Annals of Tropical Research 47 (1):56-77(2025)
https://doi.org/10.32945/atr4715.2025

Original Article

Estimation of waste generation in student dormitories and cottages at Visayas State University, Baybay City, Leyte, Philippines

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ABSTRACT

The Visayas State University, Baybay Campus, faces solid waste challenges due to rising student numbers, despite guidelines already being in place. The research emphasized the urgent need for collaborative efforts to ensure a cleaner, more sustainable campus environment and to protect public health. The waste composition analysis of student residences reveals a daily generation rate of 0.348kg/cap/day. Female occupants contribute 52%, and plastic waste shows a positive correlation with allowances. Diverse waste management practices and the lack of proper segregation in 64.81% of cases, underscore the need for interventions. Correlation analysis with allowances indicated significant relationships; for instance, organic waste had a negligible correlation, while plastic waste correlated positively with higher allowances. Metal waste exhibited a strong positive correlation with the allowances of both female and male occupants. These findings offer essential guidance for sustainable waste management and inform policy formulations for effective implementation. The study underscores the imperative for waste management strategies,

Received: 28 January 2025
Revised: 23 March 2025
Accepted: 17 April 2025
Published: 30 June 2025

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comprehensive policies, and collaboration among university stakeholders to enhance efficacy, address enforcement issues, and align with sustainability goals.

Keywords: VSU, waste generation rate, waste composition

INTRODUCTION

Solid waste management remains a significant environmental concern in most developing nations, including the Philippines. It was anticipated that between 2022 and 2025, the nation's rubbish output will total 92 million tons (Rebuelta-Teh, 2022). In addition, according to the Environmental Management Bureau (2025) approximately 1,400 metric tons of medical waste are generated daily.

Rapid urbanization, economic expansion, changes in consumption habits, and lifestyle changes have all contributed to a notable rise in waste volume and diversity over the past few decades (Oliveira et al., 2013; Premakumara et al., 2014). These issues prompted the Philippines to establish Republic Act (RA) 9003, popularly known as the Ecological Solid Waste Management Act of 2000, regarded as a landmark piece of environmental law (Festejo et al., 2013). Similarly, waste production in colleges and universities is also of growing concern. One significant factor is the sheer volume of waste generated by these institutions due to the large number of students, faculty, and staff (Vargas et al., 2020).

In studying waste management, the Waste Analysis Characterization Study (WACS) is one of the most comprehensive approaches to compiling data on the amount (in tons per day, cubic meters per day, and kilograms per household/day) and composition (in terms of biodegradable and non-biodegradable materials) of solid wastes produced from various sources (Ngohayon & Tulagan, 2022).

To contribute to the successful implementation of RA 9003, this study utilized the WACS to assess the solid wastes in the dormitories and cottages of Visayas State University (VSU), Baybay City Campus, Philippines. The analysis of the study focused on estimating the solid waste generation and composition solely in the student dormitories and cottages of VSU (Baybay campus). Students estimated their waste generation based on self-reported data collected through a questionnaire. The volume and bulk density are not included in the waste composition analysis, and the data utilized in the ultimate analysis are based on theoretical data only. An interview survey using Kobocollect was conducted to acquire data on the amount of waste generated and the solid waste management at each student's housing, as exposure to solid waste is detrimental to the researcher's health. This pioneering study estimated the waste composition and generation rate of student occupants in the dormitories and cottages at VSU, Baybay City, Leyte, using Kobocollect as a new tool in data gathering.

MATERIALS AND METHODS

Description of Study Area

VSU (Baybay campus) (10.7460°N latitude and 124.7946°E longitude (Visayas State University [VSU], n.d.)) is an internationally competitive university in Barangay

Pangasugan, Baybay City, Leyte, eight kilometers north of the city center and 34km south of Ormoc City. The VSU covers a total land area of 1,099.4 hectares, stretching from the Camotes Sea to the peak of Mt. Pangasugan.

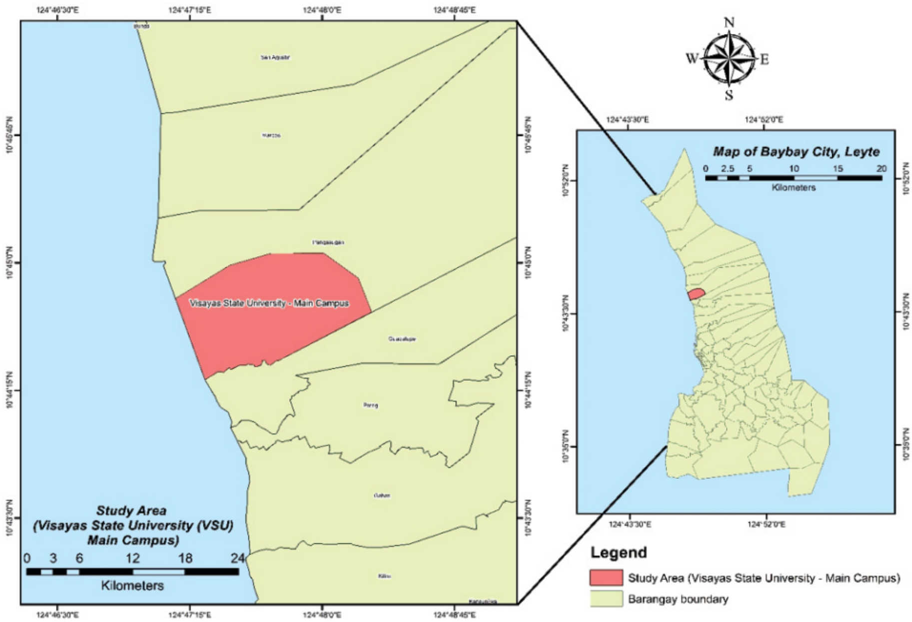

Figure 1. Geographic location of the research area of VSU (Baybay campus), Baybay City, Leyte

Student Housing in VSU (Baybay Campus)

The Visayas State University (Baybay campus) comprises three residential communities: Upper Campus (mountain side) with seven dormitories, Lower Campus (seaside) with eight dormitories and nine cottages, and the Co-ed residential hall on both campuses with two dorms. The Upper campus has a capacity of 939 beds, Lower campus accommodates 761 student occupants, and the Co-Ed Hall can house 50 students across Banahaw and Kanlaon dorms. The dormitories cater to various academic years and genders, contributing to a total student residential capacity on campus of 1,750 (Gumaod, n.d.).

