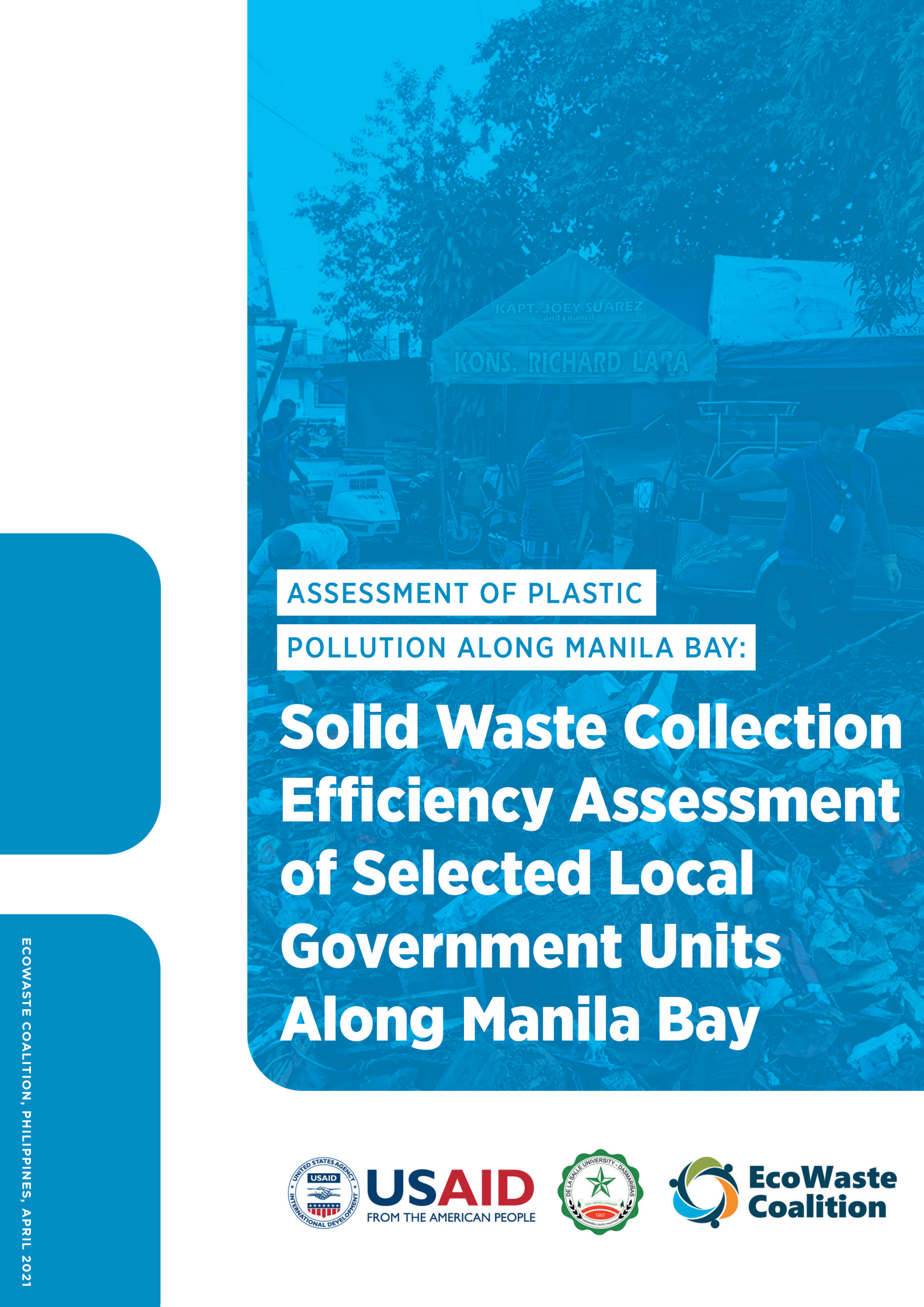




ASSESSMENT OF PLASTIC

POLLUTION ALONG MANILA BAY:

Solid Waste Collection Efficiency Assessment of Selected Local Government Units Along Manila Bay



USAID
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Solid Waste Collection Efficiency Assessment of Selected Local Government Units Along Manila Bay

Assessment of Plastic Pollution Along Manila Bay

This project was conducted collaboratively by a group of researchers-authors from a wide set of specializations in environmental science, social sciences, and municipal solid waste management as commissioned by the EcoWaste Coalition (EWC) of the Philippines. The authoring teams were led by Dr. Arlen Ancheta (Lead Consultant, University of Sto. Tomas, Manila), and Dr. Johnny A. Ching (Director of the University Research Office, De LaSalle University-Dasmariñas). Mr. Marlon Pareja (Associate Professor, De LaSalle University-Dasmariñas) consolidated the research reports and assisted EWC in the presentation of the report to target stakeholders and audiences.

The project is funded by the United States Agency for International Development (USAID) through the Development Innovations Group (DIG) in partnership with the EcoWaste Coalition (EWC) of the Philippines.

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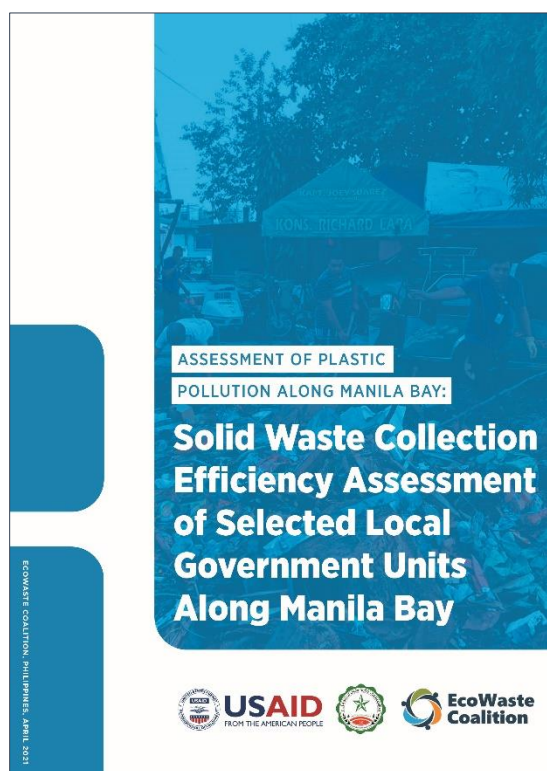
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Abstract



This report is based on the results of Solid Waste Management (SWM) collection efficiency assessment carried out in selected Local Government Units as part of the Manila Bay Watershed from July to December 2020.

The project generally aims to determine the solid waste collection, management and performance efficiency of selected local government units (LGU) that are part of the Manila Bay Watershed.

The project activities include determination of the five barangays' solid waste production, comparison of waste volumes collected by the local government units concerned, and modeling tool utilization to assess efficiency performance in SWM.

Keywords: *plastic pollution, marine litter assessment, municipal solid waste management, collection efficiency assessment, Manila bay.*

About Municipal Waste Recycling Program (MWRP)

Launched in 2017, the overarching goal of the Municipal Waste Recycling Program is to provide grants and technical assistance to support the governments of the Philippines, Indonesia, Vietnam, and Sri Lanka to address the plastic waste leakage into the marine environment. The grant to the Eco Waste Coalition is one of thirty MWRP projects. The research conducted in this project is meant to assist the authorities and local stakeholders to reduce the plastic waste pollution in the Manila Bay Area.

The Development Innovations Group (DIG) administers the program on behalf of the United States Agency for International Development (USAID).

Message



Republic of the Philippines
Department of Environment and Natural Resources

Visayas Avenue, Diliman, Quezon City. 1100
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 Website: <http://www.denr.gov.ph>

The Department of Environment and Natural Resources welcomes this publication of the research conducted by the EcoWaste Coalition of the Philippines with its partners in the academe, the University of Santo Tomas and De La Salle University - Dasmariñas.

The research findings will help us manage plastic pollution in the Manila Bay more scientifically, which is indispensable to the rehabilitation of this showcase waterbody.

We are pleased to learn that ahead of this publication, the outputs were already presented to some of the cities comprising the National Capital Region in the Manila Bay area, to several national government agencies and the Manila Bay Coordinating Council. From there, we can now proceed to take up the research outputs with the rest of the local government units comprising the Manila Bay region, and with all the agencies tasked by the Supreme Court's 2008 writ of continuing mandamus to restore Manila Bay's waters to a quality suitable for swimming, bathing, boating and other forms of contact recreation.



Hopefully, these studies will also help us in the Manila Bay Task Force, which I am honored to chair, to manage solid wastes not just in Manila Bay itself, but also right at their sources.

The research findings are valuable information that may serve as guide in our information, education, and communication efforts as we work toward achieving positive cultural and behavioral changes in solid waste management.

We thank and commend the EcoWaste Coalition of the Philippines and its partner universities for this publication, and urge everyone to participate in the rehabilitation and sustainable development of Manila Bay.

Ang ating mithiin na mas malinis at luntiang bayan ay maisasakatuparan sa ating pagkakaisa, sapagkat ikaw, ako, tayo ang kalikasan!

Mabuhay!


ROY A. CIMATU
 Secretary

Tayo ang Kalikasan!

Message

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Department of Environment and Natural Resources

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For many decades, solid and liquid wastes were dumped with impunity into Manila Bay. It is only now that our National Government, through **President Rodrigo Roa Duterte's** Administrative Order No. 16 signed on 19 February 2019, is expediting the rehabilitation and restoration of the coastal and marine ecosystem of the Manila Bay, through the Manila Bay Task Force that it created.

The responsibility at hand is massive, given that the Manila Bay drainage area encompasses 17,540 square kilometers with 17 major river systems, 187 local government units, and a coastline of 190 kilometers. The wastes that end up in the Bay come from these points; most of them are funneled into rivers and esteros, which eventually empty into the Bay. To be able to rehabilitate Manila Bay, we need to manage this waste stream more efficiently and effectively.

As the Environment Undersecretary for Solid Waste Management and Local Government Units Concerns, it bestowed upon me the responsibility to effect positive changes in the solid waste situation of the country, and I believe that the Manila Bay Rehabilitation Program is a great springboard to achieving that goal. This is because the rehabilitation program involves continuing education of the citizenry as a vital component to protect gains and ensure sustainability.

Through cooperation, hard work, and collaboration with non-government organizations such as the EcoWaste Coalition of the Philippines, we have begun to achieve desired changes as evidenced by improved water quality in the different waterbodies that drain into the Bay and the generally improved environs of the coastal communities surrounding it.

So now more than ever, we should seriously look at specific support activities to translate awareness to sound environmental practices especially in communities near and within the Manila Bay regions.

To enable us to better perform our task, we need to have fresher and better data and novel ideas and concepts. This is where this publication of research outputs on plastic pollution by the EcoWaste Coalition of the Philippines, in conjunction with the University of Santo Tomas and De La Salle University-Dasmariñas, can make a positive difference.

We are very thankful to the EcoWaste Coalition of the Philippines and its partners for this much-needed and timely publication. We will certainly make the most use out of it in our mission to clean up Manila Bay and reinvigorate its coastal and marine ecosystem.

Tayo ang Kalikasan!

BENNY D. ANTIPORDA

Undersecretary for Solid Waste Management and Local
 Government Units Concerns and
 Alternate Chair, National Solid Waste Management Commission

Message



Some environmentalists call the 21st Century as the Great Turning Point—where world consciousness is waking up to heed the call of the Great Spirit to be one in order to create a life-sustaining society. This call was heeded in December 2008 when the Supreme Court issued a writ of mandamus directing 13 government agencies to clean up, rehabilitate, and preserve the condition of Manila Bay. Sadly, today, Manila Bay is still calling out to us to show our respect and caring for her. Despite the various plans and measures implemented, Manila Bay is still treated as a waste disposal site and plastic pollution has been aggravating its condition.

Pollution is both an external and internal illness and we need to treat the illness not by band-aid methods but to root out the causes and to find where correction is needed. Enabling the rehabilitation of Manila Bay requires enabling information.



EcoWaste Coalition with the support of the United States Agency for international Development embarked on this study entitled: Assessment of Plastic Pollution Along Manila Bay through its research partners, the University of Santo Tomas and the De La Salle University-Dasmariñas. The research teams organized by the University of Santo Tomas and De La Salle University looked into the sources, causes, patterns, quantities, and processes of solid waste management in selected areas in Metro-Manila.

The study speaks to various stakeholders - **to national and local policy makers and local governments so that the findings will enable them to correct what needs to be corrected and address what have been missed; to the producers of single-use plastics - so that they can prevent and reduce pollution by redesigning their products and extending their responsibility the post consumption phase; and to the consumers and generators of single use-plastic and other wastes to adopt zero waste practice.** Let us all learn from the findings and recommendations of these studies and with strong hearts and wills, let us set forth once again - and be the instruments to heal Manila Bay.

EILEEN B. SISON

President
EcoWaste Coalition

Acknowledgement

A work that entails expertise, knowledge, and experiences of people of various disciplines could have not been done and written without the contribution of generous people. For their expertise, dedication, and willingness to assist us in this invaluable work, we are earnestly grateful.

The Ecological Waste Coalition of the Philippines gives its heartfelt thanks to the Research Teams who conducted the research, especially to **Dr. Arlen Ancheta** from the University of Sto. Tomas, Manila who headed the Research Team in conducting the Material Balance Flow Study in Selected Areas Along Manila Bay, to **Dr. Johnny A. Ching**, Director of the University Research Office of the De LaSalle University-Dasmariñas, **Dr. Jonathan Rubio** from the De LaSalle University-Dasmariñas who headed the Marine Litter Survey in Selected Areas Along Manila Bay, **Dr. Mario Torres** who headed the Research Team in the conduct of the Waste Collection Efficiency Assessment of Selected LGUs Along Manila Bay; and **Ms. Maria Nena C. Caspe** of the LaSallian Community Development Center who headed the research teams in conducting the Plastic Pollution Awareness Survey Along Manila Bay.

We are also very thankful to **Mr. Marlon Pareja** who prepared the consolidated research reports and assisted us in the presentation of the report to our target audiences.

We also give special thanks to all the participating Local Government Units of Paranaque, Pasay, Manila, Navotas and Malabon together with all the participating barangays headed by its Barangay Chairpersons **Hon. Pablo R. Olivarez** of San Dionisio, **Hon. Rosemarie B. San Miguel** of Barangay 76, **Hon. Diana E. Espinosa** of Barangay 649, **Hon. Wilfredo R. Mariano** of Barangay Tangos South; and **Hon. Ricky R. Bernardo** of Barangay San Agustin. We also give heartfelt thanks to the members of the Barangay Ecological Solid Waste Management Committees for wholeheartedly cooperating and providing support to the Research Teams despite the threats of the COVID 19 pandemic.

We are also grateful to the members of the Multi-Stakeholders platform members with representatives from the National Solid Waste and Management Commission, Manila Bay Coordinating Office, Environment Management Bureau and Biodiversity Management Bureau of the Department of Environment and Natural Resources, Department of Interior and Local Government, Metro Manila Development Authority – Solid Waste Management Division, Plastic Industry Association of the Philippines, Polystyrene Packaging Council of the Philippines, Mother Earth Foundation, OCEANA Philippines, Break Free From Plastic Philippines, and the Philippine Rural Reconstruction Movement for joining and walking with us through the completion of the project.

We are also extending our profound thanks to **Dr. Jenna Jambeck** of the University of Georgia for providing comments and critiques towards a more responsive and inclusive research outputs.

Our sincerest gratitude is also expressed to USAID through the Development Innovations Group for providing funding support and technical assistance through the Municipal Waste Recycling Program (MWRP), which made this project feasible. Finally, our eternal gratitude to the Lord Almighty for all the strengths, knowledge, skills, talents and the will to proceed with this important work amidst the challenges and hardships brought about by the disasters such as the Taal Volcano Eruption and the COVID 19 pandemic. With Your Spirit, we deliver.

Foreword

The negative impacts of plastic pollution to marine environments are widely studied, documented and established (COBSEA, 2018; Jambeck et al, 2015; GESAMP, 2015; Thevenon et al, 2014). For some reason, solutions to the problem are quite few and difficult to come by. One of the biggest challenges in addressing this problem is the very poor understanding of why plastic pollution in marine environments is happening. Many experts from a spectrum of opinions ranging from blaming and demonizing plastics to one extreme, and the pro-plastics groups in the other absolving plastics but blaming its improper use and disposal, and everyone else in between. To date, not one side has provided a single comprehensive explanation and acceptable solution to address the problem. This situation is more difficult in rapidly developing economies where waste governance failed to catch up with the rapid increase in plastic use and disposal causing huge amounts of plastic waste leaks into the environment. This underscores the fact that pollution is a very complex problem that requires appropriate solutions that combine science and technology as well as improvements in policy, governance and social and behavioral changes.

The Regional Review of Marine litter in the East Asian Seas identified a number of challenges in addressing marine litter problems in the region. The main challenge East Asian nations face is the very low level of awareness of the problem of marine litter most especially the awareness of decision-makers which directly translates into low political will to address the problem (COBSEA, 2018). The same report has listed the four major challenges specific to the Philippines in addressing marine litter pollution, namely: (1) no available information on level of awareness; (2) lack of data on status of marine litter on local/national level, on extent and nature of the problem; (3) lack of systematic data gathering on relevant information on marine litter in order to assess current situation; and (4) there is no sustained funding support to marine litter management, i.e., prevention, collection and disposal (COBSEA, 2018).

Addressing the challenges faced by the Philippines' marine waters, a comprehensive study of the issues of plastic pollution was deemed necessary, piloting Manila Bay as the study area. The Manila Bay, other than its multi-use conflict issues, is challenged by the worsening problem of plastic pollution both on its offshore and onshore areas. Various efforts at the national and local levels have been initiated. However, the lack of data and information on the extent and depth of the problems on plastic pollution in Manila Bay renders many of these efforts inutile.

To address this deficit in knowledge and raise the level of awareness about the plastic pollution in Manila Bay, the EcoWaste Coalition engaged research experts from partner academic institutions, the University of Sto. Tomas, Manila, and the Dela Salle University Dasmarias. The four (4) fundamental studies delve on: **(1) Plastic Pollution Awareness Survey in Selected Areas Along Manila Bay; (2) Plastic Material Balance Flow Accounting in Selected Areas Along Manila Bay; (3) Solid Waste Collection Efficiency Assessment of Selected Local Government Units Along Manila Bay; and (4) Marine Plastic Litter Survey in Selected Areas Along Manila Bay.** Each study is a stand-alone report, representing the final report of each research activity conducted. Such is done to give due importance and recognition to each of the studies and highlight its results and recommendations.

These studies used scientific measurements to determine, quantify and analyze the origin, process and causes of plastic pollution in Manila Bay that can provide wealth of information and reliable data to inform effective waste management planning and improve practices and standard of waste governance in Metro Manila which in turn is expected to significantly contribute to arresting plastic pollution in the Bay.

The results of the studies also provided recommendations that address plastic pollution policy gaps and solid waste management improvements. The studies conducted and recommendations given are not to critique the efforts of the government and other partner organizations working along Manila Bay, but to assist them in their initiatives to save Manila Bay and other bodies of water in the country from the very alarming plastic pollution issues. The results of the studies, especially the data and the information gathered seek to help in crafting the government's plan for sustainable development of the country's marine waters, especially the **National Action Plan for Marine Litters (NAPMALI)**.

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List of Acronyms and Abbreviations

Acronyms

BESWMC	Barangay Ecological Solid Waste Management Committee
CER	Collection Efficiency Rating
DILG	Department of Interior and Local Government
LGMPs	Local Governance Performance Management System (LGMPs)
LGU	Local government units
MEQ	Management Efficiency Questionnaire
MES	Management Efficiency Score
MRF	Material Recovery Facility
PHP	Philippine Peso
RA 9003	Republic Act of 9003, otherwise known as the Ecological Solid Waste Management Act
SUP	Single-used plastics
SWM	Solid Waste Management
SWMP	Solid Waste Management Program
USAID	United States Agency for International Development

Research Summary and Findings



Executive Summary

1. The solid waste collection efficiency of the five chosen LGUs along Manila Bay were ascertained using a systems-thinking approach through methods of determination namely: (a) Collection Process Efficiency Rating (CPER); (b) the developed Management Efficiency Questionnaire (MEQ); and (3) relative efficiency using Data Envelopment Analysis (DEA).

- The surveyed barangays obtained an average CPER of 12.83%.
- Out of 0.66 kg/day (Metro Manila), it is estimated that only 0.085 kg is collected which is disaggregated to 0.0092 kg (landfill), 0. 0.0014 kg (Recycled) and 0.00032 kg (composted).
- Mismanaged waste accounts for 87.12% of the waste generated.
- Increasing waste recovery from the computed 2.04% to 80.09% can lead to higher collection efficiency with few improvements in available logistics for waste collection.
- The Management Efficiency Score (MES) of the surveyed LGUs is 81%. In terms of management, Policy showed highest score at 91% but much improvements are needed in the area of Operations (76%) and Education (80%).
- Data Envelopment Analysis (DEA) showed that increasing waste recovery and decentralizing solid waste collection leads to higher collection efficiency.





2. Much improvements are needed in terms of policy directions for both the LGUs and the national government. These include the following recommendations:

- Manage a fully operational Material Recovery facility (MRF) by decentralizing waste management and strengthening the role of the barangay in the collection of recyclable and biodegradable wastes.
- Revisit the provisions of RA9003 pertaining to the establishment of MRF per barangay by revising the role of the barangay SWM committee from establishing to managing MRF.
- Develop a clear national policy on production, utilization, and disposal of single use plastic (SUP) as this would significantly reduce residual waste.
- Develop a clear, long-term and sustainable solid waste management plan anchored on waste recovery and reduction.

Research Background

Plastic pollution of aquatic ecosystems is now considered an environmental hazard. As demand for goods and services continuously pressure environmental limits, more and more of this waste is produced of which the oceans and freshwater ecosystems become the receiving end of waste and by-products that harm the environment. A projection reported by Pennington (2016) emphasized that only 14% of the 78 million tons of plastic produced annually are recycled and 32% end up in oceans. With the current rate of plastic production and its manner of disposal, it is estimated that plastic waste will surpass the total fish production (Pennington, 2016).

Geyer *et.al.* (2017) stated that an approximate volume of 12,000 metric tons of plastic waste materials is generated globally which majority goes into the oceans. Freshwater systems like rivers are predicted to be the main pathways for these land-based plastics into the seas and oceans (Schmidt *et.al.*, 2017) which is degraded further to microplastics (Abreo *et. al.*, 2019).

Jambeck *et. al.* (2017) reported that the Philippines is considered to be one of the largest contributors of marine plastic pollution in the world. With estimated production of about 4.52 Mt/yr., the Philippines is the third largest producer of marine plastic waste in the world after China and India (Lebreton and Andrady, 2019). A recent report by a non-government organization GAIA or Global Alliance for Incinerator Alternatives (2019), provided that aside from single use plastic bags or thin-film

bags, plastic sachets contribute more to the plastic waste generation of the Philippines. They have estimated that on the average, the Philippines generate 163 million pieces of plastic sachets daily. This amount as reported by GAIA (2019) can cover the whole land area of Metro Manila in a foot deep of plastic waste.

Being an archipelago, the Philippines has an extensive coastal zone. Given also the distance of the human population to freshwater systems like rivers and streams, the Philippines may be assumed to have the highest national plastic emissions from rivers into the ocean (Meijer *et al.*, 2019).

Manila Bay is a Philippine major marine ecosystem. Having a coastline of 190-km with the widest diameter of 58 km, it has a surface area of 1,870 sq. km (187,000 has.) and 17,540 (17.54 M has.) drainage area. It is the Philippines' major center of economic activity ranging from shipping, industrial, commercial, fishing, aquaculture and tourism activities since it's watersheds the National Capital Region (NCR), Central Luzon (Region III) and CALABARZON (Region IVA) of the Philippines that cumulatively produces more than 60% of the country's gross domestic product or GDP. Its entire watershed is drained by 17 rivers which is governed by 178 local government units (LGU). Schirinzi *et. al.* (2020) reported that the three main rivers traversing the NCR (population of about 12 million), Pasig, Tullahan and Meycauayan (Figure 1), are all included in the top five of the most plastic emitting rivers globally.

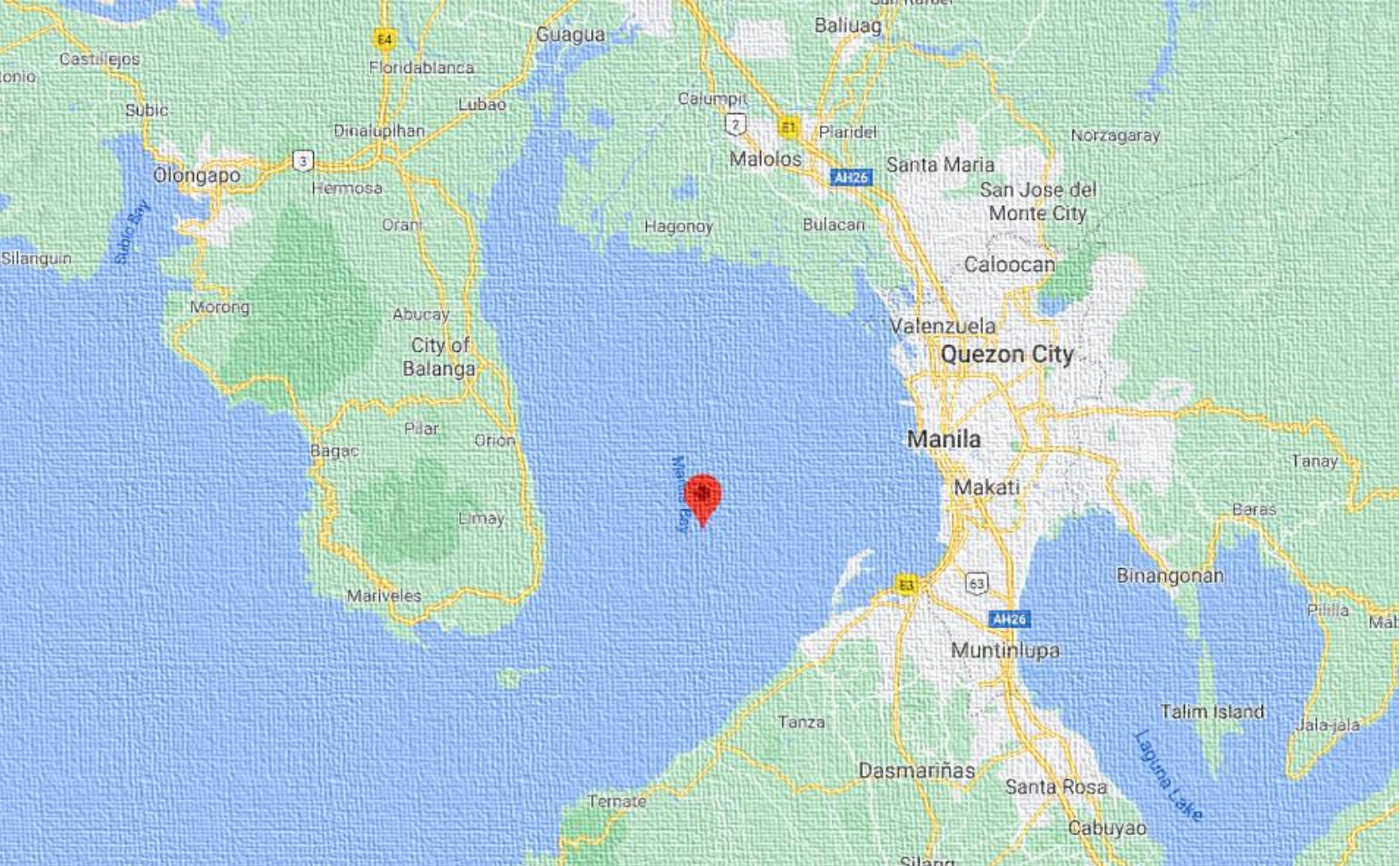


Figure 1. Google Map of the Research Site – The Manila Bay

A report by the Environmental Management Bureau (EMB) under a national agency, the Department of Environment and Natural Resources, showed that NCR is projected to increase its annual solid waste production from 13.48 million tons in 2010 to 16.63 million tons in 2020 or an increase from 22.2% to 26.7% of NCR's contribution to the country's total solid waste production, respectively (EMB, 2018). EMB also reported that the Philippines' solid waste comes primarily from domestic (56.7%) and commercial (27.1%) sources with 10.55% of the solid waste produced coming from plastics by weight.

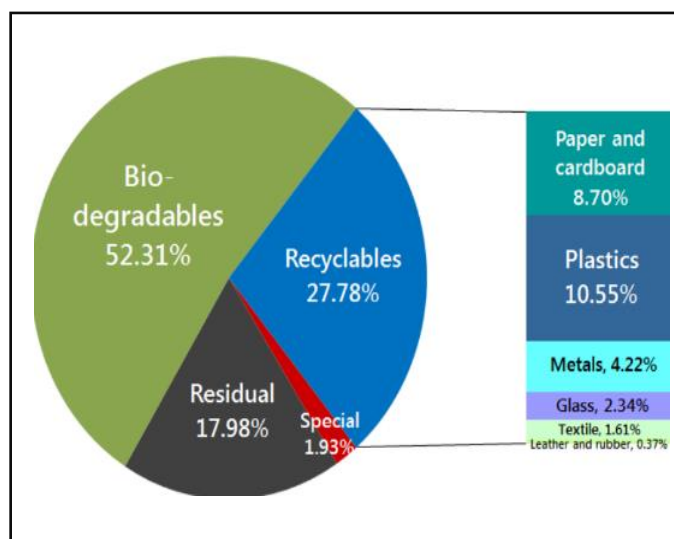
In response to the escalating problem of solid waste management, the Philippine government in 2000 enacted Republic Act (RA) 9003, also known as the Ecological Solid Waste Management (SWM) Act of 2000 which was then considered to be a broad-based and comprehensive approach to solid waste management (DENR, 2001). RA 9003 mandates the adaptation of a comprehensive, systematic, and environmentally-sound SWM program as a policy with significant implementation of the LGUs as the primary implementers.

