

# Solid Waste Management (SWM) Conditions, Practices, and Challenges of Select Barangays in Lipa City

**JOAN M. VILLANUEVA**

<http://orcid.org/0000-0001-7427-4694>  
joan.villanueva@ub.edu.ph  
University of Batangas, Lipa City  
Lipa City, Batangas, Philippines

**ANNABELLE B. MAGSINO**

<http://orcid.org/0000-0003-2849-5079>  
annabelle.magsino@ub.edu.ph  
University of Batangas, Lipa City  
Lipa City, Batangas, Philippines

**FLORYFE G. HERNANDEZ**

<http://orcid.org/0000-0002-0538-4360>  
floryfe.hernandez@ub.edu.ph  
University of Batangas, Lipa City  
Lipa City, Batangas, Philippines

**ABIGAIL MARIE U. HERNANDEZ**

<http://orcid.org/0000-0002-2792-2174>  
abigail.hernandez@ub.edu.ph  
University of Batangas, Lipa City  
Lipa City, Batangas, Philippines

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## ABSTRACT

One of the significant challenges around the globe is solid waste and solid waste management. In Lipa City alone, over 167kilos of garbage are produced per day, making it the second biggest waste generator in Batangas province. The study aimed to identify the city's solid waste management conditions, practice, and challenges, focusing on three selected barangays. The focus was to identify, evaluate, assess the existing solid waste management; and design and develop a piece of equipment as an alternative way ideal for the current condition of solid waste management for these barangays in Lipa City. This study used the descriptive-evaluative and quantitative research design; utilized the 10-year Ecological Solid Waste Management Plan of the Lipa City Environmental and Natural Resources Office or CENRO; and a personal interview with the head and 27 staff in the solid waste management of the city. This study found out that problems still arise despite the strict implementation of solid waste management in these three barangays. As part of the program to be implemented, the researchers proposed introducing a biodegradable composter known as BIOCOM.

**Keywords** — Social Science, solid waste management, descriptive-evaluative, quantitative research design, Philippines

## INTRODUCTION

Every year, people all over the earth dump a massive 2.12 billion tons of waste. If all this waste is on trucks, each truck will go around the world 24 times daily. Global waste grows to 3.40 billion tons every year. Each household will consume more in 2050 (Hoorweg & Bhada-Tata, 2012).

Solid waste affects us and our environment. It affects land, water, air, and human health. According to the UN (2010), two-thirds of the global population will migrate to cities. With the growing population, waste generation will rise. The waste in Asia alone will reach 1B tons by 2030 (Okumura, Tasaki, & Moriguchi, 2014).

According to World Health Organization (2011), the term 'solid waste' includes all non-liquid wastes generated by human activity. This also includes a range of solid waste materials like human feces disposed of in garbage; plastic water bottles and packaging from other emergency supplies; rubble resulting from the disaster; mud and slurry; alien trees and rocks; and other specialist

wastes, such as medical waste from hospitals and toxic waste from industry (Guzman, 2010).

In Asian countries, the amount of solid waste generated has increased immensely because of improved living standards, technological developments, economic growth, and cities' population. Japan has the highest waste generation, followed by South Korea, but both countries also have the highest percentage of recycled materials. With the growing population and economy, solid waste generation is predicted to increase in developing countries, yet recycling rates remain too low (Ali & Sion, 2014).

Solid Waste Management is one of the basic essential services provided by municipal authorities to keep urban centers clean. However, it is among the most poorly rendered services in the basket—the systems applied are unscientific, outdated, and inefficient; population coverage is low, and the poor are marginalized. Municipal laws governing urban local bodies do not have adequate provisions to deal effectively with the ever-growing problem of solid waste management. The urban population has grown fivefold in the last six decades, with 285.35 million people living in urban areas as per the 2001 Census.

