



# Sustainability of the Implementation of Solid Waste Management: A Comparative Study

**MA. MAGDALENA J. BERNALES\***

*Bohol Island State University, Candijay, Philippines*

*Email: mamagdalena.bernales@bisu.edu.ph*

**JAKE C. MALON**

*Bohol Island State University, Candijay, Philippines*

Received 28 February 2022 Accepted 25 July 2022 (\*Corresponding Author)

**Abstract** This study aimed to compare the status of implementation of the Solid Waste Management (SWM) in the Municipality of Candijay, Bohol, Philippines for the year 2015 and 2020 to find ways for the sustainability of the implementation of the Town's Solid Waste Management. Wastes were collected monthly for one year from the five sampled barangays with 122 households. Field investigations, on-site waste measurements and characterizations were conducted. This is a mixed method employing QUANT-Qual approach. Descriptive statistics which include percentages, and weighted mean were used for the quantitative approach while narrative analysis for the qualitative was used. The results revealed that from the previous data of SWM implementation found out that the average biodegradable waste generated in the year 2015 which was 46.14% decreased to 10.94% as a result of home proper waste disposal. Likewise, the recyclable waste which had 27.27%, the number decreased to 26.08%. Since residual wastes should be collected, the collection increased to 59.85% from 15.42% due to acquisition of additional garbage trucks. For special waste, from 11.16% previously collected, it decreased to 3.13%. There was significant difference between the biodegradable, residual and special wastes. In the present SWM implementation, innovation played an important role in recycling waste materials. Shredded plastics and crashed glasses were converted into mixture to create concrete products. The shredded biodegradable wastes were converted into organic fertilizers. The produce out of these shredded materials were used to generate income which played an important role to sustain the solid waste implementation. Thusly, the level of implementation was already properly practiced. Solid Waste Management had employed organizational structure for implementation and dissemination of personnel's function. Additional equipment and personnel were acquired. To sustain the proper SWM, recycling equipment, public awareness, funding, expertise of personnel, equipment and facilities, innovations and other provisions must be provided.

**Keywords** implementation, innovation, solid waste management, waste characterization

## INTRODUCTION

With fast growing population and lack of adequate disposal sites, solid waste has become a major problem for most medium to large-size cities in the Philippines. In recent years, inadequate solid waste management systems have posed serious health risks particularly in densely populated areas.

The increasing problem on waste management in almost all communities across the country was due to the uncontrolled population growth, coupled with rapid urbanization and industrialization, have become the primary thrust of the national government (National Solid Waste Management Commission and D.E.N.R., 2004). In addition, the low level of environmental literacy and awareness of the public, partly contributed to the difficulties in implementing and enforcing environmental laws and policy, particularly, laws on cleanliness and sanitation (Jaworski and DENR as cited by Reyes and Furto, 2013). The common observation is that people are apathetic and indifferent toward wastes issues.

In the Asian region, inadequate solid waste management and disposal practices combined with the tropical climatic condition resulted in an increasing environmental problem (Visvanathan et. al., 2004). In addition, in many rural areas, the lack of environmentally friendly, sustainable and affordable waste management has led to the widespread practice of open dumping and open burning of solid waste (Wilson, 2011). These are the easiest and considered to be the cheapest methods of removing waste from the immediate environment. This predicament made an enormous impact to public health and the environment. While the collection of solid wastes is the responsibility of the local government units (LGUs), these LGUs cannot do it alone. There should be a partnership with other institutions such as the academe, non-government organizations (NGOs), and the community (Machado, 2012). The academe can assist the LGUs through information, education, and communication (IEC) activities. The problem of solid waste and its management has become a genuine concern of the province of Bohol, Central Visayas, Philippines.

In response to the waste problem, the local government of Candijay has adopted measures in the development and implementation of the Ecological Solid Waste Management program. With this, the researchers were triggered to conduct a comparative study to find out the status of implementation of the Solid Waste Management (SWM) in the Municipality of Candijay, Bohol, Philippines for the year 2015 and 2020 and look forward on finding ways for the sustainability of the implementation of the Town's Solid Waste Management.