The law mandates to achieve 25% waste reduction target by 2010 through establishment of material recovery facilities (MRFs) in all barangays following a reduce, reuse, recycle approach to be implemented by LGU's solid waste management boards from the Barangay to the Municipal level with guidance from the National solid waste management board. The law also prohibited the use of open dumping and creation of sanitary landfills.

With a 2000 national law on solid waste management being implemented but the Philippines being a top producer of marine plastic pollution globally 20 years after the enactment of the law, a study on the efficiency of how solid waste collection by the LGUs is needed to ascertain the gaps in policy, implementation and education on solid waste management.

Significance of the Research

Presence of marine plastic pollution mirrors mismanaged solid waste. With the implementation of a 20-year-old law on solid waste management in the Philippines and the Philippines being a major contributor of marine plastic waste globally, much study is needed to determine the causes of such concern in the area of governance. At present, there have been numerous studies published and presented evaluating solid waste management implementation in the Philippines but most of these studies pinpoint only on specific areas of management like factors on behavior, socio-economic status or education. Though these are all relevant and contributory to the understanding of the concerns, a study to look on the dynamics of governance (policy, implementation and education) vis-à-vis the LGUs implementation of RA9003 is needed.



Source: DENR-EMB (2013 and 2020)

Figure 2. Percentage by Weight of MSW Fractions in the Philippines

Following this, the researchers developed a tool called the Management Efficiency Questionnaire (MEQ): A Tool for Solid Wastes Management Efficiency Assessment (see Attached tool). The MEQ is a relatively simple, tangible and standardized assessing tool to document the status and provide quantitative rating of the solid waste management or SWM program under local settings. It has been developed to provide a quick overview of progress in improving the efficiency of the local government unit's SWM program at the barangay level.

It is a simple and easy-to-use tool yet can provide a comprehensive oversight of the present management status and can monitor progress of interventions implemented. The tool can be used by local

government units, researchers and national agencies. Data, findings and recommendations in this report are significant as it may contribute to a comprehensive approach to solid waste management not just from local or national researchers and policy implementers in the Philippines. Other organizations, government and non-government, especially in similar developing countries like the Philippines may find applications for the MEQ tool and recommendations provided in this report. MEQ data can be used as leverage in pursuing important policy actions that would require national initiatives (such as selective or total ban regulations of products) and drastically reduce plastic production.

The presence of marine plastic pollution and its relationship to governance mirrors the failures of many countries of implementing an effective and sustainable solid waste management program. This calls for collaborative and science-informed solutions that can be implemented locally, nationally and globally.

This report provides information and tools that may be useful in looking at the plastic crisis at a micro or local level using a systems-thinking approach. The results and recommendations from the five (5) selected Barangays presented in this report can show concrete possibilities in having a comprehensive approach in minimizing or eradicating plastic pollution contribution to oceans.

The researchers developed a data gathering tool called the Management Efficiency Questionnaire (MEQ): A Tool for Solid Wastes Management Efficiency Assessment. The MEQ is a relatively simple, tangible and standardized assessing tool to document the status and provide quantitative rating of the solid waste management or SWM program under local settings.

The findings of this report are relevant for the national government, non-government organizations, corporations, and the Filipino consumers to look at the existential and grave problem on plastic pollution and important roles in addressing that concern. Likewise, this report amplifies the need in pursuing a Zero Waste program at the local level with the crucial role to be made by the national government.

Objectives

This project primarily aims to determine the collection and performance efficiency of selected local government units (LGUs) that sit in the Manila Bay Watershed. Specific activities include: determination of the five (5) barangay's solid waste collection efficiency; comparison of waste volumes collected by the LGUs concerned; and, modelling tool utilization to assess efficiency performance in SWM.

Scope and Coverage

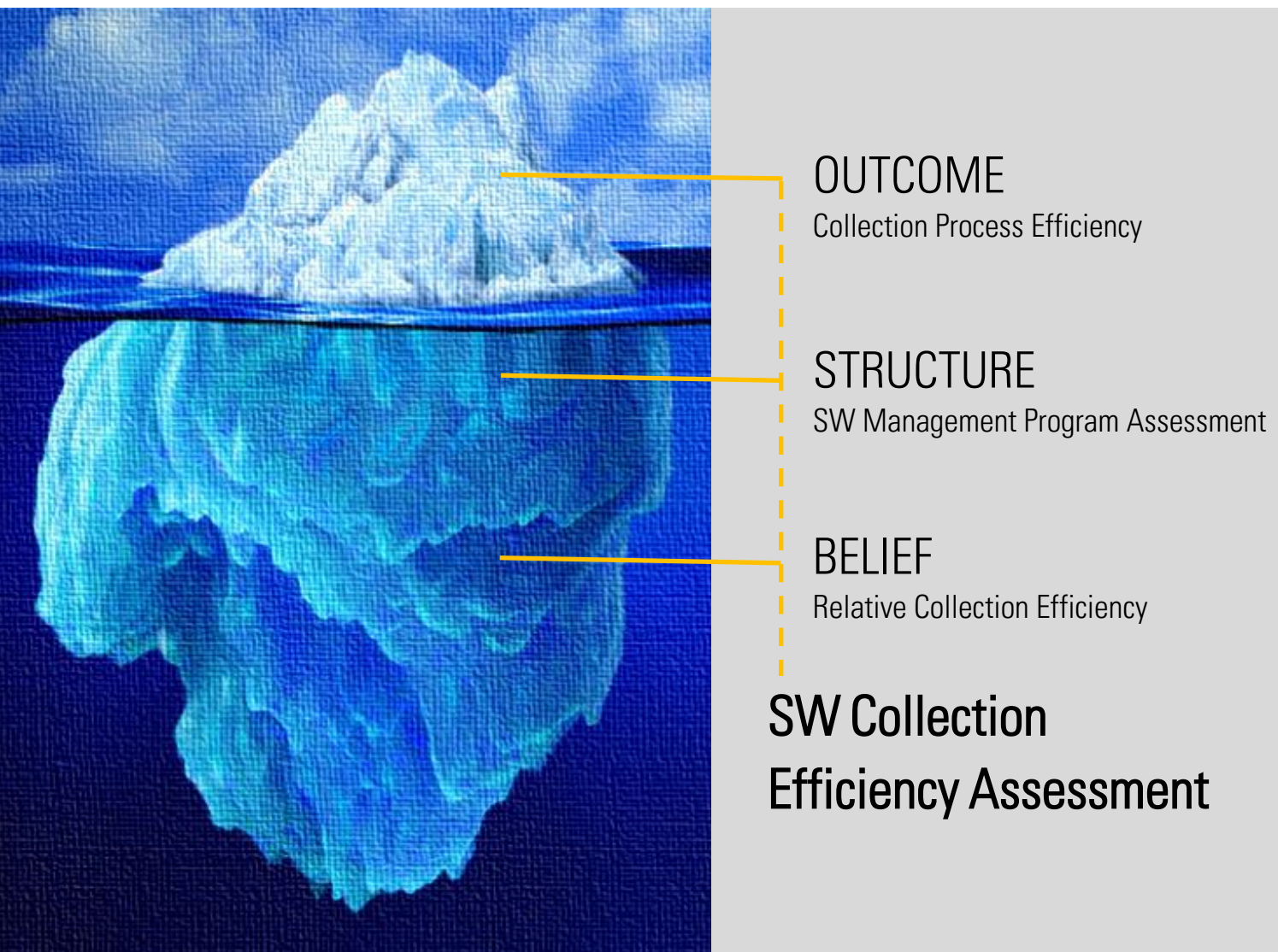
The study assessed the solid waste collection efficiency of five selected LGUs in the National Capital Region namely, Barangay Tangos South in City of Navotas, Barangay San Agustin in the City of Malabon, Barangay 76 of the City of Pasay, Barangay 649 from City of Manila and Barangay San Dionisio, City of Parañaque.

Using systems thinking approach, solid waste collection efficiency was measured using three approaches namely:

1. collection process efficiency rating (CPER) which is based on computation of collection data from generated waste;
2. a developed tool specifically for the purpose of evaluating management efficiency; and,
3. Data envelopment analysis (DEA) were also conducted to determine relative efficiency among sampled LGUs.

The study was conducted from July to December 2020.

Figure 3. Iceberg Model for the Solid Waste Collection Efficiency Assessment



Research Design

Collection process efficiency rate (CPEP) was determined through mapping the collection system flow and computing for the rate of collection.

The Barangay solid waste (SW) system flow was mapped following provisions of RA9003 implementing rules and regulations (IRR) and results of interviews and validation from stakeholders.

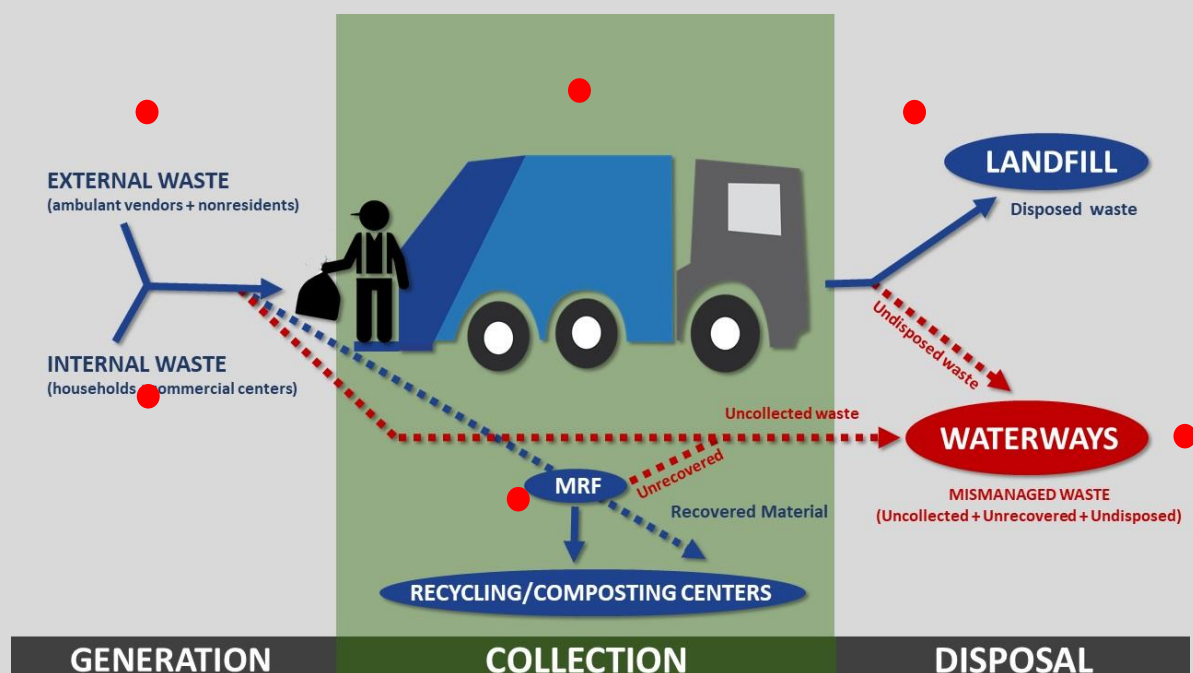
The SW system flow starts with waste generation. In waste generation, internal and external waste sources were determined. Internal waste is defined as the waste generated by residents in the Barangays which includes households, schools, commercial and industrial centers and other sectors within the Barangay. Data for internal waste were gathered from Barangay data on population and waste generation per capita, actual Barangay data or field survey of waste

generated if the first two stated data sources are not available. External waste is waste generated from non-Barangay residents which includes ambulant vendors and night market concessionaires.

These sectors generate waste as they traverse the Barangay for their trades. Data for external waste were determined by conducting a forty-eight-hour (48) field survey of waste generated from randomly selected ambulant vendors, estimated total number of ambulant vendors and deriving a weekly generated value.

For this study, a weekly waste generation value was utilized since frequency of collection are recalled by stakeholders on a weekly basis.

Figure 4. Solid Waste System Flow with marked areas (red circles) where the amount of solid wastes were estimated



Solid waste collection data were gathered after determination of the waste collecting points or system available in the Barangay. These are (a). waste collection by waste trucks provided by the Barangay and/or the City government; (b). waste recovery points which are the Barangay MRFs and/or Recyclable recovery centers or junk shops registered in the Barangay.

The units used for waste generation and collection is on kilogram per week (kg/week)

format. Likewise, for the determination of collection efficiencies in every step of the solid waste map and computation of the collection performance efficiency rate.

The difference in the TGW (100%) and the CPER would provide the value and percentage of Mismanaged waste which in turn becomes run-off to Manila Bay.

The annual generation of mismanaged waste was also determined.

Table 1. Formulas Used in Computing the Different Solid Waste Variables

Variable	Formula to obtain weekly value
External wastes (EW)	Daily average x estimated number of ambulant vendors (night and day market) x 3.5 (multiplier for weekly generation)
Internal Wastes (IW)	Interpolated weekly value based on the barangay internal wastes data (BSWMP or product of per capita production x population)
Total Generated Wastes (TGW)	$EW + IW$
Total Collected Wastes (TCW) by garbage trucks	Number of trucks x frequency of collection per week x maximum weight of wastes carried by a truck
Recovered Materials (RM) from the MRF/MRS	Recyclable and compostable RM from the barangay MRF/MRS
Percentage Recycled/Composted Materials from junkshops/centers	$RM / TGW \times 100$
Disposed Waste (DW)	Number of trucks x days or repair in a year x interpolated daily TGW
Uncollected Waste (UW); UW%	$TGW - TCW$; $UW\% = UW / TGW \times 100$
Undisposed Waste (UnW); UnW%	$TCW - DW$; $UnW\% = UnW / TGW \times 100$
Total Mismanaged Waste (TMW) assumed to be present in waterways	$UW + UnW$; $TMW\% = TMW / TGW \times 100$
Collection Process Efficiency Rating (CPER)	$DW\% + RM\%$

The study employed a mixed-method approach in determining **management efficiency rating** using the tool developed specifically for the research. Conduct of study were done using quantitative (survey of 100 randomly selected participants) and qualitative data gathering using focus group discussion for validation.

The Management Efficiency Questionnaire (MEQ) contains a set of items that have been designed to be easily answered by the assessment respondents and analyzed by the research team (external experts). The analysis, however should be supplemented by information gathered from the following sources: available secondary information from concerned offices, observations from ocular inspection of the program in the barangay, results of latest household surveys (if needed), and insights from focus group discussions (FGDs).

The recommended respondents to answer the MEQ include barangay sectoral representations, namely: barangay officials, household residents, business group, informal settlers, and SWM program staff members (waste pickers, gardeners, garbage collectors, drivers).

In most cases, the research team (external experts) should also be involved in separately answering the MEQ to ensure unbiased responses and consistency in the evaluation.

The MEQ is divided into three parts namely: barangay data sheet, efficiency score sheet, and profile of the assessment team.

▪ **Barangay Data Sheet**

This part is intended to gather supplementary information on the basic profile of the barangay being assessed in relation to its SWM program currently implemented. The data sheet also requires relevant socio-economic and solid wastes production information.

▪ **Efficiency Score Sheet**

This part is aimed in assessing the efficiency of the barangay SWM program. The efficiency indicators are structured around 25 assigned items which are presented in tabular form where two columns are allotted for writing the quantitative obtained points and recording the qualitative comments/explanation of the assessment.

▪ **Relative Efficiency Rate**

Relative efficiency was resolved using Data Envelopment Analysis (DEA). DEA is a powerful tool developed in 1979 that can compute relative performance efficiencies of given data management units. It is a mathematical technique used to evaluate the relative performance of organizations.

DEA makes it possible to identify efficient and inefficient units in a framework where results are considered in their particular context.

In this study, inputs data used were waste generation and Management Efficiency Scores and computed with output data such as waste collection, recovery and CPER.

Results & Discussion

The total land area of the research sites is 11.7072 with a total population, as of available data of 177,649 individuals distributed into about 47,693 households. Average population density is about 15, 174 individuals per square kilometer. Average individual per household is 3.72 or 4.

Barangay (Brgy.) San Dionisio in the city of Parañaque has the biggest land area among the study sites and subsequently has also the highest population of about 72,000 based on Barangay data.

The total expenditures (budget) for the five (5) barangays in a year is about 45 million pesos which when rationed with the total population translates to 252.63 pesos/person/year. Brgy. San Dionisio has the highest allotted budget among the barangays of about 39 million* and also has the highest per capita allotment of about 542 pesos in a year. Brgy. 649 (Baseco) in the city of Manila has the lowest per capita budget of 60.62 per year.

Collection Process Efficiency Rate (CPER)

Solid waste generation and collection in kg/week together with the percentages of disposed, recovered and mismanaged in each of the surveyed Barangays are shown in the Table 2 below. CPER was computed as the sum of the percentages of disposed and recovered waste.

Among the barangays, Brgy. San Dionisio in Parañaque city generates the highest waste per week at about 460,350.66 kg while Brgy. 76 in Pasay has the lowest generation at about 32,821.38 kg/week. However, Brgy. 649 in Manila has the lowest disposed waste percentage at 7.33% of the total waste generated while Brgy. San Agustin in Malabon has the highest percentage in terms of waste disposal at 61.67%.

Table 2. Summarized Computed Variables on Solid Wastes

Barangay	Generated	Collected	Mismanaged	Disposed	Recovered	CPER
San Dionisio	460,350.66	97,069.67	419,283.00	39,998.27 (8.69)	1,069.67 (0.23)	8.93%
76	32,821.38	13,088.87	19,01.57	11,635.47 (35.45)	1,383.87 (4.21)	39.66%
649	381,363.78	28,000.00	349,770.24	27,961.54 (7.33)	3,632.00 (0.95)	8.29%
San Agustin	15,516.12	11,887.16	3,628.96	9,569.23 (61.67)	2,317.93 (14.94)	76.61%
Tangos-South	57,129.31	24,126.76	33,121.78	13,041.00 (22.83)	10,966.76 (19.19)	42.02%
Total	947,181.25	174,172.46	825,605.55	102,205.51 (10.79)	19,370.23 (2.04)	12.83%

Note: In reference to EMB-DENR's per capita generation of 0.66 kg/day (Metro Manila), only 0.085 kg is collected 0.085 kg = 0.0092 kg (landfill) + 0.0014 kg (Recycled) + 0.00032 kg (Composted).

All values representing generated, collected, mismanaged, disposed, and recovered are in kg; Values in parenthesis are in percent.

Among the barangays, Brgy. San Agustin has the highest collection process efficiency rate at 76.61% and Brgy. 649 the lowest at 8.29%. The CPER range for the five (5) Barangays is 8.29% - 76.61%.

The cumulative solid waste flow map of the LGUs surveyed is shown in the succeeding figure. Total generated waste of the five (5) barangays is about 947,181.25 kg/week in which 82% are internally-generated waste (776,731.25 kg/week) are the remaining 12% as externally-generated.

From these generation, only 158,460 kg or 16.73% can be collected by the five Barangays' or Cities' waste collecting trucks. Surveyed data on downtime due to repair of these trucks amount to an equivalent of 8.2 days per year which proportioned to a weekly non-collection rate of 5.9% or 56,254.06 kg/week. This leaves only a 10.79% collection efficiency for the trucks or only 102,205.98 kg being disposed to landfills.

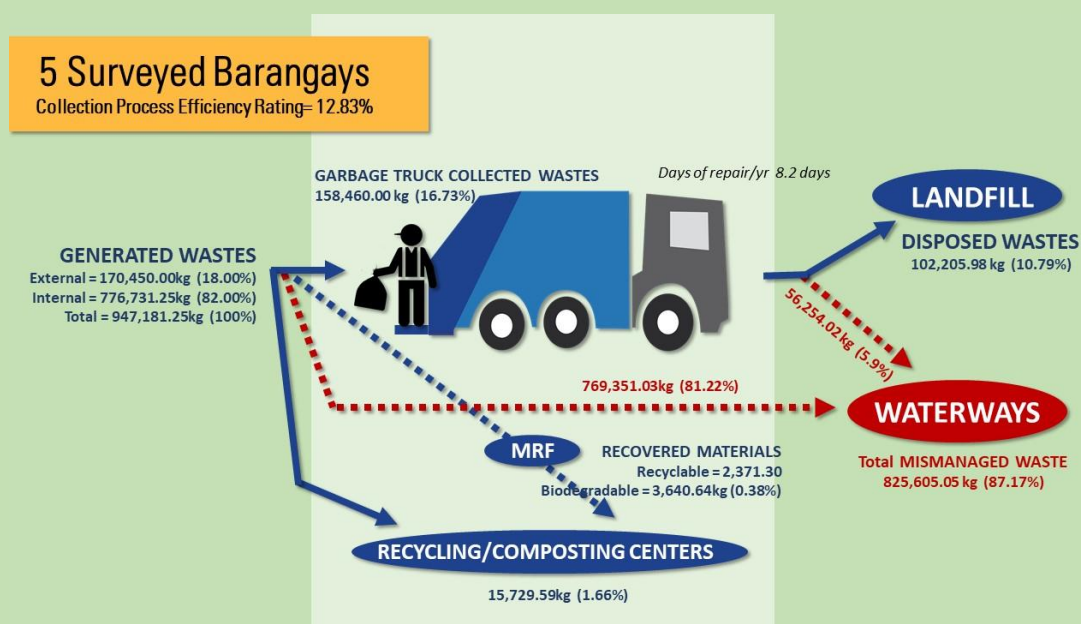
In terms of waste recovery, the Barangays are able to recover only 3,640.64 kg/week of biodegradable waste or about 0.38% of the

total waste generated. While only 15,729.59 kg or 1.66% of the generated waste are recovered by the recycling centers which gives the sum of a very low rate of 2.04% for waste recovery.

The CPER for the total generated waste for the five LGUs is equivalent to the sum of the disposed waste rate (10.79%) and the waste recovery rate (2.04%) which is 12.83%. To derive the percentage of mismanaged waste, the difference of total generated waste (100%) and collection process efficiency rate were computed and found to be 87.17% or about 825,605.05 kg/week.

Using the Environmental Management Bureau (EMB-DENR) data on per capita solid waste generation rate of 0.66 kg/day for Metro Manila residents, only 0.085 kg (12.83%) of this waste generated is collected. This collected waste can be disaggregated into 0.0092 kg goes to the landfill, 0.0014kg to recycling centers and only 0.00032 kg are composted.

Figure 5. Diagram of Solid Waste System Flow with Estimated Variables for the Surveyed Barangays



Using the 2020 population of Metro Manila which is estimated to be more than 13 million, daily mismanaged waste is computed to be about 8.40 million kilograms/day or more than 3.069 billion kilograms/year.

The 87.17% mismanaged waste is supported by a 2015 study by Jambeck et. al, (2015) which computed the mismanaged waste for the Philippines at 83%. The difference may be attributed to the scope of this paper which concentrated only in Metro Manila, which has the highest population density and contributes about 40% of the country's gross domestic product. Likewise, the Philippines average per capita waste generation is only about 0.44 kg/day compared to Metro Manila's 0.66 kg/day. Much investigation regarding this is recommended.

At present, the surveyed LGUs has a total of 19 collecting trucks with a total capacity of 35.90 tons and total collection trips of 48 trips/week. If the 87.17% mismanaged waste shall be collected by the present logistics available to the LGUs, the collecting trucks will need to increase its capacity by six times (6x) to be able to collect the mismanaged waste. But if the LGUs will focus on significantly improving its waste recovery from a dismal 2.04% to 80% (based on the waste analysis study conducted by EMB-DENR), the LGUs present collection capacity shall be enough with some improvements.

Sources of Collection Process Inefficiencies, its Impacts and Recommendations

Based on data, observations, interviews and validation with the stakeholders, the following are the sources waste inefficiencies

(leakages) pertaining to a low waste recovery rate:

1. Waste segregation scheme being practiced is based only on two waste categories: the biodegradable or decomposing ("*nabubulok*") and non-decomposing ("*di-nabubulok*") waste.

This was observed in all the barangays surveyed. The study believes that this practice is a key factor for the low waste recovery rating in all the LGUs surveyed. This segregation scheme completely made the MRF either partially or fully non-operational.

2. Failure to optimize garbage collection trucks productivity in terms of labor, vehicle, and collection schedule.

Also observed in all LGUs surveyed. This has caused the high generation of uncollected waste.

If the LGUs will focus on significantly improving its waste recovery from a dismal 2.04% to 80% (based on the waste analysis study conducted by EMB-DENR), the LGUs present collection capacity shall be enough with some improvements.

3. Either absent (1/5 barangays) or un-maximized (4/5 barangays) Material Recovery Facility.

The un-maximized MRF contributes to a high percentage of unsegregated waste which contributes to an increase pressure on logistical needs to waste collection and disposal to landfills.

4. Waste collection being handled by private entity contracted by the LGUs (2/5 barangays).

Incidentally, the LGUs with the highest percentages of uncollected waste have waste collected by a private contractor. Collection done by private contractors might be counterproductive to the segregation program since amount of waste collected or frequency of collection might be the possible references for payment contract.

Likewise, since these are contracted by the city government, logistics such trucks might be somewhat inaccessible to narrow roads and alleys of the barangays. This was validated by the residents as garbage trucks cannot enter their narrow alleys and subsequently lead to non-collection of waste.

5. High downtime on waste collecting vehicles.

Data showed that the range of vehicle downtime is 2 days to 30 days or an average of 8.2 waste collection days. This can be attributed to the age of vehicles which in some

Barangays to have an age of 30 years old.

6. Collector trucks are open trucks.

Since these are open trucks, they further contribute to mismanaged waste due to transport spillage from Barangay to Landfill site.

To be able to minimize leakages or inefficiencies in the waste collection system, the following are the recommended actions by the LGUs:

- Increase and intensify the waste recovery program by adherence to the segregation-at-source approach as stipulated in RA9003 IRR;
- Recognize the crucial role of informal waste sector and non-governmental organizations and their participation in the waste management systems;
- Empower the Barangay Ecological Waste Management Committee by making them manage the Barangay's Material Recovery Facility;
- Evaluate existing contracts with private contractors as waste collectors with suggested improvements on their role pertaining to waste recovery;
- Develop and regularly implement a preventive maintenance program for waste collecting trucks;
- Recognize the potential of the MRF as a potential source of income for the Barangay that can fund the Barangay's solid waste

management programs and operations.

The construction of a Material Recovery Facility (MRF) is one of the requirements in the implementation of RA9003 or the Ecological Solid Waste Management Act of 2000. The MRF should be constructed by every Barangay (or shared by Barangays) and shall serve as a facility for the repository of solid waste to be collected by the local LGU in compliance with the act. These solid wastes are the non-hazardous waste such as plastics, paper and other biodegradable and other waste that can be recycled.

Four (4) out of the five (5) LGUs surveyed have their own MRF except for Brgy. Tangos South that is still in the process of constructing its own MRF since it is a newly established LGU.

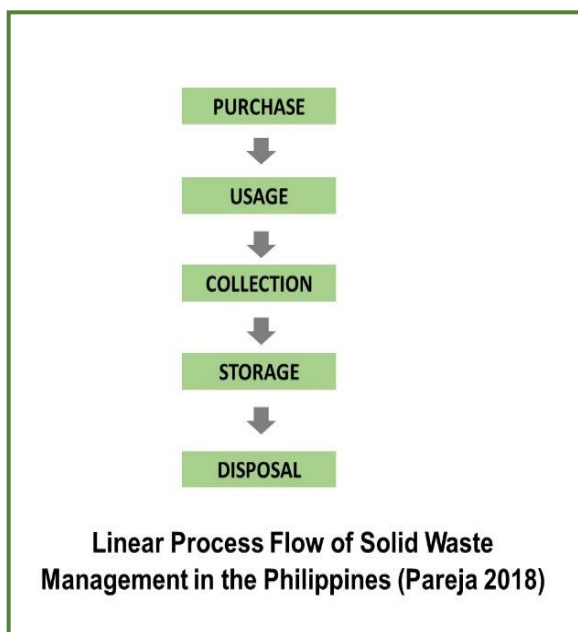
The MRF is a crucial infrastructure in the solid waste process flow in the Philippines as it functions as a storage and separation facility. In the LGUs studied with a reported MRF, none were observed to have a *fully functioning MRF* – an MRF that has a central system of collection and segregation and data are collected, recorded and evaluated. Most are constructed for compliance to the law and department orders from the Department of Interior and Local Government and the Department of Environment and Natural Resources. Though, notable in this collection are the segregation bins of Brgy. 76 in Pasay City where numerous segregation bins are

Functioning Material Recovery Facility (MRF)

present and managed by a large number of staff and equipment related to SWM.