Castillo (2012) stated that the global community recognized that Solid Waste Management (SWM) is an issue that requires serious attention. The aggressive pursuit for economic growth by developing countries like the Philippines has resulted in the manufacture, distribution, and use of products and generation of wastes that contribute to environmental degradation and global climate change. Available data showed that the Philippines is the 9th most among the countries at risk from climate change due to the rise of sea levels, intense storm surges, and droughts. Along with economic progress, the rapid population growth has also made waste management a significant environmental challenge. According to the World Population Prospects (United Nations, 2013), the population is projected to double in size from 900 million people in 2013 to 1.8 billion in 2050 among the 49 least developed countries. The Philippine National Statistics Office (NSO) estimated the country's population in 2012 to be around 97 million, with an annual growth rate of 1.87%. Based on the figure, the Philippines is the 12th largest country in the world today.

The responsibility of municipalities, according to the United Nations Human Settlement Program in 2010, is to provide solid waste collection services. It was dated back to the mid-19th century, when infectious diseases were linked for the first time to poor sanitation and uncollected solid waste (UN HABITAT, 2010).

The Philippines, like most developing countries in Asia and the Pacific Region, faces more pronounced waste management challenges in urban

metropolitan centers (Magalang, 2014). In response to the growing number of solid wastes, the Philippines Republic Act 9003 was launched on January 26, 2001. This act provides for an ecological solid waste management program, creating the necessary institutional mechanisms and incentives, declaring certain acts prohibited, and providing penalties, appropriate funds for other purposes. This act, known as the “Ecological Solid Waste Management Act of 2000.” Section 2 declared that the systematic, comprehensive, and ecological solid waste management program should: a) ensure the protection of the public health environment; b) utilize environmentally-sound methods that maximize the utilization and valuable resources and encourage resource conservation and recovery; c) set guidelines and targets for solid waste avoidance and volume reduction through resource reduction and waste minimization measures including composting, recycling, reuse, recovery, green charcoal process and others; and d) encourage greater private sector participation in solid waste management (Republic Act No. 9003, 2000).

770 million people generate an average of 0.3 to 0.7 kilograms of garbage daily, and this amount is expected to increase by 40% at the end of the decade. The Southern Tagalog Region contributes to one of the highest bulks of the country’s solid wastes (Macawile & Su, 2009). From the research of the National Solid Waste Management Council (NSWMC) 2015, the generated waste of cities and provincial capitals in the country is 0.50 kg/cap/day. Municipal solid waste comprises 52.31% biodegradables, 27.78% recyclables, 17.98% residual waste, and 1.93% particular waste (National Solid Waste Management Commission, 2015). Based on the Ecological Solid Waste Management System or ESWM Act of 2000, city governments must collect non-recyclable materials and special wastes. However, because of a lack of budget, Lipa’s City government provides financial assistance to barangays who need help to perform mandated responsibilities stated in RA 9003.

The study demonstrates the interaction and the interrelationships among the following: solid waste management, population, city budget, environmental quality (measured in greenhouse gas emissions), marketability of recovered waste, and public participation (of waste generators). The alliance explores the interrelationship of economy, environment, and society in urban solid waste management.

The Ecological Solid, Waste Management System Theory, refers to the systematic administration of activities that provide segregation at source, segregated transportation, storage, transfer, processing, treatment, disposal

of solid waste, and other waste management activities that don't harm the environment. It is composed of the three essential elements, economy, society, and environment. This system has a societal influence, the primary of which is population and existing laws. The community's characteristics, also influenced by the current economy, affect the waste generation and composition.

Guzman (2010) reported that solid waste management is one of today's most critical environmental problems. In Lipa City alone, 167,199.42 kilos of garbage are produced per day, making it the second biggest generator of waste in the whole province of Batangas (CENRO-Lipa, 2018). Lipa City's trash a day comprises 18.29% of the province's total generated waste.