Selection of Respondents

The 1,750 students accommodated by VSU every academic year, in its dormitories and cottages, makes up a significant proportion of the campus residential population, which also includes some faculty staff. Due to their substantial presence, this group significantly contributes to the generation of solid waste at the university, making them the primary focus of this study. To determine the population size of students residing in these accommodations, the full bed capacity of each dormitory or cottage was considered, as the exact population data is protected under the Data Privacy Act of 2012. The representative number of respondents from student dormitories and cottages was determined using the

Krejcie & Morgan Formula (Krejcie & Morgan, 1970). Megahed and Srikantaswamy (2020) applied the formula to determine farmers' sample sizes in Mysore, India, for assessing climate change adaptation. Sirisombat et al. (2022) used it for companies to analyze technological innovation in post-epidemic recovery. Abdillah et al. (2021) employed the formula to evaluate lecturer performance in Indonesia.

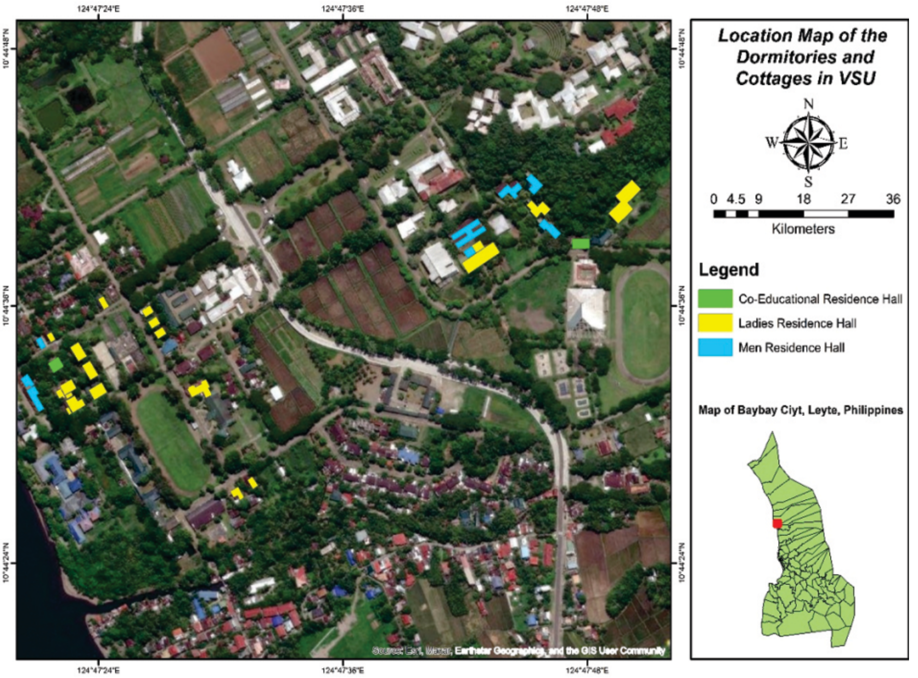

Figure2. Location map of the dormitories and cottages in VSU (Baybay campus), Baybay City, Leyte

$$n = \frac{\frac{z^2 \times P(1-P)}{e^2}}{1+\left(\frac{z^2 \times P(1-P)}{e^2 N}\right)} \qquad [1]$$

where:

n=representative number of student dormitories and cottages occupants

N=total number of student dormitories and cottages occupants=1,750 students

z= z-score for 95% confidence level=1.96

P= standard deviation=0.20

e=margin of error=5%

Solid Waste Composition Analysis

Survey (Online and Interview). The sample size was determined using the Krejcie & Morgan Formula, as calculated below and detailed in Table 1. Subsequently, random students from each dormitory and cottage were interviewed, and some answered the online questionnaire either through the Kobocollect application or by accessing the Enketo link generated via the KoboToolbox software.

$$n = \frac{\frac{1.96^2 \times 0.2(1-0.2)}{0.05^2}}{1+\left(\frac{1.96^2 \times 0.2(1-0.2)}{0.05^2(1750)}\right)} = 216$$

Table 1. Distribution of respondents by student dormitories and cottages

Name of Dormitories and Cottages	Gender	Number of Respondents
Bougainvillea Cottage	Female	3
Calachuchi Dormitory	Female	7
Camia Cottage	Female	2
Cattleya Dormitory	Female	7
Chrysanthemum Cottage	Female	2
Daffodil Cottage	Female	5
Dahlia Ladies' Dormitory	Female	10
Daisy Cottage	Female	2
Everlasting Dormitory	Female	7
Gumamela Cottage	Female	2
Ilang-Ilang Ladies' Hall	Female	32
Mariposa Ladies' Home	Female	9
Petunia Cottage	Female	2
Sampaguita Ladies' Hall	Female	34
Sunflower Dormitory	Female	12
Waling-Waling Ladies' Hall	Female	9
Coconut Dormitory	Male	6
Mabolo Men's Home	Male	7
Mahogany Men's Hall	Male	17
Molave Men's Home	Male	9
Mulberry Men's Home	Male	9
Narra Cottage	Male	2
Zea Mays Men's Hall	Male	15
Banahaw	Female	1
	Male	1
Kanlaon	Female	2
	Male	2
	Female	148
Total	Male	68
		216

The data extracted included demographic information, estimated waste generation, waste types, and solid waste management practices. The study also documented solid waste management issues and the practices implemented by dormitories and cottages to efficiently and responsibly manage their waste.

Waste Composition

The study consolidated estimated waste generated by respondents, categorizing it into types such as organic, plastic, paper, metal, glass, e-waste, hazardous waste, construction and demolition waste, medical waste, and residual waste. Menstrual waste, including sanitary pads, panty liners, and tampons, falls under residual waste as it is not compostable or recyclable, leading to disposal in dumpsites and landfills (Parayno et al., n.d.). Plastic-based sanitary pads contribute to increased residual waste accumulation (Hand et al., 2023). The disclosure of ingredients in menstrual hygiene products reveals factors like volatile organic compounds, contributing to the classification of menstrual waste as residual waste. The non-recyclable nature of tampons and sanitary textiles justifies identifying menstrual waste as residual waste, accounting for 13% of household residual waste (Lin et al., 2020).

