

Quantifying Paper Waste Generation to Support Sustainable Waste Management at the Institut Teknologi Sumatera

Mahdania Choirunissa Jasmine Saqinah¹, Yuni Lisafitri^{2*}, Suryaneta³

¹ Environmental Engineering, Faculty of Infrastructure and regional technology, Institut Teknologi Sumatera, Lampung, Indonesia

² Environmental Engineering, Faculty of Infrastructure and regional technology, Institut Teknologi Sumatera, Lampung, Indonesia

³ Cosmetic Engineering, Faculty of Industrial Technology, Institut Teknologi Sumatera, Lampung, Indonesia

*Corresponding Author: yuni.lisafitri@tl.itera.ac.id

Abstract. *Paper waste generation in higher education institutions represents a significant environmental concern due to its considerable volume and resource potential. At the Sumatera Institute of Technology, paper waste management has not been fully optimized, and data on paper waste generation are still limited. Therefore, this study aims to analyze paper waste generation at the Institut Teknologi Sumatera. The method used to calculate paper waste generation in this study was the waste sampling method based on SNI 3964-2025. Waste sampling was conducted for eight consecutive days in four administrative buildings at the Institut Teknologi Sumatera. The results indicated a total paper waste generation of 11.7 kg/day, with the highest contribution originating from the Student Affairs and Finance Office building (3.9 kg/day). The findings demonstrate that paper waste generation is influenced not only by population size but also by the characteristics of administrative activities, document processing intensity, and institutional work systems. This study provides essential baseline data to support the planning of paper waste reduction, reuse, and recycling programs, contributing to the development of sustainable waste management strategies in higher education institutions.*

Keywords: *Paper waste generation, Institut Teknologi Sumatera, SNI 3964-2025, Sustainable waste management.*

1. Introduction

Sustainable waste management has become a crucial issue in recent times, particularly in educational institutions such as universities (Adeniran et al., 2017). Paper waste represents an underutilized resource, despite its considerable volume and potential. The increasing use of paper has resulted in a corresponding increase in paper waste generation. The substantial volume of paper waste generated presents opportunities for various utilization efforts (Pribadi, 2015). Paper waste as a type of waste generated in educational institutions has received greater attention due to its quantity reaching 1,264.32 kg or 25.25% of total waste generation, with a marketable potential value of 60% of the total paper waste generation (Ruslinda et al., 2024).

Institut Teknologi Sumatera is one of the educational institutions that utilizes paper, including office paper, student assignments and examinations, notebooks, and packaging materials. According to the Institut Teknologi Sumatera Performance Report 2023, the number of active students at Institut Teknologi Sumatera reached 20,012 and was supported by 932 employees, consisting of 589 lecturers and 343 educational staff (Institut Teknologi Sumatera, 2023). With the increasing number of study programs and the growing student population at Institut Teknologi Sumatera, this situation may lead to

an increase in waste generation each year (Bertha, 2021). In 2019, the waste generation rate at Institut Teknologi Sumatera reached 1.46 m³/day and is projected to reach 4.14 m³/day by 2027. Anorganic waste dominates at Institut Teknologi Sumatera, accounting for an average of 75.35% (Berliana, 2022).

Although the potential of paper waste in educational institutions is significant, research specifically examining paper waste generation in campus environments remains limited. The lack of comprehensive data and information regarding the characteristics, composition, and utilization potential of paper waste poses challenges in designing effective and efficient management strategies. Therefore, research on paper waste generation analysis at Institut Teknologi Sumatera is necessary to address this knowledge gap. By obtaining detailed information on paper waste generation on campus, it is expected that targeted management strategies can be designed, ranging from reduce, reuse, to recycle.

2. Method

Data Collection:

Paper waste generation sampling was conducted in accordance with SNI 3964-2025 regarding the Method of Sampling and Measurement of Household Waste and Household-like Waste Generation and Composition (Badan Standardisasi Nasional, 2025). Waste collection was carried out for 8 consecutive days at the same locations. The selected locations were office buildings serving as the main sources of paper waste generation, including Building B for the Academic, Student Affairs, and Finance offices; Buildings C and D for the Faculty of Industrial Technology office; Building E for the Faculty of Infrastructure and Regional Technology office; and Building F for the Faculty of Science office. This study employed the household-like waste criteria based on SNI 3964-2025. The equipment used for waste sampling included 10 kg capacity trash bags, waste containers, measuring tape, hanging scales, and personal protective equipment (PPE) consisting of masks and gloves, while the material used was paper waste.