To address this problem, the city government has enacted several local ordinances like Kautusan Blg. 2, s.1993- Anti-Littering ordinance, General Ordinance No.3 s. 1993- Comprehensive Waste Disposal and Management Ordinance, Ordinance No.1 s. 1997- Implementation of Tapat Ko, Pananagutan Ko", Kautusan Bldg. 7 s.2004- Kautusan sa Pangmalawakan Pangkalikasan na pamamahala ng mga Basura, Gen. Ordinance No.6 s.2004 - Prohibiting all livestock farms, commercial establishments, etc. from draining, throwing, or waste to, land, river creeks, and tributaries, Gen. Ordinance No.2 s 2004-requiring all households, industries, establishments, etc. to segregate their waste and Gen. Ordinance No.1 s.2011 -prohibiting the use of Plastic bags and the total ban of Styrofoam.

Daily, the bulk and volume of wastes are continuously created and produced in Lipa's progressive city. Thus, there is a need for these wastes to be managed appropriately. The identified issues are the increase in solid waste generation, non-compliance to the introductory provisions of the ESWM Act of 2000, the limited involvement of some barangays, the ineffective IEC Campaign, the lack of Solid Waste Management facilities, the ineffective enforcement of local ordinances, and the public indifference. Tatlonghari and Jamias (2010) stated that the very high rate of waste generation from the growing population of people and establishments and the attendant health and environmental implications made it imperative to implement ecological solid waste management (SWM) programs down at the household level.

## **OBJECTIVES OF THE STUDY**

The study aimed to identify the following: current situation of city solid waste management conditions, practices, and challenges with the focus on three

selected barangays. These barangays are near the University of Batangas Lipa City's vicinity, where the researchers work as Faculty. The focus is to identify, evaluate, assess the existing solid waste management; and design and develop a piece of equipment for use as an alternative way ideal for the current condition of solid waste management for the abovementioned barangays in Lipa City. The ecological solid waste management framework is the basis of this study.

## **METHODOLOGY**

### **Research Design**

This study used a descriptive-evaluative, quantitative research design and utilized the following: (1) 10- year Ecological Solid Waste Management Plan of the Lipa City Environmental and Natural Resources Office or CENRO; (2) and a personal interview with the head and 27 staff of Lipa City Environmental and Natural Resources Office, in-charge in the solid waste management of the city. A written request was sent to the CENRO Director to seek permission before the conduct of the study.

### **Data Collection**

The ten-year (2016-2026) Ecological Solid Waste Management Plan of the Lipa City Environmental and Natural Resources Office or CENRO is a comprehensive plan. This plan encompasses the geographical scope, the current solid waste management conditions, the key issues, the plan strategy, the financial aspects, and the implementation plan and schedule. It has a vision of having a diverse city that empowers the residents; promotes and protects the community's health, safety, and general welfare. This study provided the researchers with specific information about the solid waste management of the identified barangays (City Government of Lipa, 2019).

### **Research Ethics Protocol**

Lastly, the researchers conducted an interview with Lipa City Environmental and Natural Resources Office's head and staff with consent and assurance that personal data will be kept confidential. There is constant communication with the CENRO office for the updated and relevant information regarding the topic during the research.