The percent of weight was determined by dividing the waste generated for every type of waste by the total waste generation, as shown in the equation below.

$$\%\ \text{wt.} = \frac{\text{Weight of Waste Generation}_{\text{type of waste}}}{\text{Weight of Total Waste Generation}} \qquad [2]$$

Solid Waste Generation Rate

After identifying the waste composition, the waste generation rate per respondent was calculated by dividing the total weight of waste generation by the total population that responded during data collection. A practical 7-day period was chosen for this calculation, as it balances the need for accurate data with logistical constraints, allowing researchers and waste management professionals to obtain meaningful estimates of waste generation rates while minimizing challenges and resource demands associated with daily data collection (Ilyas et al., 2017). This approach yields the estimated amount of waste generated per week for each respondent. An alternative method involves summing up the waste generation rates per type of waste to determine the overall waste generation rate.

$$\text{Waste generation rate ((kg/cap)/day)} = \frac{\text{Weight of Total Waste Generation}}{\text{Total Population x Number of Days}} \qquad [3]$$

RESULTS AND DISCUSSION

Waste Composition

The student dormitories and cottage occupants generated a total of approximately 608.73kg of waste daily (Table 2). The highest volume of waste was primarily composed of plastic waste, which made up roughly 18.51% of the total waste produced. This waste component was mainly comprised of packaging, bottles, and cellophane materials. On the contrary, the smallest quantity of waste generated fell into the hazardous waste component, including items such as lead-based paints, batteries, laboratory chemicals such as solvents and reagents. Approximately 17% of the waste produced consisted of organic wastes, which were mainly food wastes. These are suitable for composting and potentially advantageous for the university's agricultural sector. Paper waste contributed 14% of the overall daily waste production. Residual waste was 10% of the waste generated. This includes items like sanitary pads, panty liners, and tampons. The waste compositions of the different types of waste generated on a daily basis are depicted in Figure 3.

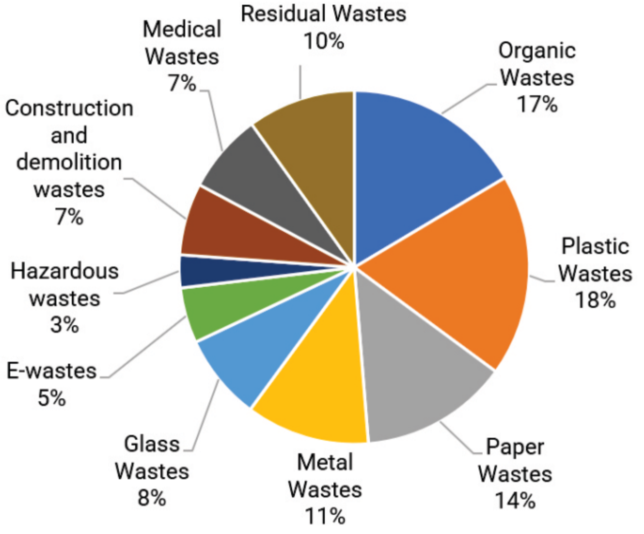

Figure 3. Daily waste composition percentages generated by student occupants

The female occupants generated the highest daily waste weight, accounting for 52% of the total. As illustrated in Figure 4, the major waste types generated included plastics, organics, residuals, metals, and papers, which comprised a substantial portion of the total waste. Notably, residual waste such as sanitary pads, pantyliners, textiles and rubbers, constituted 14% of the group's waste generation. This emphasizes the need for appropriate disposal in sanitary waste bins to avert bacterial and pathogenic contamination, which could result in health risks for those exposed to the waste. Conversely, the smallest waste fractions consisted of hazardous wastes, e-wastes, and construction wastes.

The waste produced by the male occupants amounted to around 48% of the daily total waste generated. The most significant waste components from this group included plastic waste at approximately 19% and organic waste at roughly 18%, predominantly comprising food waste. On the other hand, the least amount of waste generated comprised hazardous waste, electronic waste (e-waste), medical waste, and residual waste, as indicated in Figure 5.

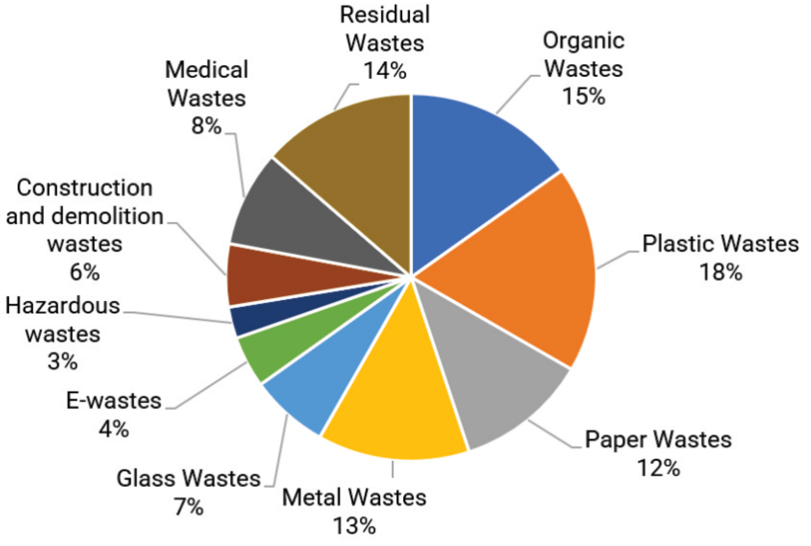

Figure 4. Daily waste composition percentages generated by female occupants

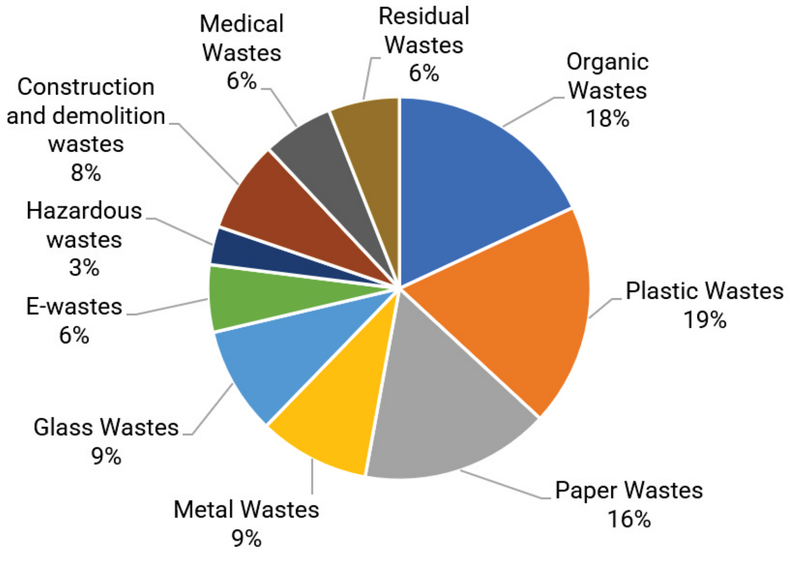

Figure 5. Daily waste composition percentages generated by male occupants

Figure 6 illustrates significant trends in waste generation with varying allowance levels. Organic wastes consistently increase, plastic waste stabilizes after an initial rise, and paper waste remains moderately influenced. Metal waste sees a slight upward trend, while glass waste decreases. E-waste significantly rises, and hazardous waste peaks at PhP2000 allowances per week. Construction, medical, and residual wastes all increase notably. These trends highlight the intricate relationship between allowance levels and waste generation, underscoring the need for targeted waste management strategies to address associated environmental impacts.