## **OBJECTIVE**

This study aims to compare the status of implementation of the Solid Waste Management (SWM) in the Municipality of Candijay, Bohol, Philippines for the year 2015 and 2020 to find out the sustainability of Town's Solid Waste Management practices.

## **METHODOLOGY**

The study was carried out in the municipality of Candijay, Bohol, Philippines to determine the average weight of waste generated daily by the household. The data gathered shall be the basis in formulating the 10-year Ecological Solid Waste Management (ESWM) plan of the municipality.

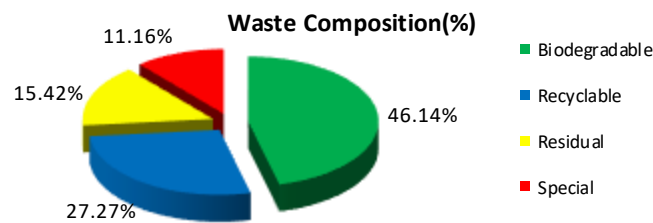
This is a mixed method employing QUANT-Qual approach. Descriptive statistics which include percentages, and weighted mean were used for the quantitative approach while narrative analysis for the qualitative interpretation of information was used. It involved the residents of the selected barangays in the municipality of Candijay as the respondents. Random sampling was used to select the possible barangays to be included in the study. Using Slovin's formula, the researchers used a sample of four (4) barangays with the total number of one hundred twenty-two (122) household respondents and five hundred forty-two (542) household members.

The researchers adopted the questionnaire of Reyes and Furto (2013) and the Questionnaire for solid waste management survey World Health Organization (WHO) 1996 on the level of implementation of proper and improper solid waste management. Minor revisions were made on the questionnaires in order to answer the questioned variable of the study. Since the questionnaire is an adopted one, there is no need to do pilot testing of the said questionnaire. The researcher asked permission to the Municipality's ESWM to disseminate the questionnaire to the selected Barangays. The respondents were also informed about the nature of the study upon the dissemination of the questionnaires.

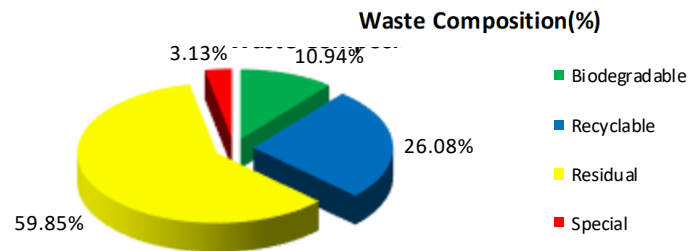
For analyzing and quantifying the waste generated, respondents were given four (4) plastic bags of different colors like green, blue, yellow and red for biodegradable, recyclable, residual, and special waste respectively. Wastes were collected daily for successive three days and measured according to type. Wastes were segregated in every household before hauling to the dumpsite. Weighing according to type as biodegradable, recyclable, residual and special waste was done in the dumpsite. For qualitative aspects, narrative analysis was also employed, since the study involved interview with the selected informants.

**RESULTS AND DISCUSSION**

Table 1 exhibits the Comparison on the level of implementation of proper SWM practices of the residents. There were six (6) items which were moderately practiced in the year 2015 that changed to fully practiced in the year 2020. The residents were observed to fully practice the segregation of biodegradable from non-biodegradable, selling of bottles, plastics, cans and other scraps to junkshops reusing of reusable materials, reducing of waste and avoiding the use of toxic and hazardous materials and chemicals. From the four (4) slightly practiced solid waste management in the year 2015, it can be seen that these practices were already fully practiced except for recycling which was moderately practiced. The study of (Atienza, 2013) pointed out that the lack of infrastructure for efficient transportation contributed in the inefficient implementation and ineffective monitoring of waste management program which was already addressed by the municipal solid waste management with the cooperation of the people in the community.



