



Received: 16-04-2024  
Accepted: 26-05-2024

## International Journal of Advanced Multidisciplinary Research and Studies

ISSN: 2583-049X

### Solid Waste Management Practices of Cebu Technological University- Danao, Carmen, and Tuburan Campus

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DOI: <https://doi.org/10.62225/2583049X.2024.4.3.2886>

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#### Abstract

The rise in global waste generation significantly hinders the effective implementation of waste management practices. CTU – Campuses have contributed to local waste generation throughout the years. To further address this arising problem, this paper assesses the solid waste practices of CTU Campuses of Danao, Carmen, and Tuburan. The study estimated how much solid waste is generated and identified which waste management strategies work best. The methodology used in this study was carried out on the 3 CTU Campuses; the use of a school waste assessment form that evaluated the current waste management practices in terms of waste generation, segregation, collection, and disposal processes across the campus facilities. Results

showed that CTU-Tuburan has more proper solid waste practices regarding composting pits. However, CTU-Tuburan has the biggest estimated volume of waste generated monthly, impacting individuals' contributions to waste generation. CTU- Carmen gives enough availability of 3 sets of garbage containers and a plastic bottle recycling collection bin in some places. CTU-Danao and Carmen have enough recycling activities and have less contribution to the estimated volume of waste generated. The three campuses have a sufficient garbage collection schedule; however, they lack comprehensive waste reduction efforts and are not consistently followed by certain individuals on the campuses.

**Keywords:** Waste Volume Generation, Waste Reduction Efforts, Waste Assessment Form, Composting Pit

#### 1. Introduction

Every facet of human activity was impacted by waste, which was an unavoidable byproduct of day-to-day living. Waste was produced at every production and consumption cycle stage, including various materials, each with special management and disposal challenges, including organic matter, plastics, metals, paper, etc. Although the quantity of hazardous waste continued to endanger society, advances in reducing waste volume and hazards sparked a well-earned dose of technological optimism (Letcher & Vallero, 2021)<sup>[3]</sup>.

Cebu Technological University (CTU) has a rich history and a significant impact on education in Cebu, Philippines. Formerly known as Cebu State College of Science and Technology (CSCST). The main campus was first established in 1911. In totality, they have 20 campuses in the province of Cebu including a major campus, nine satellite campuses, and 13 extension sites. It had evolved into a state university with multiple campuses and a wide range of academic programs. CTU offers a diverse range of programs through its various colleges, including the College of Arts and Sciences, College of Computer, Information and Communications Technology, College of Education, College of Engineering, College of Forestry and Agriculture, College of Management and Entrepreneurship, and College of Technology. Additionally, CTU collaborates with the Cebu City Medical Center for nursing programs.

Out of the 20 campuses of CTU the researchers chose only three north campuses, namely Danao, Carmen, and Tuburan, when conducting the study. This was because of several reasons. One was the distance between each campus, wherein CTU Tuburan might be the last and farthest route that could be reached throughout an entire day. However, the solid waste management

among the three campuses was different as it would be considered a factor in how they monitored their school grounds in a greener environment.

Solid waste management on campuses was a critical aspect of sustainability and environmental responsibility. Like mini-autonomous cities, Campuses could serve as models for effective solid waste management practices, contributing to sustainable development. (Parvez *et al.*, 2019) [7]. Furthermore, some scenarios might happen when conducting solid waste management on campuses. There was an increasing waste generation, and solid waste management was a major challenge that placed a significant burden on campuses (Naveen, 2021) [4]. There was ineffective waste collection and disposal (Saha *et al.*, 2023) [8]. Universities would also deal with ineffective waste collection, transportation, and disposal practices. This led to waste accumulation in streets, improper landfilling, and a lack of recycling and recovery efforts. Lastly, there was poor waste segregation and characterization, wherein Naveen (2021) [4] stated that inadequate waste segregation at the source and lack of data on waste composition and quantities make it difficult to implement appropriate waste management strategies.

