 0.05)

CONCLUSION

The survey conducted proves that the best solid waste management practices in UMS are a combination of recycling and compositing. This combination will manage to reduce up to 85% the volume of waste disposed to the landfill. This is also supported by the study done by Mbuligwe (2002) who showed the combination between recycling and composting tends to reduce the cost of collection and transportation. Nevertheless, the need to increase the student's knowledge and participation regarding the proper management and disposal of solid waste in UMS is clear.

The university has to take a practical approach on providing information, to establish proper and good facilities related to recycling and composting. It is also crucial to increase the UMS student's participations on clearing, stocking and segregation of the recyclable, non-recyclable and the compostable waste. After all this has been initiated, solid waste management in UMS can be improved.

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