Notable also are the significant contributions of non-governmental organizations as exemplified by the LGUs of Brgy. San Agustin and Brgy. Tangos South where a relatively high waste recovery rate was noted. The informal waste sector was also recognized in these two LGUs and were deputized to collect recoverable or recyclable waste within the Barangay. This has led to increase access to waste collection in narrow alleys and streets. The MRF may be a downstream facility – part of the end-of-the-pipe process flow – in the linear flow of solid waste management, but the establishment of a functioning MRF will have an upstream impact in the process as it functions in the collection and storage of generated waste (Pareja, 2018).

First, it would strengthen segregation at source and second, it would develop a data management system that will assist and guide the LGUs in the implementation of a long – term plan in the Barangay's solid waste management. The absence of a functioning MRF is concretely shown in the insufficiency of available accurate data on total solid waste generated by the barangays. Clearly, the deficiency in the acquisition and management of accurate data due to the absence of a functioning MRF is one of the major sources of solid waste collection inefficiency.



The possible reasons of not having a functional MRF by the barangays may be caused by the following:

1. RA9003 IRR provisions of having only an established Barangay MRF (not necessarily functioning MRF) as already an evidence of compliance to the act;
2. City government's centralization of solid waste collection as shown two (2) of the LGUs surveyed; and
3. Delegation to only two (2) categories of waste segregation – decomposing and non-decomposing – that has made the MRF non-functional and irrelevant.

Instead of the barangay leading its solid waste collection, private companies with contracts directly with the city government are given the responsibilities to collect all the waste in the city. This has a direct effect on segregation programs since waste recovery is

not included in the programs of these private contractors. Changes in the terms of references for these private contractors are recommended.

Nonetheless, notable and worthy of praised practices and features of the LGUs studied are the following:

1. Replacement of old collecting trucks with brand new trucks;
2. Use of creative means in increasing access to waste collections by the Barangays;
3. Commitment of the LGU leadership in implementing programs on SWM;
4. Strong partnership with the NGOs and informal waste sector; and
5. Conduct of clean-up drives and notable dedication to keep the Barangay clean.

The MRF is a crucial infrastructure in the solid waste process flow in the Philippines as it functions as a storage and separation facility. In the LGUs studied with a reported MRF, none were observed to have a fully functioning MRF – an MRF that has a central system of collection and segregation in which data are collected, recorded and evaluated.

Management Efficiency Score (MES)

Using the developed The Management Efficiency Questionnaire (MEQ) which contains a set of items that have been designed to be easily answered by the assessment respondents and analyzed by the research team (external experts), the results of the self and expert assessment based on the Management Efficiency Score (MES) are found in the proceeding Table.

The MEQ follows a mixed-method approach in data gathering thru gathering of data available on waste management, quantitative survey on questions dealing with policy, governance and education and validation of results through focus group discussions with key informants. Lastly, scoring is done

through an equal distribution of score coming from self (LGU) and expert (researchers) assessments.

Results showed that Policy got the highest Management Efficiency score of 85% followed by Education (80%) and Operations which got the lowest (76%).

In terms of policies, all LGUs surveyed have ordinances that is also anchored on the city's solid waste management plans. As required by the law, four (4) of the five (5) have established their own MRF where recyclable and biodegradable materials are supposed to be centralized thru a barangay-based collection system. Through resolutions also, each LGU has its own organized Barangay SWM Committee (BSWMC) which is tasked to oversee the implementation of the SWM within the barangay. Sectoral representations are notable in each BSWMC.

Table 3. Summarized Results of the Management Efficiency Assessment using MEQ

Element	Focus	Major findings	Score		%
			Maximum	Minimum	
Policy	Basis for the program and presence of a barangay solid wastes management committee with a workable plan	Barangay ordinances on solid waste management and presence of a Barangay solid waste management committee as stipulated in RA9003 are notable in all barangays. The ordinances are also supported by their respective city's solid waste management plans. Lacking in an ordinance in the regulation of single-use plastic bags are one of the things noted during survey and focus group discussion.	100	90	85.00
Governance	Implementation of the program based on the plan, including usage of resources, functionality of the material recovery facility, database, and sustainable management	Residents are not aware of a functioning MRF in the barangay. Usual segregation among LGUs survey is by two-type waste only (biodegradable and non-biodegradable). Solid waste collection is done by a private company with a contract with the city government. Concerns on fragmented or lack of database create gaps for effective management. Lack of enforcement of the ordinances were also noted by residents.	90	67	76.00
Education	Presence of information campaigns and their effectiveness in promoting education on wastes management	The solid waste management program has education and awareness activities that can still be enhanced to encourage cooperation and self-regulation among waste generators from the barangay.	95	65	80.00
Mean			90	71	81.00

Included also in the ordinances are policies on segregation emphasizing at-source segregation, schedule of collection and type or process of segregation. Generally observed also during the study, residents are fully aware of these ordinances with regards to segregation and schedule of solid waste collection.

However, the following were generally observed in all barangays during the study: (1) absence of specific barangay ordinance or regulation for the management and/or banning of single-use plastic; and (2) no ordinances on data collection and management.

In the area of operations, a low efficiency score of 76% was given by both assessors (self and expert) using the MEQ. This is also shown in the results of the quantitative survey among residents which showed that most needed improvements are needed in the implementation of the policies of segregation and solid waste collection.

Notable to this result is the non-functional LGU MRF. The lack of available personnel, equipment and vehicles related to SWM also contributes to the low implementation of Barangay SWM policies.

Though, there is a schedule of waste collection. Residents in these barangays notes that these are not observed regularly. Stakeholders reported that some LGUs does not follow the regular schedule and unsegregated waste are also collected.

Notable concerns in the area of operations are (1). absence of accurate database collection and management that can serve as basis for establishing goal-oriented, results-based monitoring and evaluation systems for short-, medium- or long-term solid wastes

management planning for the barangay; and, (2) enforcement issue as indicated by the occasional presence of some piled up garbage in the water ways and the outdated records of violations, penalties, or fines related to collection and segregation.

Results showed that the element Policy registered the highest Management Efficiency Score of 85% followed by the element Education with 80% and the element Operations which obtained the lowest rating of 76%.

In education, common information and education programs are clean-up drive and coastal waste collections. Though presence of signage were reported by the stakeholders, majority of respondents observed that these are not properly maintained. A more concrete and proactive education programs are recommended.

Relative Efficiency Rate

To further analyze the factors that contribute to efficiency, a data envelopment analysis (DEA) was undertaken. DEA is a novel decision-making tool that is used to compare

the relative operational efficiency of an organization (five LGUs) based on management inputs and outputs.

In this study the following management inputs were used: **Waste generated (kg/week)** and **Management Efficiency Score**. On the other hand, efficiency was compared by using the following outputs: **Waste collected (kg/week)**, **Waste recovered (kg/week)**, and **Collection Process Efficiency Rating**. The computations of relative efficiencies are found in the proceeding tables.

When waste generated (input) and waste collected (output) were utilized as management units using DEA, results showed that Brgy. San Agustin posted the highest relative efficiency which means it is able to collect the highest amount of waste from its generated waste among the LGUs compared. This was followed by Brgy.76 and Brgy. Tangos South.

In terms of waste generated (input) and waste recovered (output), Brgy. Tangos South is relatively the most efficient. Followed by Brgy. San Agustin and Brgy. 76.

When MES as input and CPER as output were used, Brgy. San Agustin posited to have relatively the most efficient among the LGUs, followed by Brgy. San Agustin. Most notable of the three most efficient LGUs is the ability of these LGUs to utilize creative means in increasing accessibility of the Barangay and the City in waste collection and waste recovery.

Benchmarking the input and output practices of these LGUs the following recommendations on management inputs can be increasing MES for Policy, Operation and Education leads to high collection process efficiency. On the other hand,

The results point to the idea that the Local Government Unit's computed poverty incidence and per capita income are not necessarily predictors of collection efficiency.

management outputs can be increasing focus on waste recovery and waste collection access leads are notable targets for efficient collection.

Analysis of DEA results also showed the following:

- 1. Budget allotment is not a predictor of efficient SWM program;**
- 2. Results further support decentralization of waste collection to Barangay level;**
- 3. Poverty incidence and per capita income are not predictors of collection efficiency; and**
- 4. Policy, operations and education plays a crucial role in waste collection.**

Table 4. Relative Efficiencies Using Identified Input and Output Factors

Barangay	Generated*	Collected*	Ratio	Relative Efficiency
San Dionisio (City of Paranaque)	460,350.66	41,067.94	0.09	11.64%
76 (City of Pasay)	32,821.38	13,019.81	0.40	51.78%
649 (City of Manila)	381,363.78	31,593.54	0.08	10.81%
San Agustin (City of Malabon)	15,516.12	11,887.16	0.77	100.00%
Tangos (City of Navotas)	57,129.31	17,906.76	0.31	40.91%

Barangay	Generated*	Recovered Waste*	Ratio	Relative Efficiency
San Dionisio (City of Paranaque)	460,350.66	1,069.67	0.0023	1.56%
76 (City of Pasay)	32,821.38	1,383.87	0.0422	21.96%
649 (City of Manila)	381,363.78	3,632.00	0.0095	4.96%
San Agustin (City of Malabon)	15,516.12	2,317.93	0.1494	77.82%
Tangos (City of Navotas)	57,129.31	10,966.76	0.1920	100.00%

Barangay	MES	CPE	Ratio	Relative Efficiency
San Dionisio (City of Paranaque)	90%	39.66%	0.44	47.17%
76 (City of Pasay)	71%	8.93%	0.13	13.46%
649 (City of Manila)	80%	8.29%	0.10	11.09%
San Agustin (City of Malabon)	82%	76.61%	0.93	100.00%
Tangos (City of Navotas)	80%	42.02%	0.53	56.22%

Single-use Plastics (SUPs)

Stakeholders in each of the barangays studied are aware of the presence and impacts of single-use plastics (SUPs) to the environment based on results on focus group discussions. This is evidenced by a consistently low efficiency score on presence of barangay policies on single-use plastics based on the MEQ. SUPs were also noted by the residents to be one of the biggest wastes observed.

Barangay administrators noted that problems from SUPs arise because of two (2) possible causes:

1. Absence of an enacting ordinance or law that will regulate the production and use of SUPs; and

2. Most common sources of SUPs are ambulant vendors that cannot be covered by the barangay policies since these vendors transfer from one barangay to another.

This concern on SUPs plus the lack of its enabling policy on its regulation and use both in the local and national level together with poor implementation of RA9003 in the barangay.

It can be cited that based on the CPER, MES and DEA aggravated by the lack of an accurate data management system in the barangay c leads to a high unaccounted solid waste which is the main sources of solid waste pollution into waterways.

Policy Recommendations

From the foregoing research findings, the following recommendations have been drawn up.

For Barangay and City Local Government Units:

1. Manage a fully operational MRF; Decentralize waste management and strengthen the role of the barangay in the collection of recyclable and biodegradable wastes.
2. Institute an accurate, science-informed and proactive BSWMP designed to guide the barangay in the evaluation and direction of SWM program.
3. Capacitate, strengthen, and empower the BSWMC with the active participation of all members.
4. Implement other proactive education campaigns involving different stakeholders (e.g., schools, residents, business sector, etc.).
5. Maximize use of social media as a tool for educational campaigns on SWM.
6. Strictly implement SWM policies and imposition of penalties.
7. See an operational MRF as a potential source of income for the Barangay.

8. Strengthen linkages with NGOs and civic groups in participation to SWM.

For the National Government:

1. Revisit the provisions of RA9003 pertaining to the establishment of MRF per barangay by enhancing the role of the BSWMC in managing MRF and monitoring and evaluating the BSWMP. A revision in the role of the BSWMC as stipulated in the IRR is recommended (DENR & DILG);
2. Recognize and strengthen the role of informal waste pickers in the SWM process (DILG). Include a BSWMC representation in the CSWMC to enhance coordination of functions and monitoring of the city SWM program (DENR & DILG)
3. Develop a clear national policy on production, utilization, and disposal of SUPs as this would significantly reduce residual waste.
4. Recognize the crucial role of informal waste sector in the implementation of solid waste management program.
5. Develop a clear, long-term and sustainable solid waste management plan anchored on waste recovery and reduction.

Barangay 76, Pasay City



Introduction

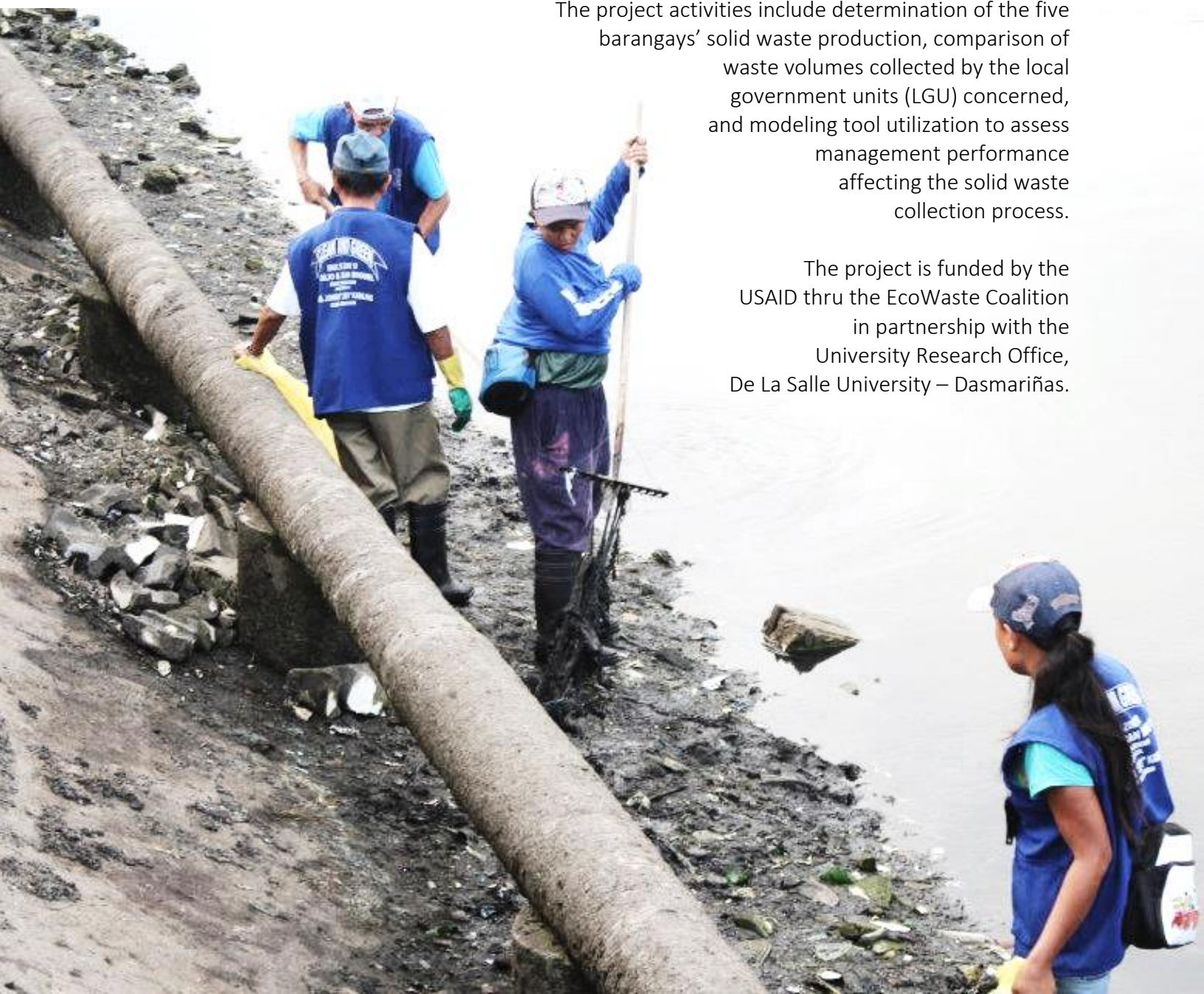
This report is based on the results of solid waste management assessment carried out in Barangay 76, Zone 10 in Pasay City from July to December 2020 for the research project

“Solid Waste Collection Efficiency Assessment of Selected Local Government Units Along Manila Bay”.

The project generally aims to determine the collection and performance efficiency of five selected local government units that are part of the Manila Bay watershed.

The project activities include determination of the five barangays’ solid waste production, comparison of waste volumes collected by the local government units (LGU) concerned, and modeling tool utilization to assess management performance affecting the solid waste collection process.

The project is funded by the USAID thru the EcoWaste Coalition in partnership with the University Research Office, De La Salle University – Dasmariñas.



Executive Summary

1

The solid waste collection efficiency rating for Barangay 76 is estimated at 39.66% based on to the disposal rate of 35.45% and material recovery rate of 4.21%. Moreover, the barangay's solid waste management efficiency score is 90.00% with the element Education Campaign having the highest rate among the three elements assessed followed by Operation and Policy:

- **Eighty five percent (85%) compliance to the criteria for the element Policy** in the Management Efficiency Questionnaire (MEQ). This means that although some areas of the Policy can still be improved (e.g., clearer work plan, periodic review, stakeholders' full participation in meetings), the presence of a barangay Solid Waste Management (SWM) committee operating on a management plan can provide a good basis for an efficient SWM at the barangay level.
- **Ninety percent (90%) compliance to the criteria for the element Operation** in the MEQ. With some issues that can create gaps constraining effective wastes management, it can be largely said that Barangay 76 is somewhat clean with adequately managed wastes.
- **Ninety five percent (95%) compliance to the criteria for the element Education Campaign** in the MEQ. The barangay-initiated education campaigns are generally perceived by the barangay stakeholders as one of the contributors in promoting awareness and disseminating information to the residents of the barangay.

The SWM program efficiency assessment generally identified three critical gaps that the barangay SWM committee members need to give attention to. These gaps comprise the following: at-source waste segregation, systematic data base, SWM regulation enforcement, and regular trainings for both staff and residents.

The following policy suggestions are recommended based on the results of management efficiency assessment:

2

- Strengthen the at-source solid waste segregation practice as well as the functionality of the Material Recovery facility (MRF) to minimize solid waste collection and disposal and occurrence of waste leakage.
- Improve database management by establishing periodic updates of database in all records pertaining to the barangay solid waste management program.
- Observe stricter program enforcement with the help of the barangay *tanod*. Violators of the ordinance should be properly dealt with based on the existing policy.
- Enhance provision for staff trainings and skills program to fully achieve the objectives of the management plan. A parallel program for trainings/seminars should be prepared to other stakeholders whenever possible to promote participation to the barangay solid waste management program.

Terms of Reference

In relation to this report, the two terms of reference for the project were the following: (1) to estimate the Collection Efficiency Rating (CER) of the barangay anchored on the solid waste system flow, and (2) determine the Management Efficiency Score (MES) of the SWM program currently implemented in the barangay.

Methods and Respondents

Computation of the variables used to estimate the CER follows a set of statistically validated formulas while the overview of the SWM program of Barangay 76 was mainly acquired through an assessment tool called Management Efficiency Questionnaire or MEQ. This was supplemented by available secondary information, ocular inspection through site visits, household survey, and series of online focus group discussions (FGD) with research informants and participants.

Representation of the key stakeholder groups in the barangay, namely: barangay officials, household residents, business group, informal settlers, SWM program staff members (waste pickers, gardeners, garbage collectors, drivers) was considered in the selection of the 100 household survey respondents and the 12 FGD participants. Self-efficiency evaluation using the assessment tool was done by the members of the Barangay SWM Committee (BSWMC).

MEQ contains 25 indicators mostly anchored on the requirements of RA9003. Five indicators are under Policy, 15 on Operation (being the center of the SWMP) and 5 under Education Campaign. The assessment indicators are presented in tabular form to allow scoring, recording the details of the assessment, and identifying any intended actions that will improve the management efficiency. The schedule of activities conducted by the research team is outlined below.

Table 5. Research Team Schedule of Activities in Brgy. 76

Activities	Month conducted
Courtesy call and orientation about the project	August
Answering of household survey/data information sheet and MEQ	August - September
Focus group discussion/interviews	September - October
Field visits and validation	August - November
Final report writing	December

Description of Barangay 76

Barangay 76 is situated at approximately 14.5402, 120.9871, Luzon island with an elevation estimated at 3.5 meters above mean sea level (www.philAtlas.com). Barangay 76 is bordered by Libertad Street (Pasay-Manila boundary) to the north, by Redemptorist Channel (Pasay-Parañaque boundary) to the south, by Roxas Boulevard to the east, and the Manila Bay to the west. The diagram on the next page summarizes the other distinct features of the barangay, such as the demographic and socio-economic references.



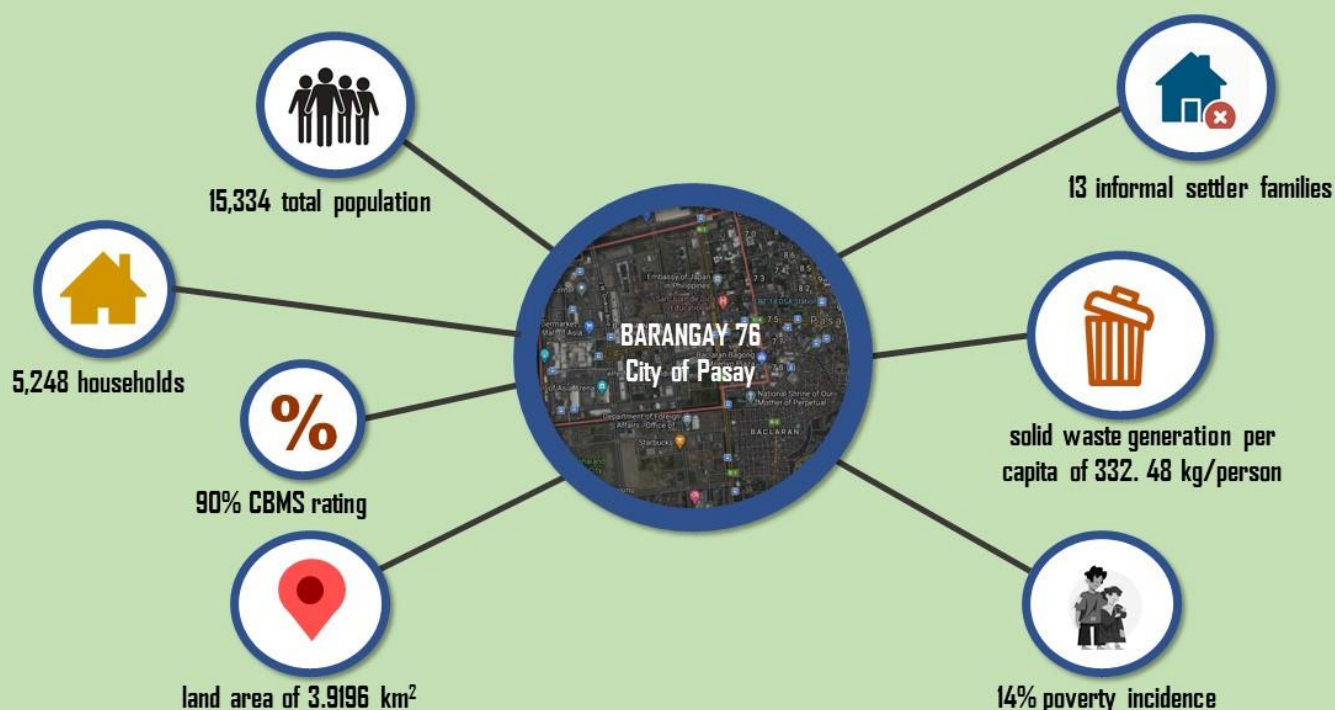


Figure 6. Demographic and Socio-economic Features in Brgy. 76

The barangay covers a total land area of 3.9196 km² supporting both residential and mixed-use area by a total population of 15,334 residents (as of June 2020 based on barangay record) representing 5,284 households. It is considered a highly urbanized and commercialized barangay in the first district of Pasay City where key government offices and buildings are situated. These include Senate of the Philippines building, Social Security System office, and two embassies, such as US Veterans and Japan. It also keeps a hospital (San Juan De Dios Educational Foundation, Inc), two private schools offering basic education, and one tertiary education institution.

The main economic activity in the barangay is distribution or utilization of products, settlements or services offered by numerous condominiums, high rise buildings, amusement parks, and malls. Moreover, there are also some barangay residents who are involved in buying and/or selling products to satisfy the day-to-day needs of life.

With a reported poverty incidence of 14% (CBMS 2018), Barangay 76 presently classified 13 families or households as informal settlers. Considering the barangay's highly dense nature and the active economic activities of the residents and non-residents working in the area, Barangay 76 registered a high 90% rating in the area of environmental governance under the Local Governance Performance Management System (LGPMs).

Solid Waste Collection Efficiency

Similar to most barangays in the municipality, Barangay 76 produces solid wastes that should be properly managed based on existing plan of the SWM Board of the City of Pasay and the barangay management plan. It should be understood that the potential risks to the environment and to public health may arise from the manner by which the solid wastes are collectively handled, collected, and disposed of (Ferronator and Torretta, 2019). The figure below summarizes the waste collection efficiency in the barangay.

In reference to source, the solid waste generated in the barangay are classified either as internal or external wastes. Those associated with domestic activities of the residents are called internal waste while the external wastes are those that are mostly generated by the activities of the ambulatory vendors selling different products (including food, beverages, and other items) in containers or packaging that are assumed to be discarded by consumers within the barangay as waste.

On a weekly basis, the barangay generates nearly 32,821.3846 kg of solid waste from both internal and external sources. From this total amount, some 923 kg of recyclable materials wind up in the recycling centers, such as the barangay-contracted junk shops.



Diagram of the solid waste system flow in Barangay 76 depicting its current solid waste management practice. It also illustrates the estimated amount and percentage of solid waste generated and handled in every stage of the system flow as well as the mismanaged waste brought about by uncollected and undisposed wastes.

Selling the recyclable and reusable materials is one way by which the barangay can increase the revolving fund for the maintenance of the MRF. The barangay MRF functions as temporary item storage area and houses the composting provision area from where the crudely estimated 1,387 kg of biodegradable material from the total generated waste are composted registering about some 4.21% material recovery rating.

An estimated 11,700 kg are collected by the municipal garbage truck and subsequently handled in the landfill accounting to a low disposal rate of 35.45% or 11,635.47 kg of disposed waste. The remaining 60.33% equivalent to about 19,801.57 kg of uncollected and undisposed waste is considered mismanaged since they leak from the usual route of garbage in the solid waste system flow. This is the type of waste that presumably end up in the water ways and in the long run reach the Manila Bay.

Considering the material recovery and disposal activities, Barangay 76 attained an approximate CER of 39.66%. However, determining the CER is just a tip of the iceberg. Systemic thinking dictates that the collection process being practiced in the barangay can be shaped by a deeper level of abstraction which is not obviously seen from the surface. Hence, looking at the structure showing the framework within which the collection process operates offers a better understanding of the issue.



Experts from Pasay City Environment Natural Office (PCENRO) demonstrating the process of composting to some residents of Barangay 76.

(Photo from FB page of /brgy76zone10)

Results of the SWM Efficiency Assessment

The table on the next page provides the summarized results of the SWM efficiency assessment conducted for Barangay 76. Here, the collection process is viewed as an Operation which can be influenced by two other elements, namely Policy and the Education Campaign.

As shown, the total MES for Barangay 76 is 90.00%. The percentage score in the element Education Campaign (95.00%) is the highest among the three elements evaluated. The element Operation achieved a mid-rating of 90.00% while the element Policy got the lowest rating of 85.00%.

Policy

Barangay 76 employs an ordinance on SWM anchored on the citywide implemented program in Pasay City. As required in the ordinance, the barangay has a designated MRF where recyclable materials recovered from garbage collection are supposed to be kept and organized prior to selling to junk shops.

Through a resolution, the barangay has created the BSWMC which is tasked to oversee the implementation of the SWM within the area. As specified in RA 9003 (2000), the committee has sectoral representation (*kagawad*, representatives from *Sanguniang Kabataan*, home owners, junk shop owners, non-government organization, market vendors) that regularly meet every second Friday of the month.

The BSWMC generally operates from a part of the PHP4,147,687 budget allocated by the city government for the barangay's general operation. It uses a management plan that specifies function and responsibilities of the committee members. The plan also emphasizes the provision on at-source waste segregation and manner of collection from households and some business establishments. Waste collection schedule is indicated in the plan, such that four days (Monday, Wednesday, Friday, Sunday) are allotted for biodegradable and three days (Tuesday, Thursday, Saturday) for non-biodegradable wastes collection including recyclable wastes.

The following observations were noted by the research team: (1) there was no clear record on the breakdown of budget allocation to fund the SWM Program; (2) SWM activities are primarily documented using the Facebook page only; (3) meetings are not regularly participated in by identified members; and, (4) absence of specific barangay ordinance or regulation for the management and/or banning of single-use plastic.

Based on the MES, Barangay 76 was able to comply with 85.00% of the criteria for the element Policy in the MEQ. This means that although some areas of the policy can still be improved (e.g., clearer work plan, periodic review, stakeholders' full participation in meetings), the presence of a BSWMC operating on a management plan can provide a good basis for an efficient SWM at the barangay level.