The same thing happened in Cebu Technological University as the segregated recyclable waste collected from August 1-28, 2021, brought in 1,369 PHP, or 27.41 USD in revenue (Amparado & Saladaga, 2020) [1]. Additionally, roughly 87% of respondents thought the paperless system was convenient and wanted to see changes made. Schools generate large volumes of waste, including electronic waste, paper, plastic, and leftovers. Encouraging efforts to reuse and repair items to increase their lifespan have been introduced for quite a while since the beginning of production but hardly thought of as a threat in the long run and up until the current flow of modern industries.

To overcome these challenges, campuses could implement strategies such as conducting waste audits to understand waste generation patterns, promoting reuse and recycling during move-outs, and addressing contamination issues through education and awareness campaigns. Campuses could promote a cleaner, more sustainable environment and set an example for the wider community on good waste management practices by engaging students, faculty, and staff in initiatives to reduce waste.

As such, the main purpose of this study was to assess the solid waste practices, starting from the source disposal of waste practiced, evaluating estimated monthly waste generation, solid waste practiced on the campuses, composting practices, and waste reduction efforts. Sustainability has become the key to reducing the solid waste impact, which has preserved the environment's limited resources and enabled communities to protect the earth by adopting these straightforward but powerful principles across society.

## 2. Materials and Methods

This study used a qualitative research approach to explore perceptions of sustainable waste strategies, focusing on solid waste management practices at Cebu Technological University campuses in Danao, Carmen, and Tuburan. The design involves structured interview questionnaires and waste collection data. It examines the survey instrument, sampling strategy, methodology, and ethical considerations, providing a comprehensive guide for effective study

execution and analysis.

The researchers utilized waste assessment questionnaires, interviews, and observations to ensure data reliability across each campus. They adapted an assessment form from a 2010 study by Northeast Recycling Council, Inc., modifying it to suit their needs. This form involves waste categorization, composition calculation, and pattern identification, along with a walkthrough observation. The researchers conducted facility tours, covering classrooms, meal preparation areas, scientific and athletic departments, administrative spaces, and teacher lounges. A hands-on waste audit was performed to determine the types, quantities, and origins of discarded materials, providing both qualitative and quantitative assessments of materials that can be reduced, reused, or recycled.

The study's respondents are the heads of sanitation responsible for managing solid waste at each campus. Data collection involved surveys, interviews, and observations to ensure efficiency and accuracy while adhering to ethical standards. Heads of sanitation and some sanitation personnel from the supply office, solid waste management, and ground maintenance departments provided essential information. Researchers observed various campus areas, including canteens, school grounds, waste disposal processes, 3Rs waste practices, composting pits, and Material Recovery Facilities (MRF). Effective solid waste management can foster a sustainable future by reducing waste and promoting recycling and bioremediation (Guneyisu & Emgin, 2021) [3]. Solid waste management is a pressing environmental issue that directly impacts various aspects of the environment, such as air quality, water purity, and soil health, as well as public health (Debrah *et al.*, 2021) [2]. Data from assessment forms will be manually consolidated.

## 3. Results and Discussions

### Profile of the Campuses that Contributed to Waste Generation

**Table 1:** Total population in the Campus

Name of Individual	CTU - Danao	CTU - Carmen	CTU - Tuburan
Student	5808	2847	4000
Instructors	85	86	76
Non-Teaching	72	121	9
<b>Total</b>	<b>5965</b>	<b>3054</b>	<b>4085</b>

The data in Table 1 presents the total population of each campus. CTU-Danao has 5,808 students, CTU-Carmen has 2,847, and CTU-Tuburan has 4,000. Regarding instructors, CTU-Danao has 85, CTU-Carmen has 86, and CTU-Tuburan has 76. For non-teaching personnel, CTU-Danao has 72, CTU-Carmen has 121, and CTU-Tuburan has 9. The overall population totals are 5,965 for CTU-Danao, 3,054 for CTU-Carmen, and 4,085 for CTU-Tuburan. Students, instructors, and non-teaching personnel contribute to waste production but can positively influence waste practices through education and awareness campaigns.