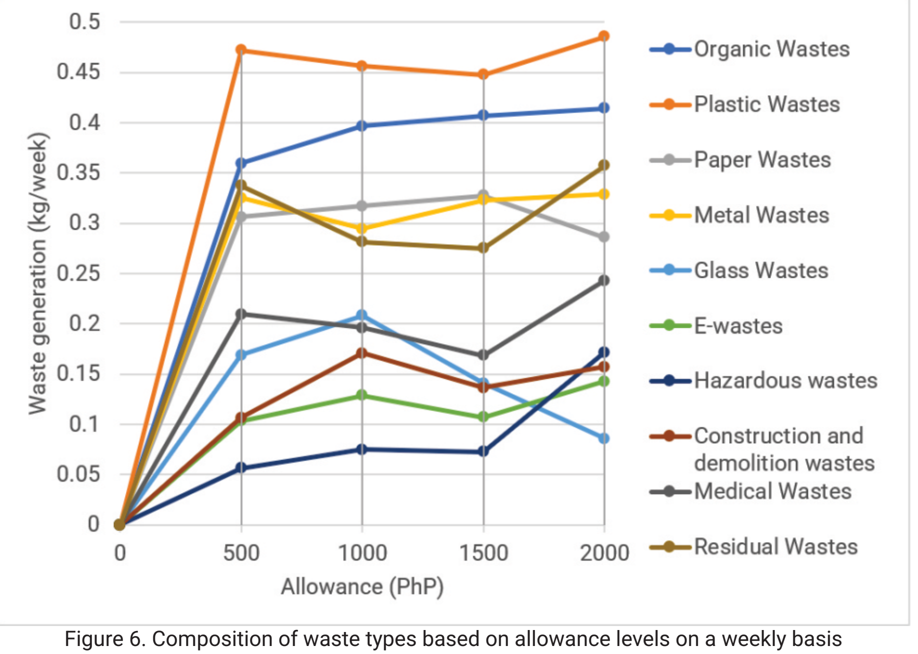

Figure 6. Composition of waste types based on allowance levels on a weekly basis

Solid Waste Generation Rate

The data presented in Table 2 reveals a significant disparity in the daily waste generation rates across various waste categories, ranging from 0.01kg/cap/day to 0.66kg/cap/day. Notably, the waste generation rate of female occupants is 0.364kg/cap/day, while male occupants generated a comparatively lower waste generation rate of 0.331kg/cap/day. This discrepancy is attributed to the fact that male occupants contribute the least to residual, medical, hazardous, and electronic waste (e-waste). It is particularly striking that plastic waste emerges as the predominant waste type, with an average daily generation rate of 0.064kg/cap/day among all waste components. The prevalence of plastic waste presents a formidable challenge to the university's solid waste management, as a substantial portion of these plastics is disposed of in the campus dumpsite, despite some being suitable for recycling. This scenario aligns with the World-Wide Fund for Nature Australia's assertion in 2021 that plastics may take as long as 500 years or more to decompose, intensifying waste management difficulties both within the university and the broader city context.

Additionally, Table 2 shows that the average waste generation rate per capita is 0.348kg/cap/day. This is the waste generation rate per student occupant from the total population of 1,750 students residing in university dormitories and cottages.

Table 2. Weekly and daily waste generation rate of student dormitories and cottages in VSU (Baybay campus)

Waste Components	Amount (kg)		Total (kg)	Per Capita Generation Rate (kg/cap/week)		Per Capita Generation Rate (kg/cap/day)	
	Female Occupants	Male Occupants		Female Occupants	Male Occupants	Female Occupants	Male Occupants
Organic Wastes	56.700	28.900	85.600	0.386	0.419	0.055	0.060
Plastic Wastes	68.400	30.100	98.500	0.465	0.436	0.066	0.062
Paper Wastes	43.400	25.600	69.000	0.295	0.371	0.042	0.053
Metal Wastes	49.800	15.000	64.800	0.339	0.217	0.048	0.031
Glass Wastes	25.800	14.500	40.300	0.176	0.210	0.025	0.030
E-wastes	17.000	9.100	26.100	0.116	0.132	0.017	0.019
Hazardous wastes	10.400	5.200	15.600	0.071	0.075	0.010	0.011
Construction and demolition wastes	20.800	12.400	33.200	0.141	0.180	0.020	0.026
Medical Wastes	31.800	9.600	41.400	0.216	0.139	0.031	0.020
Residual Wastes	50.900	9.600	60.500	0.346	0.139	0.049	0.020
Total	375.000	160.000	535.000	2.551	2.319	0.364	0.331
Average Per Capita Generation Rate				2.435kg/cap/week		0.348kg/cap/day	
Waste Generation				4261.128kg/week		608.733kg/day	

Solid Waste Generation Rate According to the Student Weekly Allowance

The waste generation rates of student residents with a weekly allowance of less than PhP500 were recorded as 0.349kg/cap/day for the female occupants and 0.313kg/cap/day for the male occupants, as shown in Table 3. This specific group contributed approximately 19.28% of the total plastic waste produced within this allowance range, followed by organic waste, which accounted for 15.98% of the total waste generated.

For students with a weekly allowance between 500 and PhP1,000, indicated in Table 4, the waste generation rates were measured at 0.366kg/cap/day for the female occupants and 0.357kg/cap/day for the male occupants. Plastic waste remained the predominant waste type in this component, comprising 18% of the total waste generated.

Students who received a weekly allowance between 1,000 and PhP1,500 exhibited waste generation rates of 0.372kg/cap/day for the female occupants, 0.288kg/cap/day for the male occupants, as shown in Table 5. Plastic waste remained the most prevalent waste type, constituting 18.62% of this allowance range.