**Fig. 1-A Composition of waste generated during 2015**



**Fig. 1-B Composition of waste generated during 2020**

**Table 1 Level of implementation of proper solid waste management practices (N=122)**

Items	Weighted Mean		Descriptive Value	
	2015	2020	2015	2020
1. Segregating of biodegradable from non-biodegradable wastes	3.01	3.6	MP	FP
2. Collecting of garbage by the municipal truck	2.41	3.5	SP	FP
3. Selling of bottles, plastics, cans and other scraps to junkshops	3.01	3.5	MP	FP
4. Reusing of reusable materials	2.51	3.7	MP	FP
5. Reducing of waste	2.50	3.6	MP	FP
6. Recycling	2.40	3.8	SP	MP
7. Feeding left over foods to pets	3.60	3.9	FP	FP
8. Avoiding the use of toxic and hazardous materials or chemicals	2.81	3.6	MP	FP
9. Composting	2.42	3.7	SP	FP
10. Providing of garbage receptacles to public areas	2.39	3.9	SP	FP
Composite mean	2.70	3.68	MP	FP

Range: 1.0-1.49: not practiced (NP), 1.5-2.49: slightly practiced (SP), 2.5-3.49: moderately practiced (MP), 3.5- 4.0: fully practiced (FP)

**Table 2 Improper solid waste management practices (N=122)**

Items	Weighted mean		Descriptive value		Rank
	2015	2020	2015	2020	
1. Burning of garbage in every household	3.01	2.1	MP	SP	1
2. Dumping garbage in rivers.	1.30	1.1	NP	NP	4
3. Paying somebody to throw garbage anywhere far from their residence	1.35	1.15	NP	NP	3
4. Burying of hazardous waste underground	2.03	1.5	SP	NP	2
Composite mean	1.92	1.46	SP	NP	

Range: 1.0-1.49: not practiced (NP), 1.5-2.49: slightly practiced (SP), 2.5-3.49: moderately practiced (MP), 3.5- 4.0: fully practiced (FP)

Table 2 presents the transition of the level of implementation of improper solid waste management. In the year 2015, burning of garbage in every household was moderately practiced, however, as compared to the year 2020 this kind of act was change to slightly practice. Burying of hazardous wastes underground was slightly practiced in the year 2015 and in the latest data in the year 2020, this was not anymore practiced. It was worth to note that dumping of garbage in rivers and paying somebody to throw garbage anywhere far from their residence were remained not practiced. The household respondents were already concerned with the effects of the emitted smoke on the atmosphere and to the health of the people. With the effort of the town's solid waste management office through information dissemination, the residents were not anymore practicing the burying of hazardous wastes underground. According to (Reyes and Furto, 2013) though these materials are buried, there are still harmful effects to the people's health but not as much as those which are exposed above the ground.

**Table 3 Problems encountered in the implementation of solid waste management (N=122)**

Items	Weighted mean	Descriptive value	Rank
1. Increasing population	2.55	S	6
2. Public Indifference (Public don't care)	2.56	S	5
3. Inefficient collection of garbage	2.04	S	10
4. Lack of financial resources	3.5	VS	3.5
5. Lack of authority to make financial decision	2.3	NS	10
6. Non-operation of good disposal	2.4	NS	9
7. Lack of trained personnel	3.5	VS	3.5
8. Lack of enforcement measure and capability	3.6	VS	2
9. Foul odor of the open dumpsites that is hazardous to health	3.7	VS	1
9. Lack of awareness among the people regarding SWM	2.44	NS	8
10. Lack of training on proper solid waste management practices	2.48	NS	7
Composite mean	3.10	S	

Range: 1.0-1.49: not a problem (NP), 1.5-2.49: not so serious (NS), 2.5-3.49: serious (S), 3.5-4.0: very serious (VS)

