

# SOLID WASTE MANAGEMENT (SWM) STRATEGIES IN MINDANAO UNIVERSITY OF SCIENCE AND TECHNOLOGY, PHILIPPINES

Van Ryan Kristopher R. Galarpe<sup>1,\*</sup>, Brawner Brian L. Heyasa<sup>2</sup>

<sup>1</sup>Department of Physics, College of Science & Mathematics, University of Science & Technology of Southern Philippines Cagayan de Oro, 9000 Philippines

<sup>2</sup>BS Electronics Engineering, Electronics & Communications Engineering Department, College of Engineering & Architecture University of Science & Technology of Southern Philippines Cagayan de Oro, 9000 Philippines

\*For correspondence; E-mail: [vanryngalarpe@gmail.com](mailto:vanryngalarpe@gmail.com)

**ABSTRACT:** Improper solid waste (SW) disposal had become a pressing environmental concern. The solid waste management (SWM) in the Philippines is institutionalized by the mandate of the Republic Act 9003, however, the extent of implementation of the act was not assessed. To extrapolate an extent of SWM support in academic institutions in the Philippines, this study was conducted. Primarily, this paper assessed descriptively the SWM strategies of the Mindanao University of Science and Technology (MUST), Philippines. Overall, SWM strategies in MUST reinforced existing knowledge on SWM among faculty, students, and staff. An active participation was observed as evidenced by; (i) number and types of SW bins; (ii) curriculum and instructions; (iii) university canteens initiative; (iv) urban gardening; and (v) reusing of waste papers. Marginal gaps which include the absence of material recovery facility (MRF), lack of trained personnel, and SW holding areas before landfill refuse were also identified. Present findings can be a basis to further evaluate how academic entities in the Philippines practiced the mandate of R.A. 9003.

Keywords: solid waste management (SWM), solid waste (SW), Republic Act 9003 (RA 9003), material recovery facility (MRF)

## 1. INTRODUCTION

The Republic Act 9003-Ecological Solid Waste Management Act provides the mandate for solid waste management (SWM) implementation in the Philippines. Despite the established policies poorly managed solid waste systems are observed. This is often reflected through the use of open landfills and dumpsites although SWM alternatives are available [1,2,3]. Socio economic and physicochemical studies of waste disposal sites in the Philippines [3,4,5,6] [7,8,9] revealed a poorly managed system due to lack of public awareness, less participation of stakeholders, and minimal policy implementations. A need for public awareness is seen necessary to help in mitigating the problem.

The university is a major source in obtaining environmental knowledge (e.g. SWM) by assuming a special societal responsibility in educating future decision makers [10]. Studies elsewhere about SWM strategies and perception analysis in universities [10,11,12,13,14,15] showed improved behaviors and practices, however, depending on a complex set of social and psychological factors [16]. It is therefore essential that key pillars from the academe are facilitating in developing SWM strategies. Likewise, students will serve as linkage between the academe-community networks for SWM.

Locally, the Mindanao University of Science and Technology (MUST) facilitated environmental strategies and participations focusing on SWM. These strategies were reflected in the: (i) introductory course in environmental science (e.g. ENVI 10) offered in undergraduate programs; (ii) specialized course in BS-MSc Environmental Science and Technology; (iii) topics taught in the course National Service Training Program (NSTP); and (iv) facilities for SWM (e.g recycle and trash bins). To determine the extent of practice of these strategies, this study was conducted. The identified strengths served as vital point for developing sustainable

SWM, whereas, determined gaps served as basis for recommendations.

## 2. MATERIALS AND METHODS

The study area was the MUST in Cagayan de Oro, Philippines. About forty three (43) buildings with four colleges were assessed for SWM strategies. These key strategies were anchored from literature review [10,11,12,13,14,15,16] about SWM in universities and academic entities. On site monitoring of the types, numbers, and nature of SW bins available in each college or buildings were descriptively assessed. Other SWM strategies were descriptively recorded. Results were summarized as basis for needs assessments and recommendations (see Figure 1). Quantitative data were then expressed using mean and standard deviation.