Paper waste sampling was conducted according to SNI 3964-2025 with the following procedures: trash bags were distributed to each office to be sampled one day before waste collection; filled trash bags were then collected; the collected waste was weighed; subsequently, the 54-liter sampling box was weighed in an empty condition; waste samples from each source were then placed into the sampling box; the box was dropped three times by lifting it to a height of 20 cm; finally, the weight of the waste was measured and the height of the waste after dropping was recorded to calculate the volume and waste generation.

Data Management and Analysis:

The method for calculating the total household-like waste generation according to SNI 3964-2025 is as follows (Badan Standardisasi Nasional, 2025):

$$qr \text{ SSSRT (kg/days)} = \frac{\sum qi}{\sum n} \quad (3.2)$$

Where :

qr = average waste generation from one household-like waste location,
expressed in kilograms per day (kg/day)

- q_i = waste generation on day i , expressed in kilograms (kg)
 n = number of waste sampling days, expressed in days (days)

3. Results and Discussions

Paper waste sampling was conducted in four office buildings at Institut Teknologi Sumatera. The sampling locations included Building B for the Academic, Student Affairs, and Finance offices; Buildings C and D for the Faculty of Industrial Technology office; Building E for the Faculty of Infrastructure and Regional Technology office; and Building F for the Faculty of Science office. Paper waste sampling was carried out for 8 consecutive days, with waste transportation and collection conducted daily at 16:00 WIB, as this represents the end of working hours at Institut Teknologi Sumatera, ensuring maximum waste accumulation at that time. Waste generation was measured in units of weight kilogram per day (kg/day) (Aulia & Hadju, 2024).

According to SNI 3964-2025, the calculation of household-like waste generation begins with the determination of the household-like waste generation rate (qr SSSRT) (Badan Standardisasi Nasional, 2025), and the results of paper waste generation can be seen in Table 1.

Table 1. Daily Paper Waste Generation at Institut Teknologi Sumatera

Location	Daily Generation (Q_r)
	Weight (kg/day)
Building B (Academic, Student Affairs and Finance Office)	3,9
Buildings C and D (Faculty of Industrial Technology Office)	2,53
Building E (Faculty of Infrastructure and Regional Technology Office)	2,91
Building F (Faculty of Science Office)	2,36
Total	11,7

Source: Primary Data, 2025

From the data in Table 1, it can be observed that the highest paper waste generator is Building B (Student Affairs and Finance Office), with an average waste generation rate of 3.9 kg/day. This can be attributed to Building B serving as the center for paper usage in supporting correspondence activities and academic needs of Institut Teknologi Sumatera students. The daily waste generation results obtained were 3.9 kg/day for Building B (Student Affairs and Finance Office), 2.53 kg/day for Buildings C and D (Faculty of Industrial Technology Office), 2.91 kg/day for Building E (Faculty of Infrastructure and Regional Technology Office), and 2.36 kg/day for Building F (Faculty of Science Office). The total paper waste generation at Institut Teknologi Sumatera amounted to 11.7 kg/day. The paper waste generation results obtained are relatively comparable to those generated by a university in Jakarta at 11.62 kg/day (Hariz & Sulaiman, 2022) and a university in Yogyakarta at 11.7 kg/day (Nursetyowati et al.,

2024). Meanwhile, another university in Jakarta showed paper waste generation of 39.41 kg/day (Meilani et al., 2021). Compared to this value, paper waste generation at Institut Teknologi Sumatera can be considered relatively low.

Table 2. Number of Educational Staff and Students in Office Buildings

Building	Number of Educational Staff	Number of Students
Academic, Student Affairs, and Finance	27	0
Faculty of Infrastructure and Regional Technology	18	6.226
Faculty of Industrial Technology	30	11.589
Faculty of Science	16	3.828
Total	91	21.643

Source: Field Observation, 2025

Factors influencing the amount of waste generation originate from various aspects, namely the type of activities (activity duration) that potentially generate waste, the population size of waste generators, and the available waste management infrastructure (Priscilla et al., 2016; Rahsia et al., 2024). However, the results obtained in this study as shown in Table 1 indicate that the highest waste generation is produced by Building B (Academic, Student Affairs, and Finance Office), whereas Table 2 shows that the number of educational staff in the Academic, Student Affairs, and Finance Office is 27 people, which is fewer than the educational staff in the Faculty of Industrial Technology at 30 people. Furthermore, based on student population, the Faculty of Industrial Technology has a larger student body of 11,589 students. This indicates that waste generation is not solely influenced by population size. Other research states that waste generation is influenced not only by population size but also by other dominant factors, namely the characteristics of administrative activities, the volume of documents processed, and the unit's work system (Damanhuri & Padmi, 2019).

