

# Solid Waste Management Practices of Select State Universities in CALABARZON, Philippines

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**Abstract** –*The enactment of the Ecological Solid Waste Management Act prompted higher education institutions including state universities and colleges (SUCs) to incorporate ecological waste management in the school system. Thus, this paper aimed to assess the extent of implementation of solid waste management practices in select SUCs in CALABARZON in terms of waste reuse, waste reduction, waste collection, waste recycling, waste treatment, and final waste disposal. Respondents of the study included university administrators, faculty members, non-teaching staff, students and concessionaries for a total of 341. A survey questionnaire was used to gather data from Batangas State University (BatState-U), Cavite State University (CavSU), Laguna State Polytechnic University (LSPU) and Southern Luzon State University (SLSU). Result revealed that solid waste management practices are implemented to a great extent. Among the practices, waste collection got the highest composite mean particularly on the promotion of 3Rs (reduce, reuse, recycle) in the collection of waste. On the other hand, waste recycling and waste treatment obtained the lowest composite mean. In terms of waste recycling, establishing partnership with local or private business for recyclable recovery program was to moderate extent. Waste treatment particularly neutralization of acid bases was also of moderate extent. The study recommended strengthening of public-private partnership (PPP) on the recycling and treatment of wastes.*

**Keywords** – *collection, recycling, reduction, reuse, solid waste management*

## INTRODUCTION

Urban solid waste management is considered as one of the most immediate and serious environmental problems in many of the developing countries [1],[2]. Still, waste collection rates are often lower than 70 per cent in low-income countries [3]. Environmental degradation is worsened by the escalating accretion of solid wastes which have been improperly thrown everywhere [4]. Solid wastes pertain to all unnecessary wastes coming from households, institutions, farming and industries. Solid wastes have been the problem of rapidly urbanizing communities [5],[6],[7] because of improper solid waste management practices in terms of waste segregation, collection and transport, waste disposal and recycling. Dumping of solid wastes had exacerbated the effects of rains, typhoons, and storms, resulting in impeding water flows and flashfloods [8],[9]. Thus, Solid Waste Management (SWM) remains a pressing environmental issue.

To address this environmental issue, the Philippine legislative bodies decreed RA 9003 or the Ecological Solid Waste Management Act. This Act provides for an

ecological solid waste management program which shall ensure proper segregation, collection, transport, storage, treatment and disposal of solid waste [10]. Moreover, solid waste management is a form of waste control, often associated with storing, collecting, transporting, processing, and disposing of solid waste that is in agreement with the codes of conservation, public health, engineering, economics and other environmental concerns [11].

The implementation and enforcement of the provisions of this Act shall be the primary responsibility of the Local Government Units (LGUs) within their respective jurisdictions as stipulated in the RA 7160, otherwise known as the Local Government Code of 1991. The law also mandates that segregation and collection of solid waste shall be conducted at the barangay level while collection of non-recyclable materials and special wastes shall be the duty of the municipality or city [10].

It is the responsibility of LGUs to practice segregation because segregation facilitates the processing of wastes and substantially decreases the

amount of wastes directed to the dumpsite. Thus, waste source segregation significantly cuts budget allotted to waste collection and transport which are the most expensive element in the total process of waste management [12].

Aside from waste segregation, solid waste management practices include house to house evaluation, consolidation of the evaluation results, record keeping of SWM violators per purok and penalizing violators through community service and fines. More importantly, some LGUs have enacted municipal solid waste management ordinances, constructed waste depository or redemption centers, conducted training on vermi-composting, prohibited open dumping and organized information, education and communication campaign in all puroks about SWM program [13].

Yet, studies revealed that many LGUs still struggle in the implementation of SWM [14] [15] [16] since SWM has not been among the top priorities in most LGUs [17]. Therefore, to achieve sustainable solid wastes management lack of awareness, technical knowledge, legislation policies, and strategies should be adequately addressed [18] [9].

In the full implementation of the Act, different stakeholders including the academe are mandated to take responsibility in the SWM. Part 6, Rule 21, Section 2 of RA 9003 mandates the Department of Education (DepEd), Commission on Higher Education (CHED) to include ecological solid waste management in the school systems at all levels, to actively engage school administrators, teaching and non-teaching staff, and studentry in school-wide and nearby community waste management actions, and to strengthen waste management content in the curricula. In addition, state colleges and universities are also mandated to assist in the LGU's extension system by improving their effectiveness and efficiency through capability-building and complementary extension activities [19].

