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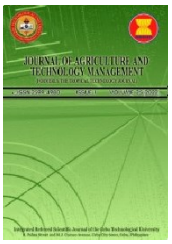

Original article

Comparative analysis of solid waste management in select campuses of a state university in the Visayas Region, Philippines

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ABSTRACT

Solid waste management requires serious attention. Environmental education brings awareness, appreciation, understanding, and solutions for us to transition to a more sustainable society. With the aim of finding a workable solution, this study on the comparative analysis of solid waste management in select campuses of a certain state university in Cebu was conducted. This involved a contextual review and qualitative analysis of the waste generation rates and waste composition data as to biodegradable, recyclable/reusable, residual, and special/hazardous wastes; physical areas such as environment and disposal, and resource recovery; and governance strategies such as inclusivity, financial sustainability, and proactive policies.

The results showed residual wastes had the highest total weight of 1.47 kg while the hazardous wastes had the lowest total weight of 0.28 kg based on the capita waste production daily of the nine campuses. The average daily waste generation rate per capita ranged from 0.22 to 0.53 kg. The campuses observed a similar process of waste collection of at least twice a week. Separate receptacles were provided for waste segregation from source but not sustained in the dumpsites. Wastes were disposed of in one open dumpsite. The Material Recovery Facilities (MRF) were not fully functional. Open burning was practiced by some campuses. There was a low score in waste collection coverage; consultation and involvement of users in decision-making on policy and solid waste management programs, planning of facilities; procedures for measuring satisfaction, and effective feedback mechanism. A lack of proactive policies existed. Integration of solid waste management in the curriculum is vital for sustainability goals.

KEYWORDS: *solid waste management, sustainability, residual, biodegradable, hazardous, recyclable*

1 INTRODUCTION

The existence of environmental problems and issues is still so evident nowadays. A lot of initiatives have already been conducted in an attempt to address these concerns. The Ecological Solid Waste Management Act of 2000 (Republic Act 9003) was approved in January 26, 2001 and came into effect on February 16, 2001. Ecological Solid Waste Management under the law refers to the *"systematic administration of activities which provide for segregation at source, segregated transportation, storage, transfer, processing, treatment, and disposal of solid waste and all other waste management activities which do not harm the environment"*. In the country, the local government units (LGUs) hold the primary responsibility for the effective and efficient solid waste management. Despite this law, however, poor solid waste management in the Philippines is still prevalent since open and controlled dumps are being used in the country. This poses great threats on the country's environment and public health (Castillo, 2013). Educational institutions had been integrating environmental education in their school curricula at all levels, whether public or private as cited in section 8 of Republic Act No. 7722, otherwise known as the "Higher Education Act of 1995" and pursuant to Republic Act No. 9512, entitled "An Act To Promote Environmental Awareness Through Environmental Education and for Other Purposes" and Republic Act No. 9729, also known as "Climate Change Act of 2009", massive information dissemination was conducted even by some concerned non-governmental organizations, and a lot of studies had been conducted.

Education is deemed vital to solve environmental problems and transform our way of life. As cited in Republic Act No. 9512, *"environmental education shall encompass environmental concepts and principles, environmental laws, state of international and local environment, local environment best practices, threats of environmental degradation and its impact on human well-being, environmental stewardship and responsibility of the citizenry to the environment and the value of conservation, protection and rehabilitation of natural resources and the environment in the context of sustainable development, climate change science, impacts, adaptations and mitigation, and institutional responses to global and local climate changes"*.

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With the pressing issue on Solid Waste Management and environmental degradation, making a continuous awareness of the environmental situations could greatly lead to the derivation of sound solutions. Higher Education Institutions are enjoined to develop an ethical will and active involvement geared towards the proper management of our environment. Dr. Patricia Licuanan, CHED Chairperson, issued CMO No. 18, series of 2011, with the subject "Mainstreaming of Sustainable Development, Including Change Mitigation and Adaptation, In Higher Education." Even CMO No. 25, series of 2005, cited as one of the general objectives of every engineering program to educate students imbued with good moral and ethical values and the acute sense of awareness of the conservation of the environment for the sustainable development of the country.