**Table 2:** Number of Kitchens

Campuses	Number of Kitchens
<b>CTU - Danao</b>	2
<b>CTU - Carmen</b>	2
<b>CTU - Tuburan</b>	1

Table 2 presents the total number of kitchens per campus. CTU-Danao has two kitchens, CTU-Carmen also has two, and CTU-Tuburan has one.

**Table 3:** Number of Canteens

Campuses	Number of Canteens
CTU - Danao	2
CTU - Carmen	1
CTU - Tuburan	1

Table 3 shows the total number of canteens on each campus. CTU-Danao has two Canteens, while CTU-Carmen and CTU-Tuburan has one campus canteen.

**Table 4:** Number of Concessionaires

Name of Campus	Number of Concessionaires
CTU - Danao	2
CTU - Carmen	5
CTU - Tuburan	4

Table 4 shows the number of concessionaires in the three CTU-North Campuses: Danao, Carmen, and Tuburan. CTU-Danao campus has two concessionaires available, Carmen campus has five, and the Tuburan Campus has four concessionaire.

**Table 5:** Type of vending machines and quantity

Name of Campus	Type of vending machine	Number of Vending Machine
CTU - Danao	Water Dispenser & Coffee Maker	4
CTU - Carmen	Water Dispenser	5
CTU - Tuburan	Water Dispenser	4

Table 5 presents the types of vending machines at the three CTU North campuses. CTU-Danao has three water dispensers and one coffee maker. CTU-Carmen has five water dispensers, while CTU-Tuburan has four water dispensers.

**Table 6:** Types of Hazardous waste produced

Campuses	Hazardous waste
CTU - Danao	broken fluorescent light bulb, battery, cleaning agents such muriatic acid
CTU - Carmen	broken fluorescent light bulb, battery, cleaning agents such muriatic acid
CTU - Tuburan	mercury, broken fluorescent light bulb, battery, motor oil residue, cleaning agents such muriatic acid

Table 6 shows the hazardous waste produced at three campuses. CTU-Danao and CTU-Carmen both produce broken fluorescent light bulbs, batteries, and cleaning agents such as muriatic acid. CTU-Tuburan produces mercury, broken fluorescent light bulbs, batteries, motor oil residue,

**Table 10:** Methods of disposing volume of waste

Campuses	Remarks
CTU - Danao	The sanitation staff collect the waste from various locations and merge it into a cartable trash can by hand every day, placing it in an area of disposal.
CTU - Carmen	The sanitation staffs are assigned to collect waste from different fixed disposal sites, every day and load it into an industrial warehouse cart with two barrels to collect the total waste and transport it to the disposal site.
CTU - Tuburan	The sanitation workers assigned to the area collect the waste from different locations, every day and place it in a larger garbage container, assisted by a heavy-duty trolley, and transport it to the disposal site.

and cleaning agents such as muriatic acid.

**Process of Disposing Solid Waste Practiced**

**Table 7:** Availability of garbage containers including biodegradable, non- biodegradable, recyclable and others

	CTU - Danao	CTU - Carmen	CTU - Tuburan
In Classrooms	N/A	1 Set - Mixed Materials	N/A
In Offices	1 Set - Mixed Materials	1 Set - Mixed Materials	1 Set - Mixed Materials
Canteen/ Kitchen/ Cafeteria	1 Set - Mixed Materials	1 set - Mixed Materials	1 set - Mixed Materials
Comfort Rooms	1 set - Mixed Materials	3 sets - Recyclable and Mixed	2 sets - Recyclable and Mixed
Lounges	N/A	3 Sets - Bio, Non-Bio, Recyclable	1 Set - Mixed

Table 7 shows the availability of garbage containers for biodegradable, non-biodegradable, recyclable, and other wastes across three CTU campuses: Danao, Carmen, and Tuburan. In classrooms, only CTU-Carmen has mixed-material containers. All campuses have mixed-material containers in offices and canteens. In comfort rooms, CTU-Danao has one mixed-material container, while CTU-Carmen and CTU-Tuburan have separate containers for recyclable and mixed materials. Lounges in CTU-Carmen have segregated containers, while CTU-Tuburan has mixed-material containers.