## RESULTS AND DISCUSSION

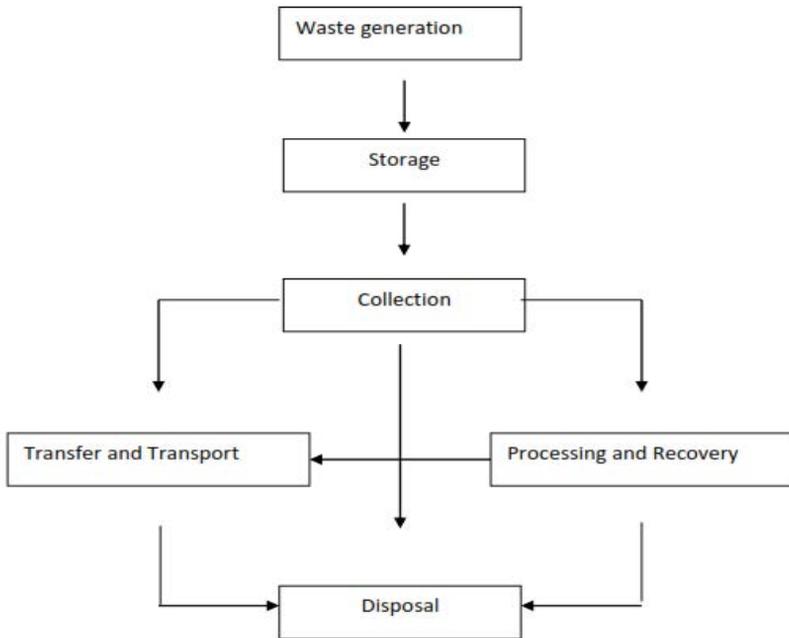


Figure 1. Waste Generation Flowchart

The figure shows the process of collecting solid wastes from three barangays; (1) household waste generation and storage, (2) scheduled collection, (3) transfer and transportation by eco-aides and cargo trucks, (4) processing and recovery using Materials Recovery Facility (MRF) and (5) Disposal.

Under RA 9003, collection, transport, and disposal of solid wastes are the local government units' responsibilities (LGUs). At present, most LGUs administer their collection systems or contract out this service to private contractors. The more impoverished areas of cities, municipalities, and rural barangays are typically unserved or under-served. The uncollected waste ends up mostly in rivers, esteros, and other water bodies, thus, polluting major water bodies and clogging the drainage systems, resulting in flooding during heavy rains (Senate Economic Planning Office Publication, 2017).

Table 1. Schedule, Mode, and Frequency of Collection in Three Barangays

Barangay	Population	Type/Mode of Collection	Frequency of Collection
1	18,714	Barangay collecting their waste and transfer it to Transfer station	M-F
2	9,072	Barangay covered by contractor's collection	M-TH
3	15,022	Barangay with a portion collected by the contractor and other amounts collected by the barangay for transferring	M-W-F

Table1 shows the schedule, mode, and frequency of collection for the selected Barangay of Lipa City. Current conditions of solid waste management of Barangays 1, 2, and 3 are as follows:

Currently, Barangay 1 has its garbage collection truck and collects waste on weekdays. After collecting waste, the barangay ecological or eco-aides manually transfer the waste into cargo trucks and forward truck of the private hauler parked in the transfer station located at the senior auction compound of the City Government. These trucks transport and dispose of the collected wastes to private disposal facilities in Barangay Bubuyan, City of Calamba Laguna. On the other hand, Metro Lipa Medical Center, the only healthcare facility in this barangay, generates about 144 kg/day collected by Chevalier Enviro Service.

Barangay 2 has its Materials Recovery Facility (MRF) used as a temporary repository area for recyclables. It collects the garbage of the local city government on Monday, Wednesday, Friday, and Saturday. Eco-aides manually transfer the waste into cargo trucks and follow the same process as the garbage collected in Barangay 1.

The contractor collects some households' garbage in Barangay 3; others by the barangay eco-aides for transferring every Mondays, Wednesdays, and Fridays. Lipa Medix Medical Center, a healthcare facility found in this area, generates about 90 kg/day of garbage, which SaniKleen Laundry Corp collects.

In Indonesia, specifically in Yogyakarta, MRF is applied by the Regional Government through the Department of the Environment. It is designed to solve government challenges at low service levels, not easily accessible areas, limited infrastructure, and funds that are currently being a constraint. The MRF managed by the community has the main activity of collecting solid waste from sources, sorting, and processing, and selling recycled products/raw materials (Putra, Damanshuri, & Sembiring, 2019).

Here in the Philippines, while recycling through the establishment of Municipal Recovery Facilities (MRF), which includes waste transfer stations, and processing, and selling recycled products/raw materials (Putra, and composting and recycling facilities, is mandated under RA 9003, most Local Government Units (LGUs) do not comply with this mandate. Even though the law requires establishing an MRF in every barangay or cluster of barangays, only about 21% or 8,843 barangays are being serviced by MRFs in the country (Castillo, 2012).

Table 2. Type of Solid Waste Management in Three (3) Barangays

Barangay	Type of Solid Waste Management		
	With Materials Recovery Facility (MRF)	Collection with Barangay Eco-Aides	No Segregation, No Collection Policy
1		/	/
2	/	/	/
3	/	/	/

Table 2 shows the summarized solid waste management of the selected barangays of Lipa City.