Fast-paced industrialization, urbanization, modern lifestyle and the rapid growth in population have also made waste management a major environmental challenge. As we are increasing in number, so is our contribution to the environment. Scientific and technological advances are now used by us. We tend to enjoy the convenience brought by the products of these advances, yet we are still utterly dependent on the environment for clean air and water, food, shelter, energy and everything else that we need to stay alive and healthy. As a result, we are part of, and not a part of, the rest of nature. (Miller, 2011).

As contributors to the perturbational state of the environment and for us to continuously derive benefits from the environment, we have our direct responsibility to perform. Every individual needs to work together to look for trade-off solutions, and develop the right attitude towards the environment.

Cebu Technological University as a higher education institution needs to assess its practices, participation and contribution in addressing environmental concerns. This is precisely the reason why the proponents come up with this study of making a comparative analysis of the solid waste management of the different campuses of the university. As such, the objectives of this study include (1) a comparison of daily waste production for each of the campuses, (2) a comparison on waste collection and waste disposal practices for each of the campuses, and (3) a comparison of the policies, budgetary management, and implementation plans and concerns of the waste management policies.

2 MATERIALS AND METHODS

The campuses which were considered in this study were the Cebu Technological University-Main Campus (Cebu City), Danao Campus, Carmen Campus, Daan Bantayan Campus, Camotes Campus, Tuburan Campus, Barili Campus, Moalboal Campus, and Argao campus. Extension campuses such as Pinamungajan Campus, Bantayan Campus, and Oslob Campus were excluded in this study. This involved a contextual review and qualitative analysis of the waste generation rates, waste composition, collection, disposal, resource recovery, and governance strategies such as inclusivity, financial sustainability, and policies on solid waste management. In design research, invoking disciplinary and non-disciplinary sources is sometimes referred to as a contextual review (Gray and Malins, 2004), which means structured and unstructured questions and data gathering methods are observed. Qualitative analysis in the study mainly includes the understanding of experiences and non-numerical methods including interviews and opinions from the key informants.

Questionnaires were distributed and supplemented with actual observations and visits to the areas to gather relevant inputs for the study. Respondents were identified through purposive and random sampling.

Table 1. Respondents of the Study

Category	Number
Pollution Control Officers	3
School Nurse	4
Ground Maintenance Team Member	15
Faculty Members	21
Students	31
Total	74

Table 2. Definition of Benchmark Indicators

Analytical Criteria	Indicator	Description
Physical Health	Waste collection and sweeping coverage	Quantitative percentage of the school's population who have access to reliable collection service
Environmental Control	Controlled disposal	Quantitative percentage of the total waste destined for disposal which goes to a controlled dumpsite
Resource Management	Materials recycled or recovered	Quantitative percentage of total waste which is recycled and utilized in various forms of organic recovery
User Inclusivity	Degree of user inclusivity	Represents the degree to which users of the solid waste services are included in the planning, policy implementation and evaluation of those services
Financial Sustainability	Population using and paying for collection	Represents the degree to which the institution is paying for waste collection services
Pro-active Policies	Degree of institutional policies	Composite score of quality indicators

In order to make a comparison among the different campuses of Cebu Technological University, a piece of detailed information was used to prepare a standardized

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campus' profile, and benchmark indicators for every analytical criterion were to be generated. A formal communication to Campus Directors was secured by the researchers to allow the conduct of the study on their respective campuses and to coordinate with key informants.

3 RESULTS AND DISCUSSION

Generation Rate and Waste Composition

The first comparison is between the relative quantities of waste generated on the nine campuses. This simple comparison posed considerable challenges. The different types of solid wastes were defined and leveled so as to have a common understanding.

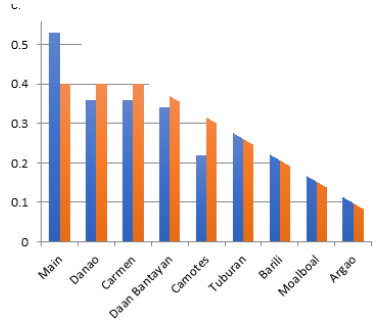
It is part of the limitation of this study that the events conducted in every campus that would most likely contribute to the generation of wastes. Moreover, the limitation of the study includes not delving into the reasons why some of the solid waste management plan was implemented, including the challenges in the implementation. Events held at every campus meant more people or visitors were in attendance that obviously left a considerable volume of wastes. This could be the reason why the Main Campus had the highest amount of waste generated, being always the hosts of system-wide meetings and seminars. And as per observation, commonly, the materials used in most events are plastics and disposable which are either reusable or residual.