Table 6. Summarized Solid Wastes Management Efficiency Assessment Results in Barangay 76

Element	Focus	Major findings	MES*		%
			Maximum	Obtained	
Policy	Basis for the program and presence of a barangay solid wastes management committee with a workable plan	The barangay follows an ordinance on solid waste management which is augmented by a management plan that can still be improved to facilitate systematic monitoring and appraisal of activities associated with the solid wastes' management program.	10	8.5	85.00
Operation	Implementation of the program based on the plan, including usage of resources, functionality of the material recovery facility, database, and sustainable management	The barangay has adequate number of tools, equipment, and staff to enforce the barangay solid waste management program but with concerns on fragmented database and inadequate material recovery facility that create a gap for effective management. An occasional issue on ordinance enforcement and residents' compliance to the ordinance was also observed.	30	27	90.00
Education	Presence of information campaigns and their effectiveness in promoting education on wastes management	The solid waste management program has education and awareness activities that can still be enhanced to encourage cooperation and self-regulation among waste generators from the barangay.	10	9.5	95.00
Total			50	45	90.00

*Highest Management Effectiveness Score (MES) is 50 points or 100%. There are three main elements (policy, operation, education campaign) which have corresponding maximum points. Based on the focus, each main element has several criteria with differing values.

Operation

The presence of the SWM staff is adequately felt within the barangay particularly during the wastes collection schedule. Presently, Barangay 76 has employed 56 staff members to handle waste collection and segregation from designated pick-up points for the maintenance of the cleanliness and greening of the barangay premises. The number of staff members has been generally perceived by the barangay stakeholders as adequate for critical management activity. Though not regularly conducted, development and training programs are occasionally provided by the barangay officials to the said staff to improve their level of orientation about the relevance of their work in relation to the program. Such activity is usually done in coordination with the Pasay City SWM Board.

Three garbage collection trucks are assigned by the city government to collect and transport the wastes generated in the barangay. Handling of wastes is done by using adequate number of tools, which include 250 segregation trash bins, 600 stick brooms with handle, and 100 dust pans. The personnel are also provided with gloves and rain boots and coats when needed. The tools are being kept and regularly inventoried at the barangay MRF. It was noted that the number of tools is proportional to the number of staff to bring about the expected results.

Aside from being the storage of the tools, the MRF is equipped with limited storage area where the collected recyclable items are temporarily placed, a shredder machine, and a provision for composting area for the biodegradable wastes being brought by some residents in the facility. According to the barangay secretary and as observed, the tools and equipment are regularly maintained to serve their purpose.



Composting seminar participants doing a hands-on activity in the barangay Material Recovery Facility. The seminar is facilitated by the Pasay City Environment Natural Office (PCENRO).

(Photo from FB page of /brgy76zone10)

As the needs arise, special meetings are conducted by the BSWMC to clarify certain questions about on-going activities and solve pressing issues. The committee chairman mentioned that the members follow a consensual approach in arriving at a decision as different sectors of the barangay (business owners, household, residents, etc.) are invited whenever there are meetings. It was also cited that the committee keeps a record of minutes of meetings and important data records (such as: assessments and capacities, historical data, income generation in the MRF, policies and other guidelines, among others).

Wastes are collected by the waste pickers from the designated pick-up points following the schedule. This, however, appear not to be fully observed by some barangay residents as evident by the occasional presence of garbage in some corners of the street as well as in the pick-up sites even after the scheduled garbage collection. Likewise, it was mentioned by some FGD respondents that segregation is not totally followed by both the waste pickers and the residents particularly at the level of the household. Nonsegregated wastes from households are, just the same, collected by waste pickers and placed directly in the garbage trucks.

The following other observations were noted by the research team: **(1) designated segregation bins distributed within the barangay are generally not properly utilized by the residents and people passing the barangay; (2) unavailability of updated financial record on the selling of the recovered recyclable materials as well as how the fund is used in maintaining the activities of the MRF; (3) absence of accurate database that can serve as basis for establishing goal-oriented, results-based monitoring and evaluation systems for short, medium or long term solid wastes management planning for the barangay; and, (4) enforcement issue as indicated by the occasional presence of some piled up garbage in the water ways and the outdated records of violations, penalties, or fines related to collection and segregation.**

Based on the MES, Barangay 76 was able to comply with 90.00% of the criteria for the element Operation in the MEQ. With some issues that can create gaps constraining effective wastes management, it can be largely said that Barangay 76 is somewhat clean with adequately managed wastes.



Volunteers from Barangay 76 participating in the annual Coastal Cleanup Day to spread awareness in keeping the coastline clean.

(Photo from FB page of /brgy76zone10)

Education Campaign

Barangay 76 regularly implements three main projects to provide education and information awareness on the importance of SWM. These activities include setting up a social media account, participating in the national coastal clean-up day and holding regular barangay clean-up day, and creating waste disposal and/or information signages.

A social media/Facebook account <https://www.facebook.com/brgy76zone> 10 is being managed by the barangay secretary. With 700 followers, the barangay officials view the platform as a mechanism to effectively provide information and updates on waste management program to the barangay constituents.

As spearheaded by the barangay council, volunteer residents of Barangay 76 regularly hold a weekly clean-up drives to clean waterways within the barangay. Similarly, the same group actively participates in the annual coastal clean-up activity in an effort to provide awareness on the protection and conservation of the coastal area. It is cited to be a successful project in terms of increasing number of participants every year.

The barangay also provides info and/or reminders on ordinances, program and places where and when wastes should be disposed. Barangay officials claimed that these signages are maintained and/or replaced when needed. Some participant, however cited that the use of signages as tool for behavioral change are ineffective since some residents' negative attitude affecting favorable practice on SWM is still a major concern in the barangay.

The following additional observations were noted by the research team: (1) absence of any partnership project or activity with specific barangay stakeholder in reference to SWM education and information campaigns; and, (2) current effort does not fully help achieve the education campaigns objective as evidence by the respondents' confusing or different response when asked for the presence of barangay ordinance or regulation on the use of single-use plastic.

Based on the MES, Barangay 76 was able to comply with 95.00% of the criteria for the element "Education Campaign" in the MEQ. The cited barangay-initiated projects are generally perceived by the barangay stakeholders as one of the contributors in promoting awareness and disseminating information to the residents of the barangay. Whether or not the cited education campaigns are translated into some positive behavioral response of the residents to the barangay SWM program can be a subject of a deeper inquiry.



Student volunteers to the annual Coastal Cleanup Day actively participated by Barangay 76.

(Photo from FB page of /brgy76zone10)

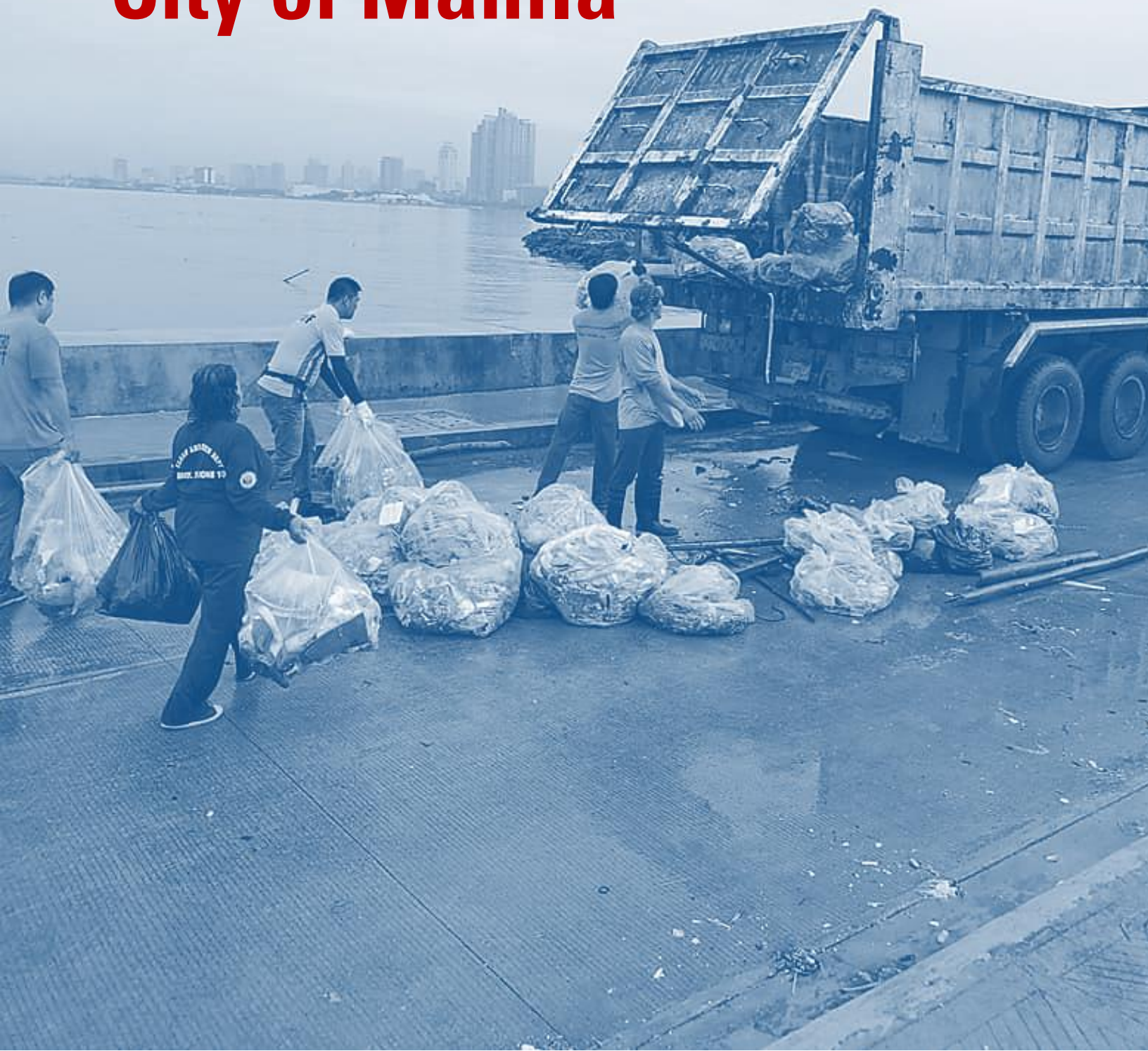
Policy Suggestions

The findings identified four critical gaps that BSWMC members need to give attention to. These gaps comprise the following: the need to strengthen the solid waste segregation practice, establish systematic data base, a stronger SWM regulation enforcement, and necessity for regular trainings and/or seminars for both SWM staff and residents. In view of these, the following policy recommendations are suggested:

- Strengthening of the barangay solid waste segregation practice as well as recovery of biodegradable, recyclable, and reusable materials prior to waste collection. In addition, the MRF should be made functional to minimize the quantity of solid waste being collected and disposed by the LGU.
- Improvement of database management by establishing periodic updates of database in all records pertaining to the barangay SWM. The barangay should utilize the output for the formulation and/or revision of the management plan
- Imposition of stricter program enforcement with the help of the barangay *tanod*. Violators of the ordinance should be properly dealt with based on the existing policy.
- Further improvement of staff trainings and skills program to fully achieve the objectives of the management plan. A parallel program for trainings/seminars should be prepared to other stakeholders whenever possible to promote participation to the barangay SWM program.



Brgy. 649, Zone 68
District V, Baseco,
City of Manila



Introduction

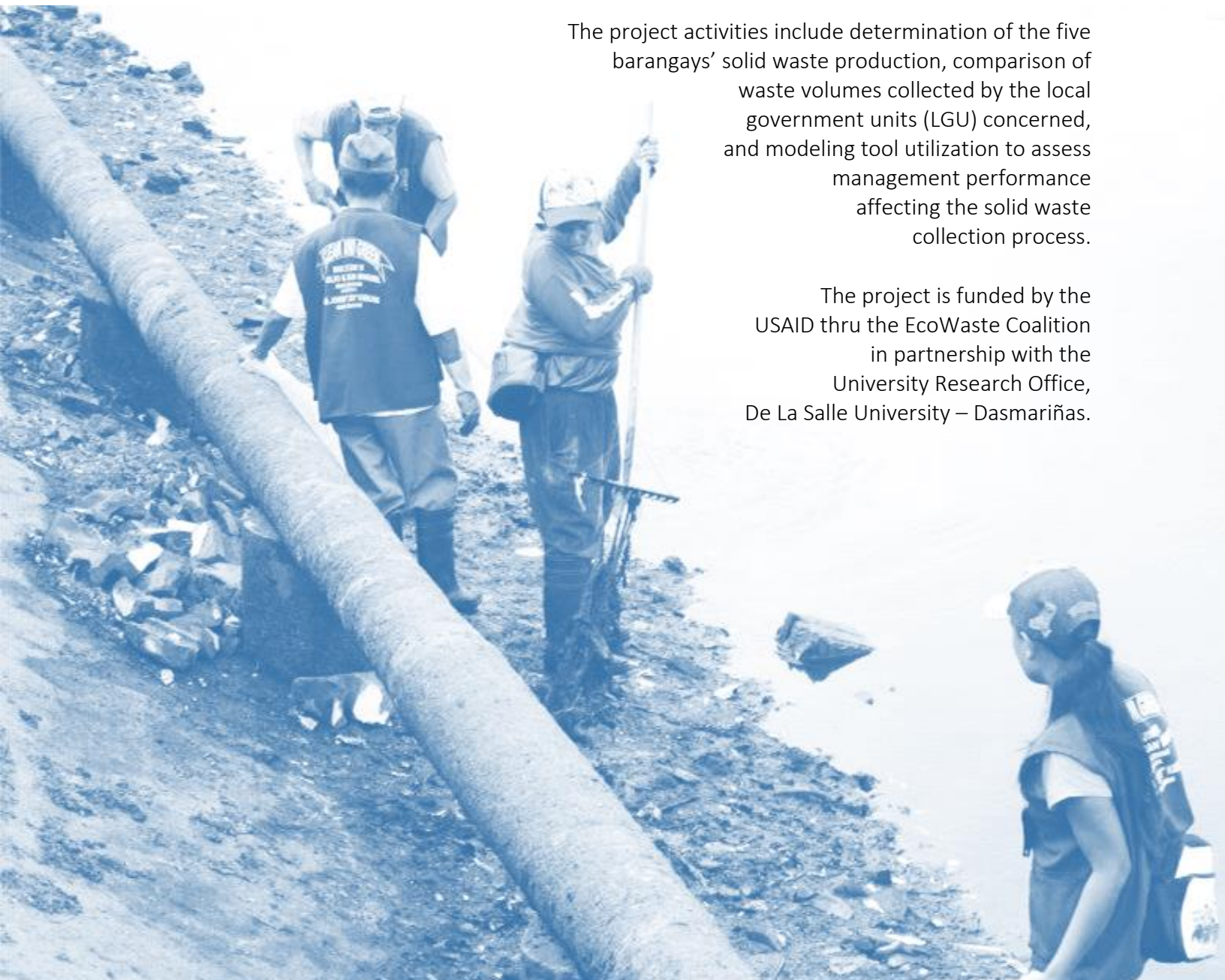
This report is based on the results of solid waste management assessment carried out in Barangay 649, Zone 68, District V in the City of Manila from July to December 2020 for the research project

“Solid Waste Collection Efficiency Assessment of Selected Local Government Units Along Manila Bay”.

The project generally aims to determine the collection and performance efficiency of five selected local government units that are part of the Manila Bay watershed.

The project activities include determination of the five barangays’ solid waste production, comparison of waste volumes collected by the local government units (LGU) concerned, and modeling tool utilization to assess management performance affecting the solid waste collection process.

The project is funded by the USAID thru the EcoWaste Coalition in partnership with the University Research Office, De La Salle University – Dasmariñas.



Executive Summary

1

The solid waste collection efficiency rating for Barangay 649 is estimated at 8.29% based on to the disposal rate of 7.33% and material recovery rate of 0.71%. Moreover, the barangay's solid waste management efficiency score is 82.00% with the element Policy having the highest rate among the three elements assessed followed by Education Campaign and Operation:

- **One hundred percent (100%) compliance to the criteria for the element Policy** in the MEQ was observed. There are more than three ordinances in the barangay that is being implemented with one ordinance emphasizing on the imposition with penalties to violators. However, there are some areas of the Policy that can still be improved such as clearer work plan, periodic review, and stakeholders' full participation in meetings, among others. Moreover, the presence of a Barangay SWM Committee operating on a management plan can provide a good basis for an efficient SWM at the barangay level.
- **Sixty-seven percent (67%) compliance to the criteria for the element Operation** in the MEQ. With some issues that can create gaps constraining effective wastes management, it can be noted that Barangay 649 is working very hard to adequately manage its wastes.
- **Eighty percent (80%) compliance to the criteria for the element Education Campaign** in the MEQ. The barangay-initiated education campaigns are generally perceived by the barangay stakeholders as one of the contributors in promoting awareness and disseminating information to the residents of the barangay.

The solid waste management (SWM) program efficiency assessment generally identified three critical gaps that the barangay SWM committee members need to give attention to. These gaps comprise the following: the need to establish systematic data-base, a stronger SWM regulation enforcement, and necessity for regular trainings and/or seminars for both staff and residents. The following policy suggestions are recommended based on the results of management efficiency assessment:

2

- Strengthen the solid waste segregation practice as well as the functionality of MRF to minimize solid waste collection and disposal and occurrence of waste leakage.
- Improve database management by establishing periodic updates of database in all records pertaining to the barangay solid waste management program.
- Observe stricter program enforcement with the help of the barangay *tanod*. Violators of the ordinance should be properly dealt with based on the existing policy.
- Enhance provision for staff trainings and skills program to fully achieve the objectives of the management plan. A parallel program for trainings/seminars should be prepared to other stakeholders (e.g., households, schools, business sector) whenever possible to promote participation to the barangay solid waste management program.

Terms of Reference

In relation to this report, the two terms of reference for the project were the following: (1) to estimate the Collection Efficiency Rating (CER) of the barangay anchored on the solid waste system flow, and (2) determine the Management Efficiency Score (MES) of the SWM program currently implemented in the barangay.

Methods and Respondents

Computation of the variables used to estimate the CER follows a set of statistically validated formulas while the overview of the SWM program of Barangay 649 was mainly acquired through an assessment tool called Management Efficiency Questionnaire or MEQ. This was supplemented by available secondary information, ocular inspection through site visits, household survey, and series of online focus group discussions (FGD) with research informants and participants.

Representation of the key stakeholder groups in the barangay, namely barangay officials, household residents, business group, informal settlers, SWM program staff members (waste pickers, gardeners, garbage collectors, drivers), was considered in the selection of the 100 household survey respondents and the 10 FGD participants. Self-efficiency evaluation using the assessment tool was done by the members of the Barangay SWM Committee (BSWMC).

MEQ contains 25 indicators mostly anchored on the requirements of RA9003. Five indicators are under Policy, 15 under Operation (being the center of the SWMP), and 5 under Education Campaign. The assessment indicators are presented in tabular form to allow scoring, recording the details of the assessment, and identifying any intended actions that will improve the management efficiency. The schedule of activities conducted by the research team is outlined below.

Table 7. Schedule of activities of the research team

Activities	Month conducted
Courtesy call and orientation about the project	February
Answering of household survey/data information sheet and MEQ	July
Focus group discussion/interviews	August
Field visits and validation	July - November
Final report writing	December

Description of Barangay 649

Barangay 649 is located along the reclaimed area, the Port Area in Manila under the jurisdiction of Philippine Ports Authority (PPA). It is bordered by Delpan to the north, Intramuros to the east, Manila Bay to the west and, Port Area to the south. The figure on the next page summarizes the other distinct features of the barangay, such as the demographic and socio-economic references.



The residents are actively participating in the clean-up drive in Barangay Baseco.

(Photo credit: Kagawad Markdolph J. Navalta)

Barangay 649 has a total land area of 0.5400 km² with a total population of 59,819 representing 14,121 residents. The per capita income ranges from PHP1,000 to 10,000.00 per month based on the 13,276 households (December 2013). The poverty incidence is about 60-70% with total number of informal settler families (ISF) reaching 24,690, categorizing the barangay as Urban poor.

Nevertheless, there are two identified sources of income for the economic conditions of the barangay. The primary sources include the following: fishing, vending, scavenging, and tricycle/pedicab driving, while the secondary sources are construction worker/laborer, OFW, government/private employee, truck driver and security guard. The data presented in the figure were based on the 2015 Barangay profile.

In terms of the Local Governance Performance Management System (LGPMs), the environmental governance rating of the barangay is 85%.

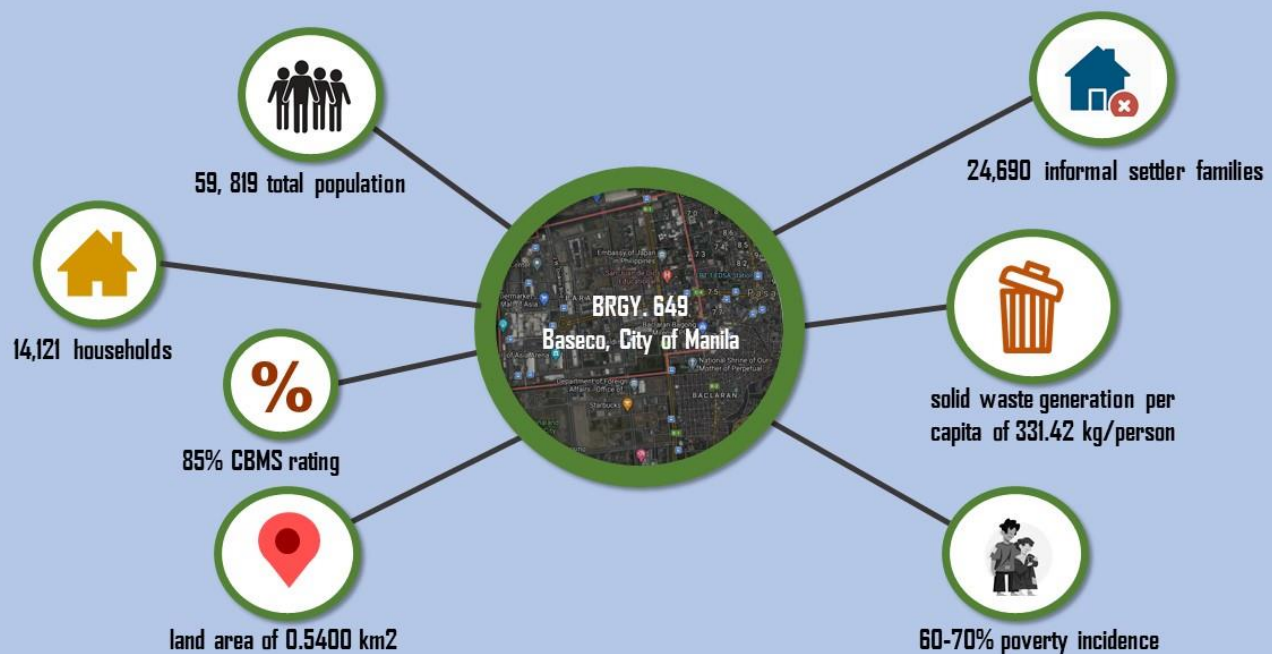


Figure 7. Demographic and Socio-economic Features in Brgy. Baseco

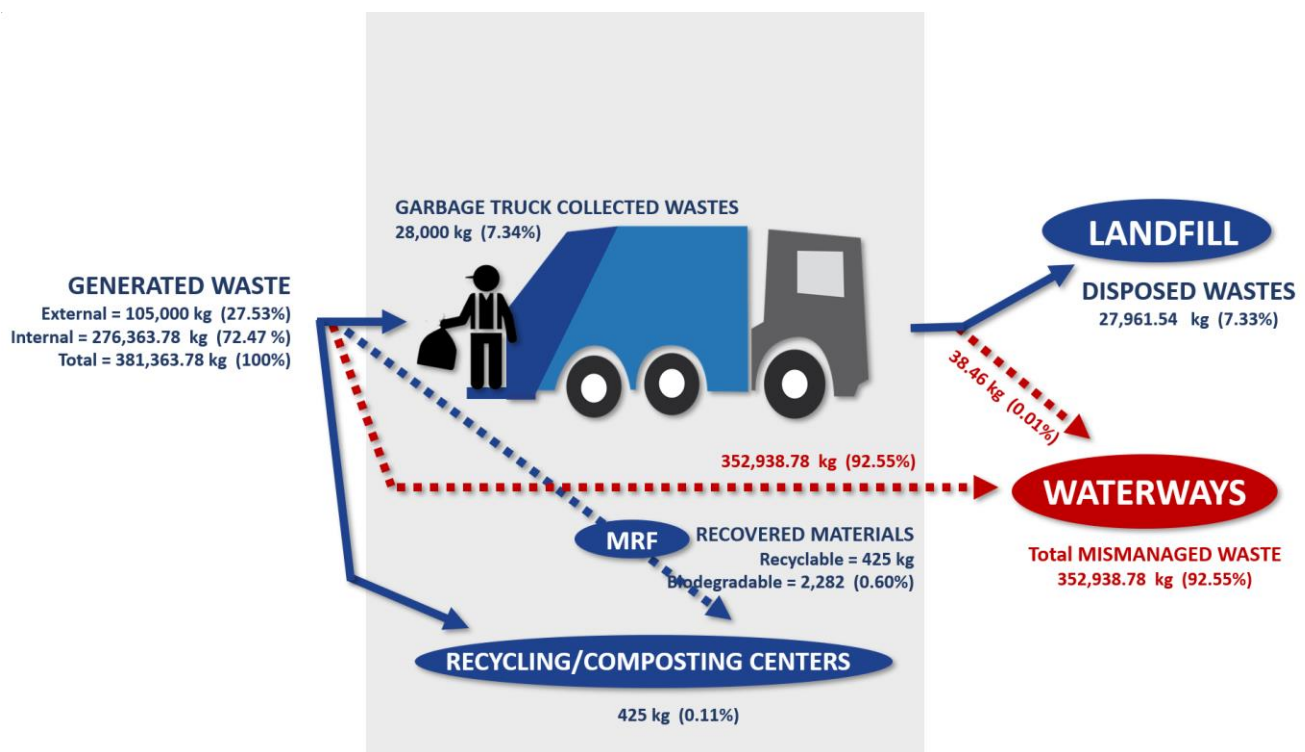


Diagram of the solid waste system flow in Barangay 649 depicting its current solid waste management practice. It also illustrates the estimated amount and percentage of solid waste generated and handled in every stage of the flow as well as the mismanaged waste from uncollected and undisposed waste.

Solid Waste Collection Efficiency

Similar to most barangays in the municipality, Barangay 649 produces solid wastes that should be properly managed based on existing plan of the SWM Board of Manila City and the barangay management plan. It should be understood that the potential risks to the environment and to public health may arise from how the solid wastes are collectively handled, collected, and disposed of (Ferronator and Torretta, 2019).

In reference to source, the solid waste generated in the barangay are classified either as internal or external wastes. Those associated with domestic activities of the residents are called internal waste while the external wastes are those that are mostly generated by the activities of the ambulatory vendors selling different products (including food, beverages, and other items) in containers or packaging that are assumed to be discarded by consumers within the barangay as waste.

On a weekly basis, the barangay generates nearly 381,363.78 kg of solid waste from both internal and external sources. From this total amount, some 425 kg of recyclable materials wind up in the recycling centers such as the barangay-contracted junk shops.

Selling the recyclable and reusable materials is one way by which the barangay can increase the revolving fund for the maintenance of the MRF. The barangay MRF functions as temporary item storage area and houses the composting provision area from where the crudely estimated 2,282 kg of biodegradable material from the total generated waste are composted registering about some 0.71% material recovery rating.

An estimated 28,000kg are collected by the municipal garbage truck and subsequently handled in the landfill accounting to a low disposal rate of 7.33% or 27,961.54kg of disposed waste. The remaining 92.55% equivalent to about 352,938.78 kg of uncollected and undisposed waste is considered mismanaged since they leak from the usual route of garbage in the solid waste system flow. This is the type of waste that presumably end up in the water ways and in the long run reach the Manila Bay.

Considering the material recovery and disposal activities, Barangay 649 attained an approximate CER of 8.29%. However, determining the CER is just a tip of the iceberg. Systemic thinking dictates that the collection process being practiced in the barangay can be shaped by a deeper level of abstraction which is not obviously seen from the surface. Hence, looking at the structure showing the framework within which the collection process operates offers a better understanding of the issue.



Results of the SWM Efficiency Assessment

The table on the next page provides the summarized results of the SWM efficiency assessment conducted for Barangay 649. Here, the collection process is viewed as an Operation which can be influenced by two other elements, namely Policy and the Education Campaign.

As shown, the total MES for Barangay 649 is 82.00%. The percentage score in the element Policy (100.00%) is the highest among the three elements evaluated. The element Education Campaign achieved a mid-rating of 80.00% while the element Operation got the lowest rating of 67.00%.

Policy

Barangay 649 employs an ordinance on SWM anchored on the citywide implemented program in Manila City. As required in the ordinance, the barangay has a designated MRS cum MRF covered by MOA with junkshops such as the Ucag Junkshop, where recyclable materials recovered from garbage collection are supposed to be kept and organized prior to selling to junk shops. These recyclables being sold to a partner junkshop is for the barangay's other source of income.

Moreover, the MRS was established at a strategic area sponsored by DENR-NCR-EMB located at Block1 Gasangan. As of today, the ongoing construction of MRF sponsored by the Coca-Cola Philippines and Caritas-Manila, is near completion and is located at Block 9 Old Site. In 2020, a partnership with DOST and DENR-EMB-NCR was established to set-up some units of biodigesters in the community.