**Table 8:** Frequency of Disposals

Information	CTU-Danao	CTU-Carmen	CTU-Tuburan
Frequency of School Waste Collection	Everyday	Everyday	Everyday

Table 8 presents the disposal frequencies of solid waste within the school premises. It shows that all three campuses dispose of their waste daily in designated disposal areas.

**Table 9:** Availability of Composting Pits

Campuses	Remarks
CTU - Danao	The CTU-Danao had an open area composting pit.
CTU - Carmen	The CTU-Carmen had an area that is closed that makes the materials to be secure.
CTU - Tuburan	The CTU-Tuburan had an open dug hole.

Table 9 shows the availability of composting pits at three campuses. CTU-Danao has an open-area composting pit, CTU-Carmen has a closed-area pit that secures the materials, and CTU-Tuburan has an open dug hole.

Table 10 shows the methods of disposing of the volume of waste. Both CTU-Danao and CTU-Carmen practice a method of disposing of waste from small to bigger garbage containers. The difference lies in the method of transfer: CTU-Danao transfers the garbage manually, whereas CTU-Tuburan uses a heavy-duty trolley for waste disposal. The three campuses employ similar approaches to trash

collection from various locations; the primary distinction lies in the equipment utilized. In Danao, personnel use cartable trash bins, CTU-Carmen employs an industrial warehouse cart with two barrels, while Tuburan utilizes heavy-duty trolleys.

**Solid Waste Practiced by the Campus**

**Table 11:** Availing External Garbage Collection

Campuses	Availed external garbage collector	Person / organization involved in the collection
CTU - Danao	Yes	Danao City Garbage Collector
CTU - Carmen	Yes	Carmen Municipal Garbage Collector Scrap Metals – Scrap Collectors
CTU - Tuburan	Yes	Tuburan Municipal Garbage Collector/ Organic Biodegradable- Agriculture Personnel Scrap Metals – Scrap Collectors

Table 11 shows that three campuses availed external garbage collectors. CTU – Danao, the organization involved, is the Danao City Garbage Collector. In CTU-Carmen, the organization involved is the Carmen Municipal Garbage Collector, and for scrap metals, scrap metal collectors are responsible.

Tuburan Municipal Garbage Collector manages the collection of CTU – Tuburan's organic biodegradable agriculture waste, and scrap metals are collected by scrap metal collectors.

**Table 12:** Frequency of external garbage collection

Information	CTU - Danao	CTU - Carmen	CTU - Tuburan
Frequency of external garbage collection	Twice a month	Weekly scheduled calls	Daily- for biodegradable Other waste- scheduled calls

Table 12 presents the frequency of external garbage collection at three campuses: Danao, Carmen, and Tuburan. At CTU - Danao, garbage collection occurs twice a month. In contrast, CTU - Carmen has a more frequent collection schedule, with weekly scheduled calls for garbage pickup. CTU - Tuburan adopts a different approach, with daily collections specifically for biodegradable waste, while other types of waste are collected based on scheduled calls.

**Table 13:** Availability of Material Recovery Facilities

Campuses	Remarks Material Recovery Facilities
CTU - Danao	There are NO material recovery facility in CTU- Danao campus.
CTU - Carmen	It has multiple stations wherein it also has different bins for particular materials like papers, plastic bottles, and cardboard. The height is somewhat at 4 feet tall and 3 feet wide.
CTU - Tuburan	Does not have an office. However multiple areas of the campus consist of mrf stations used to collect tin cans, card boards and any recyclable waste and is collected when for the time of monthly disposal.

Table 13 outlines the availability and details of Material Recovery Facilities (MRFs) at three campuses: Danao, Carmen, and Tuburan. At CTU - Danao, there are no material recovery facilities available on the campus. In contrast, CTU - Carmen is equipped with multiple stations that include bins specifically designated for various materials such as paper, plastic bottles, and cardboard. These stations are described as being approximately 4 feet tall and 3 feet wide. CTU - Tuburan does not have a dedicated office for MRFs; however, the campus has multiple MRF stations spread across different areas. These stations are used to collect recyclable materials like tin cans, cardboard, and other recyclables, which are gathered for monthly disposal.