In compliance to the RA 9003, the National Solid Waste Management Commission (NSWMC) established a comprehensive approach in "Mainstreaming Ecological Solid Waste Management in the Philippine Educational System Project" among private educational institutions. This project was spearheaded by the Department of Environment and Natural Resources (DENR) with the end goal of enhancing the capacity of students' waste management through an Ecological Solid Waste Management Training Program. Through this project, students, teachers, and school administrators were empowered to

create their own school-based solid waste management program[20]. With this cooperation of different public educational programs on waste management, waste minimization and recycling could be successful [21] [7].

However, a study revealed that among sources of wastes universities ranked second in generating biodegradable waste and was the top producer of recyclable materials where most of the wastes were related to instruction process [9]. Thus, this study assessed the extent of implementation of solid waste management practices in select state universities (SUs) in CALABARZON in terms of waste reuse, waste reduction, waste collection, waste recycling, waste treatment, and final waste disposal. There were many studies conducted on the level of implementation among LGUs SWM plan. However, only few have delved on school-based SWM, particularly among SUs in CALABARZON area. This study would be significant in producing baseline data for policy makers and SUCs management to look deeper into the problem which is normally associated to urbanization. Since CALABARZON is a rapidly urbanized region [22], and cities are the nexus for the production of increasing quantity and complexity of wastes, while municipalities cannot cope with the accelerated pace of waste production [3], it is worth studying the extent of SUs implementation of RA 9003 in their respective areas.

#### **OBJECTIVES OF THE STUDY**

This study assessed the extent of implementation of solid waste management practices in select state universities (SUs) in CALABARZON in terms of waste reuse, waste reduction, waste collection, waste recycling, waste treatment, and final waste disposal.

#### **MATERIALS AND METHODS**

The respondents of the study were purposively selected based on the following criteria: (1) they must be practicing solid waste management, (2) they must be a state university in CALABARZON, (3) they must be willing to take part in the study. After considering the set criteria, the qualified respondents were Batangas State University Main Campus I in Batangas City, Cavite State University main Campus in Indang, Laguna State Polytechnic University Main Campus in Sta. Cruz, and Southern Luzon State University Main Campus in Lucban.

To determine the sample size, Slovin's formula was used with a margin error of 0.05 [23].

Table 1. Respondents from the four state universities in CALABARZON

State University	Administration & Faculty	Non-teaching Staff	Students	Concessionaires	Total
Batangas State University	14	25	24	6	69
Cavite State University	11	24	30	6	71
Laguna State Polytechnic University	18	14	57	10	99
Southern Luzon Polytechnic University	15	17	58	12	102
<b>Total</b>					<b>341</b>

Then stratified sampling was employed to get the size proportional to each group (administration and faculty, non-teaching staff, students, and concessionaires) within each stratum- the four state universities. The breakdown is presented in Table 1.

A researcher-made questionnaire to assess the extent of implementation of SWM practices was validated by experts in the field: Environment and Natural Resources Officers from Malvar and Batangas City and Environmental Management Unit Director.

The questionnaire was divided into six parts namely: waste reuse, waste reduction, waste collection, waste recycling, waste treatment, and final waste disposal, with five statements for each. The survey used a five-point Likert scale with the following interpretation: Implemented to a very great extent (VGE): 4.20 – 5.00 ; Implemented to a great extent (GE): 3.40 – 4.19 ; Implemented to a moderate extent (ME): 2.60 – 3.39 ; Implemented to a least great extent (LGE): 1.80 – 2.59 ; Not at all implemented (NI): 1.00 – 1.79

Data collection started with the request sent to SU presidents to conduct the study in June 2014. Approval of the said request took a month. Survey forms were given in August and retrieved in September. Data were

tallied and statistically analyzed using weighted mean. Then, published and unpublished materials were reviewed including newspaper and online journal articles and reports on SWM.

**RESULTS AND DISCUSSION**

School-based solid waste management practices are measures to observe, implement and ensure proper waste disposal because the largest fraction of municipal waste is generated from paper cardboard and other school-related materials [24]. Thus, institutions like schools, private and state universities have to model responsible solid waste management in terms of waste re-use, waste reduction, waste collection, waste recycling, waste treatment, and final waste disposal.

Table 2 shows that in general waste re-use was implemented to a great extent. Among SUs, SLPU’s implementation was to a great extent (3.71) while CvSU practiced waste re-use to a moderate extent (3.26). This means that waste re-use practices should be intensified. Among the waste re-use practices, maintenance of material recovery facility (MRF) ranked first (3.6) while conversion of paper waste into cooking fuel ranked the least(3.37).