As shown in table 3, residual wastes had the highest total weight of 1.47 kg, and special or hazardous wastes had the lowest total weight of 0.28 kg.

As reported in the National Waste Management Status Report 2008-2018 made by the National Solid Waste Management Commission Secretariat based at the Environmental Management Bureau (EMB) that the capita waste production daily is estimated to be 0.4 kg. This means that each person can produce 400 grams of waste per day. Castillo also cited that about 35,580 tons of garbage is generated every day in the Philippines. On the average, each person in the country produces about 0.4 kg and 0.3 kg of garbage every day in the urban and rural areas (2013).

As reflected in Figure 1, most of the campuses have lower generation rates compared to the estimated weight of 0.4 kg. Most of the campuses under study are located in the rural areas except for the Main Campus and Danao Campus, and data is consistent with the study conducted by the EMB for estimated production of waste for rural and urban areas.

Figure 1. Average Daily Generation Rate Per Capita (in kilograms)



Physical Areas Collection

For the frequency of collection, the nine campuses observed a common practice of having at least twice every week. Daily collection of wastes usually happens if the campus would host big events. Utility workers were utilized in the collection of wastes. Equipment used for primary collection were wheelbarrows, push carts, trash bags and sacks, and motor vehicles utilized as garbage trucks. Municipal garbage collectors were only to collect the residual and special or hazardous wastes from the school's Material Recovery Facility (MRF) upon the school's request.

CTU, Camotes Campus established a strong linkage with the Local Government Unit of their municipality. Regular collection of their residual and special wastes was done by the municipal garbage collectors. San Francisco, Camotes has a salutary solid waste management program, and has been an awardee for several times in the region. A well-defined and well-managed MRF existed in the municipality.

Environment and Disposal, and Resource Recovery

The campuses have similar methods of waste disposal. While recycling through the establishment of a Material Recovery Facility (MRF), which includes a waste transfer station, and composting and recycling

Table 3. Comparative Data on Average Daily Generation Rate (in kg) And Waste Composition for the Nine Campuses

Types of Solid Wastes	Main Campus	Danao Campus	Carmen Campus	Daan Bantayan Campus	Camotes Campus	Tuburan Campus	Barili Campus	Moalboal Campus	Argao Campus	Total
Biodegradable/Compostable Wastes	0.12	0.13	0.15	0.09	0.06	0.07	0.08	0.09	0.12	0.91
Recyclable/Reusable Wastes	0.24	0.13	0.16	0.14	0.08	0.12	0.23	0.13	0.14	1.37
Residual Wastes	0.23	0.20	0.18	0.18	0.12	0.12	0.10	0.18	0.16	1.47
Special or Hazardous Wastes	0.06	0.03	0.02	0.02	0.02	0.04	0.03	0.03	0.03	0.28
Total	0.65	0.49	0.51	0.43	0.28	0.35	0.44	0.43	0.45	4.03

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facilities, is mandated under RA 9003, the CTU campuses failed to comply with this mandate, as shown in Table 4. Structures considered as MRF existed in the campuses but were not fully functional or operational, as shown in Table 4. Open dump sites were utilized for biodegradable and compostable wastes for the majority of the campuses. Composting was practiced by the campuses offering Bachelor of Science in Agriculture to be obviously utilized in the conditioning and fertilization of the soil, these campuses are Carmen Campus, Camotes Campus, Tuburan Campus, Barili Campus, Moalboal Campus, and Argao Campus.

The MRF of Carmen Campus has the following components: 1) sorting station, 2) recycling station, 3) composting station, 4) storage area for recyclable or the recycling station, 5) transfer station or the residuals storage area. It also has a small area utilized as bottle vegetation garden.

The presence of stray animals such as dogs was noted in most of the campuses. This contributed to the scattering of wastes if not properly disposed of. This also created an eye sore if not attended to by the concerned staff and personnel.

