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Solid Waste Generation Rate in the Port of Ozamiz, Philippines

Marie Rosellynn C. Enguito and Victoria E. Matunog

[1]Natural Science Department, Misamis University, H. T. Feliciano St., Ozamiz City 7200, Philippines
Corresponding author: Marie Rosellynn C. Enguito, email: marierosellynndce@gmail.com

Abstract

Data on solid waste generation are useful in planning for collection, transportation and disposal systems of solid waste management. In Ozamiz City, solid waste generation rate of households, establishments, schools, and market was determined but there is no account on the generation rate of solid waste in the port area of the city. This study aimed to determine the solid waste generation rate in the Port of Ozamiz. Wastes from trash bins in the port and ships were collected at particular time of the day for three consecutive days using pre-weighed bags labeled as biodegradable (food, paper, green waste) and non-biodegradable wastes (glass, plastic, cans, metals, fabrics, clothes, construction waste, electrical appliances, fluorescent bulbs, medical waste) respectively. Daily average weight and the annual generation rate of the solid wastes collected were calculated. Results showed that the bulk of solid waste in the Port of Ozamiz is biodegradable comprised mostly of papers from offices. Plastic bottles have the highest quantity for the nonbiodegradable waste. The results of this study may be used as input to the environmental and waste management planners in crafting policies and programs and project development to address solid waste management concerns in the Port of Ozamiz.

Keywords: biodegradable, disposal, nonbiodegradable, ships, trash

Introduction

Solid waste generation is a major issue of global concern. Increase in human population coupled with massive urbanization has led to increased quantity of solid waste generated (Das & Bhattacharyya, 2014). As a consequence and by-product of human activities, waste increases enormously in volume for the past decade.

Economic development and improved living standards have been linked to increased bulk of solid waste generated both in developing countries (Sharholy et al., 2008; Ogwueleka, 2009; Das & Bhattacharyya, 2014) and highly-developed nations (Daskalopoulos et al., 1998). However, the situation in developing countries is more acute than the developed nations. The problem is partly caused by inadequate provision for solid waste management, poor servicing of solid waste collection vehicles, poor state of infrastructure, and the lack of adequate funding for the disposal service (Henry et al., 2006).

Various waste management initiatives taken in developing countries aim to reduce the solid waste generation rate (Zia & Devadas, 2007; Shamsuddoha, 2009; Agarwal et al., 2015). Authorities in the developing countries experience great challenge in the implementation of Solid Waste Management (SWM) wherein its application of techniques ensures the orderly execution of the functions of collection, transport, and disposal (Robinson,1986). The pressing problem of SWM is mainly due to the increasing generation of solid waste and the burden in terms of budget as a result of the high costs associated with its implementation (Guerrero et al., 2013). The lack of understanding over a diversity of factors that affect the different stages of waste management also remains a challenge. Linkages necessary to enable the entire handling system functioning have also been an issue.

In the Philippines, the local government units are mandated to establish a Local Government Solid Waste Management Program (LGSWMP) as stipulated in Republic Act (R. A.) No. 9003, otherwise known as the "Philippine Ecological Waste Management Act of 2000" (Matunog & Awa, 2013). As required in "The Ecological Solid Waste Management (ECOSWAM) Act, which emanated from R. A. No. 9003, municipalities must dispose waste in a sanitary and environmentally

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friendly manner (Naz & Naz, 2008). The procedures and guidelines in the implementation of the solid waste management (SWM) plan stipulated in Administrative Order No. 2001-7434 in 2001, otherwise known as the Implementing Rules and Regulations (IRR) of the provisions of R. A. No.9003, serve as the framework.

As the center of commerce in the province of Misamis Occidental in Northern Mindanao, the port of Ozamiz City provides the shipping services for the transport of commodities and people across neighboring places. Thousands of people utilize the port daily for business and transportation. The Philippine Port Authority (PPA) is the government office that is tasked to manage the Port of Ozamiz. The PPA has been taking an active involvement in ensuring that the proper Solid Waste Disposal is implemented. Reception facilities for biodegradable and non-biodegradable waste are strategically located in the port area. The General Services Office of Ozamiz City is tasked to collect the wastes from the vicinity of the port. In order to aid the local government unit (LGU) in the collection of wastes from the port and residual waste from ships, the PPA established linkage with Barangay Annex in the city as an environmental initiative to involve the community in the collection, segregation, and recycling of waste.