Table 2. Extent of implementation of solid waste management practices in terms of waste re-use

Re-Use	BatStateU			CvSU			LSPU			SLPU			Overall		
	WM	VI	R	WM	VI	R	WM	VI	R	WM	VI	R	WM	VI	R
1. Paper waste is converted into paper pulp which can be used as cooking fuel	3.57	GE	5	3.1	ME	5	3.49	GE	2.5	3.32	ME	5	3.37	ME	5
2. Scrap iron and materials collected are sold by and utilize/spend for the maintenance of the recovery facilities	3.79	GE	1	3.31	ME	2	3.49	GE	2.5	3.8	GE	2.5	3.6	GE	1
3. Enhance partnership with the industry, academic and community groups to reuse recycled materials	3.69	GE	2	3.26	ME	3	3.56	GE	1	3.8	GE	2.5	3.58	GE	2
4. Recyclables processing is conducted to ensure that the diverted materials are recovered and reused locally	3.6	GE	4	3.2	ME	4	3.18	ME	4.5	3.83	GE	1	3.45	GE	4
5. Use compostable wastes in the production of organic fertilizers	3.62	GE	3	3.41	GE	1	3.18	ME	4.5	3.79	GE	4	3.5	GE	3
<b>Compositemean</b>	<b>3.65</b>	<b>GE</b>		<b>3.26</b>	<b>ME</b>		<b>3.46</b>	<b>GE</b>		<b>3.71</b>	<b>GE</b>		<b>3.52</b>	<b>GE</b>	

This means that all SUs have maintained MRF but not all of them have utilized paper waste into cooking fuel. Thus, paper charcoal technology must be implemented as part of SUs SWM practices. This technology must be adopted by SUs since most of their wastes are papers from instructional materials.

In terms of waste reduction, overall implementation of SUs is to a great extent (3.79), SLPU has the highest (4.25) and CvSU has the lowest mean (3.5). This means that CvSU's organic waste for animal feed should be improved and waste generators should be more informed about their waste characterization. Among the

five indicators, source reduction of waste generation ranked first, followed by shredding of paper waste which is the most common waste among universities [24], while organic waste turned into animal feed ranked last. This means that SUs have to adapt technology like vermicomposting to convert organic waste into feed for African Night Crawler (ANC) or simply collect and sell organic waste to a piggery [25]. This can be done because higher percentage of waste generated in the Philippines is made up of organics [2]. In addition, non-household sources like universities generate most of biodegradable wastes [9].

Table 3. Extent of implementation of solid waste management practices in terms of waste reduction

Source reduction	BatStateU			CvSU			LSPU			SLPU			Overall		
	WM	VI	R	WM	VI	R	WM	VI	R	WM	VI	R	WM	VI	R
1. Minimize source of waste generation for significant environmental impact	3.93	GE	2	3.88	GE	2	3.7	GE	2	4.11	GE	1	3.9	GE	1
2. The University organic waste: including waste from the canteens are often collected for animal feed	3.81	GE	3	3.2	ME	5	3.49	GE	5	3.9	GE	4	3.6	GE	5
3. The waste generators are informed about waste characterization	3.75	GE	5	3.25	ME	4	3.58	GE	4	3.96	GE	3	3.63	GE	4
4. Shredding of waste is done to reduce solid waste in the University	3.77	GE	4	4.19	GE	1	3.6	GE	3	3.87	GE	5	3.86	GE	2
5. The institutional "no littering policy" is strictly implemented in the University	3.97	GE	1	3.48	GE	3	3.9	GE	1	4.06	GE	2	3.85	GE	3
<b>Compositemean</b>	<b>3.77</b>	<b>GE</b>		<b>3.5</b>	<b>GE</b>		<b>3.65</b>	<b>GE</b>		<b>4.25</b>	<b>GE</b>		<b>3.79</b>	<b>GE</b>	

Table 4. Extent of implementation of solid waste management practices in terms of waste source collection