For resource recovery, 33% of the campuses indulged in the recycling of wastes which usually include non-biodegradable materials such as paper, plastic, bottles and others. Sixty-seven percent were into

Table 4. Environment and Disposal

Items	Main	Danao	Carmen	Daan Bantayan	Camotes	Tuburan	Barili	Moalboal	Argao
Disposal Method									
• Open Dumping	×	/	/	/	×	/	/	/	/
• Controlled Tipping	×	×	×	×	×	/	/	x	x
• Sanitary Landfill	×	×	×	×	×	×	×	x	x
• Dumping into Water Body	×	×	×	×	×	×	×	x	x
• MRF	/	/	/	×	/	/	/	/	/
Existence of Waste Pickers/ Scavengers on Site	x	x	x	x	x	x	x	x	x
Existence of Animals on Site	x	/	/	/	x	/	/	/	/
Existence of Open Burning on Site	x	x	x	/	x	/	/	x	/
Resource Recovery									
• Recycling	x	x	x	x	/	/	/	x	x
• Composting	x	x	/	x	/	/	/	/	/
• Reusing	/	/	/	/	/	/	/	/	/

Legend: / - existed
x – did not exist

Burning of trash as a manner of waste disposal was being practiced. Four out of nine, or about 44% of the campuses were into open burning. This is not in accordance with the provisions of Republic Act No. 8749 otherwise known as The Clean Air Act of 1999. Though it could readily reduce the volume of solid wastes, at a cost, it may release toxins into the air and create ash that evidently affects the quality of air and are hazardous to human health.

R.A 8749 clearly states that *"no person shall be allowed to burn any materials in any quantities which shall cause the emission of toxic and poisonous fumes. Such materials include but are not limited to plastic, polyvinyl chloride, polypropylene, paints, ink, wastes containing heavy metals, organic chemicals, petroleum related compounds, industrial wastes, ozone depleting substances, and other similar toxic and hazardous wastes. Further, no establishment, firm, company, government or private entity or organizations shall be allowed to burn or cause open burning of waste materials in their premises, area of jurisdiction, including recognized or unrecognized dumpsites in any quality or quantity."*

composting of kitchen and garden wastes. All of the campuses claimed that they were reusing their solid wastes whenever possible.

Governance Strategies Inclusivity

The data collection focused on issues such as waste collection coverage; consultation and involvement of users in decision-making on policy and solid waste management programs, planning and siting of facilities; and procedures for measuring satisfaction and effective feedback mechanism of the policy or program.

Almost all of the campuses had a low score on inclusivity. It had been quoted that only three out of the

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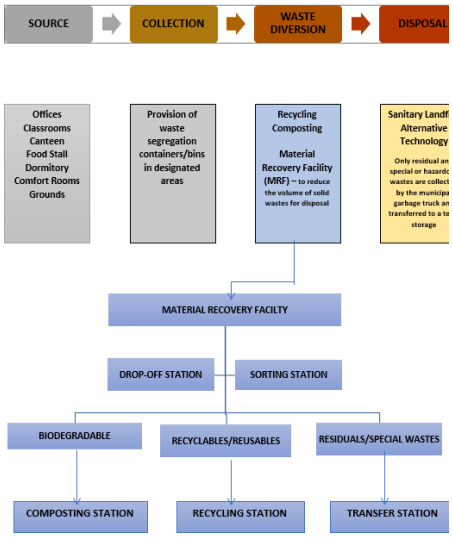
nine campuses had an existing solid waste management plan but still not fully implemented due to lack of both, human and physical facilities. The need to work cooperatively with all the concerned school officials and students was so evident.

Figure 2. Flow Chart of the Solid Waste Management System



Financial Sustainability

A sound waste governance requires financial sustainability, cost and budgeting mechanisms are relevant.

The institutions did not collect any amount from the students for waste collection and disposal. Utility workers and job orders were responsible for the collection and disposal of solid wastes. Student organizations were utilized in the purchase of garbage bins and receptacles. The institutions engaged in selling their solid waste to some entrepreneurs. About 25% of the solid wastes, which were usually limited to scrap metals, plastics and cardboards were sold following the standard bidding procedures. Reselling of reusable and recyclable materials could contribute some amount to the institutions.