According to Das and Bhattacharyya (2014), data on solid waste generation are useful in planning for collection, transportation and disposal systems of SWM. Matunog and Awa (2013) reported huge amounts of biodegradable wastes generated by households, establishments, schools, and market in Ozamiz City. The LGU of Ozamiz City utilized the results of their study in obtaining facilities to improve the management of waste in the area. However, there is no study on the generation rate of solid waste in the port area of the city. In order to formulate a more efficient SWM for the city, a comprehensive data on the volume of solid waste generated in different areas in the city is necessary. This study aimed to determine the solid waste generation rate in the Port of Ozamiz calculated based on daily weight of solid wastes collected from offices, port terminals, ships, and vicinities inside the port. Findings of this study could be used as input to the environmental and waste management planners in crafting policies and

programs and project development to address solid waste management concerns in the Port of Ozamiz.

Materials and Methods

Study area

This study was conducted at the Port of Ozamiz with coordinates at 8.1449685° latitude and 123.84355° longitude. Figure 1 shows the aerial view of the port. It is nestled at the entrance of Panguil Bay. The Port of Ozamiz is one of the major seaports in the Philippines which provides the shipping services for commodities and people across nearby places in Lanao del Norte and farther in Metro Manila, Cebu City, Dapitan, Iligan, Iloilo City, and Tagbilaran. The port has a total land area of 21,274 square meters (Ports.com, 2014).

Figure 1. Aerial view of the Port of Ozamiz (source: flickr.com).

Research design and collection procedures

The descriptive research design was adopted for this study. The general guidelines and procedures in conducting waste characterization survey of Briones (2011) was used in this study. Before

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the actual data gathering, permission from the Philippine Port Authority (PPA) of Ozamiz City to conduct the study was secured.

Wastes from trash bins and ships were collected at particular time of the day for three consecutive days using pre-weighed bags labeled with biodegradable (food, paper, green waste) and non-biodegradable wastes (glass, plastic, cans, metals, fabrics, clothes, construction waste, electrical appliances, fluorescent bulbs, medical waste), respectively. Collected wastes were placed in an unoccupied area in the port for processing.

Wastes placed in plastic bags were weighed. Each type of waste was segregated and weighed before placing it into the respective bag using a 100-g and 1000-g weighing scales.

Data analysis

Daily average weight per waste category was calculated using this formula:

$$AW_d = \frac{W1 + W2 + W3}{N}$$

where AW_d = average weight of wastes per category per day; W= weight of wastes per day collection; and N = number of days. The daily average weight was multiplied by 365 days to obtain the annual solid waste generation rate in the port. The annual waste percentage of biodegradable and nonbiodegradable wastes was also determined.

Results and Discussion

Results showed that the greater bulk of solid wastes in the Port of Ozamiz are biodegradable wastes (Table 1). This type of waste is capable of undergoing decomposition (Saveyn & Eder, 2014). Composting of biodegradable waste is deemed useful for its utilizable end product as nutrient-rich organic fertilizer (Wu et al., 2014). However, various environmental issues may arise during the composting process, including the formation of malodorous or toxic gases (Maulini-Duran et al., 2014).

Table 1. Average weight (g) of the different types of solid wastes in the Port of Ozamiz.

	Biodegradable					Non-Biodegradable								
Bag No.	Food (g)	Paper (g)	Green waste (g)	Toilet waste (g)	Total weight (g)	Glass Bottle (g)	Plastic (g)	Cans (g)	Metals (g)	Plastic bottle (g)	Construction waste (g)	Styrofoam (g)	Total weight (g)	Grand Total (g)
1	2,050	4,050	6,550	1,600	14,250	600	7,050	50	250	2,100	-	150	10,200	24,450
2	650	2,100	2,250	2,850	7850	-	2,650	-	-	800	-	100	3,550	11,400
3	1,200	8,000	3,100	2,350	14,650	-	3,850	350	-	1,700	100	200	6,200	20,850
4	700	2,200	3,300	2,250	8450	450	8,050	-	-	700	-	-	9,200	17,650
5	2,600	6,250	11,550	5,800	26,200	900	9,000	150	250	2,950	250	150	13,650	39,850
6	1,250	5,500	3,650	3,250	13,650	400	6,050	-	-	1,650	-	250	8,350	22,000
7	1,950	9,900	5,200	2,350	19,400	-	5,100	350	-	2,050	100	200	7,800	27,200
8	700	2,200	3,300	2,250	8,450	450	9,550	-	-	1,100	250	-	11,350	19,800
Total	11,100	40,200	38,900	22,700	112,900	2,800	51,300	900	500	13,050	700	1,050	70,300	183,200
% of Total	6.06	21.94	21.23	12.39	61.63	1.53	28.00	0.49	0.27	7.12	0.38	0.57	38.37	100.00