Source Collection	BatStateU			CvSU			LSPU			SLPU			Overall		
	WM	VI	R	WM	VI	R	WM	VI	R	WM	VI	R	WM	VI	R
1. Promote the "3R's"(reduce, reuse, and recycle) locally when collecting solid waste	4.11	GE	1	3.68	GE	1	3.90	GE	1	4.45	VGE	1	4.03	GE	1
2. The solid wastes are collected daily at designated area	3.83	GE	3	3.59	GE	2	3.67	GE	3	4.24	VGE	3	3.83	GE	2
3. The solid wastes are properly handled by collectors and other personnel who are equipped with protective equipment	3.81	GE	4.5	3.57	GE	3	3.71	GE	2	4.18	GE	4	3.82	GE	3
4. The solid waste segregated and placed in separate containers with marking for re-use, recycling and composting	3.81	GE	4.5	3.41	GE	4	3.57	GE	5	4.34	VGE	2	3.78	GE	4
5. There is MRF for segregation, processing and or buying area for recyclables	3.88	GE	2	3.29	ME	5	3.62	GE	4	4.06	GE	5	3.71	GE	5
<b>Compositemean</b>	<b>3.85</b>	<b>GE</b>		<b>3.50</b>	<b>GE</b>		<b>3.69</b>	<b>GE</b>		<b>4.25</b>	<b>GE</b>		<b>3.82</b>	<b>GE</b>	

Table 4 shows that implementation of SWM practice in terms of waste source collection among SUs is to a great extent. Promotion of the “3R’s” obtained the highest rank while the presence of MRF for segregation, processing and buying ranked the least. This means that respondents from the SUs are well informed and oriented about “3R’s.” However, MRF should not just be visible but operationally marketable since recyclable wastes are also highly generated [2] and can highly provide income as buying area for recyclables. In addition, MRF is essential to advance recycling facility [9] because wastes are segregated for proper collection, process, and disposal.

Recycling is the method of waste disposal people would want to put into use [24]. However, Table 5 shows that implementation of waste recycling though to a great extent, is still the lowest (3.49) among the SWM practices. In particular, CvSU moderately implemented recycling with the lowest mean (3.05). Among SUs applied recyclable collection was to a great extent with a highest mean of 3.58 while establishment of partnership with local or private business for recyclable recovery program was to a moderate extent. This means that SUs have not fully looked into possibilities of

transforming waste into resources by boosting the recycling industry [2]. SUs have not fully utilized the MRF and still lack coordination with private business such as junkshop for turning trash into cash. If MRF is maximized, in this way, generation of resources as the fourth function of SUs mandated by CHED is performed.

When it comes to waste treatment, SUs' implementation is still to a great extent though neutralisation of acid bases is to a moderate extent. This is because acid base neutralisation requires compliance to LGUs' sanitary and sewerage system. Another reason is SUs limited operations, if not lacking, of Environmental Health and Safety Office that takes care of this acidbase neutralization.

It can be gleaned also from Table 6 that CvSU garnered the lowest mean (3.31) for its moderately extent implementation of the waste treatment indicators. It is followed by BatStateU (3.35). This means that waste treatment as a SWM practice is seldom performed because waste generated are usually re-used, reduced, and recycled, not really treated as in having waste water treatment facility.

Table 5. Extent of implementation of solid waste management practices in terms of waste recycling

Recycling	BatStateU			CvSU			LSPU			SLPU			Overall		
	WM	VI	R	WM	VI	R	WM	VI	R	WM	VI	R	WM	VI	R
1. The "Recyclable Collection" is applied for recycle materials and ready for manufacturing process	3.73	GE	1	2.96	ME	5	3.69	GE	1	3.96	GE	1	3.58	GE	1
2. Collected plastic containers are processed into functional articles (e.g., ables/monoblock souvenirs)	3.46	GE	5	3.13	ME	1.5	3.66	GE	2	3.73	GE	5	3.49	GE	3
3. Sufficient recycling facilities with market opportunity for recycled products are given emphasis	3.62	GE	3	2.97	ME	4	3.49	GE	3	3.81	GE	3	3.47	GE	4
4. The recyclables marketing is done by the person concerned to encourage market development in recyclable products	3.67	GE	2	3.13	ME	1.5	3.45	GE	4	3.85	GE	2	3.52	GE	2
5. Establishing partnership with local or private business for recyclable recovery program	3.58	GE	4	3.04	ME	3	3.18	ME	5	3.75	GE	4	3.39	ME	5
<b>Compositemean</b>	<b>3.61</b>	<b>GE</b>		<b>3.05</b>	<b>ME</b>		<b>3.49</b>	<b>GE</b>		<b>3.82</b>	<b>GE</b>		<b>3.49</b>	<b>GE</b>	

Table 6. Extent of implementation of solid waste management practices in terms of waste treatment

