Study of Solid Waste Management in the Buildings Area of Integrated Campus of Universitas Islam Indonesia

F M Iresha¹, Kasam², F Muhamad³, A Rahmat²
¹Department of Environmental Engineering, Universitas Islam Indonesia, Indonesia
²Research Center for Limnology, Indonesian Institute of Sciences, Bogor, Indonesia
E-mail: fajri.mulya@uii.ac.id

Abstract. One of the problems that are faced by the Universitas Islam Indonesia (UII) is the amount of solid waste generated each year, add the increasing number of the student each year, then the problem becomes much worse and difficult to handle. Regarding it, the awareness of each student about solid waste management is needed. The 2 main purpose of this study is first to determine the composition and the generation of solid waste using the samples taken from 10 temporary solid waste dumps (FPSB, D3 Economics, FMIPA, FTI, FIAI, FTSP, FK, Central Library, Kahar Muzakir, GKU, and Rectorate) and the second is to identify student’s perceptions and behavior about individual solid waste management. The research was conducted using qualitative and quantitative descriptive approaches. The results show that the average amount of solid waste generated is 0.017 kg/person/day this is in line with the solid waste management record that shows that on daily basis each person produces approximately 0.010 - 0.020 kg. While the study about the students’ perceptions and behavior towards solid waste management shows that while most of the students are aware of it, the implementation is still lacking.

1. Introduction
Almost all human activities produce wastes and the common wastes produced are solid wastes or solid waste. The increasing population and changing consumption patterns also add to the increasing amount of solid waste produced while there are no efficient and effective solutions, making solid waste management is a problem that is hard to solve.

The obligation in implementing solid waste sorting in 2008 is regulated in Law Number 18, the Year 2008, Article 13 concerning Solid waste Management. Managers of residential areas, commercial areas, industrial areas, special areas, public facilities, social facilities, and other facilities are required to provide solid waste sorting facilities [1]. This means that campus such as UII is required by law to provide the necessary solid waste management facilities which also explained in Regulation from Ministry of Public Work [2]. A community can also participate in solid waste management by sorting between organic and inorganic solid wastes, turning organic solid wastes into compost, or reducing the usage of non-recyclable material [3].

At the Integrated Campus of the Universitas Islam Indonesia, around six faculties contribute to the total solid waste generated which is then transported to a temporary dump and then moved to the final solid waste dump. The difference in the amount of solid waste generated by each faculty could be caused by the behavior of the students regarding litter/solid waste management and also the growing number of students. Regarding this problem, it is necessary to conduct research related to the
perceptions and behavior of students about littering. This research focuses on the condition of solid waste management and the behavior of students regarding littering.

2. Materials and Methods

The sample will be taken from ten temporary solid waste dumps located in the integrated campus environment of the Universitas Islam Indonesia. This research was conducted by measuring the daily solid waste generation and its composition in each building adapted by SNI 19-3964-1994 [4].

Data regarding student behavior were taken using simple random survey sampling. The number of student samples needed was calculated using the formula from Slovin:

\[ n = \frac{N}{1 + N \alpha^2} \]  

Whereas \( n \) is the number of samples, \( N \) is the total population and \( \alpha \) is the error tolerance limit, which is 10%.

The percentage of solid wastes' weight calculation:

\[ \% \text{Worth selling} = \frac{\text{Worth selling average weight}}{\text{Average total weight}} \times 100 =...\% \]  

\( (2) \)

**Percentage of solid waste volume calculation**

\[ \% \text{Worth selling} = \frac{\text{Worth selling average weight}}{\text{Average total volume}} \times 100 =...\% \]  

\( (3) \)

**Calculating solid waste/solid waste weight (kg/person/day)**

\[ \text{Average total weight (kg)} \]  

\[ = \frac{\text{Student number + Staff number}}{\text{Calculating the volume of solid waste (liter/person/day)}} \]  

\[ = \frac{\text{Average total volume (liter/person/day)}}{\text{Student number + Staff number}} \]  

\( (4) \)

\( (5) \)

Data analysis regarding perceptions, attitudes, and behaviors of students are graded by qualitative and quantitative assessment scores. There are five categories, 1) Very bad, 2) Bad, 3) Adequate, 4) Good, 5) Very good.

| No. | Assessment  | Value  |
|-----|-------------|--------|
| 1   | Very Bad    | < 6    |
| 2   | Bad         | 6 – 7  |
| 3   | Adequate    | 8 – 9  |
| 4   | Good        | 10 – 11|
| 5   | Very Good   | > 11   |

**Table 1.** The interval values for littering, and managing solid waste.

| No. | Assessment   | Value  |
|-----|--------------|--------|
| 1   | Very Bad     | < 13   |
| 2   | Bad          | 13 – 15|
| 3   | Adequate     | 16 – 18|
| 4   | Good         | 19 – 21|
| 5   | Very Good    | > 21   |

**Table 2.** The interval value of students' perceptions and attitudes towards solid waste.
3. Results and Discussion

3.1. Solid waste composition

Figure 1 shows the amount of solid waste generated from each point in the UII Integrated Campus. The general weight of solid waste for each building in the UII Integrated Campus is still dominated by recyclable and disposable solid waste. However, recyclable solid waste is the most dominant out of two. This is because almost every faculty has sorted the solid waste before it is transferred to the temporary solid waste dump in each building. During the sampling process, it was found that the disposable solid waste is sorted more carefully, there are some could be reused.