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Dumping sites with huge amount of biodegradable waste can also have health impact as they attract flies, mosquitoes, and rodents to thrive and proliferate and may become transmitters of infectious diseases (Abul, 2010). Thus, the generation of biodegradable waste should be reduced to a minimum in terms of their quantity and hazard potential.

As noted, among the different types of biodegradable wastes, the quantity of paper (21.94%) is greater than the other types, followed by green waste (21.23%), then toilet (12.39%) and food (6.06%) wastes. The offices inside the port area may have contributed to the amount of paper wastes. The study of Matunog and Awa (2013) on the generation rate of waste of some establishments in Ozamiz City also showed that offices are the main generators of paper wastes. Accordingly, reuse is an option to minimize the generation of these wastes. In India, a greener approach towards waste management for papers has been utilized by converting this waste to carboxymethyl cellulose, a most widely used product for various applications (Joshi et al., 2015).

Green waste refers to organic refuse from gardens such as grass cuttings, leaves, hedge clippings, prunings, weeds, leaves, plant litters, and soil-bound roots (Williams & Kelly, 2003). Plants seen inside the port near the offices used for landscaping may have contributed to the bulk of green waste as regular maintenance of the garden has always been carried out.

In other countries, millions of tons of green wastes are produced every year and the situation brings concern because the waste are contaminated with other materials (Kane, 2015). Similar situation is seen in the study area, segregation is still not 100%. It has been observed that green wastes are far from green as they are contaminated with plastics and other rubbish. Despite the huge amount, composting the green waste helps reduce the amount of rubbish which are deposited in the landfill, and can provide farmers with a valuable source of fertilizer. Hence, segregation is important to make the waste management work.

The toilet wastes observed in this study are the tissue papers. Travelers usually use the toilet while waiting for the schedule of their trip. The port is also staffed with many personnel thus contributing to

the quantity of tissue papers generated. These materials are common solid waste that are put into landfill (Miezah et al., 2015; Edjabou et al., 2015). A landfill not properly designed can cause problems. Even tissue papers and other organic waste degrade very slowly in a landfill if deprived of adequate air and water (Demirbas, 2011). Another issue with landfill is when untreated leachates containing dissolved harmful substances enter into the natural environment are expected to create a threat to health and nature. Landfill leachate treatment has received significant attention in recent years (Amor et al., 2015; Hilles et al., 2016). Hence, paper recycling technology can minimize the bulk of tissue papers put into landfill (Pivnenko et al., 2016).

Food wastes are also common in the port. People traveling long distance, especially those with their children or family, may bring food or take time to eat in the restaurants inside the Port of Ozamiz. It was observed that travelers were bringing foods, most notably from Jollibee, McDonalds or Chowking. These are three food establishments in the city that are near the port area and people in a hurry could easily drop and buy. Both passengers and workers in ships produce different types of wastes, including food waste as shown also in the study of Klein (2011) in ports. However, food waste generated in ships can be discharged by the ship crew into the sea at a distance of 12 NM (nautical miles) from the coast (Wilewska-Bien et al., 2016). Hence, the food wastes collected from the Port of Ozamiz were mainly those coming from travelers who ate while inside the port area. The food waste discharged to the sea will most likely enter the marine food web such as feed for fish. Nutrient contribution to sea from food wastes will be relatively larger in the future if no restrictions or policies governing their disposal are in place (Wilewska-Bien et al., 2016). This large amount of nutrient load may cause harmful algal bloom resulting to fish kill (McCabe et al., 2016). Hence, regulation on disposal of food wastes would be the most efficient way of reducing the total nutrient load.