Among students with a weekly allowance ranging from 1,500 to PhP2,000, as shown in Table 6, waste generation rates were 0.386kg/cap/day for the female occupants and 0.357kg/cap/day for the male occupants. Plastic waste accounted for a significant portion, at 18.18%.

The group of students with a weekly allowance exceeding PhP1,500 to PhP2,000 demonstrated the highest waste generation rate at 0.371kg/cap/day, while those with an allowance under PhP500 and between PhP1,000 and PhP1,500 had the lowest waste generation rate at 0.33kg/cap/day.

Across all allowance ranges, the female occupants consistently generated the most waste among the two groups. This was primarily because 67% of the total population of student dormitories and cottage occupants on campus were female. The standard deviation, ranging from 0.001 to 0.042, indicated that the waste generation rate data exhibited relative consistency. This suggests a lower degree of variability in waste generation rates and implies a higher level of predictability.

Table 3. Waste composition analysis of waste generated with <500 PhP allowance per week

Allowance Range	Waste Components	Waste Generation Rate (kg/cap/day)		Mean ± SD	Amount (kg) (daily basis)		Total (kg)	Waste Composition Percentage (% WT.)		Total (% WT.)
		Female Occupants	Male Occupants		Female Occupants	Male Occupants		Female Occupants	Male Occupants	
<500 PhP	Organic Wastes	0.051	0.064	0.058±0.009	1.643	0.643	2.286	14.706	20.548	15.984
	Plastic Wastes	0.067	0.060	0.064±0.005	2.157	0.600	2.757	19.309	19.178	19.281
	Paper Wastes	0.044	0.054	0.049±0.007	1.400	0.543	1.943	12.532	17.352	13.586
	Metal Wastes	0.046	0.024	0.035±0.016	1.486	0.243	1.729	13.299	7.763	12.088
	Glass Wastes	0.024	0.036	0.030±0.008	0.771	0.357	1.129	6.905	11.416	7.892
	E-wastes	0.015	0.019	0.017±0.003	0.471	0.186	0.657	4.220	5.936	4.595
	Hazardous wastes	0.008	0.003	0.005±0.004	0.257	0.029	0.286	2.302	0.913	1.998
	Construction and demolition wastes	0.015	0.024	0.020±0.006	0.486	0.243	0.729	4.348	7.763	5.095
	Medical Wastes	0.030	0.021	0.026±0.006	0.957	0.214	1.171	8.568	6.849	8.192
	Residual Wastes	0.048	0.007	0.028±0.029	1.543	0.071	1.614	13.811	2.283	11.289
Total		0.349	0.313		11.171	3.129	14.300	100.000	100.000	100.000

Table 4. Waste composition analysis of waste generated with >500–1,000 PhP allowance per week

Allowance Range	Waste Components	Waste Generation Rate (kg/cap/day)		Mean ± SD	Amount (kg) (daily basis)		Total (kg)	Waste Composition Percentage (% WT.)		Total (%WT.)
		Female Occupants	Male Occupants		Female Occupants	Male Occupants		Female Occupants	Male Occupants	
>500-1,000 PhP	Organic Wastes	0.055	0.059	0.057 ± 0.003	4.429	2.543	6.971	15.122	16.888	15.722
	Plastic Wastes	0.066	0.065	0.065 ± 0.001	5.300	2.714	8.014	18.098	18.027	18.073
	Paper Wastes	0.040	0.056	0.048 ± 0.011	3.229	2.343	5.571	11.024	15.560	12.564

Table 4. continued

Allowance Range	Waste Components	Waste Generation Rate (kg/cap/day)		Mean ± SD	Amount (kg) (daily basis)		Total (kg)	Waste Composition Percentage (% WT.)		Total (%WT.)
		Female Occupants	Male Occupants		Female Occupants	Male Occupants		Female Occupants	Male Occupants	
>500-1,000 PhP	Metal Wastes	0.048	0.031	0.040 ± 0.012	3.871	1.300	5.171	13.220	8.634	11.662
	Glass Wastes	0.028	0.034	0.031 ± 0.005	2.214	1.443	3.657	7.561	9.583	8.247
	E-wastes	0.017	0.021	0.019 ± 0.003	1.357	0.900	2.257	4.634	5.977	5.090
	Hazardous wastes	0.011	0.011	0.011 ± 0.0001	0.857	0.457	1.314	2.927	3.036	2.964
	Construction and demolition wastes	0.022	0.030	0.026 ± 0.006	1.743	1.257	3.000	5.951	8.349	6.765
	Medical Wastes	0.031	0.023	0.027 ± 0.005	2.457	0.986	3.443	8.390	6.546	7.764
	Residual Wastes	0.048	0.027	0.037 ± 0.015	3.829	1.114	4.943	13.073	7.400	11.147
Total		0.366	0.357		29.286	15.057	44.343	100.000	100.000	100.000

Table 5. Waste composition analysis of waste generated with >1,000–1,500 PhP allowance per week

Allowance Range	Waste Components	Waste Generation Rate (kg/cap/day)		Mean ± SD	Amount (kg) (daily basis)		Total (kg)	Waste Composition Percentage (% WT.)		Total (% WT.)
		Female Occupants	Male Occupants		Female Occupants	Male Occupants		Female Occupants	Male Occupants	
>1,000-1,500 PhP	Organic Wastes	0.058	0.059	0.058 ± 0.001	1.671	0.886	2.557	15.476	20.530	16.919
	Plastic Wastes	0.065	0.062	0.063 ± 0.002	1.886	0.929	2.814	17.460	21.523	18.620
	Paper Wastes	0.046	0.048	0.047 ± 0.001	1.343	0.714	2.057	12.434	16.556	13.611

Table 5. continued

Allowance Range	Waste Components	Waste Generation Rate (kg/cap/day)		Mean ± SD	Amount (kg) (daily basis)		Total (kg)	Waste Composition Percentage (% WT.)		Total (% WT.)
		Female Occupants	Male Occupants		Female Occupants	Male Occupants		Female Occupants	Male Occupants	
>1,000-1,500 PhP	Metal Wastes	0.050	0.039	0.044 ± 0.008	1.443	0.586	2.029	13.360	13.576	13.422
	Glass Wastes	0.022	0.017	0.019 ± 0.003	0.629	0.257	0.886	5.820	5.960	5.860
	E-wastes	0.017	0.011	0.014 ± 0.004	0.500	0.171	0.671	4.630	3.974	4.442
	Hazardous wastes	0.009	0.013	0.011 ± 0.003	0.257	0.200	0.457	2.381	4.636	3.025
	Construction and demolition wastes	0.022	0.015	0.018 ± 0.005	0.629	0.229	0.857	5.820	5.298	5.671
	Medical Wastes	0.031	0.010	0.021 ± 0.015	0.900	0.157	1.057	8.333	3.642	6.994
	Residual Wastes	0.053	0.012	0.033 ± 0.029	1.543	0.186	1.729	14.286	4.305	11.437
Total		0.372	0.288		10.800	4.314	15.114	100.000	100.000	100.000