Solid waste is generally sorted into three main groups, recyclable solid waste (recycling), compostable solid waste (organic), and disposable solid waste (residue). In general, the composition of the density of solid waste is dominated by resalable paper waste by 30% and disposable paper solid waste by 25%. In previous research, it was estimated that the daily waste of the Lagos Akoka University campus is about 32.2 tons with PET bottles being the largest part of the waste 34% and has a high recycling potential (75%) [5].

![Figure 1. Total weight of general solid waste in each building on the UII Integrated Campus.](image)

3.2. Solid waste volume composition

The volume of solid waste according to their respective composition are presented in Figure 2. The total volume of solid waste is calculated using a 40-liter container resulted in around 1981.88 liters of solid wastes produced each day. The total number of staff, lecturers, and students is 16,837 people. Meaning that on average each people produce around 0.12 liters of solid waste each day, the volume of school solid waste produced per person per day is 0.10-0.15 liters [6].

Meanwhile, the total weight of solid waste is 295.02 kg/day and based on calculation, each person produced around 0.017 kg/day. This data is similar to the previous research, in that each person per day produced around 0.010 - 0.020 kg of solid wastes [6]. As a comparison in Bhayangkara University Jakarta, the average generation volume 1.68 m³/day (123.43 kg/day) with a composition of 58.53% organic and 41.47% organic [7].
3.3. Solid waste management habits

The assessment of the habit of solid wastes management is based on the amount of pocket money that students have, to see its' effect on students' habits in managing solid waste. From the results of observations, many students think that only certain types of solid waste must be managed independently. It can be seen that 51% of students are in the "adequate" category. About 6% of the total students fall into the "bad" category. This could be due to the opinion that managing solid wastes requires more money than the price of the item itself. On the "good" category there are 42% and 1% on the "very good" category.

3.4. Littering habits

The observation on littering habit of student are presented in Figure 4. Based on it, about 43% of students fall into the "adequate" category. Most students are found to be aware of not littering around and assume that it is good enough to not litter. While there are 21% in the "bad" category and 1% in the "very bad" category. This is due to the opinion from the student that the solid waste/solid waste
thrown away will not smell bad and will not be a source of disease, and also because of the students' opinion that the thrown solid waste will be sorted by others.

![Figure 4. Student’s littering habit.](image)

### 3.5. Solid waste disposal location habit

Solid waste disposal location also becomes one of the main attentions on this study. The results of the questionnaire on the solid waste disposal location are shown in Figure 5. Based on the questionnaire around 43% of the students are in the "adequate" category, 21% are in the "bad" category and 1% in the "very bad" category. This is because of the students' opinions about the solid waste dumps that are already provided by campus and some staff will take care of the trash. Around 33% are in the "good" category and 2% "very good" category. For them, each person has the responsibility to maintain their surrounding environment. Based on observations, the location of solid waste in each building is different, which affect the students' habit.

![Figure 5. Solid waste disposal location habits.](image)

### 3.6. Students' perception

To find out the students' enthusiasm for solid waste management, an assessment of student perception on solid waste disposal was conducted. The data is presented in Figure 6. Based on the results of the questionnaire, 50% of students fall into the "very good" category and 27% fall into the "good" category. Most students thought that having good rules and regulations regarding solid waste management would improve campus cleanliness. They also supported the green campus program, but they felt the campus needed to increase further efforts to improve campus cleanliness.
Figure 6. Students' perceptions on solid waste disposal behavior.

About 18% fall into the "fair" category. They assume that the solid waste generated does not have a direct and immediate impact on the environment and they feel that the campus effort is sufficient. 5% of students fall into the "bad" category. They think that solid waste management is needed to be carried out by the campus only and there is no need for student corporations.

3.7. Student attitude
Assessment of the student’s solid waste disposal behavior to see student enthusiasm to solid waste management. The value can be seen in Figure 7.

Figure 7. Students' attitudes toward solid waste disposal behavior.

Based on the results of a questionnaire, 61% of students think that some types of waste do not need to be managed independently. 12% of the "bad" category and 7% of the "very bad" category thought that the scattered solid waste would not interfere with campus activities and that the solid waste disposal is left entirely to cleaners staff who had been properly paid. Some students also consider that they feel that they do not need to pay additional costs for solid waste management because the solid waste management budget is included in the tuition fee that they already paid. In previous research in 10 campuses in China, the results showed that 95% respondents agree the need for separation waste from the source, while only 20% who agree to separate two or three type of waste from the source [8]. So, basically, student can change their habit if the system are built.
3.8. Analysis of students' solid waste management
Analysis of student solid waste management is assessed based on the ways and habits of littering and managing solid waste, the location of solid waste bin, as well as student perceptions and attitudes.