Proactive Policies

A strong and transparent institutional framework or program is essential to proper management of solid waste. In the absence of such a framework or program, the sustainability of working towards environmental concerns will not work well over a long term. It will just keep on coming back to the level of environmental awareness instead of reaching to the level of application and participation. There is a need for the involvement of every individual and a strong ethical commitment to attain tangible results.

Despite the number of studies aimed at improving the SWM, the campuses had no disposal alternative to open dumping. The situation regarding both inadequate waste collection and open dumping posed a great challenge. There existed a SWM system in the nine campuses which hopefully could be geared toward a gradual progress and positive result. The presence of some initiatives conducted despite inadequate resources may be deemed significant.

CTU, Carmen Campus had an existing flow chart of solid waste management which was formulated in November of 2015 as shown in Figure 2.

4 CONCLUSIONS AND RECOMMENDATION

Based on the above findings, the following conclusions were drawn:

Residual wastes had the highest total weight of 1.47 kg while special or hazardous wastes had the lowest total weight of 0.28 kg based on the daily waste production. The average waste generation rate per capita of the campuses ranges from 0.22 to 0.53 kg. Only the Main Campus had higher than 0.4 kg which was the estimated per capita waste generation based on a study conducted by the National Solid Waste Management Commission Secretariat based at the Environmental Management Bureau (EMB) for 2008-2018.

The campuses have a common frequency of waste collection of at least twice a week. Residual wastes were to be collected by the collectors of the Local Government Unit but it was done irregularly, except for Camotes Campus. Camotes Campus had a strong linkage with their LGU which has a well-defined and well implemented SWM system.

The campuses had a Material Recovery Facility (MRF) that needed to be improved and be fully functional. Open dumping was observed on most campuses. There were campuses that conducted open burning to readily eliminate the growing volume of solid wastes. Such practice is not in accordance with the provisions of RA 8749 otherwise known as “The Clean Air Act of 1999.”

For resource recovery, 33% of the campuses indulged in the recycling of wastes which usually include non-biodegradable materials such as paper, plastic, bottles and others. Sixty-seven percent were into composting of kitchen and garden wastes. All of the campuses claimed that they were reusing their solid wastes whenever possible.

The campuses of Cebu Technological University had a low score in waste collection coverage; consultation and involvement of users in decision-making on policy and solid waste management programs, planning and siting of facilities; and procedures for measuring satisfaction and effective feedback mechanism of the solid waste policy or program.

Financial support being an essential part of a good governance needed to be strengthened for the

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implementation and sustainability of SWM program. The campuses engaged in the selling of about 25% of their solid wastes which were usually scrap metals, plastics and cardboards.

Pro-active policies needed to be formulated. There is a strong need for the involvement of every individual and a strong ethical commitment to attain tangible results. A strong and transparent institutional framework or program is essential to proper management of solid waste. Environmental initiatives needed to be increased. It is recommended that the CTU campuses should continue to integrate solid waste management in its curriculum. Increasing the level of awareness on issues and concerns of the environment of the entire population of the university could further help in the compliance and adherence of proper solid waste management. Sufficient knowledge and acquisition of skills and technology for material or resource recovery are very necessary and could further help formulate plans of incorporating this environmental consciousness in the areas of instruction, extension and production.

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CONFLICT OF INTEREST

No conflict of interest was declared by the authors

REFERENCES

Castillo, A. L. and S. Otoma. 2013. Status of solid waste management in the Philippines. The University of Kitakyushu, Japan.

Gray, C., & Malins, J. (2004). Visualizing research: A guide to the research process in art and design. Aldershot, Hants, England: Ashgate.

Miller, G. T., Jr. 2011. Introduction to environmental science. 2nd Edition. Cengage Learning Asia Pte. Ltd.

National Waste Management Status Report 2008-2018, https://emb.gov.ph/wpcontent/uploads/2019/08/National-Solid-Waste-Management-Status-Report-2008-2018.pdf

Waste Management and Research. 2012. International Solid Waste Association.

Republic Act No. 9003 (Ecological Solid Waste Management Act of 2000).

Republic Act No. 9512 (National Environmental Awareness and Education Act of 2008).

Republic Act No. 7722 (Higher Education Act of 1995).

Republic Act No. 9729 (Climate Change Act of 2009).

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