Through a resolution, the barangay has created the BSWMC which is tasked to oversee the implementation of the SWM within the area. As specified in RA 9003 (2000), the committee has sectoral representation (*kagawad*, *Sangguniang Kabataan*, homeowners association, public/private school, parent-teachers association, religious organization, business community, environment NGO, market vendors association, and junkshop owners association) that regularly meet once every three months (2nd week of the 3rd month) with emergency meetings when there is a new project/s. BSWMC also involved Block Coordinators and Peace and Order Committee as additional members, to apprehend the violators.

It can also be noted that there were more than three (3) barangay ordinances with Brgy Ordinance no.1 effecting penalties and fines for violators. Penalty includes 6 hours of community service (1st offense), fine of PHP300.00-1,000.00 (2nd offense) and turn over to authority (3rd offense). The children apprehended were turned over to the Barangay Council for the Protection of Children.

The BSWMC generally operates from a part of the PHP400,000.00 budget allocated by the city government for the barangay's general operation. Annual budget is based on LGU-mandated template project. Other source of budget includes World Vision's funding for the facility and resource persons, training, and development plan; sponsors from Brgy Agency Network and other NGOs and selling of recyclables. It uses a management plan that specifies function and responsibilities of the committee members. The plan also emphasizes the provision on at-source waste segregation and manner of collection from households and some business establishments. Waste collection schedule is daily at 7:00 a.m. to 10:00 a.m.; unsegregated wastes are being collected also with donation as allowance of door-to-door collectors.

Table 8. Summarized Solid Wastes Management Efficiency Assessment Results in Barangay 649

Element	Focus	Major findings	MES*		%
			Maximum	Obtained	
Policy	Basis for the program and presence of a barangay solid wastes management committee with a workable plan	The barangay follows an ordinance on solid waste management which is augmented by a management plan that can still be improved to facilitate systematic monitoring and appraisal of activities associated with the solid wastes' management program.	10	10	100.00
Operation	Implementation of the program based on the plan, including usage of resources, functionality of the material recovery facility, database, and sustainable management	The barangay has adequate number of tools, equipment, and staff to enforce the barangay solid waste management program but with concerns on fragmented database and inadequate material recovery facility that create a gap for effective management. An occasional issue on ordinance enforcement and residents' compliance to the ordinance was also observed.	30	20	67.00
Education	Presence of information campaigns and their effectiveness in promoting education on wastes management	The solid waste management program has education and awareness activities that can still be enhanced to encourage cooperation and self-regulation among waste generators from the barangay.	10	8.0	80.00
Total			50	38.0	82.00

*Highest Management Effectiveness Score (MES) is 50 points or 100%. There are three main elements (policy, operation, education campaign) which have corresponding maximum points. Based on the focus, each main element has several criteria with differing values.

The following observations were noted by the research team: (1) there was no clear record on the breakdown of budget allocation to fund the SWM Program; (2) SWM activities are primarily documented using the Facebook page only; (3) meetings are not regularly participated in by identified members; and (4) absence of specific barangay ordinance or regulation for the management and/or banning of single-use plastic. (Note: Accordingly, the banning of SUP is already passed as a City ordinance but not implemented at the barangay level because many will be affected, such as the ordinary/street vendors)

Based on the MES, Barangay 649 was able to comply with 100.00% of the criteria for the element Policy in the MEQ. This means that although some areas of the policy can still be improved (e.g., clearer work plan, periodic review, stakeholders' full participation in meetings), the presence of a BSWMC operating on a management plan can provide a good basis for an efficient SWM at the barangay level.

Operation

The presence of the SWM staff is not adequately felt within the barangay particularly during the wastes collection schedule. At present, the BSWMC, created by the Barangay Council, is aided by only thirty (30) street sweepers divided into six (6) groups and eight (8) waste collectors from the Department of Public Services (DPS) of the City of Manila, aside from the independent and informal waste collectors. They handle waste collection and segregation from designated pick-up points for the maintenance of the cleanliness and greening of the barangay premises. However, the number of staff members has been generally perceived by the barangay stakeholders as inadequate for its critical management activity.

The BSWMC is trying to maximize all resources available to ensure that they can still impose SWM-related projects. However, concerns on its sustainability are at risk. Projects like contests using recyclable materials and submitting selected wastes are not sustained as these are dependent to its sponsors.



Attendance to training and seminars on solid waste management and single use plastics is subject for sponsorship from of the private sector or the city government. Street sweepers are not fully geared with protective robe when they do their duties. Cleaning materials and the number of streetsweeper have a ratio of 1:1, thus the staff must find ways to improvise if the cleaning materials break until they are replaced.

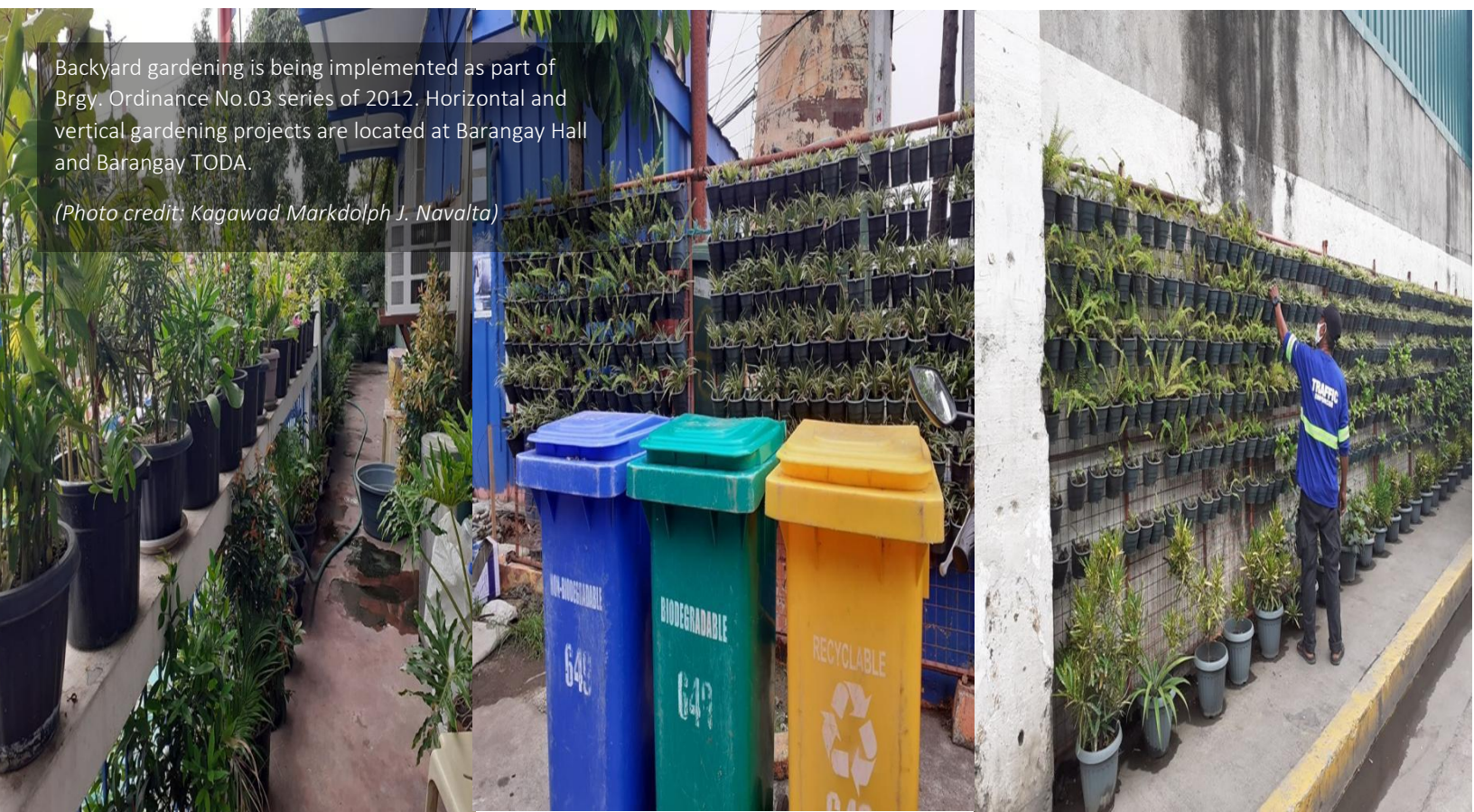
Policy enforcement would always carry challenges. Behavior of individual waste generators is one of the factors affecting the implementation of the SWM policy that sometimes put the safety of the implementers at risk. The Barangay officials admitted that they are taking extra effort to discipline the neighborhood as the implementers' safety and security are at stake, especially the street vendors who are also residents of the barangay.

Two (2) mini-compactor (MC) garbage collection trucks are assigned by the city government to collect and transport the wastes generated in the barangay. To date, the Barangay has only garbage bins, trash bags, and 30 carts that their personnel use to handle wastes. The personnel are also provided with gloves, rain boots, and raincoats when needed. The tools are being kept and regularly inventoried at the barangay MRF. However, it was noted that the number of tools is not proportional to the number of staff to bring about the expected results. Street sweepers and garbage collectors play vital roles in the fulfillment of the SWM policy; thus, their protection should be ensured and should be given full protective gear while on duty.

As the needs arise, special meetings are conducted by the BSWMC to clarify certain questions about ongoing activities and solve pressing issues. The committee chairman mentioned that the members follow a consensual approach in arriving at a decision, as different sectors of the barangay (business owners, household, residents, etc.) are invited whenever there are meetings. It was also cited that the committee keeps a record of minutes of meetings and important data records (such as assessments and capacities, historical data, income generation in the MRF, policies and other guidelines, among others).

Backyard gardening is being implemented as part of Brgy. Ordinance No.03 series of 2012. Horizontal and vertical gardening projects are located at Barangay Hall and Barangay TODA.

(Photo credit: Kagawad Markdolph J. Navalta)

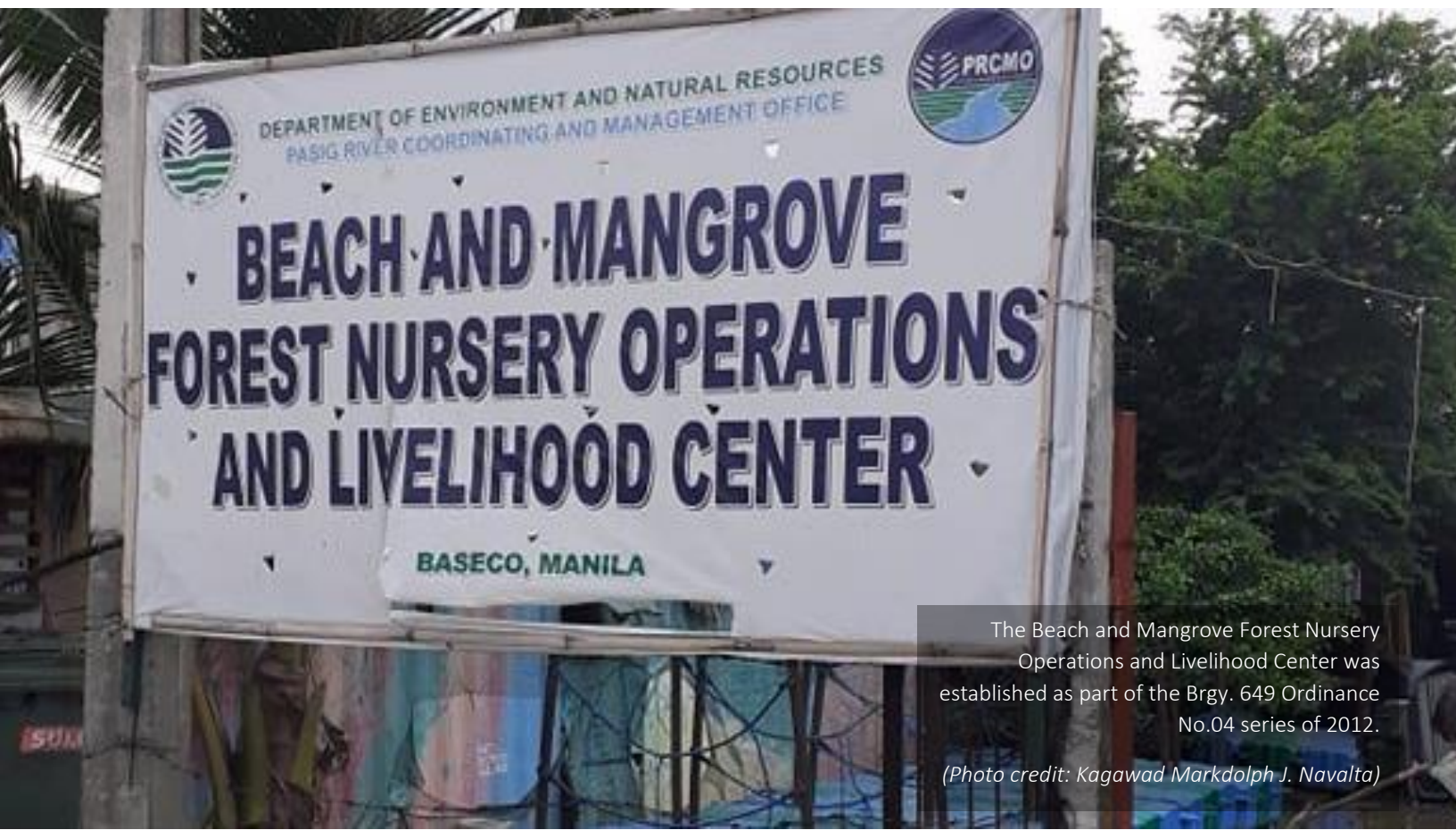


Wastes are collected by the waste pickers from the designated pick-up points following a schedule. This, however, has not been fully practiced by some barangay residents the occasional presence of garbage in some corners of the street, as well as in the pick-up sites even after the scheduled garbage collection, has been observed.

Likewise, it was mentioned by some FGD respondents that segregation is not totally followed by both the waste pickers and the residents particularly at the household level. Nonsegregated wastes from households are, just the same, collected by waste pickers and or street children in exchange of giving donations in any amount, and placed directly in the garbage trucks. Practicing segregation-at-source by some residents is being driven by incentives as generally observed by the BSWMC.

The following other observations were noted by the research team: **(1) designated segregation bins distributed within the barangay are generally not properly utilized by the residents and people passing the barangay; (2) unavailability of updated financial record on the selling of the recovered recyclable materials as well as how the fund is used in maintaining the activities of the MRF; (3) absence of accurate database that can serve as basis for establishing goal-oriented, results-based monitoring and evaluation systems for short, medium, or long term solid wastes management planning for the barangay; and (4) enforcement issue as indicated by the occasional presence of some piled up garbage in the waterways and the outdated records of violations, penalties, or fines related to collection and segregation.**

Based on the MES, Barangay 649 was able to comply with 67.00% of the criteria for the element Operation in the MEQ. With some issues that can create gaps constraining effective wastes management, it can be largely said that Barangay 649 needs to improve its operations in managing wastes.



The Beach and Mangrove Forest Nursery Operations and Livelihood Center was established as part of the Brgy. 649 Ordinance No.04 series of 2012.

(Photo credit: Kagawad Markdolph J. Navalta)

Education Campaign

Barangay 649 regularly implements three main projects to provide education and information awareness on the importance of SWM. These activities include **setting up a social media account, participating in the national coastal clean-up day and holding regular barangay clean-up drive (e.g., backyard and seaside), and creating waste disposal and/or information signages.**

A social media/Facebook account <https://www.facebook.com/groups/396664697653934> (Baseco Public Information Office) is being managed by the barangay. With 11.0K followers, the barangay officials view the platform as a mechanism to effectively provide information and updates on waste management program to the barangay constituents.

Spearheaded by the barangay council, volunteer residents of Barangay 649 regularly hold a weekly clean-up drives to clean waterways within the barangay. Similarly, the same group actively participates in the annual coastal clean-up activity in an effort to provide awareness on the protection and conservation of the coastal area. It is cited to be a successful project in terms of increasing number of participants every year. In addition, the mandatory seaside clean-up drive conducted every Sunday from 6:00 a.m. to 8:00 a.m. is being participated in by around 300-500 residents. In exchange, the barangay provides incentives and/or prioritizes these volunteer residents in their future programs/projects. A backyard clean-up drive and/or backyard gardening is another option given for those who cannot join the seaside clean-up activity.

The barangay has an active partnership with several organizations as sponsors or trainers for their SWM education and information campaigns as well as for their beautification programs such as Unilever's *Misis Walastik* project; while partner NGOs (e.g., Caritas, *Kabalikat* and World Vision) provide SWM training for barangay personnel and visit to model barangays. Another project that will help resolve the garbage problem in the barangay is the launching of "*Aling Tindera*" where high-valued PPE plastics will be bought at 10 pesos per kilo. The composting activity is also being partnered with an NGO focusing on *Ilog Pasig* project.

The barangay also provides information and/or reminders on ordinances, program, and places where and when wastes should be disposed. Barangay officials claimed that these signages are maintained and/or replaced when needed. Some participants, however, cited that the use of signages as tool for behavioral change are ineffective since some of the residents' negative attitude are affecting the favorable practice on SWM, and it is still a major concern in the barangay.

The following additional observations were noted by the research team: (1) the absence of any partnership project or activity with specific barangay stakeholder in reference to SWM education and information campaigns; and (2) the current effort does not fully help achieve the education campaigns objective as evidenced by the respondents' confusing or different responses when asked about the presence of barangay ordinance or regulation on the use of single-use plastic.

Based on the MES, Barangay 649 was able to comply with 80.00% of the criteria for the element Education Campaign in the MEQ. The cited barangay-initiated projects are generally perceived by the barangay stakeholders as one of the contributors in promoting awareness and disseminating information to the residents of the barangay. Whether or not the cited education campaigns are translated into some positive behavioral response of the residents to the barangay SWM program can be a subject of a deeper inquiry.

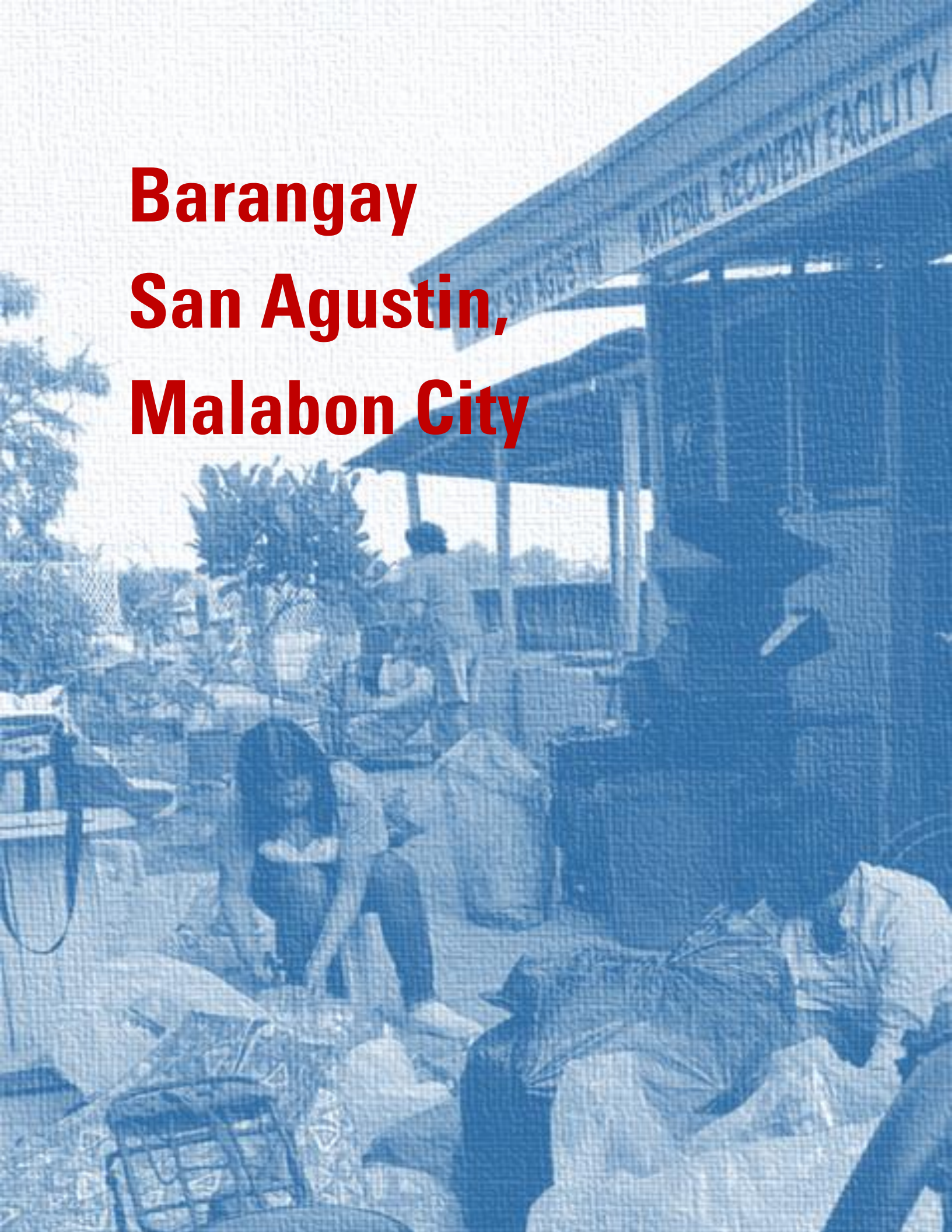
Policy Suggestions

The findings identified four critical gaps that BSWMC members need to give attention to. These gaps comprise the following: the need to strengthen the solid waste segregation practice, establish systematic data base, a stronger SWM regulation enforcement, and necessity for regular trainings and/or seminars for both SWM staff and residents. In view of these, the following policy recommendations are suggested:

- Strengthening of the barangay solid waste segregation practice as well as recovery of biodegradable, recyclable, and reusable materials prior to waste collection. In addition, the MRF should be made functional to minimize the quantity of solid waste being collected and disposed by the LGU.
- Improvement of database management by establishing periodic updates of database in all records pertaining to the barangay SWM. The barangay should utilize the output for the formulation and/or revision of the management plan
- Imposition of stricter program enforcement with the help of the barangay *tanod*. Violators of the ordinance should be properly dealt with based on the existing policy.
- Further improvement of staff trainings and skills program to fully achieve the objectives of the management plan. A parallel program for trainings/seminars should be prepared to other stakeholders (e.g., households, schools, business sector) whenever possible to promote participation to the barangay SWM program.



Barangay San Agustin, Malabon City



Introduction

This report is the product of the Solid Waste Management (SWM) efficiency assessment conducted in Barangay San Agustin, Malabon City from August to December 2020 for the project

**“Solid Wastes Management Efficiency Assessment
of Selected Local Government Units
Along Manila Bay”.**

Overall, the project aims to determine the collection and performance efficiency of five selected local government units comprising the Manila Bay Watershed.

The project activities include determination of the barangays’ solid waste production, comparison of waste volumes collected by the concerned local government units and modeling tool utilization to assess efficiency performance in SWM.

The project is funded by the USAID thru the EcoWaste Coalition in partnership with the University Research Office, De La Salle University – Dasmariñas.



Executive Summary

1

The solid waste collection efficiency rating for Barangay San Agustin is estimated at 76.61% based on to the disposal rate of 61.67% and material recovery rate of 14.94%. Moreover, the barangay's solid waste management efficiency score is 90.00% with the element Policy having the highest rate among the three elements assessed followed by Education and Operation:

- Barangay San Agustin was able to comply with **90.00% in the criteria of Policy** in the MEQ. This means that that the barangay chief executive is effectively carrying out its mandate on R.A. 9003 and related ordinances that it has laid down for its constituents with respect to the establishment of a functioning Materials Recovery Facility and solid waste collection among households.
- Barangay San Agustin was able to comply with **77.00% of the criteria for the element of Operation** in the MEQ. This particular area leaves much room to be desired because of the complexity of the solid waste problem, especially with regards to segregation at source. The underlying cause is behavioral in character requiring a thorough study on changing behavior and cultural viewpoints on solid wastes.
- Barangay San Agustin was able to comply with **80.00% of the criteria for the element Education campaign** in the MEQ. Environmental awareness in formal education is indubitably felt among the learned individuals while more attention should be given to the informal sector to strike a balance between these two areas.

The solid waste management program efficiency assessment generally identified three critical gaps that the Barangay solid waste management committee members need to give attention to. These gaps comprise the following: strengthen the implementation of the lingering ordinance against single-use plastics; behavioral modification towards segregation-at-source; and, enhancing education in the informal sector. The following policy suggestions are recommended based on the results of the management efficiency assessment:

2

- Barangay San Agustin administration's delay on the enforcement of the ordinance against single-use plastics can be strengthen if a policy can be enacted on a national level.
- Barangay San Agustin administration must exert more effort on segregation within the households to significantly reduce the volume of residual wastes during collection, relieving the burden on the over-extended capacity of disposal facilities.
- Barangay San Agustin administration must mobilize barangay personnel and capacitate them as educational facilitators in the informal sector who do not have the benefit of receiving information and education on proper solid waste management as compared to formal education.

Terms of Reference

In relation to this report, the two terms of reference for the project were the following: 1) to estimate the Collection Efficiency Rating (CER) of the barangay anchored on the solid waste system flow, and (2) determine the Management Efficiency Score (MES) of the SWM program currently implemented in the barangay.

Methods and Respondents

Computation of the variables used to estimate the CER follows a set of statistically validated formulas while the overview of the SWM program of Barangay 76 was mainly acquired through an assessment tool called Management Efficiency Questionnaire or MEQ. This was supplemented by available secondary information, ocular inspection through site visits, household survey, and series of online focus group discussions (FGD) with research informants and participants.

Representation of the key stakeholder groups in the barangay, namely: barangay officials, household residents, business group, informal settlers, SWM program staff members (waste pickers, gardeners, garbage collectors, drivers) was considered in the selection of the 100 household survey respondents and the 10 FGD participants. Self-efficiency evaluation using the assessment tool was done by the members of the Barangay SWM Committee (BSWMC).

MEQ contains 25 indicators mostly anchored on the requirements of RA9003. Five indicators are under policy, 15 on operation (being the center of the SWMP) and 5 indicators are listed under education campaign. The assessment indicators are presented in tabular form to allow scoring, recording the details of the assessment, and identifying any intended actions that will improve the management efficiency. The schedule of activities conducted by the research team is outlined below.

Table 9. Research Team Schedule of Activities in Brgy. San Agustin

Activities	Month conducted
Courtesy call and orientation about the project	August
Answering of household survey/data information sheet and MEQ	August - September
Focus group discussion/interviews	September - October
Field visits and validation	August - November
Final report writing	December

Description of Barangay San Agustin

The target community is among 21 barangays of the City of Malabon with a total land area of 31.59 hectares representing 2.5% of Malabon City's total land area of 15.71 sq. km. Current population figures furnished by the barangay local government is approximately 11, 496 residents distributed among 3,300 households. There are about 80 documented informal settlers (ISF). The main livelihood of the majority of the population work as factory workers and municipal / barangay clerks or staffs.

Barangay Agustin was rated with an average performance score of 76% in the latest Local Governance Performance Management System (LGPMs) on environmental governance. According to the report, the barangay has their own functional Material Recovery Facility occupying a land area of 500 km².



House-to-house collectors use carts that can travel through the narrow alleys of the barangay and bring them to a common collection point for the garbage trucks.

Photo courtesy of Barangay Administrator

In 2018, Barangay San Agustin implemented a Solid Waste Collection (Household) program from January to December, where its constituents are the beneficiaries, with a cost of around Php 302,400.00 taken from its own Barangay Fund.

For the current year, the allocated budget for environmental management was Php 500,000 and another Php 500,000 for declogging activities. Total solid wastes generated by the barangay based on diversion rate is 143.4 tons for one whole year. For the recyclables generated in a year, the total weight generated from recyclable plastics was approximately 12,000 kilogram/year, while the total weight of recyclable plastics collected per year was around 1,296 kilograms.

The barangay also actively participated in the city government program on waste segregation and recycling, hence the barangay was able to generate income from waste management amounting to Php 40,000/year and an estimate of Php 20,000 /year income from total compost produced per year. Residual wastes produced per year from the barangay is almost 14.3 or 10% of the diversion rate (CPDD 2018).

The barangay's strong support for SWMC is evident through their own resources and campaign materials. Its human resources include 15 personnel who are garbage collectors and sweepers and 1 environment police officer, and equipment consisting of 1 mini dump truck for garbage collection and 12 handcarts "kariton".

Other materials for barangay collectors and sweepers include stick brooms, dustpans, tongs, boots, and raincoats. In addition, information campaigns are conducted quarterly through the use of Information, Education and Communication (IEC) materials such as leaflets and the use of social media together with 12 public address equipment for broadcasting.