From the results of student solid waste management analysis, it can be said that solid waste management still lacking and that it failed to implement integrated or alternative solid waste management. Several waste management solutions in Universitas Diponegoro refers to 3R waste management (reuse, reduction, and recycling) by application i.e. waste sorting by trash bin differentiation, manufacture composting, waste recycling paper, return student assignments so that it does not accumulate and can be used returned by the student [9]. In other research, the highest operational cost level was influenced by use of trash bags [10].

![Figure 8. Flow diagram of solid waste management at UII Integrated Campus.](image-url)
Table 3. Alternative solid waste management policies in the UII Integrated Campus.

| Alternative 1                                      | Alternative 2                                      |
|---------------------------------------------------|---------------------------------------------------|
| The campus is to add more cleaning staff to sort waste and manage sorted solid waste bins. | Campus makes a collection of waste from students so they don't blame each other in waste management. |
| Providing temporary dumps in every building in the UII Integrated Campus with a capacity that matches the amount of waste generated by each building. | The campus educates on independent waste management to create a caring attitude towards environmental cleanliness. |
| Provide receptacle facilities in accordance with the sorted solid waste. | The campus formulates a waste management policy at the UII Integrated Campus. |
| Empowering recycling to turn solid wastes into something useful. |                                                   |

4. Conclusion
From the research, the amount of waste generated in the UII Integrated Campus Area was by an average of 295.50 kg/day or 1981.88 liters/day. The solid waste generated by each person is 0.017 kg/day. The volume produced is 0.12 liters/person/day. The composition of waste is dominated by 52% recyclable waste (recyclable), 38% disposable waste (residue), and 10% organic waste (compostable). From the study conducted on student perception and attitudes on littering, from 100 respondents it is found that 50 respondents fall into the "very good" category, 27 respondents with the "good" category, 18 respondents with the "adequate" category, and 5 respondents with "bad" category. While the results for students' attitudes in the solid waste disposal study show that from 100 respondents obtained 61 respondents with an "adequate" category, 12 respondents with a "good" category, 8 respondents with a "bad" category, and 7 respondents with "very bad" category. This shows that while students' knowledge about solid waste and its management is good, but the application still lacking.

References
[1] Undang-Undang Republik Indonesia Nomor 18 Tahun 2008 Pengelolaan Sampah. 7 Mei 2008. Lembaran Negara Republik Indonesia Tahun 2008 Nomor 69. Jakarta.
[2] Peraturan Menteri Pekerjaan Umum No. 03 Tahun 2013 tentang Penyelenggaraan Prasarana dan Sarana Persampahan dalam Penanganan Sampah Rumah Tangga dan Sampah Sejenis Rumah Tangga. Jakarta. Departemen Pekerjaan Umum.
[3] Yolarita E. 2011. Pengelolaan sampah dengan prinsip 3R di Kota Solok [tesis]. Bandung (ID): Universitas Padjajaran. [Internet]. [Accessed 2016 November 2]. Available at: http://pustaka.unpad.ac.id/archives/119693.
[4] SNI 19-3964-1994, Metode Pengambilan dan Pengukuran Contoh Timbulan dan Komposisi Sampah Pertokaan Departemen Pekerjaan Umum. Bandung : Yayasan LPMB.
[5] Adeniran, A.E., Nubi, A.T. and Adelopo, A.O. 2017. Solid waste generation and characterization in the University of Lagos for a sustainable waste management. Waste management, 67, pp.3-10.
[6] Damanhuri, E. and Padmi, T., 2010. Pengelolaan sampah. Diktat kuliah TL, 3104, pp.5-10.
[7] Masrida, R. 2017. Kajian timbulan dan komposisi sampah sebagai dasar pengelolaan sampah di kampus ii universitas bhayangkara jakarta raya. Journal of Environmental Engineering and Waste Management, 2(2), pp.69-78.
[8] Zhang, H., Liu, J., Wen, Z.G. and Chen, Y.X. 2017. College students’ municipal solid waste source separation behavior and its influential factors: A case study in Beijing, China. Journal of cleaner production, 164, pp.444-454.
[9] Fadhilah, A., Sugianto, H., Hadi, K., Firmandhani, S.W., Murtini, T.W. and Pandelaki, E.E. 2011. Kajian Pengelolaan Sampah Kampus Jurusan Arsitektur Fakultas Teknik Universitas Diponegoro. Modul, 11(2).
[10] Fitria, R., Samadikun, B.P. and Priyambada, I.B., 2016. Studi Timbulan, Komposisi Dan Karakteristik Dalam Perencanaan Pengelolaan Sampah Universitas Diponegoro Studi Kasus: Fakultas Psikologi Dan Fakultas Kesehatan Masyarakat (Doctoral dissertation, Diponegoro University).