Through the City Environmental and Natural Resources Office (CENRO), the city government coordinates with the Barangay Solid Waste Management Committees of the three barangays to implement the collection activities for residual wastes. They sustain the improvements in collection efficiency for all sources of residual wastes in the service areas. They also monitor the enforcement of solid waste management ordinances; and rules and regulations relating to an effective collection system.

Different barangays collect the biodegradable waste and recyclable waste from households, commercial establishments, and institutions by barangays based on their barangay ordinance. No segregation no collection policy is implemented in all barangays. There are two collectors of waste in the barangay. One eco-aide collects the recyclables, and the other eco-aide will collect the compostable. The City ENRO services the barangays without composting area. The city's centralized MRF is the location for processing biodegradable wastes into composts. In a study by Bernardo (2008), the households in Metro Manila rely on the government's garbage collection. Most respondents said that garbage collection and disposal are the government's responsibility.

The biodegradable waste and recyclable waste coming from the public market was collected twice daily in the morning and the evening by the contracted hauler and by the City Government hauler. The collection point is at the rooftop of Building 3 of the Public Market, utilizing the contractor/city government's available trucks. The biodegradable wastes will be contained in half-drum size containers, whereas the recyclables are in sacks or plastic bags. The segregated residuals in the public market are also collected daily using the available trucks at the same collection point.

The residual waste is collected in the serviced barangays twice a week utilizing the contracted hauler and the city government's available trucks. The urban barangays are serviced daily in the evening, and the rest of the service barangays will be in the day-time.

The respective barangay MRFs or designated pick-up points on a predetermined schedule collect all residuals and are placed in sacks or plastic bags.

### **Problems and issues concerning solid waste management activities**

The city's waste collection is under contract services with a private hauler and transporter, RC Bella Waste Management & Disposal Services. The collected wastes consisted of residuals and biodegradables. Each household initially segregated this waste. The serviced areas included twelve (12) urban barangays, urban subdivisions, public market and night market, five (5) rural barangays, main thoroughfare (Ayala Highway), and LGU offices and buildings.

Twenty-two rural barangays had their garbage trucks and collection schedule, and they are bringing their wastes to the transfer station. The remaining 37 rural barangays had no system of waste collection. The households of the remaining barangays managed their wastes. Though there were nine rural barangays with eco-aides, they use them in street sweeping and vegetation control.

Aside from that, there was no transfer station for the barangays with service trucks, but the City Government utilized the old auction compound as the centralized transfer station/MRF. The barangay eco-aides manually transferred their wastes to cargo trucks and forward truck of the private hauler parked in the transfer station.

Developing countries across Asia have already established national strategies to address challenges related to waste and environmental management. Each has its respective policies, programs, plans and procedures and regulations and standards. Issues related to implementation, coordination and capacity is

apparent for most countries (United Nation Environment Programme, 2017).

Government shortcoming in implementing the law on national and local levels, lack of public information and lack of environmental education has always been a challenge for solid waste management in the Philippines ((Ali et al., 2014).

Improper waste disposal, inefficient waste collection, and lack of disposal facilities are among the dominant concerns in the country's solid waste management. Unless these are addressed, the wastes generated from various sources will continually lead to health hazards and severe environmental impacts such as ground and surface water contamination, flooding, air pollution, and the spread of diseases (Senate Economic Planning Office Publication, 2017).

### **Alternative Management Scenarios Residents Can Apply**

The residents might do garbage segregation of biodegradable and non-biodegradable. Non-biodegradable wastes may be further segregated in different recyclable waste, which may be sold to junk shops. About 36 registered junk shops out of 40 operate in Lipa, which is present in 40 barangays. There is one junkshop organization, Lipa Kalikasan Junkshop Association, identified with 30 to 40 members. On the other hand, there are seven junkshops with Memorandum of Agreement (MOA) as MRF with the Sangguniang Barangay.