Table 6. Waste composition analysis of waste generated with > 1,500–2,000 PhP allowance per week

Allowance Range	Waste Components	Waste Generation Rate (kg/cap/day)		Mean ± SD	Amount (kg) (daily basis)		Total (kg)	Waste Composition Percentage (% WT.)		Total (% WT.)
		Female Occupants	Male Occupants		Female Occupants	Male Occupants		Female Occupants	Male Occupants	
>1,500-2,000 PhP	Organic Wastes	0.060	0.057	0.058 ± 0.002	0.357	0.057	0.414	15.432	16.000	15.508
	Plastic Wastes	0.071	0.057	0.064 ± 0.010	0.429	0.057	0.486	18.519	16.000	18.182
	Paper Wastes	0.038	0.057	0.048 ± 0.013	0.229	0.057	0.286	9.877	16.000	10.695

Table 6. continued

Allowance Range	Waste Components	Waste Generation Rate (kg/cap/day)		Mean ± SD	Amount (kg) (daily basis)		Total (kg)	Waste Composition Percentage (% WT.)		Total (% WT.)
		Female Occupants	Male Occupants		Female Occupants	Male Occupants		Female Occupants	Male Occupants	
>1,500-2,000 PhP	Metal Wastes	0.052	0.014	0.033 ± 0.027	0.314	0.014	0.329	13.580	4.000	12.299
	Glass Wastes	0.012	0.014	0.013 ± 0.002	0.071	0.014	0.086	3.086	4.000	3.209
	E-wastes	0.017	0.043	0.030 ± 0.019	0.100	0.043	0.143	4.321	12.000	5.348
	Hazardous wastes	0.019	0.057	0.038 ± 0.027	0.114	0.057	0.171	4.938	16.000	6.417
	Construction and demolition wastes	0.019	0.043	0.031 ± 0.017	0.114	0.043	0.157	4.938	12.000	5.882
	Medical Wastes	0.038	0.014	0.026 ± 0.017	0.229	0.014	0.243	9.877	4.000	9.091
	Residual Wastes	0.060	0.000	0.030 ± 0.042	0.357	0.000	0.357	15.432	0.000	13.369
Total		0.386	0.357		2.314	0.357	2.671	100.000	100.000	100.000

Solid Waste Management

Solid Waste Storage. The data indicated in Figure 7 indicates that most respondents, approximately 54.5%, utilize a trash can, bin, or drum for their solid waste storage needs. This is followed by 24.9% of respondents who prefer the use of garbage bags or sacks.

A smaller percentage of respondents, around 8.2%, opt for piling their waste in a yard, while 6.4% employ a composting heap for their waste storage. A hazardous waste container is used by a minority of respondents, specifically 4.1%. The least common method of waste storage is a box (carton), with a mere 1.8% of respondents choosing this option.

The data, thus, provides an overview of the preferred methods of waste storage, with traditional methods like trash cans and garbage bags being the most prevalent, while alternative methods like composting heaps or hazardous waste containers are less commonly used.

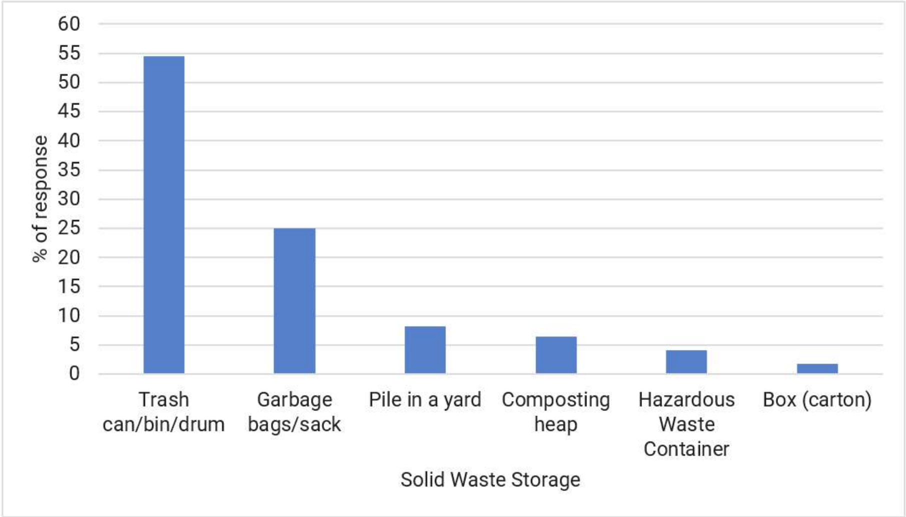

Figure 7. Percentage distribution of solid waste storage methods used by respondent

Proper Waste Segregation

The provided data in Figure 8 indicates that 64.81% of individuals do not engage in proper waste segregation, whereas 35.19% adhere to the practice. In terms of gender, 40.74% of female and 24.07% of male occupants incorrectly segregate waste. This highlights a pressing necessity for focused interventions aimed at enhancing waste management practices, particularly considering the observed variations across diverse demographic groups.