Table 3 shows that item number 9 “Foul odor of the open dumpsites which were hazardous to health” got the highest rank with a weighted mean of 3.7 with descriptive value of very serious. The next in rank is the lack of enforcement measure and capability had a weighted mean of 3.6 with a descriptive rating of very serious. The lowest was on the item number 5 “lack of authority to make financial decision” with a weighed mean of 2.3, not serious. The overall perception of the respondents in terms of the problems encountered is serious with a weighted mean of 3.10. It implies that lack of enforcement measure and capability, trained personnel and financial resources are encountered very seriously by the respondents. Problems such as increasing population, public indifference were encountered in a serious manner while lack of training on proper solid waste management practices is encountered not seriously. The result of the study is supported by the study of (Ali et. al., 2013) entitled open dumping of municipal solid waste and its hazardous impacts on soil and vegetation diversity at waste dumping sites of Islamabad city wherein the main environmental problem associated with the disposal site is the potential risk to the soil.

**Table 4 Difference of waste generation by weight in terms of grams and level of implementation of solid waste management practices**

Items	F <sub>computed</sub>	F <sub>table</sub>	Interpretation
Proper and Improper Solid waste Management Practices	-29.79	7.815	Significant
Waste Generation	10.14	7.815	Significant

Table 4 presents the difference on the level of implementation of solid waste management practices among the different barangays in the municipality of Candijay. It can be gleaned from the table that the computed F values of proper and improper solid waste management practices and waste generation were -29.79 and 10.14 respectively which is beyond and greater than the tabular value of 7.815 at 0.05 level of significance. Thus, the null hypothesis of no significant difference is rejected. This means that there is a difference that exists on the level of implementation of solid waste management. Differences were indicated from the result using Kruskal Wallis test. There was a difference that exists on the level of implementation of solid waste generated among the different barangay. This could be due to the factors such as location, population, facilities and possibly to the income of the community. Densely populated barangays like Poblacion and Cogtong generate more solid waste making their SWM practices different from those scarcely populated as in Tugas and San Isidro. It is where the difference lies in terms of weight of waste generated. Moreover, Cogtong is a coastal barangay where in the respondents may throw their waste in the seas aside from burning. In addition to that there is a part of Poblacion that is adjacent to the river where waste can be found.

### Improvement Highlights

The average biodegradable waste generated in the year 2015 which was 46.14% decreased to 10.94% in the year 2020 as a result of home proper waste disposal. Likewise, the recyclable waste which had 27.27%, the number decreased to 26.08%. Since residual wastes should be collected, the 2020 collection increased to 59.85% from 15.42% in the year 2015, this is because of the acquisition of additional garbage trucks. For special waste, from 11.16% previously collected, it decreased to 3.13% in the year 2020. For this, it can be deduced that there was significant difference between the biodegradable, residual and special wastes. In the present SWM implementation, innovation played an important role in recycling waste materials. Based on the 2015 data, there were problems identified in the implementation on the management of the solid waste in the town of Candijay. These identified problems were considered as the immediate concern which needed to be eradicated. In 2020, through observation in the locale and interview of the selected individuals, it was found out that in the present SWM implementation, innovation played an important role in recycling waste materials. Acquisition of shredder for biodegradable, plastics and glass waste materials were already realized. Shredded plastics and crashed glasses were converted into mixture to create concrete products like bricks and hallow blocks. On the other hand, the shredded biodegradable wastes were converted into organic fertilizers. The produce out of these shredded materials were used to generate income which played an important role to sustain the solid waste implementation. Thusly, the level of implementation was already properly practiced. Solid Waste Management had employed organizational structure for implementation and dissemination of personnel's function. Additional equipment and personnel were acquired. To sustain the proper SWM, recycling equipment, public awareness, funding, expertise of personnel, equipment and facilities, innovations and other provisions were already provided