**Table 14:** Current composting efforts (Composting Collection Data)

Information	CTU-Danao	CTU-Carmen	CTU-Tuburan
Is there any current composting in the school?	Yes	Yes	Yes
Who is in charge of the composting program?	Solid Waste Management Personnels	Maintenance Personnels	Teachers
Who participates in the composting?	Sanitation Personnels	NSTP-CWTS Students	Maintenance Personnels and Teachers
What is composted?	Food Scraps from Cafeteria; Solid Paper, Including Napkins	Kitchen Scraps; Food Scraps from Cafeteria	Grass; Leaves
Who collects the materials?	Custodian	NSTP-CWTS Students	Maintenance Personnels
How frequent is the in-school collection?	Daily	Daily	Monthly
How are the materials collected?	Manual	Wheelbarrow	Wheelbarrow
How much materials are collected?	50 Buckets a month (200 kgs Monthly)	4 Buckets a Month (20 kgs Monthly)	10 kgs a Day (300 Kgs Monthly)
Are the collected materials composted on site?	Yes	Yes	Yes
How is the collected material transported to the compost site?	Manual	By Pails; Buckets; Sacks	Wheelbarrow
Who transport it?	Sanitation	Sanitation Personnels	Maintenance

	Personnels		Personnels
Are there fees for transportation and composting?	No	No	No
Who takes care the school grounds?	Sanitation	School Maintenance/Custodial Staff	School Maintenance/Custodial Staff
Are grass clippings left on the ground mowed?	No	Sometimes	Sometimes
What happens to leaves?	Collected for Composting Onsite	Collected for Composting Onsite	Collected for Disposal
What happens to brush?	Sweeping	N/A	Trimmed and disposed

Table 14 reveals data on the current composting efforts and groundskeeping practices at the three CTU-North campuses: Danao, Carmen, and Tuburan. Each campus has designated personnel responsible for composting. At CTU-Danao, solid waste management personnel oversee composting. Maintenance personnel handle this task at the Carmen campus, while teachers and instructors are in charge at the Tuburan campus. Additionally, CTU-Danao has sanitation personnel involved, NSTP-CWTS students participate at Carmen, and maintenance personnel and teachers assist at Tuburan. The composting materials vary by campus. At CTU-Danao, food scraps from the cafeteria and solid paper, including napkins, are composted. The Carmen campus focuses on kitchen scraps, mainly food from the cafeteria. At Tuburan, grass and leaves are the primary composting materials. During material collection, campus custodians are responsible at CTU-Danao, NSTP-CWTS students at Carmen, and maintenance personnel at Tuburan. Collection is done daily at the Danao and Carmen campuses, while the Tuburan campus conducts monthly collections. The Danao

campus uses manual collection, Carmen and Tuburan campuses utilize wheelbarrows. The quantity of materials collected each month is significant. CTU-Danao collects 50 buckets (200 kg), Carmen collects four buckets (20 kg), and Tuburan collects 10 kg (400 kg). These materials are composted onsite. At CTU-Danao, materials are transported manually to the compost site, while at Carmen, they use pails, buckets, or sacks, and at Tuburan, they use wheelbarrows. Transportation of composting materials is managed by sanitation personnel at CTU-Danao, sanitation personnel at Carmen, and maintenance staff at Tuburan, with no transportation or composting fees involved. Groundskeeping practices also differ. CTU-Danao employs sanitation personnel, whereas both Carmen and Tuburan rely on school maintenance or custodial staff. Leaves collected after mowing are composted onsite at CTU-Danao and Carmen, while Tuburan disposes of them. The brush used post-mowing is utilized for sweeping at CTU-Danao and for trimming and disposing at Tuburan. CTU-Carmen does not have brushes available.

**Table 15:** Availability of Waste Reduction Efforts

Campuses	Waste Reduction Efforts
CTU - Danao	No plastics allowed that is taken outside from school Leftovers foods were given to dogs and cats.
CTU - Carmen	Plastic Bottle Recycling collection bin Leftovers foods were given to dogs and cats
CTU - Tuburan	Recycling efforts specifically in: Cartoon Boxes: Give to other office as a storage for documents Ground Maintenance: Recycling and segregation Newspaper: Put inside shelves to make catalogue Electrical: charge to damage of repair for school use Science Building: Make cleaning schedule Cafeteria and Kitchen: Separate bones, for dog and other left over are feed for ducks and pigs Leftovers foods were given to ducks and pigs and bones to dogs and cats.