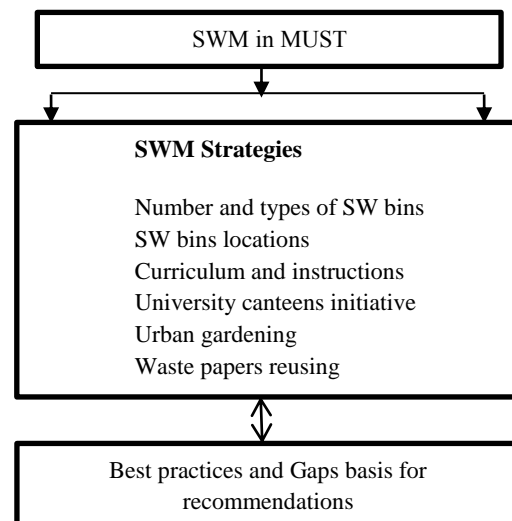


Figure (1) Framework of the study

### 3. RESULTS AND DISCUSSION

**Trash bins to encourage proper SW disposal** The SWM initiatives were mainly facilitated by the university Janitorial and Landscaping Unit. This included the greening program by providing: (i) workforce involved in solid waste handling and collection; (ii) monitoring of solid waste bins; and (iii) scheduling of solid waste transport to the Cagayan de Oro City landfill. The recommended solid waste bins (three containers-3%) were limited and mainly located in the ground floor of all university buildings (refer to Figure 3).



Figure (2) types of solid waste bins available in MUST

This is ideal for SWM strategies to motivate in keeping the wastes appropriately and may encourage the practice of reducing, reusing, and recycling [11,17]. The two container solid waste bins (18%) and the single solid waste bins (66%) were along major pathways and building hallways. Other bins include pale (5%) and NSTP donated bins for PET bottles (5%) Overall, the two container solid waste bins were the highest in total units dispatched in the university (see Figure 3).

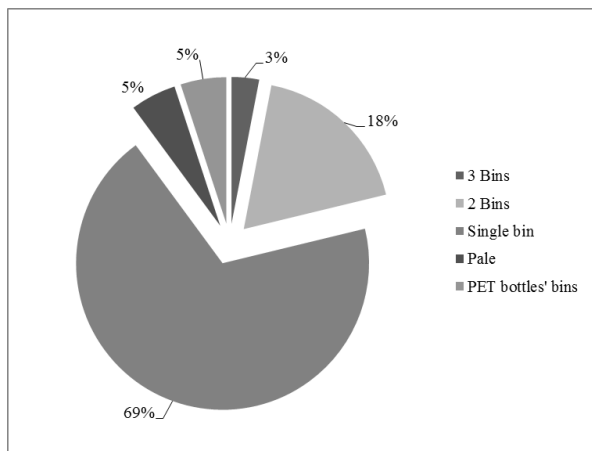


Figure (3) percentage of SW bins in the university

#### Solid waste bins by location

About 44 building structures were purposively utilized in teaching, research, and administrative functions in the university. These facilities can be categorized into the following functions:

- (i) CAS- College of Arts and Sciences
- (ii) CEA- College of Engineering and Architecture
- (iii) CIIT- College of Industrial and Information Technology
- (iv) CPSEM- Policy Studies, Education and Management
- (v) Senior High School
- (vi) Administration and others- non teaching support offices, gymnasium, and canteen

Overall, only CAS, CIIT, and CEA had three SW bins. Two and single SW bins were mainly found in CAS. It is a service college with greater number of students daily, consequently SW generation is high. This was followed by CEA, CIIT, CPSEM, and Senior High. The facilities for administrative functions and non-teaching support offices had the lowest number of SW bins (see Figure 4).