### CONCLUSION

Based on the findings of the study, the following conclusions are drawn: a) the most produced waste in the 2015 was the biodegradable which was tremendously reduced in the 2020 data b) the level of implementation on proper solid waste management by the residents was already fully

practiced while Improper Solid Waste Management was never practiced yet there were still few household who slightly practiced the burning of waste c) because of the identified problems encountered in the implementation of solid waste management in the year 2020, the concerned agency addressed these problem through the following; close monitoring of the open dumpsite which caused unpleasant odors, provide enforcement measure and capabilities, acquiring of well trained personnel and financial resources, efficient collection of garbage to a maximum level d) different barangays in the municipality of Candijay had unified scheme in responding the implementation of solid waste management e) mandate households to do recycling of the recyclable waste materials, f) with the effectiveness of the SWM implementation and serious reinforcement of the concerned agency, it's level of implementation of solid waste management practices was fully practiced and dramatically improved which turned out as the key for implementation sustainability.

## **ACKNOWLEDGEMENTS**

The authors acknowledge the following; Municipal Mayor of Candijay, Bohol, Philippines through Municipal Planning and Development Office (MPDO), The Office of the Sangguniang Bayan (Municipal Council), Municipality of Candijay, Province of Bohol for providing the documents needed in the study, Municipal Ecological Solid Wastes Management and MENRO office.

## **REFERENCES**

- Ali, S.M., Pervaiz, A., Afzal, B. Hamid, N. and Yasmin, A. 2014. Open dumping of municipal solid waste and its hazardous impacts on soil and vegetation diversity at waste dumping sites of Islamabad city. *Journal of King Saud University - Science*, 26 (1), 59-65, Retrieved from DOI <https://doi.org/10.1016/j.jksus.2013.08.003>
- Atienza, V. 2013. Review of the management system in the Philippines, Initiatives to promote waste segregation and recycling through good governance. Kojima and Michida (Eds.), *Economic Integration and Recycling in Asia, An Interim Report*, Chosakenkyu Hokokusho, Institute Developing Economics, 65-97, Retrieved from <https://www.nswai.org/docs/Review%20of%20the%20Waste%20Management%20System%20in%20the%20Philippines.pdf>
- Bahadir, A. 2013. The importance of energy and the use of energy as a power of factor. *Journal of Energy Technologies and Policy, Special issue for International Conference on Energy, Environment and Sustainable Economy*, 3 (11), 6-15, Retrieved from <https://www.iiste.org/vol-3-no-11-2013-journal-of-energy-technologies-and-policy/>
- Chiemchaisri, C., Juanga, J.P. and Visvanathan, C. 2004. Municipal solid waste management in Thailand and disposal emission inventory. *Environmental Monitoring and Assessment*, 135, 13-20, Retrieved from DOI <https://doi.org/10.1007/s10661-007-9707-1>
- Machado, T.M. 2012. Challenge on municipal solid waste management in Cagayan de Oro city, mulberry suites, Cagayan de Oro city. Retrieved From [https://pcieerd.dost.gov.ph/images/downloads/presentation\\_materials/gmi\\_06272012/07\\_SWM\\_of\\_CDO\\_Machado.pdf](https://pcieerd.dost.gov.ph/images/downloads/presentation_materials/gmi_06272012/07_SWM_of_CDO_Machado.pdf)
- Reyes, P.B. and Furto, M.V. 2013. Greening of the solid waste management in Batangas city. *Journal of Energy Technologies and Policy, Special issue for International Conference on Energy, Environment and Sustainable Economy*, 3 (11), 187-194, Retrieved from <https://research.lpubatangas.edu.ph/wp-content/uploads/2014/04/JETP-Greening-of-the-Solid-Waste-Management.pdf>
- Wilson, D.C. 2011. Acting alone to partnerships, Strategic approach for sustainable municipal waste management. UN-Commission for Sustainable Development (CSD), *International Conference on Building Partnerships for Moving toward Zero Waste*, Retrieved from <https://www.uncrd.or.jp/>
- World Health Organization (WHO). 1996. Questionnaire for Solid Waste Management Survey. Retrieved from [https://www.academia.edu/28925080/Questionnaire\\_for\\_Solid\\_Waste\\_Management\\_Survey](https://www.academia.edu/28925080/Questionnaire_for_Solid_Waste_Management_Survey)