Table 15 highlights the recycling efforts at the three CTU-North campuses: Danao, Carmen, and Tuburan. CTU-Danao has implemented a policy that prohibits students from bringing plastics from outside the campus, effectively minimizing plastic usage. CTU-Carmen has established recycling collection bins specifically for plastic bottles. In contrast, CTU-Tuburan has the most extensive waste reduction efforts, with six distinct initiatives. These include reusing cardboard boxes as storage bins for office documents, emphasizing recycling and waste segregation by ground maintenance staff, and retaining newspapers to create catalogs. Additionally, the electrical department

charges for damages or repairs of school-use items, promoting responsibility. The campus also encourages regular cleaning habits, particularly in the Science Building, and separates bones in the cafeteria and kitchen for consumption. CTU-Tuburan's comprehensive range of initiatives spans various waste materials and campus areas, including recycling and reusing materials like cardboard boxes and newspapers, specific waste management practices in the Science Building and cafeteria, and policies for maintaining electrical equipment. In contrast, CTU-Danao focuses primarily on reducing plastic use, and CTU-Carmen concentrates on recycling plastic bottles.

**Table 16:** Description of recycling activity

Campuses	Description
CTU - Danao	On site waste segregation. Selling scrap metals to collectors. Sustainability projects and integrating it to contest and events. NSTP – CWTS waste collection.
CTU - Carmen	NSTP – CWTS waste collection. Recycling the scrap metals by bidding to generate income. Sustainability projects and integrating it to contest and events. Collecting and recycling the materials from the MRF. Proper waste segregation in the pocket forest.
CTU - Tuburan	Sustainability projects and integrating it to contest and events. Collecting and recycling the materials from the MRF.

Table 16 shows the recycling activities at three campuses: Danao, Carmen, and Tuburan. At CTU-Danao, recycling efforts include on-site waste segregation, selling scrap metals to collectors, participating in sustainability projects that are integrated into contests and events, and conducting waste collection through the NSTP-CWTS program. CTU-Carmen engages in similar NSTP-CWTS waste collection, recycles scrap metals by bidding to generate income, and integrates sustainability projects into contests and events. Additionally, Carmen collects and recycles materials from the Material Recovery Facility (MRF) and ensures proper waste segregation in the pocket forest. Meanwhile, CTU-Tuburan focuses on sustainability projects integrated into contests and events, and also collects and recycles materials from the MRF. This table highlights the specific recycling practices and initiatives unique to each campus, illustrating their commitment to sustainability and waste management.

**Estimated Volume of Waste Generated Monthly**

**Table 17:** Estimated volume of waste generated monthly of materials

Materials	CTU - Danao	CTU - Carmen	CTU - Tuburan
<b>Biodegradable:</b>			
Food	70 kg	30 kg	N/A
Non-food	65 kg	18 kg	204 kg
<b>Non-biodegradable:</b>			
Scrap Metals	N/A	3 kg	12 kg
Aluminum Cans	N/A	N/A	6 kg
Electrical/Electronic Waste	N/A	N/A	1 kg
Plastic Bottles	40 kg	10 kg	30 kg
Total Estimated Kilograms per Month	<b>174 kg</b>	<b>61 kg</b>	<b>253 kg</b>