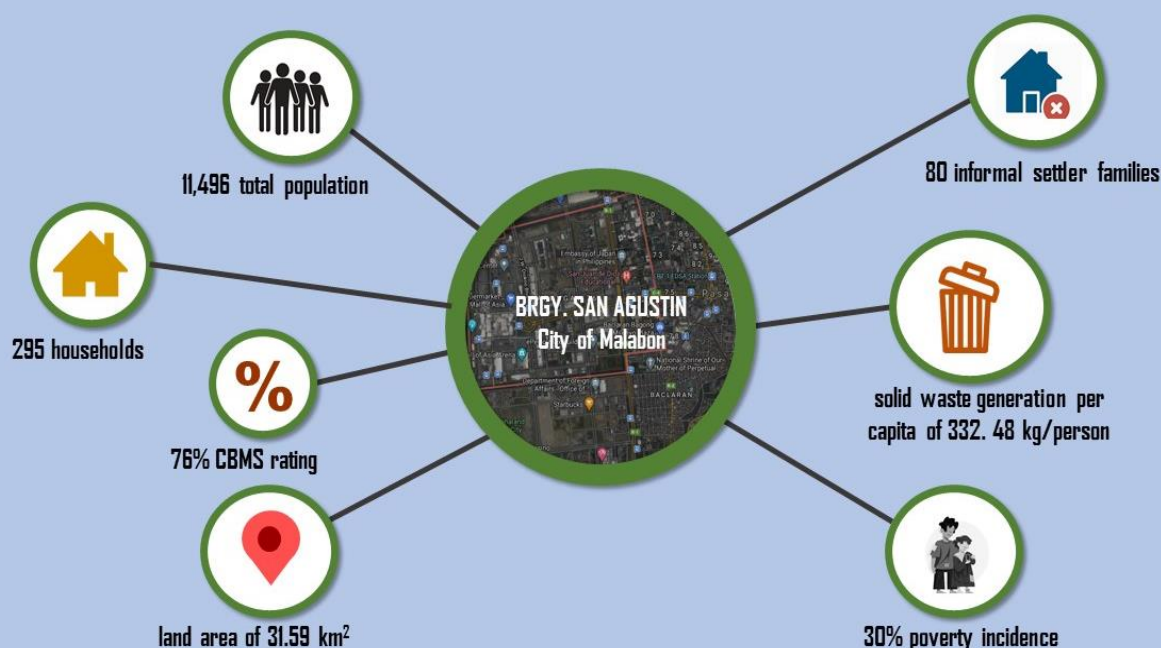


Figure 8. Demographic and Socio-economic Features in Brgy. San Agustin

Solid Waste Collection Efficiency

While the study focused on Barangay San Agustin, it can be typically described that most of the barangays in the municipality generates solid wastes that requires proper management, that to effectively carry it out, the barangay solid waste management plan must be consistent with that of the SWM Board of Malabon City. The potential risks to the environment and to public health may arise from the manner by which the solid wastes are collectively handled, collected, and disposed of (Ferronator and Torretta, 2019). The figure below summarizes the waste collection efficiency in the barangay.

In reference to the source, the solid waste generated in the barangay are classified either as internal or external wastes. Those associated with domestic activities of the residents are called internal waste while the external wastes are those that are mostly generated by the activities of the ambulatory vendors selling different products (including food, beverages, and other items) in containers or packaging that are assumed to be discarded by consumers within the barangay as waste.

On a weekly basis, the barangay generates nearly 15,516.12 kg of solid waste from both internal and external sources. From this total amount, some 1,324.79 kg of recyclable materials wind up in the recycling centers such as the barangay-contracted junk shops.



Diagram of the solid waste system flow in Barangay San Agustin depicting its current solid waste management practice. It also illustrates the estimated amount and percentage of solid waste generated and handled in every stage of the flow as well as the mismanaged waste from uncollected and undisposed waste.

Selling the recyclable and reusable materials is one way by which the barangay can increase the revolving fund for the maintenance of the MRF. The barangay MRF functions as temporary item storage area and houses the composting provision area from where the crudely estimated 2,317.93 kg of biodegradable material from the total generated waste are composted registering about some 14.94% material recovery rating.

An estimated 9,600 kg are collected by the municipal garbage truck and subsequently handled in the landfill accounting to a low disposal rate of 61.67% or 9,569.23 kg of disposed waste. The remaining 23.29% equivalent to about 3,628.96 kg of uncollected and undisposed waste is considered mismanaged since they leak from the usual route of garbage in the solid waste system flow. This is the type of waste that presumably end up in the water ways and in the long run reach the Manila Bay

Considering the material recovery and disposal activities, Barangay San Agustin attained an approximate CER of 76.61%. However, determining the CER is just a tip of the iceberg. Systems thinking dictates that the collection process being practiced in the barangay can be shaped by a deeper level of abstraction which is not obviously seen from the surface. Hence, looking at the structure showing the framework within which the collection process operates offers a better understanding of the issue.



Kitchen and other biodegradable wastes subjected to composting in the barangay MRF.

(Photo courtesy of Barangay Administrator)

Results of the SWM Efficiency Assessment

The table on the next page provides the summarized results of the SWM efficiency assessment conducted for Barangay San Agustin. Here, the collection process is viewed as an operation which can be influenced by two other elements, namely policy and the education campaign.

As shown, among the three areas of solid waste management purposely identified in the study, operation leaves much to be desired, particularly in the collection and transport stages of solid waste management as well as a failure of the constituents to perform its shared responsibility in waste reduction at source.

Policy

The enactment of ordinances related to solid wastes management is intended to further the goals of RA 9003 and curb marine pollution brought about by single-use plastics and other debris. It can be seen that the law prohibiting the throwing of garbage as stated in the Philippine Clean Water Act is diligently observed and practiced by the residents brought about by their long history of flooding to which Malabon is known for (Rodolfo 2006). What is lacking though is the difficulty of the local government to effectively carry out the ordinance on banning the use of single-use plastics. An ordinance was already drafted as early as 2013 but until the present, it has yet to be implemented due to the many issues that arose which include inflicting a negative impact on the fish trading industry and other small-scale businesses which heavily relies on plastic packaging.

The seemingly lackluster enforcement of the plastic ban is attributed to the absence of a national policy on plastic ban. Perhaps a promising effort by the National Solid Waste Management Commission is the passing of NSWMC Resolution No. 1353, a national policy requiring all local government offices to implement banning single-use plastics in their respective areas.



Residents are taught how to recycle PET bottles by repurposing them for a different use.

(Photo courtesy of Barangay Administrator)

Table 10. Summarized Solid Wastes Management Efficiency Assessment Results for Brgy. San Agustin

Element	Focus	Major findings	MES*		%
			Maximum	Obtained	
Policy	Enactment of solid waste-related ordinances by the Sangguniang Barangay aligned with R.A. 9003 and integrated in the BSWM Plan	The barangay saw the need to further the goals of R.A. 9003 to include prohibition on throwing garbage in the river and the banning of single-use plastics. The plastic ban, however, was not seriously enforced for reasons that would affect the city's economy that relied heavily on plastics.	10	9	90.00
Operation	Logistical and human resources dedicated for solid waste management as required by R.A. 9003 on Materials Recovery Facility, collection, processing and transport and the shared responsibility between the local authority and its constituents.	The barangay has a fully functional Material Recovery Facility complete with compost pits but the low diversion rate of 14.3% indicates that the MRF has not reached its optimum level of efficiency as large volumes of residual wastes are still being collected from the households, an indication of non-segregation at source. A low waste diversion rate would consequently require more collectors, more carts and more vehicles for transport.	30	23	77.00
Education	Disparity of the Information Education Communication Campaign between formal and informal education.	Educational awareness is well integrated in formal education, while the need for an intensified information and education campaign for the less fortunate, informal sector of society should be given more attention. Values formation towards faithful segregation within the households is the key to a genuine waste reduction at source.	10	8	80.00
Total			50	40	82.30

*Highest Management Effectiveness Score (MES) is 50 points or 100%. There are three main elements (policy, operation, education campaign) which have corresponding maximum points. Based on the focus, each main element has several criteria with differing values.

Operation

A notable attribute that needs further strengthening are the current logistical and manpower resource employed by the barangay for their solid waste management activities. Even though the LGU scored itself with a satisfactory result, a contrasting view suggests further improving the status quo by upgrading its equipment, employing more personnel and building their capacity even better. The Material Recovery Facility which was likewise identified by most respondents as not having reached its full potential can benefit with the added manpower and equipment to increase its profits since the sale of its compost and recyclables would significantly improve the MRF's output.

One of the weakest areas of compliance is the perceived failure or negligence of many households to actually segregate their own wastes, thus putting the burden on the barangay to do most of the sorting and segregation process.

While there is no clear indicator of the performance of residents on reduction at source, the regular conduct of barangay-wide clean-up compensates the situation in order to maintain the cleanliness of its surroundings. However, it also reveals the shortcomings of its citizens because the trash indiscriminately discarded endlessly compels the barangay to always clean up afterwards. If only citizens perform their role in disposing their own garbage properly, that the need for barangay clean-up would no longer be done frequently.



Transferring collected solid wastes from several small carts to a garbage truck.

(Photo courtesy of Barangay Administrator)

Education Campaign

Admittedly, the local government has not reached the desired level of satisfaction towards the overall cleanliness of the barangay because many of the residents are not fully complying with the barangay's policy on solid waste management.

A more aggressive information and dissemination campaign that clearly delineates the roles of the citizens and the barangay should be strongly emphasized to lessen the dependence of the citizenry on the local government and make them more self-reliant, proactive and true contributors to a clean environment.

A very noticeable finding is the high disagreement among PWDs, which can be construed as either having limited access to services related to solid waste management or their non-inclusion in the overall efforts on solid waste management. Persons-with-disabilities may serve as good indicators of public service performance since they are largely marginalized due their handicaps. Their inclusion in the study revealed the flaws in public governance for its failure to make the solid waste management program inclusive to marginalized people such as persons-with-disabilities (Karagiannidis et al., 2008).

The use of a multipurpose shredder complements the MRF by reducing its storage requirements.

(Photo courtesy of Barangay Administrator)



Policy Suggestions

- 1.** With the passing of NSMC Resolution no 1353 ordering all local government units to implement the ban on single-use plastics in their respective offices, the Sangguniang Barangay should convene to amend its 10-year Barangay Solid Waste Management Plan to include the banning of specific single-use plastics stipulated in the Resolution but at the same time consider adopting other alternatives to the use of plastics that are heavily used in fish trade and small-scale businesses (NSWMC 2020). A careful study is required to weigh the costs and benefits of shifting away from the use of plastics without negatively affecting the economy of the City resulting to the adverse effects it might have on the plastic manufacturing industry that contribute a large revenue to the local economy.
- 2.** A Material Recovery Facility when operating at its optimum level has the potential of effectively reducing the number of residual wastes that the barangay has to dispose of, if the recyclables and biodegradables are effectively removed from the waste stream. When the volume of residuals is significantly reduced as indicated by the decreased number of dump trucks mobilized, and a lesser volume of garbage is hauled, can one say that the diversion of the recyclables away from the landfill was fulfilled by home segregation through a fully-optimized Material Recovery Facility. Thus, the savings in the budget for waste hauling and disposal can be realigned with other projects that can further improve the current solid waste management program.
- 3.** While the efforts of the local government units are highly commendable, the efforts on the part of the citizenry leaves much to be desired. A more comprehensive information and education campaign should be more inclusive of all sectors of the community. There are still many provisions in RA 9003 that require more dissemination and clearer explanation to the ordinary citizen so their role as responsible citizens dedicated to the protection and care of the environment is deeply ingrained in their attitudes and practices. Inclusiveness of all sectors should be encouraged to uplift nationalism and patriotism of even the marginalized people who instead of completely relying on government subsidies can be transformed into productive and confident citizens.
- 4.** When governments or states wage war against their home-grown social and environmental problems, they can sustain their war efforts if they continuously improve their logistical and manpower with cutting edge knowledge and technology. Many have lost wars because of the failure of governments to upgrade their equipment and improve the skills and competencies of their manpower. Thus, it is imperative that the constant search for best practices and the adoption of best available technologies can be found through communication and collaboration with other local government units, non-governmental organizations. The desire to improve for the better should be the major attribute of a local government unit in the pursuit of a cleaner environment and sustainable development (Ali et al., 2010).

Brgy. San Dionisio, Parañaque City



Introduction

This report is based on the results of solid waste management assessment carried out in Barangay San Dionisio, Parañaque City from July to December 2020 for the research project **“Solid Waste Collection Efficiency Assessment of Selected Local Government Units Along Manila Bay”**.

The project generally aims to determine the collection and performance efficiency of five selected local government units that are part of the Manila Bay watershed.

The project activities include determination of the five barangays’ solid waste production, comparison of waste volumes collected by the local government units (LGU) concerned, and modeling tool utilization to assess management performance affecting the solid waste collection process.

The project is funded by the USAID thru the EcoWaste Coalition in partnership with the University Research Office, De La Salle University – Dasmariñas.



Executive Summary

1

The solid waste collection efficiency rating for Barangay San Dionisio is estimated at 8.92% based on to the disposal rate of 8.69% and material recovery rate of 0.23%. Moreover, the barangay's solid waste management efficiency score is 71.00% with the element Policy having the highest rate among the three elements assessed followed by Education and Operation:

- **Ninety percent (90.00%) compliance to the criteria for the element Policy** in the Management Efficiency Questionnaire (MEQ). This means that that the barangay has established the necessary mandate on RA 9003 through its ordinances in compliance also to the City's solid waste management plan.
- **Sixty-seven percent (67.00%) compliance to the criteria for the element Operation** in the MEQ. This particular area can be further improved because of the complexity of the solid waste problem, especially with regard to segregation at the source. The underlying cause is behavioral and requires a thorough study on changing behavior and cultural viewpoints of the residents on solid wastes.
- **Sixty-five percent (65.00% of the criteria for the element Education Campaign** in the MEQ. Environmental awareness should be strengthened through formal and non-formal methods.

The solid waste management program efficiency assessment generally identified three critical gaps that the Barangay solid waste management committee members need to give attention to. These gaps comprise the following: strengthen the implementation of segregation at source, manage properly its Material Recovery Facility, of the lingering ordinance against single-use plastics; behavioral modification towards segregation-at-source; and, enhancing education in the informal sector. The following policy suggestions are recommended based on the results of the management efficiency assessment:

2

- Enforce a barangay ordinance against single-use plastics. This can be strengthened if a policy can be enacted on a national level.
- Influence households to do waste segregation at home to significantly reduce the volume of residual wastes during collection to relieve the burden on the over-extended capacity of disposal facilities.
- Mobilize barangay personnel and train them to be educational facilitators in the informal sector who do not have the benefit of receiving information and education on proper solid waste management as compared to those who receive formal education.
- Evaluate its existing contract with its private contractor pushing concentration on waste recovery.

Terms of Reference

In relation to this report, the two terms of reference for the project were the following: (1) estimate the Collection Efficiency Rating (CER) of the barangay anchored on the solid waste system flow, and (2) determine the Management Efficiency Score (MES) of the SWM program currently implemented in the barangay.

Methods and Respondents

Computation of the variables used to estimate the CER follows a set of statistically validated formulas (Attachment C), while the overview of the SWM program of Barangay San Dionisio was mainly acquired through an assessment tool called Management Efficiency Questionnaire or MEQ (Attachment D). This was supplemented by available secondary information, ocular inspection through site visits, household survey, and series of online focus group discussions (FGD) with research informants and participants.

Representation of the key stakeholder groups in the barangay, namely barangay officials, household residents, business group, educational institutions, persons-with-disabilities and barangay SWM personnel (waste pickers, gardeners, garbage collectors, drivers), were considered in the selection of the 100 survey respondents and the 10 FGD participants. Self-efficiency evaluation using the assessment tool was done by the members of the Barangay SWM Committee.

MEQ contains 30 indicators mostly anchored on the requirements of RA 9003. Five indicators are under Policy, 15 under Operation (being the center of the SWMP), and 5 under Education Campaign. The assessment indicators are presented in tabular form to allow scoring, recording the details of the assessment, and identifying any intended actions that will improve the management efficiency. The schedule of activities conducted by the research team is outlined below.

Table 11. Research Team Schedule of Activities in Brgy. San Dionisio

Activities	Month conducted
Courtesy call and orientation about the project	August
Answering of household survey/data information sheet and MEQ	August - September
Focus group discussion/interviews	September - October
Field visits and validation	August - November
Final report writing	December

Description of Brgy. San Dionisio

Barangay San Dionisio is a coastal community located in the City of Parañaque. It is bordered by La Huerta and Moonwalk in the north, Moonwalk and San Isidro to the east, Manila Bay to the west, and Manuyo to the south. San Dionisio is one of the earlier barrios in Parañaque.

Following the Spanish customs of naming people and places after patron saints, the barrio was named after St. Dionysius. Saint Dionysius was a bishop who defied death in order to propagate the Christian faith. In previous years, it was a large area consisted of rice fields, salt beds, and irrigable lands until they have been converted into several subdivisions.



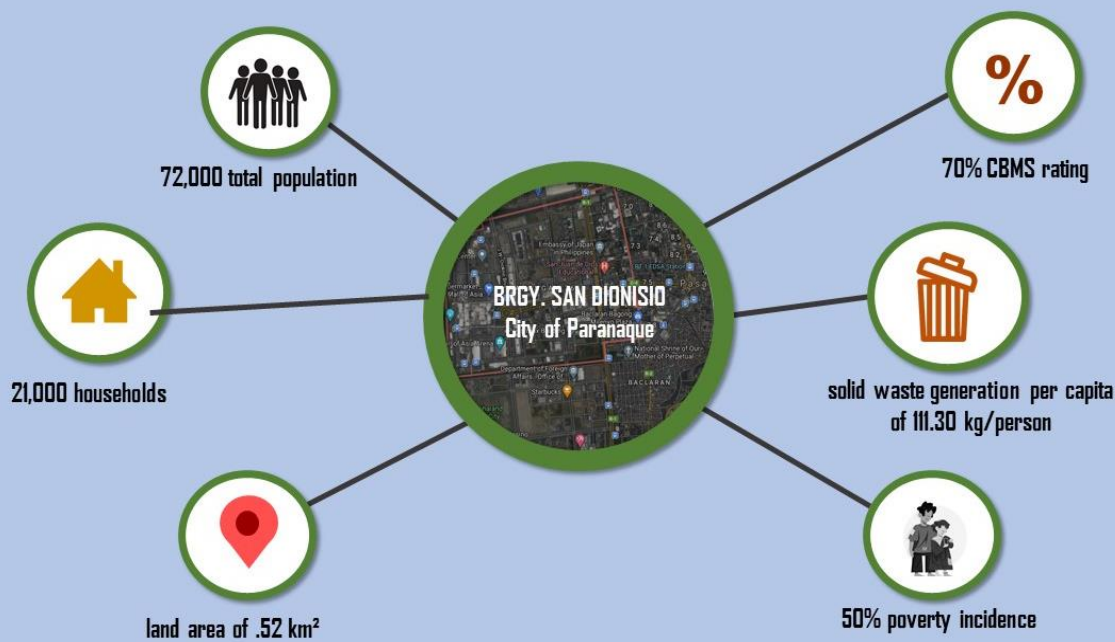


Figure 9. Demographic and Socio-economic Features in San Dionisio

Barangay San Dionisio has a total land area of 6.62 sq.km. or 662 ha. with a total population of 72,000 (barangay data), representing about 21,000 households. Projected density is 102 individuals/ha. The per capita income ranges from PHP1,000 to PHP30,000 per month based on barangay survey.

The poverty incidence is about 50%, but no data were given on total number of informal settler families (ISF) The primary sources of income include the following: fishing, vending, scavenging, PUV driving, government/private sector employee, and business owners, while the other sources are construction worker/laborer, service-oriented labor, and OFW. The data presented in the figure on the next page were based on the 2020 barangay profile.

Barangay San Dionisio was rated with an average performance score of 76% in the latest Local Governance Performance Management System (LGPMS) on environmental governance. According to the report, the barangay has their own functional Material Recovery Facility, occupying a land area of 500 m².

Based on data provided by the barangay, a total of 2.019 tons of wastes daily or an estimate of 737 tons of wastes yearly are being generated by the barangay, with 1.564 tons of recyclable plastics collected each year. However, there are only estimated number of other types of wastes, such as biodegradables (usually left-over food), non-recyclables, and non-biodegradable residuals, that are generated and collected.

Solid Waste Collection Efficiency

While the study focused on Barangay San Dionisio, it can be typically described that most of the barangays in the municipality generates solid wastes that require proper management, and to effectively carry it out, the barangay solid waste management plan must be consistent with that of the SWM Board of Parañaque City. The diagram below summarizes the waste collection efficiency in the barangay.

In reference to the source, the solid waste generated in the barangay are classified either as internal or external wastes. Those associated with domestic activities of the residents are called internal waste (92.02% of the waste generated), while the external wastes are those that are mostly generated by the activities of the ambulatory vendors selling different products (including food, beverages, and other items) in containers or packaging that are assumed to be discarded by consumers within the barangay as waste, which comprise 7.98% of the waste generated.

On a weekly basis, the barangay generates nearly 460,350 kg of solid waste from both internal and external sources. From the available logistics of the city and the barangay such as the number of garbage trucks and frequency of collection per week of these trucks, only 21.08% of the generated waste are collected. And with an average downtime of trucks for repair to about 30 days per year, about 56,000 kg or 12.16% are not collected or disposed of. This translates to a weekly disposal to only 8.69%. This means that of the total 460,350.66 kg generated per week, only 8.69% of these are disposed to the landfill.



Diagram of the solid waste system flow in Barangay San Dionisio depicting its current solid waste management practice. It also illustrates the estimated amount and percentage of solid waste generated and handled in every stage of the flow as well as the mismanaged waste from uncollected and undisposed waste.

From the generated waste, only 1,069.67 kg, or a dismal 0.23% of the total generated waste, of recyclable materials wind up in the recycling centers, such as the junk shops. Together with the 8.69% disposed and the 0.23% of recovered waste, the solid waste collection efficiency of Barangay San Dionisio is 8.93%.

From the 460,350.66 kg of waste generated per week and with only a total of 8.93% collected, either being disposed to landfill or recovered through MRF or the Barangay junk shops, this leaves a 419,283 kg of mismanaged waste or 91.07%. These mismanaged wastes eventually become pollutants to the waterways that will eventually reach the Manila Bay.

Converted to an annual value, the estimated mismanaged waste generated by Barangay San Dionisio would amount to 21,802,716 kg or 21,802.716 tons.

Sources and Impacts of Inefficiencies

In the area of waste generation, the decision to shift waste segregation to non-biodegradable (*dinabubulok*) and biodegradable (*nabubulok*) instead of segregating waste to recyclable waste, biodegradable, and residual waste had an impact on collection. Segregation based on only these two categories will definitely mix residual, biodegradable, and recyclable waste (mixed waste) that recovery of recyclable and biodegradable waste would be difficult. This practice not only made the Material Recovery Facility (MRF) non-functioning—as exemplified by the dismal production of the barangay's MRF—but also reduced recovery of the junkshops.

This also increased pressure from the collecting trucks since collection of mixed waste is shifted to collection by trucks instead to MRF and junkshops. Since there is a shift to collecting trucks, the capacity to collect waste will be based on available logistics, which include the number of trucks, the capacity of trucks, frequency of collection, personnel, and the maintenance program of these logistics. Eventually, this logistical need would depend on capacity of the barangay and the city to finance this need.

In the area of collection, the sources of inefficiencies are the following: (1) failure to optimize vehicle productivity because of insufficient number of vehicles for collection; (2) non-functioning Material Recovery Facility; (3) lack of barangay vehicles for collection; and (4) waste collection delegated to a private contractor. These inefficiencies can be traced to the contracting a private contractor to handle waste collection of the barangay.

Since private contractors are bounded by contract in terms of number of collections and on a one city, one method approach using large collecting trucks, the inaccessibility to narrow roads and alleys becomes a major issue of collection as validated by stakeholders. Second, since private contractors are limited by the budget provided by the city government, budget contracts might be limited to a maximum number of collections, number of trips to landfills, number of trucks or personnel, which makes waste recovery to be not included in the reduction of waste generation. It was also reported that downtime of these collecting trucks amount to about 30 days per year which increases the amount of uncollected to mismanaged waste.

Results of the SWM Efficiency Assessment

The table on the next page provides the summarized results of the SWM efficiency assessment conducted for Barangay San Dionisio. Here, the collection process is viewed as an operation which can be influenced by two other elements, namely policy and the education campaign.

The general perspective thru the conduct of survey and interview with the 100 randomly selected respondents representing four (4) sectors namely households (70%), school (10%), business (10%) and barangay (10%), is shown in Table 4 (see also Appendix). Based on the SWM efficiency questionnaires covering 16 questions, the school sector has the highest score (4.73) followed by barangay (4.68), then business (4.52), and household with the lowest score (4.46). The general average mean score of Barangay San Dionisio is 4.60, indicating a very high SWM efficiency among the 100 respondents.

In summary, the top 5 best practices based on the SWM efficiency questionnaires are the following: **(1) Garbage-burning is strictly prohibited in the Barangay; (2) I am proud of my Barangay's Solid Waste Management Program; (3) There is a regular schedule of waste collection; (4) The throwing of garbage in esteros or rivers is strictly prohibited as well as burning of garbage; and (5) There is an ordinance on SWM.**

While the top 5 areas that need improvement are the following: **(1) There is an existing ordinance that regulates the use of single-use plastic; (2) Our Barangay has sufficient equipment in SWM; (3) our recyclable wastes are collected separately by our Barangay; (4) All residents follow the barangay's SWM; and (5) the barangay has an MRF where we surrender our recyclables.**

In terms of the SWM program efficiency assessment for Barangay San Dionisio, there were three (3) elements considered: Policy, Operation, and Education Campaign. The total SWM efficiency score for Barangay San Dionisio is 71%. The percentage score in the element Policy (90%) is the highest among the three elements evaluated. The elements Education Campaigns and Operation obtained a low rating of 65% and 67%, respectively.



Table 12. Summarized Solid Waste Management Results

Element and Indicator	Assessment Score*		
	Self	Expert	Average
1. Policy	9	9	9.0
1.1 Basis of barangay SWM program	1	1	1.0
1.2 Creation of committee on solid waste management	5	5	5.0
1.3 Feasible management plan and management budget	3	3	3.0
2. Operation	25	15	20.0
2.1 Needed personnel and equipment	4	4	4.0
2.2 Implementation of solid waste management	8	5	6.5
2.3 Usefulness of material recovery facility	5	1	4.0
2.4 Staff training and solid waste management activities	4	3	3.5
2.5 Functional database	2	1	1.0
2.6 Review of management plan	2	1	1.0
3. Education	10	9	9.5
3.1 Presence and conduct of campaigns	4	2	2.5
3.2 Signages and other information materials	3	2	2.5
3.3 Effectiveness of education campaigns	1	1	1.0
Total score in all aspects	42	23	25

The solid waste management programs of Barangay San Dionisio are anchored on the city ordinance of the City of Paranaque. The barangay serves as the implementor of the ordinance on solid waste management and the city's 10-year solid waste management plan that was implemented in 2016. As such, the ordinances that the barangay observe and implement are on waste segregation, anti-littering, prohibition of open burning of garbage, and the prohibition of dumping of garbage at the esteros and/or rivers. They do not have an ordinance on single-use plastic, and it is also not found in any information campaign.

The Barangay Council, with the initiative of the city government, created a Barangay Ecological Solid Waste Management Committee (BESWMC) who will manage the programs and operations of the barangay in relation to solid waste management. This includes execution of the city ordinance and evaluation of programs. The Committee manages the 24-barangay staff delegated to SWM with 30 tools and equipment and one vehicle for SWM.

The barangay budget on SWM is under the city's SWM budget which centralizes the collection of solid waste through a private contractor (Leonel Waste Management). Donations and sponsorships are also accepted by the BESWMC to help sustain their programs on solid waste management, like purchase of equipment and materials that can be used by the Committee.

At present, there is one constructed MRF in the barangay located in front of the Barangay Hall. However, this MRF is not functional based on a site visit and inspection. Updated data on collected and stored waste are also not available when requested. Composting activities adjacent to the MRF involves vegetable gardening and would still require a sustainable infrastructure on composting.

The community acknowledges the implementation of the City Ordinance in Barangay San Dionisio. Garbage is collected regularly. Though, there are some clusters that reported that collection is not frequent. Based on RA 9003 implementing rules and regulations, wastes are segregated only into two categories: biodegradable and non-biodegradable. Some households reported that there is no strict implementation of segregation as unsegregated wastes are also collected. Based on barangay data, the barangay generates 737 tons of solid wastes in a year, which translates to about 61 tons per month. Since all wastes are collected by the private contractor of the city, collection, storage, and disposal of recyclable wastes are not being practiced.

Recycling is being done by individual households or institutions and are not necessarily required to surrender them to the MRF. The residents are aware of the policies on anti-littering, burning of waste, and throwing waste into the river systems, however they cannot recall if someone was apprehended or penalized for not following these policies. It was discussed during the focus group discussions that most of the garbage are coming from the street vendors and non-residents. These garbage contribute to the waste on the streets. Coded trash bins following RA 9003 are not present along the streets of the barangay. Waste collected by street sweepers are also not segregated. Given the number of waterways (i.e., river and creeks) that traverse the barangay, most of these wastes are possibly washed as run-offs during heavy rainfall.



Residents have reported that there are numerous IEC posters in both English and Filipino present in the barangay. The barangay posted signages/tarpaulins to remind its residents of the city ordinance with block-to-block campaigns. Social media is also used to reach out to their residents. Barangay activities include the following: clean-up drive, contests using recyclable materials and sending selected wastes, and disinfection activities.