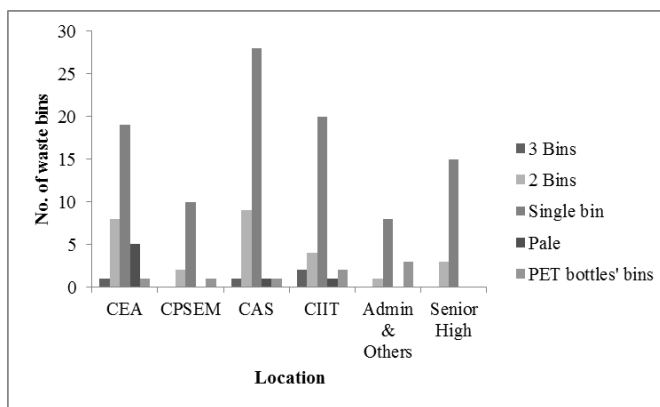


Figure (4) SW bins location in the university

#### Curriculum and instructions

All undergraduate programs in the university have NSTP courses, covering SWM topics. Another course which supports SWM strategies is ENVI 10 (Environmental Science) for CAS, CPSEM, and CIIT and ES 30 (Environmental Engineering) for CEA (Figure 5).

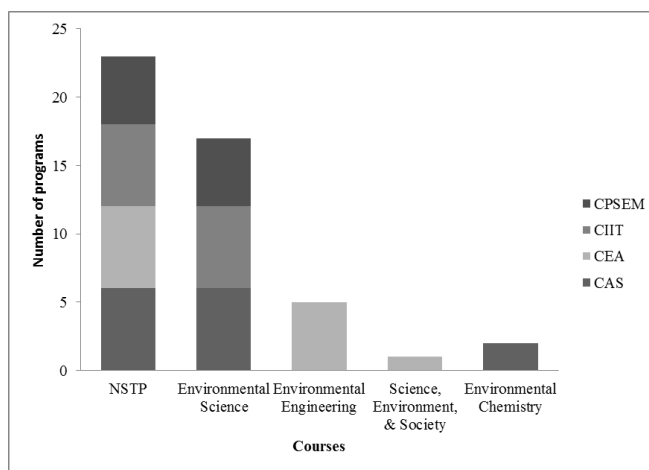


Figure (5) SW bins location in the university

The specialized elective courses covering SWM as cognate topic is offered for BS Environmental Science and Technology students under CAS. Environmental chemistry on the other hand is offered for two programs under CAS. Overall, these curricular offerings are evidenced of active participation of establishing SWM strategy by the university [16].

The NSTP courses on the other hand initiated SWM strategies through donated waste bins (Figure 6) as receptacles for recyclable waste PET bottles. All adjacently located along major pathways and densely populated area in the university (canteen). This practice may promote positive attitude towards recycling [18] and as a convenient activity by familiarizing the public with recycling sites [19]. The

present initiative can become a persuasive communication to reduce people’s notion on recycling inconvenience [20].



Figure (6) separate collecting bins for PET bottles

**University canteen’s initiative**

The university canteens green product initiative by providing food container options reflected through i) signage, and ii) value added payment for using plastics (Figure 7) can essentially influence the clients norms. A study about consumer’s attitude towards green product is attributed to personal norms [21]. Further, putting publicly written feedback or signage in the university canteen similarly increase recycling related behaviors [22].



Figure (7) policy of banning plastics in the university canteen

This practice however needs improvement since other occupants of the canteen (e.g. food carts) do not entirely implement the policy.

**Urban gardening initialized by CPSEM**

The program under the Technology and Livelihood Education (TLE) courses incorporates urban gardening among students of CPSEM. This practice utilized used sacks and plastic containers as plant pots of some valued crops, encouraging solid waste reduction. Urban gardening provides advantage for the provision of school facilities and potential commodity output use [23]. Refer to Figure 8.



Figure (8) urban gardening initialized by CPSEM

**Reusing of waste papers**

Back page of used papers (e.g. used examination questionnaires or office papers) were utilized to circulate all communication letters in the university, aiming to reduce paper waste generation (Figure 9). This practice was seen effective in recycling, reducing purchase of new paper, and promoting a sustainable office system [24].