The greater bulk of nonbiodegradable waste in the Port of Ozamiz is plastic (28.0%) (plastic bags, cellophane, bubble wraps, plastic or stretch wrap). The plastic bottles (7.12%) of mineral water were weighed separately and found to be next in quantity. The glass

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bottles (1.53%) were found to be next to plastic in quantity, followed by Styrofoam (0.57%), then cans (0.49%), construction materials (0.38%), and metals (0.27%) having the lowest quantity. In other countries, plastic bag ban and charge or tax coupled with paper bag fees decrease the total disposable bag demand and generation rate (Taylor & Villas-Boas, 2016; Martinho et al., 2017). However, without policy on plastic usage, global plastic production and generation rate in other countries rise while recycling lags behind (Gourmelon, 2015; Jambeck et al., 2015). The local government of Ozamiz City may generate provisions that limit the consumption of plastic carrier bags and other plastic materials and intensify recycling.

Figure 2 shows the waste percentage computed on annual basis. The total waste generated from all categories per year was 66,868,000 g (66.868 tons). The higher bulk of wastes generated in the port area was biodegradable (62%) but the quantity of nonbiodegradable waste (38%) cannot be ignored. The increasing number of passengers that brought different kinds of biodegradable wastes like foods, papers and even green wastes has contributed to the generation rate of these materials. Taking into account the decomposition characteristic of biodegradable wastes, degradation of these materials is not difficult.

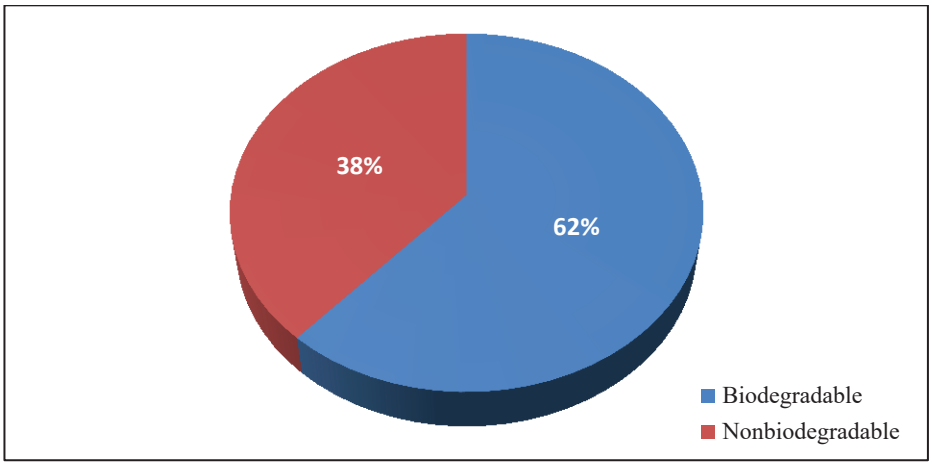

Figure 2. Annual percentage of wastes generated in the Port of Ozamiz.

As mentioned, plastic waste including plastic bottles comprised the bulk of nonbiodegradable waste in the port. The city waste collectors are tasked to bring these wastes to the landfill of Ozamiz City in Gala, Ozamiz City. Nevertheless, the port has not been contributing much of their waste to the landfill because the PPA has a system to manage its waste by collaborating with a barangay near the port to collect the waste as source of income for the residents. The bulk of food waste also would not cause much problem aside from being degradable because there are people who would collect food waste as feed for their swine. Hence, the port is not contributing more of its waste to the landfill. This practice is an initiative of the PPA to also provide community extension program to the barangay near the port. What is important to consider is the management of these wastes while in the port to ensure that these wastes will not become health hazard. Well-covered trash bins should be provided to store the wastes prior to collection.

Conclusion and Recommendations

The bulk of solid waste in the Port of Ozamiz is biodegradable comprised mostly of papers from offices, followed by green waste, then toilet and food waste. The generation rate of nonbiodegradable waste cannot also be ignored with plastic bottles having the highest quantity. All sectors of the community need to collaborate for the effective implementation of the policies in the management of the solid waste. Policy recommendations from the Port of Ozamiz are essential to ensure that visitors coming from various places who might have little awareness about solid waste policies in Ozamiz City could get the basic information of proper waste disposal.

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