The common recyclable materials that were accepted are alloy, aluminum and tin cans, copper, metal, PVC, PET bottles, plastic film and container, bottle, vehicle batteries, and electronic waste, such as computers, printers, and appliances.

SM Lipa has its environmental program that focuses on the solid waste hierarchy of "reduce, reuse, and recycle." Every 1st Friday and Saturday of the month at the Transport Terminal, they have a recycling market event called "Trash to Cash" wherein all the mall tenants, barangays, subdivisions, companies, and schools are invited to participate in the event and bring all recyclable materials in exchange of cash.

As part of the proposal, the use of the BIOCOM machine is recommended. BIOCOM is a biodegradable composter, a handy device that means a tank that grinds or decomposes organic material biologically and ends with fertilizer as a by-product. This product is inspired by the food blender in its breaking process and its blade. It is a solar/rechargeable generated machine that produces fertilizers in a faster way for household consumption. Also, it is designed and fabricated to suit any household. Moreover, this idea came from the researchers' objective to bring easy biodegradable composting in homes to make a difference in our polluted environment.

The proposed solution's benefit is that the wastes are transformed into something more useful as organic animal feeds and fertilizer. The machine produces organic feeds and fertilizers that would benefit the animals and residents and make room to be used by our farmers, agricultural sectors, and livestock industries. It would be a steppingstone to restore our agricultural and livestock sectors, which our country is known worldwide. Likewise, it would address the problem and satisfy the needs because it can prevent households from piling their biodegradable waste into the waste collection by dump trucks. Biodegradable waste accumulation will eventually be answered.

## CONCLUSIONS

Solid wastes in three barangays are manually collected on a scheduled basis and transferred to a rented private disposal facility in Calamba. Healthcare facilities generating more of the solid wastes have their private collecting services.

City Environmental and Natural Resources Office (CENRO) of Lipa City strictly implements solid waste management ordinances and creates programs. These programs include an effective collection system, monitoring waste collection from residential, public, and private areas, composting, recycling, and segregation of wastes through Materials Recovery Facility (MRF).

Problems and issues concerning the complete collection of wastes are still encountered despite the strict implementation of solid waste management ordinances. This implementation undergoes instigation since the city's collection of wastes is under contract services with a private hauler and can only accommodate the group in urban and public areas/barangays. There is also a limited number of garbage trucks, and some rural barangays still don't have a waste collection system.

With some of the problems/issues concerning solid waste management, residents of selected barangays can utilize the process of garbage segregation and recycling, which can generate additional income. Other public and private establishments implement their environmental programs for solid waste management such as "Reduce, Reuse, and Recycle" and "Trash for Cash."

Solid waste management for the three barangays is administered properly during the storage, collection, transfer, and transportation, processing, and recovery up to final disposal. However, an extensive program for solid waste control, including regulatory and enforcement of barangay officials, public education, awareness, and involvement, must be given full attention. The biggest

challenge for LGU Lipa is to develop a concrete plan for the effective and strict implementation of solid waste management for all barangays.

## RECOMMENDATIONS

For the City of Lipa to address the strict implementation of solid waste management for all barangays, the researchers thereby recommend an intervention plan focusing on the following strategies: (1) improvement of the delivery system of solid waste management through updated databases, concrete guidelines, and regulations; (2) promotion of public awareness and information dissemination drives through seminars, dialogues and use of social and mass media; (3) enactment of clear responsibilities and tasks among government implementing agencies; (4) development of standards for environmental sustainability through 3R activities; and (5) opportunities of increasing active participation with private sectors.

As part of the program to be implemented, the researchers proposed introducing equipment, a biodegradable composter, also known as BIOCOM, developed even by students from the Industrial Engineering Department.

BIOCOM is a machine that is composed of a tank that grinds and decomposes organic materials biologically that ends as fertilizer and animal feeds as inspired by the functions of a food blender and powered by electricity and is designed and fabricated for household usage.

The five-year development plan of the UBLC College of Engineering and Architecture's Community Extension Services (CES) program includes PDP. The machine will be introduced to each barangays for utilization as part of the implementation of this research.

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