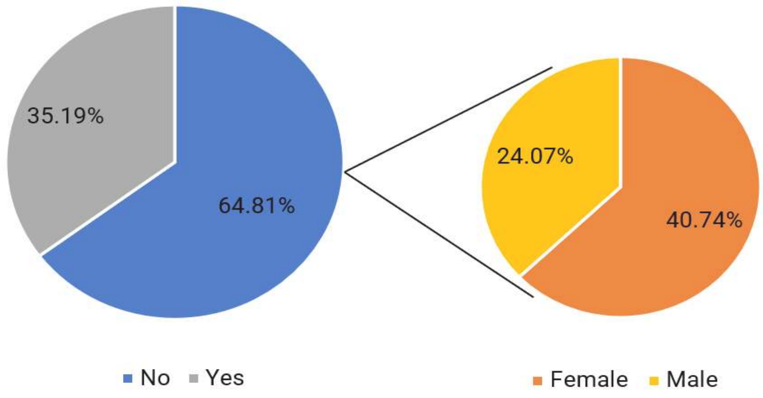

Figure 8. Gender distribution in non-adherence to proper waste segregation practices

Disposal Methods

The VSU (Baybay campus) followed a structured waste management system that included segregation, scheduled collection, a prohibition on single-use plastics, and recycling through its Material Recovery Facility. All student occupants are urged to compost, recycle, and reduce garbage, with the excess being delivered to Baybay City's sanitary landfill. As shown in Figure 9, organic waste is disposed of predominantly by campus garbage trucks (49.07%), while plastic waste is primarily managed by garbage trucks (70.37%) and disposed of noticeably at campus dumpsites (12.04%). The VSU dumpsite is about one kilometer from upper campus residences and two kilometers from lower campus, ensuring that waste is transported and handled systematically. Paper wastes see 66.67% disposed of via garbage trucks, and metal wastes exhibit primary methods of garbage trucks (70.37%) and burying (12.04%). Glass wastes rely on garbage trucks (60.65%) and burying (12.04%), with a concerning 11.57% in rivers and gullies. E-waste primarily uses garbage trucks (41.20%) and dumpsite (34.26%). Hazardous wastes show 43.98% through garbage trucks and 33.80% in dumpsite. Construction and demolition wastes use garbage trucks (51.39%) and dumpsite (20.83%). Medical waste is collected at 47.22% through garbage trucks and 35.65% in dumpsite. Residual wastes, non-recyclable and non-hazardous, have 57.41% through garbage trucks and 31.48% in dumpsite.

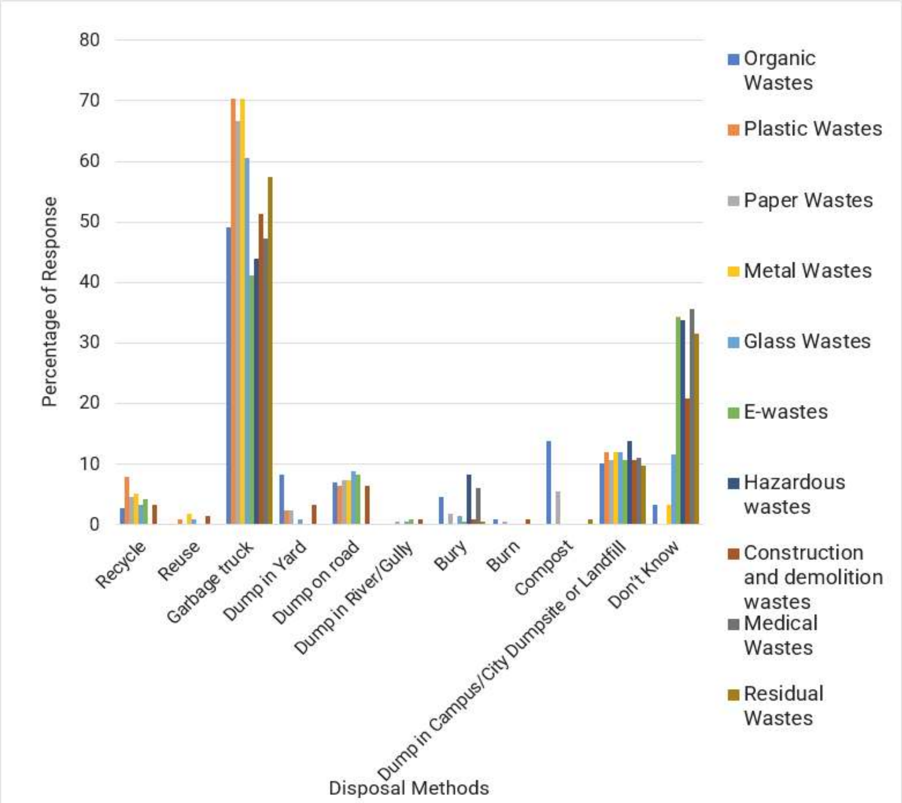

Figure 9. Percentage distribution of waste disposal methods by waste type

Figure 10 shows that while approximately 1.85% of areas experienced daily garbage collection, the remainder experienced a relatively infrequent but consistent schedule. The majority, around 43.52%, undergo weekly garbage collection, reflecting a common and regular routine. A significant portion, about 37.04%, sees garbage trucks collecting waste twice a week, indicating a more frequent pickup schedule. In some areas, around 11.11% of waste is collected three times a week, highlighting a higher demand for waste disposal services. Monthly garbage collection accounts for approximately 3.24%, signifying less frequent waste pickup. Additionally, the 15th of the month is a specific date for garbage collection in about 3.24% of cases, possibly representing a scheduled monthly pickup date for certain areas.

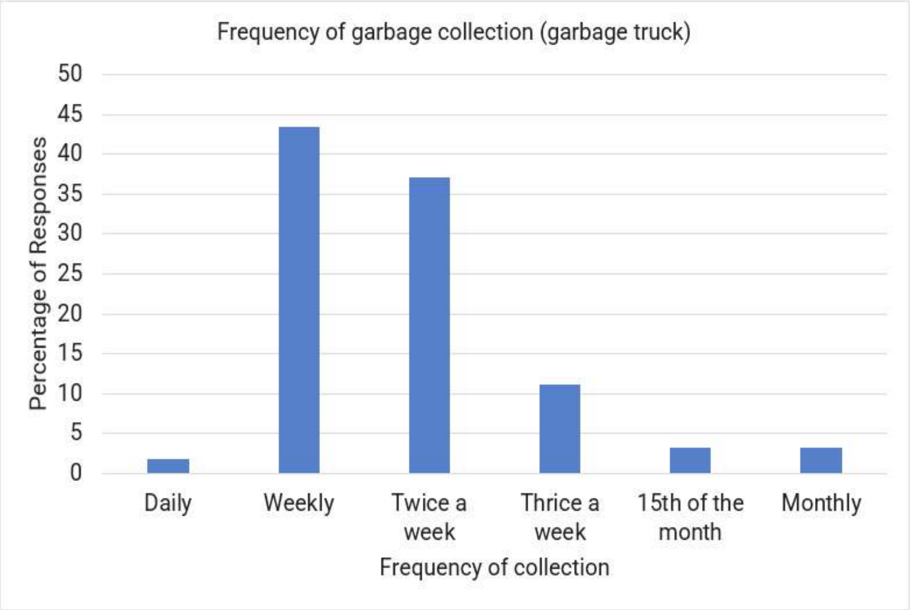

Figure 10. Frequency distribution of garbage collection through garbage trucks

On-campus Solid Waste Management Concerns

The data on waste management issues in campus dormitories, presented in Table 7, categorized by gender, reveals notable differences. Female occupants report higher instances of problems such as the lack of proper waste segregation, insufficient disposal facilities, inadequate waste collection and disposal, as well as inappropriate disposal of hazardous waste. There's also a greater concern among female residents regarding the lack of awareness and education, insufficient infrastructure (material recovery facilities, recycling facilities, or composting sites), and inconsistencies in waste management policies. Both genders identify issues related to inefficient waste collection routes, but the numbers are relatively low. These findings highlight the importance of targeted efforts to improve waste management practices, with a focus on educational initiatives, infrastructure development, and policy consistency, both in female and male residences.