Treatment	BatStateU			CvSU			LSPU			SLPU			Overall		
	WM	VI	R	WM	VI	R	WM	VI	R	WM	VI	R	WM	VI	R
1. Hazardous wastes are treated according to existing law of the DENR and DOH	3.81	GE	1	3.41	GE	2	3.66	GE	1	3.79	GE	4	3.67	GE	1
2. The special wastes such as print cartridges, electronic parts, paint, thinner, whiteboard markers, laboratory waste and medical wastes are treated properly	3.57	GE	2	3.2	ME	4	3.56	GE	3	3.83	GE	2	3.54	GE	2
3. Acid bases are neutralized	3.24	ME	3	3.48	GE	1	3.12	ME	5	3.73	GE	5	3.39	ME	5
4. All items contaminated with potentially infectious materials are treated through sterilization	3.03	ME	5	3.19	ME	5	3.6	GE	2	3.82	GE	3	3.41	GE	4
5. Treatment for special waste is managed by professional and laboratory personnel	3.1	ME	4	3.29	ME	3	3.5	GE	4	3.86	GE	1	3.44	GE	3
<b>Compositemean</b>	<b>3.35</b>	<b>ME</b>		<b>3.31</b>	<b>ME</b>		<b>3.49</b>	<b>GE</b>		<b>3.81</b>	<b>GE</b>		<b>3.49</b>	<b>GE</b>	

Table 7. Extent of implementation of solid waste management practices in terms of waste disposal

Treatment	BatStateU			CvSU			LSPU			SLPU			Overall		
	WM	VI	R	WM	VI	R	WM	VI	R	WM	VI	R	WM	VI	R
1. Contracting with private/public hauler for solid waste disposal	3.65	GE	3	3.35	ME	1	3.62	GE	2	3.84	GE	3	3.61	GE	1
2. Setting up cooperative to managed solid waste operations	3.63	GE	4	3.30	ME	2	3.53	GE	5	3.88	GE	7	3.58	GE	3
3. Collected broken glassware are disposed in a right box that is marked as "broken glassware"	3.87	GE	1	3.19	ME	4	3.63	GE	1	3.64	GE	5	3.58	GE	3
4. Engineering appropriate processing equipment and technically viable and environmentally sound recycling and re-use process	3.71	GE	2	3.16	ME	5	3.60	GE	3	3.73	GE	4	3.55	GE	5
5. Remaining solid waste brought and disposed in city or municipal landfill	3.62	GE	5	3.24	ME	3	3.56	GE	4	3.90	GE	1	3.58	GE	3
<b>Compositemean</b>	<b>3.69</b>	<b>GE</b>		<b>3.24</b>	<b>ME</b>		<b>3.58</b>	<b>GE</b>		<b>3.79</b>	<b>GE</b>		<b>3.57</b>	<b>GE</b>	

Improper waste disposal is one of the problems in the country [9]. However, Table 7 illustrates that SUs in CALABARZON implemented waste disposal to a great extent. They have contracted private/public hauler for solid waste disposal to a great extent. Yet, engineering appropriate processing equipment and technically viable and environmentally sound recycling and re-use process has to be improved since it ranks the least among the five indicators. Nevertheless, SW cannot be easily solved by engineering or innovative technology since there are still other issues to be considered for a sound environmental governance [26]. One of which is compliance to existing national laws or local ordinances in the city or municipal level. If there is compliance, monitoring of how these laws are implemented is the usual problem.

#### CONCLUSION AND RECOMMENDATION

The responsibility of SUs in the implementation of SWM is clearly stipulated in RA 9003. In compliance to this mandate, SUs along with the officials, faculty members, staff, and studentry have implemented SWM. Though SUs in CALABARZON practiced SWM to a great extent in terms of waste re-use, reduce, collection, recycling, treatment and disposal, there are still rooms for improvement. Practices for waste recycling and treatment need more careful planning to convert waste to resources or make cash out of trash particularly in the recycling process.

Thus, it is recommended that for recycling to be effective, functional and marketable MRF should be put up in the university to attract recycling entrepreneurs. With the MRF, partnership with local or private recycling business would be established. This partnership would bring additional finances for the university utility workers who themselves collect and segregate wastes. Then, identification of appropriate technology based on the waste generated and collected would be easy. It would be better also if a recycling campaign once a week would be initiated by the Supreme Student Council (SSC) for the student entry to take part, embrace, and live the recycling advocacy.

For the waste treatment, it would be better if a treatment facility would be invented by students through their undergraduate research. A treatment facility for special wastes like ink cartridges, paint, thinner, whiteboard markers, and others would really lessen and convert this waste into resources. This would surely be a cost-effective measure for the university.

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