4. Conclusions

This study demonstrates that the total paper waste generation at Institut Teknologi Sumatera reached 11.7 kg/day, with the highest contribution from Building B (Student Affairs and Finance Office) at 3.9 kg/day. This waste generation is influenced not only by population size but also by the characteristics of administrative activities, the volume of documents processed, and the unit's work system. These results are comparable to paper waste generation at universities in Jakarta (11.62 kg/day) and Yogyakarta (11.7 kg/day), but lower than another university in Jakarta (39.41 kg/day). It is recommended to identify the types and characteristics of paper waste generated in each building and to design targeted paper waste management strategies based on the waste generation data of 11.7 kg/day by implementing *reduce*, *reuse*, and *recycle* programs according to the specific characteristics of each paper type and building.

5. Acknowledgements

The author thank faculties of Institut Teknologi Sumatera for technical assistance and support.

6. References

- Adeniran, A. E., Nubi, A. T., & Adelopo, A. O. (2017). Solid waste generation and characterization in the University of Lagos for a sustainable waste management. *Waste Management*, 67, 3. 10.1016/j.wasman.2017.05.002
- Aulia, U., & Hadju, V. A. (2024). Analisis Faktor Yang Berpengaruh Terhadap Angka Timbulan Sampah. *Jurnal Kolaboratif Sains*, 7(6), 2239 -2245. 10.56338/jks.v7i6.5535
- Badan Standardisasi Nasional. (2025). Metode pengambilan dan pengukuran contoh timbulan dan komposisi sampah rumah tangga dan sampah sejenis rumah. SNI 3964-2025.
- Berliana, A. M. (2022). Optimalisasi Sistem Pengelolaan Sampah Kampus Institut Teknologi Sumatera. Repository ITERA. <https://repo.itera.ac.id/depan/submission/SB2201280021>
- Bertha, I. E. (2021). Perencanaan Bangunan TPS 3R (Reduce, Reuse, Recycle) di Institut Teknologi Sumatera. Repository ITERA. <https://repo.itera.ac.id/depan/submission/SB2102050006>
- Damanhuri, E., & Padi, T. (2019). Pengelolaan sampah terpadu. ITB Press.
- Hariz, A. R., & Sulaiman. (2022). Pengelolaan Sampah Kampus 2 Uin Walisongo Semarang (Tinjauan Multidimensi). *EnviroScientiae*, 18(2), 76 - 86.
- Institut Teknologi Sumatera. (2023). LAPORAN KINERJA. ITERA. Retrieved December 11, 2025, from <https://www.itera.ac.id/wp-content/uploads/2024/02/Lakin-2024-ITERA-Final.pdf>
- Meilani, S. S., Masrida, R., Hasya, H., & Navanti, D. (2021). Potensi Daur Ulang Sampah Dari Kampus Universitas Bhayangkara Jakarta Raya. *RADIAL : Jurnal Peradaban Sains, Rekayasa dan Teknologi*, 9(1), 75 - 80. <https://doi.org/10.37971/radial.v9i1.222>
- Nursetyowati, P., Safrilah, & Zahra, N. (2024). Strategi Pengelolaan Sampah Terintegrasi Menuju Kampus yang Berkelanjutan di Universitas Bakrie. *Jurnal Ilmu Lingkungan*, 22(6), 1424 - 1434. 10.14710/jil.22.6.1424-1434
- Pribadi, A. (2015). Pemanfaatan Limbah Kertas Koran Sebagai Bahan Pengganti Agregat Kasar Dalam Campuran Papercrete Serta Aplikasinya Untuk Elemen Struktur Ringan Dan Non Struktur Ramah Lingkungan. *Jurnal Teknik Lingkungan*, 1(1), 1-10.
- Priscilla, E., Handayani, D. S., & Samudra, G. (2016). Studi Timbulan, Komposisi dan Karakteristik dalam Perencanaan Teknik Operasional Pengelolaan Sampah di Fakultas Perikanan dan Ilmu Kelautan Universitas Diponegoro. *Jurnal Teknik Lingkungan*, 5(2).
- Rahsia, S. A., Anggraini, I. M., & Marbu, J. (2024, Juni). Pola Timbulan Sampah Dan Praktik Pengelolaan Di Universitas: Prespektif Dari Literatur. *E-Journal Teknologi Infrastruktur*, 3(1). <https://jurnal.upb.ac.id/index.php/ft>

Ruslinda, Y., Ramadhani, A. P., & Gunawan, H. (2024). Optimasi Pemanfaatan Sampah Kertas Layak Jual. *Jurnal Serambi Engineering*, IX(4), 10853-10863.