Figure (9) utilization of waste papers for circulating university wide communication letters

**Gaps and Future Trends**

While present initiatives from the university towards SWM showed favorable responses among students APP, it was also apparent that some initiatives need reinforcement to ensure a sustainable SWM practice. The following gaps were identified:

- (i) absence of Material Recovery Facility (MRF)
- (ii) lack of appropriate solid waste holding area prior to refuse to landfill (see Figure 10).
- (iii) insufficient three container waste bins
- (iv) lack of signage to encourage solid waste management
- (v) lack of trained personnel for SWM
- (vi) passive participation of students to SWM



Figure (10) SW dumping stations in MUST

Given the identified gaps the following are recommended as future trends to ideally develop a proactive sustainable SWM practice in MUST. These were extrapolated from literature fitting the need of MUST.

- (i) Establishing of campus environmental committee to facilitate communication on environmental matters [13] with emphasis on messages concerning what, how, and where to recycle rather than the messages on why to recycle [15]. This may also include on putting publicly posted written feedback or signage [22].
- (ii) Developing adoption of sustainable practice by creating suitable programs for students at all levels [10].

- (iii) Providing suitable and enough number of recycling bins to encourage participation and familiarity in recycling activities [11,19,20].
- (iv) Creating a strategic policy optimization and techniques of the recycling potential of solid waste in the university [12,14]
- (v) Developing a provision on monetary incentive for school garbage banks [25] which may include MRF.

#### 4. CONCLUSIONS

Overall, present SWM strategies in MUST was reflective of the mandate of R.A. 9003. These strategies reinforced existing knowledge on SWM among faculty, students, and staff. An active participation were observed as evidenced by; (i) number and types of SW bins; (ii) curriculum and instructions; (iii) university canteens initiative; (iv) urban gardening; (v) reusing of waste papers. Marginal gaps which include the absence of MRF, lack of trained personnel, and SW holding areas before landfill refuse were also identified.