Barangay San Dionisio's solid waste management efficiency rating, following the USAID-EcoWaste-DLSU-D Management Efficiency Questionnaire (UED-MEQ) tool is 71%. High efficiency score is noted on Policy, but much improvement is needed on Operation (67%) and Education Campaign (65%). The score is somewhat the same with DILG's Local Governance Performance Management System (LGMPS) on Environment for Barangay San Dionisio which is 70%, though the factors measured in both tools are different. Barangay ordinances, in compliance with the city government's SWM ordinances and 10-year development solid waste management plan, are in placed together with the establishment of a Barangay Solid Waste Management Committee (BSWMC).

This high rating on Policy is supported by a high efficiency rating on Policy with four of the five best practices which are the following: **(1) Garbage-burning is strictly prohibited in the barangay; (2) There is a regular schedule of waste collection; (3) The throwing of garbage in esteros or rivers is strictly prohibited as well as burning of garbage; and (4) There is an ordinance on SWM.**

When it comes to Operation, the barangay MEQ efficiency score is 67%. Though a Material Recovery Facility is present, the facility is not a functioning MRF in which recyclables and biodegradable materials are collected, stored, and disposed. This is validated by a visual inspection and attested by residents listing "Having an MRF where we surrender our recyclables" and "Our recyclables are collected separately by our Barangays" as items that need improvement based on the efficiency survey. The absence of an updated and barangay-specific data on solid waste (residual, recyclable and biodegradable) also reflects the lack of utilization of the MRF.

The lack of a functioning MRF has an upstream effect on the collection of waste specifically on segregation at sources (households, schools, and commercial areas). When there is no centralized system of collection of segregated waste, proper segregation is discouraged and segregation becomes an individual or household initiative.



Clean-up drive activity with the Barangay leaders and volunteer residents

(Photos from 10-year solid waste Management plan for Paranaque).

The absence of a functioning MRF is also aggravated by the two-category segregation (biodegradable and non-biodegradable waste) and the city government-contracted private contractor to collect garbage in the barangay. Though both types of waste are collected by the private contractor, residents have reported that even unsegregated waste are collected and some wastes are not collected regularly, especially those with inaccessible roads. This may contribute further to waste burning or dumping of wastes into esteros and river systems. These become street litter which become part of run-offs during rainfall and subsequently to different waterways in the barangay.

On the concerns of single-use plastics (SUP), the absence of an ordinance regulating or banning SUPs makes the use of SUPs unregulated, its disposal ambiguous, and its data lacking. The presence of a policy on SUP is one of the supported measures of the residents as the “the existence of ordinance that regulates the use of single-use plastic” is listed as the number 1 factor that needs improvement on the efficiency survey. The lack of an ordinance also contributes to unregulated use and disposal of SUPs used by ambulant vendors and this contributes to unsegregated waste. Based on barangay data, vending is considered as one of the main occupations of the residents. Presence of a policy on SUP and its implementation may significantly contribute to SUP reduction in waterways. Education Campaign also garnered a low score on the efficiency evaluation with a score of 65%. This is supported by residents answer with “All residents follow the barangay’s SWM” as one of the items that needs immediate improvement in the efficiency survey. Based on the focus group discussions with the residents, there are signages and billboards on SWM but these are not updated and maintained properly. There is also a need to have aggressive campaigns on proper segregation as this contributes significantly, together with proper implementation of ordinances, in following SWM programs.

Policy enforcement would always carry challenges. Behavior of residents is one of the factors affecting the implementation of the SWM policy that sometimes put the safety of the implementers at risk. The barangay officials admitted that they are taking extra effort to discipline the residents as the implementers’ safety and security are at stake, especially the street vendors who are also residents of the Barangay.

Policy Recommendations

1. Evaluate the existing waste segregation and fully implement the implementing rules and regulation of RA9003 Evaluate the existing waste segregation and fully implement the implementing rules and regulation of RA 9003 pertaining to waste segregation.
2. Empower the BSWMC with regular meetings and implementation of programs.
3. Focus on waste recovery by fully utilizing the Material Recovery Facility.
4. Develop a waste data and information management system that will guide the barangay in evaluation and implementation of effective and efficient programs on waste management.
5. Enactment of a barangay ordinance that regulate the use of single-use plastics, especially to vendors with imposition of penalties and revocation of business license.
6. Give incentives to those who practice proper waste segregation and participate in SWM-related activities.
7. Work with the city government on defining the role of the barangay in waste collection and segregation as stipulated in RA 9003 and evaluate the existing contract on waste disposal with the private contractor; and
8. Develop an aggressive and sustainable program in information and education campaigns.

Brgy. Tangos South, Navotas City



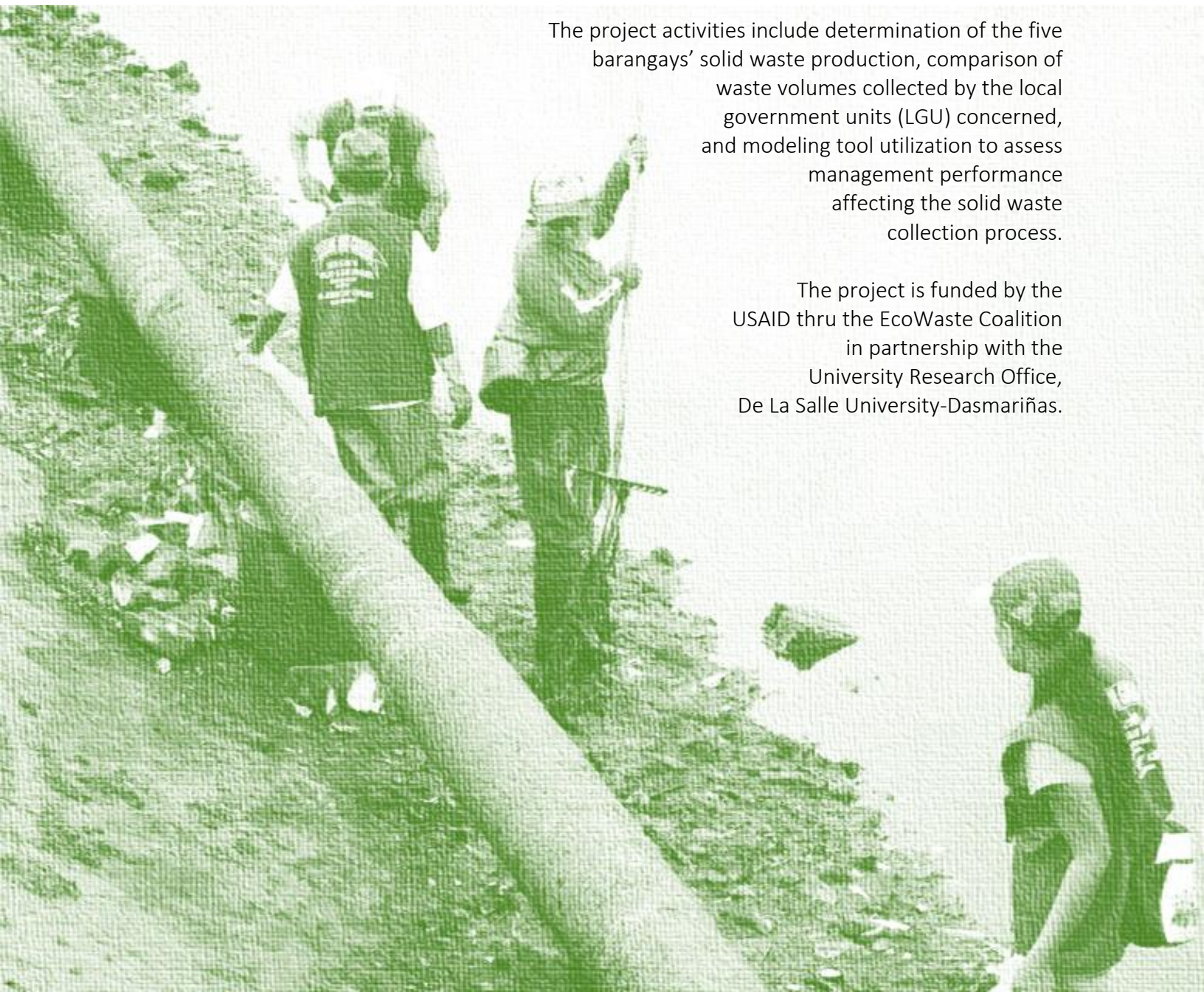
Introduction

This report is based on the results of solid waste management assessment carried out in Barangay Tangos South, in Navotas City from July to December 2020 for the research project **“Solid Waste Collection Efficiency Assessment of Selected Local Government Units Along Manila Bay”**.

The project generally aims to determine the collection and performance efficiency of five selected local government units that are part of the Manila Bay watershed.

The project activities include determination of the five barangays’ solid waste production, comparison of waste volumes collected by the local government units (LGU) concerned, and modeling tool utilization to assess management performance affecting the solid waste collection process.

The project is funded by the USAID thru the EcoWaste Coalition in partnership with the University Research Office, De La Salle University-Dasmariñas.



Executive Summary

1

The solid waste collection efficiency rating for Barangay Tangos South is estimated at 42.02% based on to the disposal rate of 22.83% and materials recovered from junkshops of 19.19% due to the absence of a Material Recovery Facility. Moreover, the barangay's solid waste management efficiency score is 64.00% with the element Policy having the highest rate among the three elements assessed followed by Education and Operation:

- **Eighty percent (80%) compliance to the criteria for the element Policy** in the MEQ. This means that the ordinances are present, regular schedule of collection is observed. They also have logistical equipment like *kariton* (cart) assigned in *eskinita* (narrow alley) for collection. The personnel are involved and there is presence of signages for constant reminder to be responsible with their wastes.
- **Fifty seven percent (57%) compliance to the criteria for the element Operation** in the MEQ. The barangay at present has no functioning Material Recovery Facility (MRF) due to the difficulty to find a suitable location for the MRF. They have a Material Recovery System (MRS) instead. Consequently, the efficient disposal of residual wastes cannot be accomplished because only 50% of the population practice waste segregation at the source. Waste segregation is conducted at the barangay level.
- **Seventy percent (70%) compliance to the criteria for the element Education Campaign** in the MEQ. The Information and Education Campaign is highly effective in formal education in academic institutions of the barangay. But with the pervasive behavior of many residents of having little concern towards the proper disposal of solid wastes remains to be a challenging aspect in making the Information and Education effective in informal education.

The solid waste management (SWM) program efficiency assessment generally identified three critical gaps that the barangay SWM committee members need to give attention to. These gaps comprise the following: the need to establish systematic data base, a stronger SWM regulation enforcement, and necessity for regular trainings and/or seminars for both staff and residents. The following policy suggestions are recommended based on the results of management efficiency assessment:

2

- Strengthen the solid waste segregation practice as well as the installation of MRF to minimize solid waste collection and disposal and occurrence of waste leakage.
- Improve database management by establishing periodic updates of database in all records pertaining to the barangay solid waste management program.
- Observe stricter program enforcement with the help of the *barangay tanod*. Violators of the ordinance should be properly dealt with based on the existing policy.
- Enhance provision for staff trainings and skills program to fully achieve the objectives of the management plan. A parallel program for trainings/seminars should be prepared to other stakeholders whenever possible to promote participation to the barangay solid waste management program.

Terms of Reference

In relation to this report, the two terms of reference for the project were the following: (1) to determine the collection efficiency rating (CER) of the barangay anchored on the solid waste system flow, and (2) efficiency of the solid waste management (SWM) program currently implemented in the barangay.

Methods and Respondents

Computation of the variables used to estimate the CER follows a set of statistically validated formulas (Attachment C) while the overview of the SWM program of Barangay Tangos South was mainly acquired through an assessment tool called Management Efficiency Questionnaire or MEQ. This was supplemented by available secondary information, ocular inspection through site visits, household survey, and series of online focus group discussions (FGD) with research informants and participants.

Representation of the key stakeholder groups in the barangay, namely: barangay officials, household residents, business group, informal settlers, SWM program staff members (waste pickers, gardeners, garbage collectors, drivers), was considered in the selection of the 100 household survey respondents and the 12 FGD participants. Self-efficiency evaluation using the assessment tool was done by the members of the Barangay SWM Committee (BSWMC).

MEQ contains 25 indicators mostly anchored on the requirements of RA9003. Five indicators are under Policy, 15 under Operation (being the center of the SWMP), and 5 indicators under Education Campaign. The assessment indicators are presented in tabular form to allow scoring, recording the details of the assessment, and identifying any intended actions that will improve the management efficiency. The schedule of activities conducted by the research team is outlined below.

Table 13. Research Team Schedule of Activities in Brgy. Tangos South

Activities	Month conducted
Courtesy call and orientation about the project	August
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Focus group discussion/interviews	September - October
Field visits and validation	August - December
Final report writing	December

Description of Barangay Tangos South

The target community is a pre-colonial settlement which has evolved into a highly urbanized area predominated by low to middle class households dotted with low-rise infrastructure. By virtue of Republic Act 10934, signed and approved by President Rodrigo Duterte on August 23, 2017 and ratified the following year, Barangay Tangos was officially divided into North and South Tangos. Thus, Barangay Tangos South became the latest among the 9 barangays of the 1st District of Navotas City located at the northern section of the 1st district and serves as the boundary between the two districts. Its land area covers approximately 166,694.7 434 square meters or 16.67 hectares.

Current population data provided by the barangay administration is approximately 21,100 residents with a high population density of around 0.11 person/square meter distributed among the 4,520 households registered in the latest barangay census. Geographically, the barangay forms part of the aggregate shoreline of the city along the coastline of Manila Bay, whose landform primarily consists of active tidal flats consistent with the topography of the contiguous territory of Navotas and Malabon and the municipalities of Paombong and Hagonoy in Bulacan.

The common land use are fishponds, salt beds, and urbanized areas. The active tidal flat area is constantly flushed with high and low tide seawater but poorly drains, making it highly prone to flooding and deposition of marine debris along its coast.

The economic activities included are about (80%) in fishing, driving public utility vehicles, and laborers, while 20% of the population are the small-scale business owners or those belonging to higher income brackets. Local fishing activities are further subdivided depending on ownership of livelihood assets (boat owners, fish laborers, shellfish gatherers, shrimp paste makers).

Barangay Tangos South has a reported poverty incidence of 5.5% (PSA 2015) and classified 852 families or households as informal settlers. Barangay Tangos South registered a high 80% rating in environmental governance under the Local Governance Performance Management System (LGPMs).

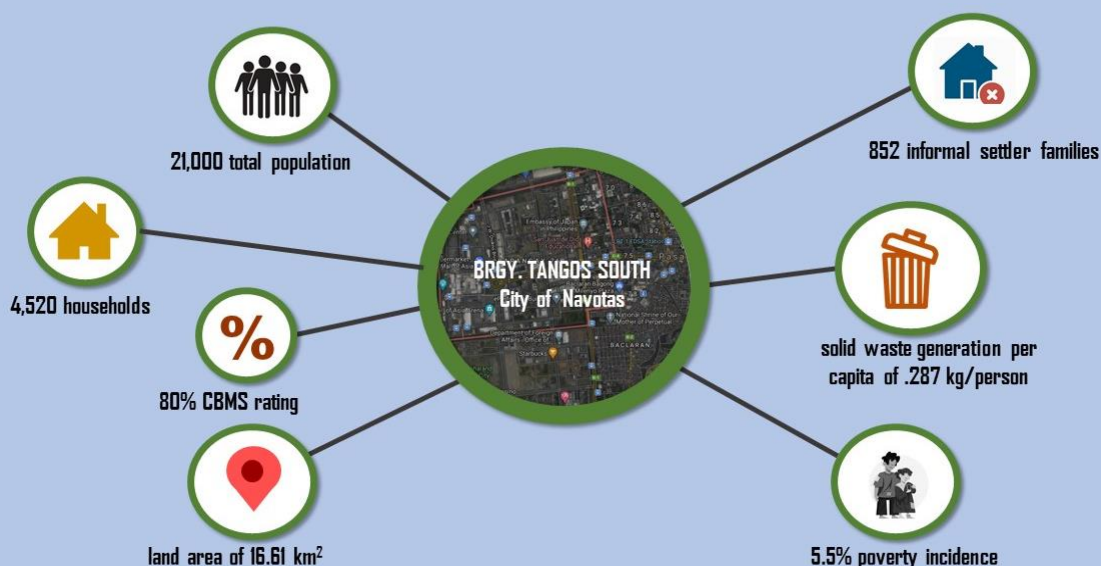


Figure 10. Demographic and Socio-economic Features in Brgy. Tangos South

Solid Waste Collection Efficiency

Similar to most barangays in the municipality, Barangay Tangos South produces solid wastes that should be properly managed based on existing plan of the SWM Board of Navotas City and the barangay management plan. It should be understood that the potential risks to the environment and to public health may arise from the manner by which the solid wastes are collectively handled, collected, and disposed of (Ferronator and Torretta, 2019). The figure summarizes the waste collection efficiency in the barangay.

In reference to source, the solid waste generated in the barangay are classified either as internal or external wastes. Those associated with domestic activities of the residents are called internal waste, while the external wastes are those that are mostly generated by the activities of the ambulatory vendors selling different products (including food, beverages, and other items) in containers or packaging that are assumed to be discarded by consumers within the barangay as waste.

On a weekly basis, the barangay generates nearly 57,129.31 kg of solid waste from both internal and external sources. From this total amount, some 10,966.76 kg of recyclable materials wind up in the recycling centers such as the barangay-contracted junk shops since they do not have MRF yet.

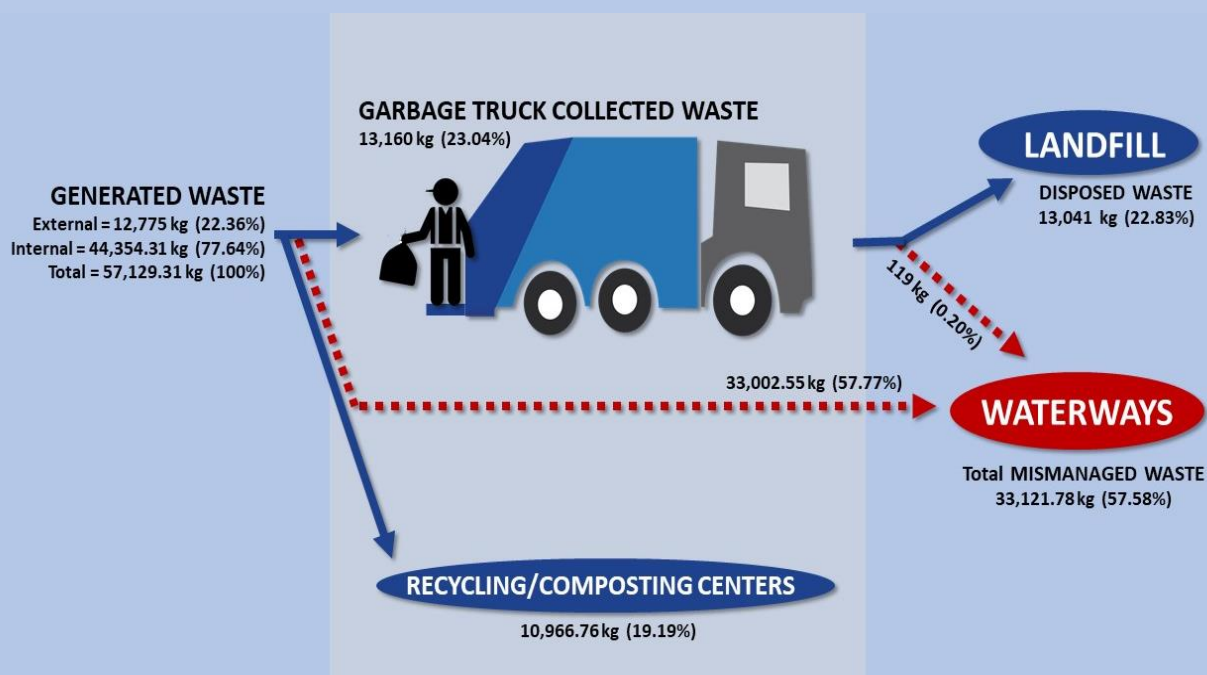


Diagram of the solid waste system flow in Barangay Tangos South depicting its current solid waste management practice. It also illustrates the estimated amount and percentage of solid waste generated and handled in every stage of the flow as well as the mismanaged waste from uncollected and undisposed waste.

Selling the recyclable and reusable materials in the junkshop is one way by which the barangay can lessen its wastes in the absence of MRF. The barangay has MRS that functions as temporary item storage area.

An estimated 13,160 kg of wastes are collected by the barangay garbage truck and subsequently handled in the landfill, accounting to a low disposal rate of 22.83% or 13,041 kg of disposed waste. The remaining 57.58%, equivalent to about 33,121.78 kg of uncollected and undisposed wastes, is considered mismanaged since they leak from the usual route of garbage in the solid waste system flow. This is the type of waste that is presumably end up in the water-ways and, in the long run, reach the Manila Bay.

Considering the material recovery and disposal activities, Barangay Tangos South attained an approximate CER of 42.02%. However, determining the CER is just a tip of the iceberg. Systemic thinking dictates that the collection process being practiced in the barangay can be shaped by a deeper level of abstraction, which is not obviously seen from the surface. Hence, looking at the structure showing the framework within which the collection process operates offers a better understanding of the issue.



Results of the SWM Efficiency Assessment

The table on the next page provides the summarized results of the SWM efficiency assessment conducted for Barangay Tangos South. Here, the collection process is viewed as an Operation which can be influenced by two other elements, namely Policy and the Education Campaign. As shown, the total SWM efficiency score for Barangay Tangos South is 64.00%. The percentage score in the element “Policy” (80.00%) is the highest among the three elements evaluated. The element “Education” achieved a mid-rating of 70.00%, while the element “Operation” got the lowest rating of 57.00%.

Policy

Barangay Tangos South employs an ordinance on SWM anchored on the citywide implemented program in Navotas City. Though residents are willing and are required to comply by the ordinance, the barangay has no designated MRF yet where recyclable materials recovered from garbage collection are supposed to be kept and organized prior to selling to junk shops. The officials are still looking for a location where the MRF can be constructed.

Through a resolution, the barangay has created the BSWMC, which is tasked to oversee the implementation of the SWM within the area. As specified in RA 9003 (2000), the committee has sectoral representation (*kagawad*, representatives from *Sanguniang Kabataan*, homeowners, junk shop owners, non-government organization, market vendors) that regularly meet twice a month.



Table 14. Summarized Solid Wastes Management Efficiency Assessment results for Barangay Tangos South

Element	Focus	Major findings	MES*		%
			Maximum	Obtained	
Policy	Presence of ordinances and/or regulations about wastes, management plan and/or barangay solid wastes committee	Ordinances are present, regular schedule of collection every day from 5:00 a.m. to 8:00 a.m. is observed; logistical equipment like <i>kariton</i> assigned in <i>eskinita</i> for collection; personnel involved; presence of signage for constant reminder to be responsible with their wastes.	10	8	80
Operation	Functionality of management program committee, and material recovery facility; efficiency of data	The barangay has no functioning Material Recovery Facility due to the difficulty in finding a suitable location for the MRF. They have a Material Recovery System (MRS) instead. Consequently, the efficient disposal of residual wastes cannot be accomplished because only 50% of the population practice waste segregation at the source. Waste segregation is conducted at the barangay level.	30	17	57
Education	Presence of information campaigns and their effectiveness in promoting education to barangay residents	The Information and Education Campaign is highly effective in formal education in academic institutions of the barangay. But with the pervasive behavior of many residents of having little concern towards the proper disposal of solid wastes, these so called <i>pasaways</i> remain to be a challenging aspect in making the Information and Education effective in informal education.	10	7	70
Total			50	32	67

*Highest Management Effectiveness Score (MES) is 50 points or 100%. There are three main elements (policy, operation, education campaign) which have corresponding maximum points. Based on the focus, each main element has several criteria with differing values.

The BSWMC generally operates from a part of the PHP150,000.00 budget allocated by the city government for the barangay's general operation. It uses a management plan that specifies function and responsibilities of the committee members. The plan also emphasizes the provision on at-source waste segregation and manner of collection from households and some business establishments. Waste collection schedule is daily from 5:00 a.m. to 9:00 a.m. It was observed that there are some narrow alleys in each household, but the barangay was able to manage collection due to provision of *kariton* or garbage carts that can be used in collecting wastes.

The following observations were noted by the research team: **(1) there was no clear record on the breakdown of budget allocation to fund the SWM Program; (2) SWM activities are primarily documented using the Facebook page only; (3) meetings are not regularly participated in identified members; and (4) absence of specific barangay ordinance or regulation for the management and/or banning of single-use plastic.**

Based on the MES, Barangay Tangos South was able to comply with 80.00% of the criteria for the element Policy in the MEQ. This means that although some areas of the policy can still be improved (e.g., clearer work plan, periodic review, stakeholders' full participation in meetings), the presence of a BSWMC operating on a management plan can provide a good basis for an efficient SWM at the barangay level.

Operation

The presence of the SWM staff is adequately felt within the barangay particularly during the wastes collection schedule. Presently, Barangay Tangos South has employed 20 staff members to handle waste collection and segregation from designated pick-up points for the maintenance of the cleanliness and greening of the barangay premises. The number of staff members has been generally perceived by the barangay stakeholders as adequate for critical management activity. Orientation for staff is regularly conducted by the barangay but training programs are occasionally provided by NGOs like Caritas and Mother Earth to improve their level of orientation about the relevance of their work in relation to the program. Such activity is usually done in coordination with the Navotas City SWM Board.

Two garbage collection trucks and one raccal are provided by the barangay to collect and transport the wastes that they have generated. Handling of wastes is done by using adequate number of tools which include stick brooms with handle, dust pans, rake, and shovel. Garbage carts are used in narrow roads for collection.

The personnel are also provided with gloves and rain boots and coats when needed. The tools are being kept and regularly inventoried at the barangay hall. The tools and equipment are regularly maintained to serve their purpose. It was noted that the number of tools is proportional to the number of staff to bring about the expected results.

In the appraisal of the barangay profile in the initial data gathered, the barangay has no functioning Material Recovery Facility due to the difficulty in finding a suitable location for the MRF. Consequently, the efficient disposal of residual wastes cannot be accomplished due to the absence of a processing facility to segregate solid waste at the barangay level.

Wastes are collected by the waste pickers from the designated pick-up points following the schedule. This, however, has not been fully practiced by some barangay residents as the occasional presence of garbage in some corners of the street as well as in the pick-up sites even after the scheduled garbage collection, has been observed. Likewise, it was mentioned by some FGD respondents that segregation is not totally followed by both the waste pickers and the residents particularly at the household level. Nonsegregated wastes from households are, just the same, collected by waste pickers and placed directly in the garbage trucks.

The following other observations were noted by the research team: (1) segregation at source is not totally practiced by the residents; (2) efficient disposal of residual wastes cannot be accomplished because only 50% of the population practiced waste segregation at the source, and there is no location identified yet for the construction of MRF; (3) absence of accurate database that can serve as basis for establishing goal-oriented, results-based monitoring and evaluation systems for short, medium or long term solid wastes management planning for the barangay; and, (4) enforcement issue as indicated by the occasional presence of some piled up garbage in the water ways and the outdated records of violations, penalties, or fines related to collection and segregation.

Based on the MES, Barangay Tangos South was able to comply with 57.00% of the criteria for the element Operation in the MEQ. The barangay at present has no functioning Material Recovery Facility due to the difficulty of finding a suitable location for the MRF. It has a Material Recovery System (MRS) instead. Therefore, the efficient disposal of residual wastes cannot be accomplished because only 50% of the population practice waste segregation at the source. Waste segregation is conducted at the barangay level.



Volunteers from Barangay Tangos South participating in the annual Coastal Cleanup Day to spread awareness in keeping the coastline clean.

(Photo from Brgy. Secretary of Tangos South, Navotas City)

Education Campaign

The barangay is not remiss in the implementation of its Information and Education Campaign on the proper solid waste management particularly on waste segregation at home. But with the pervasive behavior of many residents of having little concern towards the proper disposal of solid wastes, these so called *pasaway* (stubborn) remain to be a challenging aspect in making the Information and Education effective in informal education. However, the Information and Education Campaign is highly effective in formal education in academic institutions of the barangay as expressed by respondents from the school sector.

As spearheaded by the barangay council with the support coming from NGOs like Caritas and Mother Earth, volunteer residents of Barangay Tangos South regularly hold a clean-up drive to clean waterways within the barangay. Residents actively participate in the annual coastal clean-up activity to provide awareness on the protection and conservation of the coastal area.

The barangay also provides info and/or reminders on ordinances, program, and places where and when wastes should be disposed. Barangay officials claimed that these signage are maintained and/or replaced when needed. Some participants, however cited that the use of signage as tool for behavioral change are ineffective since some residents' negative attitude affecting favorable practice on SWM is still a major concern in the barangay.

The following additional observations were noted by the research team: **(1) presence of partnership project or activity with specific barangay stakeholder like Caritas and Mother Earth in reference to SWM education and information campaigns;** and **(2) current effort does not fully help achieve the education campaigns objective as evidenced by the respondents' confusing or differing response when asked for the presence of barangay ordinance or regulation on the use of single-use plastic.**

Based on the MES, Barangay Tangos South was able to comply with 70% of the criteria for the element Education Campaign in the MEQ. The cited barangay-initiated projects are generally perceived by the barangay stakeholders as one of the contributors in promoting awareness and disseminating information to the residents of the barangay. Whether or not the cited education campaigns are translated into some positive behavioral response of the residents to the barangay SWM program can be a subject of a deeper inquiry.