Table 17 presents the estimated volume of waste generated monthly at three Cebu Technological University (CTU) campuses: Danao, Carmen, and Tuburan. The table categorizes waste into biodegradable and non-biodegradable materials. For biodegradable waste, CTU-Danao generates 70 kg of food waste and 65 kg of non-food waste monthly, totaling 135 kg. CTU-Carmen produces 30 kg of food waste and 18 kg of non-food waste, amounting to 48 kg. CTU-Tuburan, on the other hand, does not generate food waste but produces a significant 204 kg of non-food biodegradable waste monthly. Regarding non-biodegradable waste, CTU-Danao generates 40 kg of plastic bottles each month but does not report any scrap metals, aluminum cans, or electrical/electronic waste. CTU-Carmen generates small amounts of non-biodegradable waste: 3 kg of scrap metals and 10 kg of plastic bottles, with no aluminum cans or

electrical/electronic waste reported. CTU-Tuburan produces 12 kg of scrap metals, 6 kg of aluminum cans, 1 kg of electrical/electronic waste, and 30 kg of plastic bottles monthly. In summary, the total estimated monthly waste generation is 174 kg for CTU-Danao, 61 kg for CTU-Carmen, and 253 kg for CTU-Tuburan. This table highlights the varying volumes and types of waste generated at each campus, with CTU-Tuburan producing the highest total amount of waste, largely due to its significant non-food biodegradable waste.

**Table 18:** Estimated Individual contribution for monthly waste generation

	CTU - Danao	CTU - Carmen	CTU - Tuburan
Total Estimated Volume Generated	174	61	235
Total no. of Population	5965	3054	4085
Individual contribution	0.029	0.0199	17.383

Table 18 provides data on the estimated individual contribution to monthly waste generation at three Cebu Technological University (CTU) campuses: Danao, Carmen, and Tuburan. It shows that CTU-Danao generates a total of 174 kg of waste monthly with a population of 5965, resulting in an individual contribution of approximately 0.029 kg per person per month. CTU-Carmen produces 61 kg of waste each month with a population of 3054, leading to an individual contribution of about 0.0199 kg per person per month. In contrast, CTU-Tuburan generates 235 kg of waste monthly with a population of 4085, which translates to a significantly higher individual contribution of approximately 17.383 kg per person per month. This indicates a substantial disparity in waste generation among the campuses, with CTU-Tuburan having a markedly higher individual waste contribution compared to CTU-Danao and CTU-Carmen. Non-food was comprised of corrugated papers, bond papers, and wood waste. On the other hand, food is purely composed of food waste.

**4. Conclusion**

In summary CTU-Danao has the largest population with 5965 individuals, followed by CTU-Tuburan with 4085, and CTU-Carmen with 3054. Both CTU-Danao and CTU-Carmen have the highest number of kitchens, but CTU-Danao uniquely has 2 canteens. CTU-Carmen leads in the number of concessionaires with 5 stalls, compared to 4 in Tuburan and 2 in Danao. Additionally, CTU-Carmen has the most water vending machines, with five on campus. All campuses have similar hazardous waste and use mixed-material garbage bins without proper segregation. Waste disposal frequency is daily across all campuses, which also

have composting pits and assigned sanitation personnel. Regarding external garbage collection, the municipal garbage collector serves all three campuses. CTU-Tuburan practices daily external waste collection, whereas CTU-Danao collects twice a month, and CTU-Carmen weekly. CTU-Carmen and CTU-Tuburan both have material recovery facilities (MRFs). CTU-Tuburan stands out with the most recycling efforts, integrating on-site waste segregation and sustainability projects into contests and events. It also generates the highest amount of solid waste at 253 kg per month and has the highest individual waste contribution at 17 kg per month. Overall, CTU-Tuburan exhibits the most extensive and effective waste management practices among the three campuses.

In assessing the three CTU Campuses, the researchers concluded that CTU Tuburan has more proper solid waste practices in composting pits and efforts to produce organic waste. Methods of disposing of the volume of waste through the heavy-duty trolley. Daily external garbage collection, MRF area wherein the materials are secured and safe, waste recycling efforts. However, CTU-Tuburan has the most considerable estimated volume of waste generated monthly, impacting individuals' contribution to waste. CTU- Carmen gives enough availability of 3 sets of garbage containers in comfort rooms, a pocket forest, and a plastic bottle recycling collection bin. CTU-Danao and Carmen have enough recycling activities conducted on each campus; the schools contribute less to the estimated volume of waste generated. The waste recycling efforts of the three campuses are limited and need to be correctly adhered to by some individuals on the campuses.

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