Table7. On-campus waste management issues in dormitories by gender

Dormitories and On-Campus Waste Management Issues	Percentage of Responses	
	Female Occupants	Male Occupants
Lack of proper waste segregation	26.02%	28.92%
Insufficient waste disposal facilities or inadequate trash cans or bins	20.05%	14.46%
Inadequate waste collection and disposal	8.59%	9.64%
Lack of awareness and education	14.8%	10.84%
Inefficient waste collection routes	3.58%	5.42%
Inappropriate disposal of hazardous waste	8.35%	9.64%
Lack of infrastructure such as material recovery facilities, recycling facilities or composting sites	8.83%	10.24%
Inconsistent waste management policies	8.35%	8.43%
No issues observed	1.43%	2.41%

Solid Waste Management Respondents Recommendations

In addressing solid waste management on the campus, the respondents emphasize the establishment of specialized collection stations for hazardous waste and the provision of designated compost bins for organic waste, including food scraps. They advocate for solid waste reduction through practices such as recycling, avoiding single-use items, and raising awareness among residents. The respondents believe that efficient garbage collection, proper waste segregation, and educational initiatives play pivotal roles in effective waste management. Additionally, they stress the importance of adopting reusable and eco-friendly practices, including reducing plastic usage. The "Clean As You Go" (CLAYGO) approach, market practices like bringing their containers, and adhering to waste sorting principles are actions they endorse. The respondents also highlight the significance of following the 3 R's (reduce, reuse, recycle), regular waste collection, financial support, individual discipline, and community collaboration as integral components of the proposed waste management strategy.

Best Solid Waste Management Practices in VSU Baybay campus dormitories and cottages

In dormitories or cottages, best waste management practices revolve around designated bins for biodegradable and non-biodegradable waste. While bins are present, some areas lack proper waste management due to insufficient labeling. To address this, prioritizing educational initiatives is crucial to enhancing awareness and ensuring strong implementation, including providing clearly labeled bins. Exemplary practices involve meticulous waste categorization into biodegradable, non-biodegradable, recyclable, hazardous, and food waste. Strategies like composting and clear signage contribute significantly. Emphasizing the waste hierarchy—reduce, reuse, recycle, and recover—cultivates responsible disposal habits. The lack of access to biodegradable sanitary pads at VSU adds to the challenge in reducing menstrual waste. Recommendations underscore the need for additional labeled bins and the establishment of composting systems. Challenges persist, warranting ongoing education, awareness campaigns, and practical steps like minimizing plastic use. To instill a sense of responsibility, key suggestions include designated bins for recyclables and the implementation of a comprehensive campus-wide recycling program. The focal point remains education, awareness, infrastructure, and sustained efforts for effective waste management, with an emphasis on regular cleaning and hygiene practices as essential best practices.

CONCLUSION

This study exposes significant solid waste management challenges at Visayas State University (VSU), particularly in student living spaces. The substantial daily waste generation, predominantly plastic, calls for urgent and targeted management strategies. Lack of knowledge about biodegradable pads and its accessibility underscores the critical need for long-term menstrual health solutions and education for female residents. Plastic waste, a major concern due to its prevalence and slow decomposition, requires focused reduction efforts. Correlation analysis linking waste generation to student allowances underscores the financial dimension's importance. The findings directly inform VSU's waste management policies, advocating for tailored educational programs, infrastructure upgrades, and gender-specific initiatives. Recommendations for specialized stations, compost bins, and adherence to the 3 R's offer practical steps for improved waste management. Continuous efforts in education, awareness, and infrastructure are vital for sustainable practices at VSU. This study lays the groundwork for informed decision-making and policy development, fostering a more effective and sustainable solid waste management system at VSU.

Effective Action Plan Proposal for Achieving 3R Goals (Reduce, Reuse, Recycle) at VSU Dormitories and Nearby Villages:

- Gender-Inclusive Awareness Programs: Develop gender-inclusive waste management awareness programs, considering the varying contributions of male and female occupants. Provide targeted educational initiatives to ensure all students adopt sustainable waste practices, aligning with RA 9003's emphasis on community participation.

  a. Assessment and Tailoring

  Conduct a thorough assessment of waste management habits among female and male occupants. Use this data to tailor awareness programs specifically addressing their needs and challenges.

  b. Customized Educational Materials

  Develop gender-inclusive educational materials, such as pamphlets, posters, and online resources, addressing both male and female students' waste management responsibilities and opportunities. Highlight the different waste generation patterns of each group to encourage more effective and targeted waste reduction strategies.

c. Collaboration with Campus Organizations:

Collaborate with relevant student organizations, including women's groups and mixed-gender environmental or sustainability clubs, to amplify the reach of awareness programs. Leverage existing networks and resources to promote broad community engagement and ensure participation from all genders in sustainable waste management efforts.

ACKNOWLEDGMENT

The authors gratefully acknowledge the faculty and staff of the Department of Agricultural and Biosystems Engineering, Visayas State University (VSU), for their invaluable support throughout this work. Special appreciation is extended to Dr. Daniel Leslie S. Tan for his insightful contribution.

AUTHOR CONTRIBUTIONS

AMM conceptualization, formal analysis, methodology, resources, Writing: original draft. MGCS writing, review and editing, resources, validation, supervision. MJC investigation, writing, review and editing, supervision. DL investigation & supervision.

FUNDING SOURCE

This paper was completed without any external funding or financial support.

AVAILABILITY OF DATA AND MATERIALS

Data will be made available on request.

ETHICAL CONSIDERATIONS

This study obtained informed consent prior to participation. Participants were fully informed about the nature of the research, their rights, and the use of their data.

COMPETING INTEREST

The authors declare that they have no competing interests.

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