#### 5. REFERANCES

- [1] Galarpe, V.R.K.R, and R.B. Parilla, "Influence of seasonal variation on the bio-physicochemical characterizations of leachate and groundwater in Cebu City sanitary landfill, Philippines" *International Journal of Chemical and Environmental Engineering*, **3**(3): 175-181(2012).
- [2] Galarpe, V. R. K. R., and R.B. Parilla, "Opportunities and Threats to Adjacent Community in a Sanitary Landfill, Philippines" *EnvironmentAsia*, **7**(1): 112-125(2014a).
- [3] Galarpe, V.R.K.R., "Socio-Demographic Assessment of Surrounding Community to a Material Recovery Facility (MRF) and a Dumpsite: The Case of Lapu-Lapu City, Philippines" *Journal of Sustainable Development Studies*, **8**(2): 260-274(2015).
- [4] Sia Su, G. L., "Determinants of Economic Dependency on Garbage: The Case of P on Garbage: The Case of Payatas, Philippines" *Asia-pacific Social Science Review*, **7**(1):77-85(2007a).
- [5] Sia Su, G. L., "Impact on drinking water sources in close proximity to the Payatas dumpsite, Philippines" *Journal of public health*, **15**(1):51-55(2007b).
- [6] Galarpe, V. R. K. R., and R.B. Parilla, "Analysis of Heavy Metals in Cebu City Sanitary Landfill, Philippines" *Journal of Environmental Science and Management*, **17**(1): 50-59(2014b).
- [7] Nazareno, P. A. G., I.E. Buot, and M.E. Flavier, "The plants in a landfill in the Philippines and their behavior towards lead and mercury: their potential use for future remediation of metal-contaminated soils in the country" *Journal of Environmental Science and Management*, **14**(1):60-70(2011).
- [8] Ejares, J. A., M.K.O. Paler, and M.E.L. Aguilar, "Socio-Demographic Profile of Scavenging Households in Umapad Dumpsite, Mandaue City Cebu, Philippines" *Journal of Sustainable Development Studies*, **6**(1): 175-192(2014).
- [9] Buagas, D. J. B., C.C.F. Megraso, J.D.O. Namata, P.J.Y. Lim, K.P. Gatus, and A.M. Cañete, "Tracking quicksilver: estimation of mercury waste from consumer products and subsequent verification by analysis of soil, water, sediment, and plant samples from the Cebu City, Philippines, landfill" *Environmental monitoring and assessment*, **187**(3):1-12(2015).
- [10] de Vega, C. A., S. O. Benitez, and M.E. Ramí, "Characterization and quantification of household solid wastes in a Mexican city" *Resources, Conservation and Recycling*, **39**(3): 211-222(2003).
- [11] Malakahmad, A., M.Z.M. Nasir, S.R. Kutty, and M.H. Isa, "Solid waste characterization and recycling potential for university technology PETRONAS academic buildings" *American Journal of Environmental Sciences*, **6**(5):422-427(2010).
- [12] de Vega, C. A., S. O. Benítez, and M.E.R. Barreto, "Solid waste characterization and recycling potential for a university campus" *Waste management*, **28**:S21-S26 (2008).
- [13] Mason, I. G., A.K. Brooking, A. Oberender, J.M. Harford, and P.G. Horsley, "Implementation of a zero waste program at a university campus" *Resources, Conservation and Recycling*, **38**(4):257-269(2003).
- [14] Smyth, D. P., A.L. Fredeen, and A.L. Booth, "Reducing solid waste in higher education: The first step towards 'greening' a university campus" *Resources, Conservation and Recycling*, **54**(11):1007-1016(2010).
- [15] Kaplowitz, M. D., F.K. Yeboah, L. Thorp, and A.M. Wilson, "Garnering input for recycling communication strategies at a Big Ten University" *Resources, Conservation and Recycling*, **53**(11):612-623(2009).
- [16] Desa, A., N.B.Y.A. Kadir, and F. Yusoooff, "A study on the knowledge, attitudes, awareness status and behaviour concerning solid waste management" *Procedia-Social and Behavioral Sciences*, **18**:643-648(2011).
- [17] Ivy, N., M.M. Uddin, and M.K. Hossain, "People's Perception on Using Waste Bins in Reduce, Reuse and Recycle (3Rs) Process for Solid Waste Management (SWM) in Chittagong, Bangladesh" *International Journal of Applied Science, Technology and Engineering Research*, **2**:30-40(2013).
- [18] Omran, A., A. Mahmood, H. Abdul Aziz, and G.M. Robinson, "Investigating households attitude toward recycling of solid waste in Malaysia: a case study" *International journal of environmental research*, **3**(2):275-288(2009).
- [19] Sidique, S. F., F. Lupi, and S.V. Joshi, "The effects of behavior and attitudes on drop-off recycling activities" *Resources, conservation and recycling*, **54**(3):163-170(2010).
- [20] McCarty, J. A., and L.J. Shrum, "The recycling of solid wastes: Personal values, value orientations, and attitudes about recycling as antecedents of recycling behavior" *Journal of Business Research*, **30**(1): 53-62(1994).
- [21] Chen, T. B., and L.T. Chai, "Attitude towards the environment and green products: consumers'

- perspective” *Management science and engineering*, **4**(2): 27-39(2010).
- [22] Kim, S., S. Oah, and A.M. Dickinson, “The impact of public feedback on three recycling-related behaviors in South Korea” *Environment and Behavior*, **37**(2):258-274(2005).
- [23] Specht, K., R. Siebert, I. Hartmann, U.B. Freisinger, M. Sawicka, A. Werner, S. Thomaier, D. Henckel, H. Walk, and A. Dierich. “Urban agriculture of the future: an overview of sustainability aspects of food production in and on buildings” *Agriculture and Human Values*, **31**(1): 33-51(2014).
- [24] Cole, E. J., and L. Fieselman. “A community-based social marketing campaign at Pacific University Oregon: Recycling, paper reduction, and environmentally preferable purchasing” *International Journal of Sustainability in Higher Education*, **14**(2): 176-195(2013).
- [25] Suttibak, S., and V. Nitivattananon, “Assessment of factors influencing the performance of solid waste recycling programs” *Resources, Conservation and Recycling*, **53**(1):45-56(2008).

---

\*For correspondence; E-mail:vanryangalarpe@gmail.com