"Battle for the *Esteros*" cleanup drive participated DENR personnel and members of the community members of the community.

Policy Suggestions

The findings identified four critical gaps that BSWMC members need to give attention to. These gaps comprise the following: the need to strengthen the solid waste segregation practice, establish systematic database, a stronger SWM regulation enforcement, and necessity for regular trainings and/or seminars for both SWM staff and residents. In view of these, the following policy recommendations are suggested:

- Strengthening of the barangay solid waste segregation practice as well as recovery of biodegradable, recyclable, and reusable materials prior to waste collection. The challenges of a functional Material Recovery Facility due to the difficulty of finding a suitable location is yet to be resolved.
- Improvement of database management by establishing periodic updates of database in all records pertaining to the barangay SWM. The barangay should utilize the output for the formulation and/or revision of the management plan.
- Imposition of stricter enforcement program with the help of the *barangay tanod*. Violators of the ordinance should be properly dealt with based on the existing policy.
- Further improvement of staff trainings and skills program to fully achieve the objectives of the management plan. A parallel program for trainings/seminars should be prepared to other stakeholders whenever possible to promote participation to the barangay SWM program.



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Appendices

Attachment A.

Summarized Results of the SWM Efficiency Assessment Scores in Brgy 76, Pasay City

Element and Indicator	Assessment Score*		
	Self	Expert	Average
1. Policy	9	8	8.5
1.1 Basis of barangay SWM program	1	2	1.5
1.2 Creation of committee on solid waste management	4	4	4.0
1.3 Feasible management plan and management budget	4	2	3.0
2. Operation	29	25	27.0
2.1 Needed personnel and equipment	5	5	5.0
2.2 Implementation of solid waste management	8	7	7.5
2.3 Usefulness of material recovery facility	6	5	5.5
2.4 Staff training and solid waste management activities	4	4	4.0
2.5 Functional database	4	2	3.0
2.6 Review of management plan	2	2	2.0
3. Education	10	9	9.5
3.1 Presence and conduct of campaigns	4	4	4.5
3.2 Signages and other information materials	4	3	3.5
3.3 Effectiveness of education campaigns	2	1	1.5
Total score in all aspects	48	42	45

* **Self score** is the collective score provided by the Barangay SWM Committee members while the **expert score** is given by the research team. The **average scores** are reflected as **obtained scores** in Table 3.

**Summarized Results of the SWM Efficiency Assessment Scores
in Brgy 649, Baseco, City of Manila**

Element and Indicator	Assessment Score*		
	Self	Expert	Average
1. Policy	9	9	9.0
1.1 Basis of barangay SWM program	1	1	1.0
1.2 Creation of committee on solid waste management	5	5	5.0
1.3 Feasible management plan and management budget	3	3	3.0
2. Operation	25	22	23.5
2.1 Needed personnel and equipment	4	4	4.0
2.2 Implementation of solid waste management	8	6	7.0
2.3 Usefulness of material recovery facility	5	4	4.5
2.4 Staff training and solid waste management activities	4	4	4.0
2.5 Functional database	2	2	2.0
2.6 Review of management plan	2	2	2.0
3. Education	8	8	8.0
3.1 Presence and conduct of campaigns	4	4	4.0
3.2 Signages and other information materials	3	3	3.0
3.3 Effectiveness of education campaigns	1	1	1.0
Total score in all aspects	42	39	40.5

* **Self score** is the collective score provided by the Barangay SWM Committee members while the **expert score** is given by the research team. The **average scores** are reflected as **obtained scores** in Table 3.

**Summarized Results of the SWM Efficiency Assessment Scores
in Brgy. San Agustin, Malabon City**

Element and Indicator	Assessment Score*		
	Self	Expert	Average
1. Policy	28.2	21.5	24.8
1.1 Basis of barangay SWM program	9.5	7.6	8.5
1.2 Creation of committee on solid waste management	9.3	7.3	8.3
1.3 Feasible management plan and management budget	9.4	6.6	8.0
2. Operation	51.4	43.7	47.5
2.1 Needed personnel and equipment	4.9	3.0	3.9
2.2 Implementation of solid waste management	5.0	3.0	4.0
2.3 Usefulness of material recovery facility	12.5	12.3	12.4
2.4 Staff training and solid waste management activities	11.7	12.0	11.85
2.5 Functional database	9.2	6.7	7.95
2.6 Review of management plan	8.1	6.7	7.4
3. Education	14.7	9	11.85
3.1 Presence and conduct of campaigns	5.0	3.0	4.0
3.2 Signages and other information materials	4.7	3.0	3.85
3.3 Effectiveness of education campaigns	5.0	3.0	4.0
Total score in all aspects	94.3	74.2	84.15

* **Self score** is the collective score provided by the Barangay SWM Committee members while the **expert score** is given by the research team. The **average scores** are reflected as **obtained scores** in Table 3.

**Solid Wastes Management Program Efficiency Assessment in
Brgy. San Dionisio, Parañaque City**

Element and Indicator	Assessment Score*		
	Self	Expert	Average
1. Policy	10	8	9.0
1.1 Basis of barangay SWM program	1	2	1.5
1.2 Creation of committee on solid waste management	5	4	4.5
1.3 Feasible management plan and management budget	4	2	3.0
2. Operation	25	15	20.0
2.1 Needed personnel and equipment	5	3	4.0
2.2 Implementation of solid waste management	6	4	5.0
2.3 Usefulness of material recovery facility	5	2	3.5
2.4 Staff training and solid waste management activities	4	2	3.0
2.5 Functional database	3	2	2.5
2.6 Review of management plan	2	2	2.0
3. Education	8	5	6.5
3.1 Presence and conduct of campaigns	3	2	2.5
3.2 Signages and other information materials	3	1	2.0
3.3 Effectiveness of education campaigns	2	2	2.0
Total score in all aspects	43	28	35.5

* **Self score** is the collective score provided by the Barangay SWM Committee members while the **expert score** is given by the research team. The **average scores** are reflected as **obtained scores** in Table 3.

Summarized Results of the SWM Efficiency Assessment Scores in Brgy. Tangos South

Element and Indicator	Assessment Score*		
	Self	Expert	Average
1. Policy	25	18	20.8
1.1 Basis of barangay SWM program	9	6	7.3
1.2 Creation of committee on solid waste management	8	6	6.8
1.3 Feasible management plan and management budget	8	6	6.8
2. Governance	44	36	40.0
2.1 Needed personnel and equipment	4	3	3.6
2.2 Implementation of solid waste management	4	3	3.7
2.3 Usefulness of material recovery facility	11	9	9.8
2.4 Staff training and solid waste management activities	12	8	9.9
2.5 Functional database	7	6	6.5
2.6 Review of management plan	6	7	6.5
3. Education	10	6	8.0
3.1 Presence and conduct of campaigns	5	3	4.0
3.2 Signages and other information materials	5	3	4.0
Total score in all aspects	79	60	68.8

* **Self score** is the collective score provided by the Barangay SWM Committee members while the **expert score** is given by the research team. The **average scores** are reflected as **obtained scores** in Table 3.

Attachment B

Summarized Results of Household Survey in Brgy. 76, Pasay City

Statement	Sectoral representatives scores					Average	Interpre- tation
	BO	BG	HH	IS	SS		
There is an ordinance on Solid Waste Management in our Barangay.	4.90	4.80	4.56	4.50	4.30	4.58	SA
The waste segregation program in our Barangay is strictly implemented.	4.70	4.58	4.56	4.55	4.20	4.50	SA
There is a regular schedule of waste collection in our Barangay.	4.90	4.67	4.50	4.55	4.20	4.50	SA
Our recyclable waste is collected separately by our Barangay.	4.80	4.23	4.40	4.20	4.35	4.35	SA
Our Barangay has a Material Recovery Facility where we surrender our recyclable materials.	4.90	4.52	4.40	4.40	4.40	4.47	SA
There is an existing Barangay ordinance that control the use of single-use plastics.	5.00	4.28	4.53	4.45	4.40	4.48	SA
Our Barangay is fully-equipped as far as solid waste collection is concerned.	4.90	4.33	4.43	4.60	4.35	4.47	SA
Our Barangay has personnel that implements our community's solid waste management program.	5.00	4.23	4.46	4.60	4.40	4.48	SA
The throwing of garbage in esteros or rivers is strictly prohibited in our Barangay.	4.50	4.61	4.46	4.65	4.40	4.52	SA
Burning of garbage is strictly prohibited in our Barangay.	4.80	4.28	4.56	4.50	4.45	4.49	SA
All the Barangay residents follow the Barangay's solid waste management policies.	4.70	4.33	4.30	4.50	4.20	4.36	SA
We are properly and regularly educated by our Barangay with regard to Solid Waste Management.	4.90	4.23	4.50	4.60	4.10	4.42	SA
There is a regular Barangay-wide cleaning program in our area.	4.90	4.38	4.40	4.60	4.3	4.46	SA
Our Barangay is generally clean.	4.90	4.42	4.46	4.65	4.4	4.52	SA
Our Barangay has an efficient Solid Waste Management System.	4.90	4.47	4.46	4.60	4.35	4.51	SA
I am proud of our Barangay's Solid Waste Management Program.	4.90	4.55	4.50	4.65	4.45	4.57	SA

*Note: BO - Barangay Official; BG – Business Group; HH – Household; IS – Informal Settler; SS – Street Sweeper
Strongly Disagree SD (1 – 1.80); Disagree D (1.81-2.60); Neutral N (2.61 – 3.40); Agree A (3.41 – 4.20); Strongly Agree SA (4.21 – 5.00)*

Summarized Results of Household Survey in Brg. 649, Baseco, City of Manila

Statement	Sectoral representatives scores				Average	Interpretation
	HH	SP	BG	BO		
There is an ordinance on Solid Waste Management in our Barangay.	4.46	4.60	4.60	4.50	4.54	SA
The waste segregation program in our Barangay is strictly implemented.	4.21	4.70	4.40	4.10	4.31	SA
There is a regular schedule of waste collection in our Barangay.	4.66	4.80	4.70	4.40	4.70	SA
Our recyclable wastes are collected separately by our Barangay.	4.09	4.50	4.20	3.90	4.16	A
Our Barangay has a Material Recovery Facility where we surrender our recyclable materials.	4.11	4.10	4.00	3.90	4.13	A
There is an existing Barangay ordinance that control the use of single-use plastics.	3.99	4.40	4.00	3.70	4.05	A
Our Barangay is fully-equipped as far as solid waste collection is concerned.	4.33	4.70	4.40	4.20	4.41	SA
Our Barangay has personnel that implements our community's solid waste management program.	4.33	4.70	4.40	4.20	4.41	SA
The throwing of garbage in esteros or rivers is strictly prohibited in our Barangay.	4.43	4.60	4.60	4.50	4.52	SA
Burning of garbage is strictly prohibited in our Barangay.	4.41	4.70	4.60	4.50	4.52	SA
All the Barangay residents follow the Barangay's solid waste management policies.	3.91	3.50	4.10	3.60	3.90	A
We are properly and regularly educated by our Barangay with regard to Solid Waste Management.	4.27	4.80	4.50	4.10	4.38	SA
There is a regular Barangay-wide cleaning program in our area.	4.27	4.50	4.60	4.43	4.39	SA
Our Barangay is generally clean.	3.93	3.90	4.00	3.80	3.96	A
Our Barangay has an efficient Solid Waste Management System.	4.23	4.20	4.20	3.90	4.23	SA
I am proud of our Barangay's Solid Waste Management Program.	4.34	4.60	4.10	4.10	4.36	SA

Note: BO - Barangay Official; BG – Business Group; HH – Household; SP-School Personnel

Strongly Disagree SD (1 – 1.80); Disagree D (1.81-2.60); Neutral N (2.61 – 3.40); Agree A (3.41 – 4.20); Strongly Agree SA (4.21 – 5.00)

Summarized Results of Household Survey in Brgy. San Agustin, Malabon City

Statement	Sectoral Representative Scores					Average	Interpretation
	HH	PWD	EI	BG	BO		
There is an ordinance on Solid Waste Management in our Barangay.	4.75	4.70	4.92	4.79	5.00	4.83	SA
The waste segregation program in our Barangay is strictly implemented.	4.77	4.60	4.77	4.79	5.00	4.79	SA
There is a regular schedule of waste collection in our Barangay.	4.75	4.60	5.00	4.93	5.00	4.86	SA
Our recyclable waste is collected separately by our Barangay.	4.81	4.40	4.54	5.00	4.90	4.73	SA
Our Barangay has a Material Recovery Facility where we surrender our recyclable materials.	4.72	4.50	4.69	4.79	4.90	4.72	SA
There is an existing Barangay ordinance that control the use of single-use plastics.	4.64	4.60	4.69	4.50	5.00	4.69	SA
Our Barangay is fully-equipped as far as solid waste collection is concerned.	4.66	4.50	4.77	4.86	5.00	4.76	SA
Our Barangay has personnel that implements our community's solid waste management program.	4.70	4.50	4.77	4.79	5.00	4.75	SA
The throwing of garbage in esteros or rivers is strictly prohibited in our Barangay.	4.79	4.50	5.00	4.93	5.00	4.84	SA
Burning of garbage is strictly prohibited in our Barangay.	4.79	4.60	4.92	4.93	5.00	4.85	SA
All the Barangay residents follow the Barangay's solid waste management policies.	4.72	4.30	4.54	4.93	5.00	4.70	SA
We are properly and regularly educated by our Barangay with regards to Solid Waste Management.	4.83	4.50	4.92	5.00	5.00	4.85	SA
There is a regular Barangay-wide cleaning program in our Barangay.	4.75	4.40	4.69	4.86	5.00	4.74	SA
Our Barangay is generally clean.	4.68	4.40	4.77	4.79	4.60	4.65	SA
Our Barangay has an efficient Solid Waste Management System.	4.87	4.40	4.77	4.93	5.00	4.79	SA
I am proud of our Barangay's Solid Waste Management Program.	4.89	4.50	4.92	4.93	5.00	4.85	SA

Note:

HH-Household; PWD-Person with Disabilities; EI-Educational Institution; BG-Business Group; BO-Barangay Official
 Strongly Disagree SD (1 -1.80); Disagree D (1.81 – 2.60); Neutral N (2.61 – 3.40); Agree A (3.41 – 4.20); Strongly Agree SA (4.21 – 5.00)

Summarized Results of Household Survey in Brgy. San Dionisio, Parañaque City

Statement	Sectoral representatives scores					Average	Interpretation
	BO	BG	HH	IS	SS		
There is an ordinance on Solid Waste Management in our Barangay.	4.90	4.80	4.61	4.50	4.30	4.67	SA
The waste segregation program in our Barangay is strictly implemented.	4.70	4.58	4.56	4.55	4.39	4.61	SA
There is a regular schedule of waste collection in our Barangay.	4.90	4.67	4.50	4.55	4.37	4.70	SA
Our recyclable wastes are collected separately by our Barangay.	4.80	4.23	4.40	4.20	4.35	4.47	SA
Our Barangay has a Material Recovery Facility where we surrender our recyclable materials.	4.51	4.52	4.40	4.56	4.40	4.54	SA
There is an existing Barangay ordinance that control the use of single-use plastics.	4.60	4.28	4.53	4.45	4.40	4.45	SA
Our Barangay is fully-equipped as far as solid waste collection is concerned.	4.90	4.33	4.43	4.60	4.47	4.47	SA
Our Barangay has personnel that implements our community's solid waste management program.	5.00	4.23	4.46	4.60	4.42	4.60	SA
The throwing of garbage in esteros or rivers is strictly prohibited in our Barangay.	4.50	4.61	4.46	4.65	4.40	4.69	SA
Burning of garbage is strictly prohibited in our Barangay.	4.80	4.46	4.70	4.50	4.60	4.75	SA
All the Barangay residents follow the Barangay's solid waste management policies.	4.70	4.33	4.30	4.50	4.30	4.54	SA
We are properly and regularly educated by our Barangay with regard to Solid Waste Management.	4.90	4.32	4.50	4.60	4.45	4.59	SA
There is a regular Barangay-wide cleaning program in our area.	4.77	4.38	4.40	4.60	4.3	4.56	SA
Our Barangay is generally clean.	4.90	4.42	4.46	4.65	4.4	4.58	SA
Our Barangay has an efficient Solid Waste Management System.	4.90	4.50	4.46	4.60	4.35	4.61	SA
I am proud of our Barangay's Solid Waste Management Program.	4.80	4.55	4.50	4.65	4.45	4.60	SA

Note: HH – Household; PWD – Person with Disabilities; EI – Educational Institution; BG – Business Group; BO – Barangay Official; Strongly Disagree SD (1 -1.80); Disagree D (1.81 – 2.60); Neutral N (2.61 – 3.40); Agree A (3.41 – 4.20); Strongly Agree SA (4.21 – 5.00)

Summarized Results of Household Survey in Brgy. Tangos South

Statement	Sectoral Representative Scores					Average	Interpretation
	HH	PWD	EI	BG	BO		
There is an ordinance on Solid Waste Management in our Barangay.	4.17	4.30	4.20	4.60	4.30	4.31	SA
The waste segregation program in our Barangay is strictly implemented.	3.93	4.20	3.70	3.30	4.20	3.87	A
There is a regular schedule of waste collection in our Barangay.	4.37	4.70	4.50	4.70	4.70	4.59	SA
Our recyclable wastes are collected separately by our Barangay.	3.65	4.10	3.70	3.00	4.40	3.77	A
Our Barangay has a Material Recovery Facility where we surrender our recyclable materials.	3.87	3.80	4.00	3.60	4.30	3.91	A
There is an existing Barangay ordinance that control the use of single-use plastics.	3.92	3.90	3.90	2.50	4.00	3.64	A
Our Barangay is fully- equipped as far as solid waste collection is concerned.	4.07	4.40	4.20	4.70	4.80	4.43	SA
Our Barangay has personnel that implements our community's solid waste management program.	4.17	4.60	4.10	3.70	4.50	4.21	SA
The throwing of garbage in esteros or rivers is strictly prohibited in our Barangay.	4.25	4.70	4.20	3.70	4.20	4.21	SA
Burning of garbage is strictly prohibited in our Barangay.	4.32	4.40	4.10	4.10	4.50	4.28	SA
All the Barangay residents follow the Barangay's solid waste management policies.	4.07	4.90	3.70	3.20	4.30	4.03	SA
We are properly and regularly educated by our Barangay with regards to Solid Waste Management.	4.13	4.50	3.70	3.20	4.50	4.01	SA
There is a regular Barangay-wide cleaning program in our Barangay.	4.03	4.60	3.70	2.90	4.70	3.99	A
Our Barangay is generally clean.	3.92	4.30	3.60	3.10	4.40	3.86	A
Our Barangay has an efficient Solid Waste Management System.	4.02	4.30	3.70	2.70	4.30	3.8	A
I am proud of our Barangay's Solid Waste Management Program.	4.12	4.60	3.80	3.30	4.30	4.02	SA

Note: HH – Household; PWD – Person with Disabilities; EI – Educational Institution; BG – Business Group; BO – Barangay Official; Strongly Disagree SD (1 -1.80); Disagree D (1.81 – 2.60); Neutral N (2.61 – 3.40); Agree A (3.41 – 4.20); Strongly Agree SA (4.21 – 5.00)

Attachment C

Formulas Used in Computing the Collection Efficiency Rating in Brgy. 76, Pasay City

Amount of SW (kg/week)

Variable	Formula to get weekly value
External Wastes (EW)	Daily average x estimated number of ambulant vendors (night and day market) x 3.5 (multiplier for weekly generation)
Internal Wastes (IW)	Interpolated weekly value based on the barangay internal wastes data (BSWMP or product of per capita production x population)
Total Generated Wastes (TGW)	$EW + IW$
Total Collected Wastes (TCW) by garbage trucks	Number of trucks x frequency of collection per week x maximum weight of wastes carried by a truck
Recovered Materials (RM) from the MRF/MRS	Recyclable and compostable RM from the barangay MRF/MRS

Amount of SW (kg/week)

Variable	Formula to get weekly value
Percentage Recycled/Composted Materials from junkshops/centers	$RM / TGW \times 100$
Disposed Waste (DW)	Number of trucks x days or repair in a year x interpolated daily TGW
Uncollected Waste (UW) ; UW%	$TGW - TCW$; $UW\% = UW / TGW \times 100$
Undisposed Waste (UnW) ; UnW%	$TCW - DW$; $UnW\% = UnW / TGW \times 100$
Total Mismanaged Waste (TMW) assumed to be present in waterways	$UW + UnW$; $TMW\% = TMW / TGW \times 100$
Collection Process Efficiency Rating (CPER)	$DW\% + RM\%$

**Formulas Used in Computing the Collection Efficiency Rating
in Brgy. 649, Baseco, Manila**

Amount of SW (kg/week)

Variable	Formula to get weekly value
External Wastes (EW)	Daily average x estimated number of ambulant vendors (night and day market) x 3.5 (multiplier for weekly generation)
Internal Wastes (IW)	Interpolated weekly value based on the barangay internal wastes data (BSWMP or product of per capita production x population)
Total Generated Wastes (TGW)	$EW + IW$
Total Collected Wastes (TCW) by garbage trucks	Number of trucks x frequency of collection per week x maximum weight of wastes carried by a truck
Recovered Materials (RM) from the MRF/MRS	Recyclable and compostable RM from the barangay MRF/MRS

Amount of SW (kg/week)

Variable	Formula to get weekly value
Percentage Recycled/Composted Materials from junkshops/centers	$RM / TGW \times 100$
Disposed Waste (DW)	Number of trucks x days or repair in a year x interpolated daily TGW
Uncollected Waste (UW) ; UW%	$TGW - TCW$; $UW\% = UW / TGW \times 100$
Undisposed Waste (UnW) ; UnW%	$TCW - DW$; $UnW\% = UnW / TGW \times 100$
Total Mismanaged Waste (TMW) assumed to be present in waterways	$UW + UnW$; $TMW\% = TMW / TGW \times 100$
Collection Process Efficiency Rating (CPER)	$DW\% + RM\%$

**Formulas Used in Computing the Collection Efficiency Rating
in Brgy. San Agustin, Malabon City**

Amount of SW (kg/week)

Variable	Formula to get weekly value
External Wastes (EW)	Daily average x estimated number of ambulant vendors (night and day market) x 3.5 (multiplier for weekly generation)
Internal Wastes (IW)	Interpolated weekly value based on the barangay internal wastes data (BSWMP or product of per capita production x population)
Total Generated Wastes (TGW)	EW + IW
Total Collected Wastes (TCW) by garbage trucks	Number of trucks x frequency of collection per week x maximum weight of wastes carried by a truck
Recovered Materials (RM) from the MRF/MRS	Recyclable and compostable RM from the barangay MRF/MRS

Amount of SW (kg/week)

Variable	Formula to get weekly value
Percentage Recycled/Composted Materials from junkshops/centers	$RM / TGW \times 100$
Disposed Waste (DW)	Number of trucks x days or repair in a year x interpolated daily TGW
Uncollected Waste (UW) ; UW%	$TGW - TCW$; $UW\% = UW / TGW \times 100$
Undisposed Waste (UnW) ; UnW%	$TCW - DW$; $UnW\% = UnW / TGW \times 100$
Total Mismanaged Waste (TMW) assumed to be present in waterways	$UW + UnW$; $TMW\% = TMW / TGW \times 100$
Collection Process Efficiency Rating (CPER)	$DW\% + RM\%$

**Formulas Used in Computing the Collection Efficiency Rating
in Brgy. San Dionisio, Parañaque City**

Amount of SW (kg/week)

Variable	Formula to get weekly value
External Wastes (EW)	Daily average x estimated number of ambulant vendors (night and day market) x 3.5 (multiplier for weekly generation)
Internal Wastes (IW)	Interpolated weekly value based on the barangay internal wastes data (BSWMP or product of per capita production x population)
Total Generated Wastes (TGW)	$EW + IW$
Total Collected Wastes (TCW) by garbage trucks	Number of trucks x frequency of collection per week x maximum weight of wastes carried by a truck
Recovered Materials (RM) from the MRF/MRS	Recyclable and compostable RM from the barangay MRF/MRS

Amount of SW (kg/week)

Variable	Formula to get weekly value
Percentage Recycled/Composted Materials from junkshops/centers	$RM / TGW \times 100$
Disposed Waste (DW)	Number of trucks x days or repair in a year x interpolated daily TGW
Uncollected Waste (UW) ; UW%	$TGW - TCW$; $UW\% = UW / TGW \times 100$
Undisposed Waste (UnW) ; UnW%	$TCW - DW$; $UnW\% = UnW / TGW \times 100$
Total Mismanaged Waste (TMW) assumed to be present in waterways	$UW + UnW$; $TMW\% = TMW / TGW \times 100$
Collection Process Efficiency Rating (CPER)	$DW\% + RM\%$

**Formulas Used in Computing the Collection Efficiency Rating
in Brgy. Tangos South, Navotas City**

Amount of SW (kg/week)

Variable	Formula to get weekly value
External Wastes (EW)	Daily average x estimated number of ambulant vendors (night and day market) x 3.5 (multiplier for weekly generation)
Internal Wastes (IW)	Interpolated weekly value based on the barangay internal wastes data (BSWMP or product of per capita production x population)
Total Generated Wastes (TGW)	$EW + IW$
Total Collected Wastes (TCW) by garbage trucks	Number of trucks x frequency of collection per week x maximum weight of wastes carried by a truck
Recovered Materials (RM) from the MRF/MRS	Recyclable and compostable RM from the barangay MRF/MRS

Amount of SW (kg/week)

Variable	Formula to get weekly value
Percentage Recycled/Composted Materials from junkshops/centers	$RM / TGW \times 100$
Disposed Waste (DW)	Number of trucks x days or repair in a year x interpolated daily TGW
Uncollected Waste (UW) ; UW%	$TGW - TCW$; $UW\% = UW / TGW \times 100$
Undisposed Waste (UnW) ; UnW%	$TCW - DW$; $UnW\% = UnW / TGW \times 100$
Total Mismanaged Waste (TMW) assumed to be present in waterways	$UW + UnW$; $TMW\% = TMW / TGW \times 100$
Collection Process Efficiency Rating (CPER)	$DW\% + RM\%$

The Research Team



Marlon C. Pareja is an Associate Professor of Biology of the College of Science and Computer Studies and the Graduate School of the College of Engineering, Architecture and Technology of De La Salle University – Dasmariñas (DLSU-D). He is also a Research Fellow of the Community of Partners on Research on Sustainability at Nanyang Technological University, Singapore. In 2018, he was invited by the Singapore government, thru its National Institute of Education, to join other global researchers and educators on sustainability to draft Singapore’s National Policy on Research on Sustainability. A peer reviewer of the International Science Council (France) draft Report on Sustainable Development Goals and an invited expert reviewer for the 6th IPCC report on Climate Change

in the area of Water Ecosystems, he has conducted and published researches on sustainability, water ecosystems monitoring and natural products. He is a recipient of various scholarships in Biotechnology Leadership (Taiwan), Energy Efficiency and Management (India), Environmental Education (Philippines) and Science, Technology and Society (Philippines). He is a trainer on 5S, Systems Thinking and Sustainability of DTI-Cavite and a TEDx speaker.

A/Prof. Pareja has led research teams on Sustainability (CHED-funded), Water Footprints (Nanyang Technological University) and Environmental Monitoring (University – funded). He was the former department chair of the Biological Sciences Department, Research Coordinator and Director of the Environment Office and presently the Vice-Principal for Academics and Research of DLSU-D. He was a recipient of the De La Salle Philippines President Award of Excellence (2006) and the Most Outstanding Faculty of the College of Science (2011).

Mario S. Torres is an Associate Professor of Biology at the Biological Sciences Department and the Graduate School of Science and Computer Studies in De La Salle University-Dasmariñas where he primarily teaches courses in Bioethics, Environmental Ethics, Biodiversity Conservation, Ecology & Environmental Science, and Biology. Dr. Torres is a seasoned educator and school administrator who previously held six institutional and collegiate administrative positions in the University. He has co-authored seven college instructional books and laboratory manuals about Environmental Science, Biology, Zoology, and Food Microbiology. His research interests are in Conservation Biology, Environmental Governance and Policy-making, and Environmental Education. He has also co-published papers on Parasitology and Environmental Attitudes in various scientific journals.





Dr. Arnold B. Fonollera is a licensed Environmental Planner with a PhD in Environmental Studies covering over 16 years of experience in various capacities as a consultant in solid waste management, river ecotourism and pollution control. He holds a rank of Commander of the 111th Squadron of the Philippine Coast Guard Auxiliary (PCGA), participating in its various coastal clean-up activities of the organization. Moreover, he is also currently an Associate Professor of Environmental Science and Biology in De La Salle University-Dasmariñas for over 25 years of professorial service to the Lasallian Institution. With his experience as an educator, Dr. Fonollera went beyond the halls of the academe to be actively engaged in environmental trainings of pollution control officers in collaboration with DENR/EMB-recognized training organizations and institutions like the Pollution Control

Association of the Philippines and Solid Waste Management Association of the Philippines with whom he is previously among its Board of Directors.

Jocelyn P. Luyon, MSc. is a faculty assigned to the office of Environmental Resource Management Center. She is an Associate Professor (loaned faculty) at the Biological Sciences Department of the De LaSalle University-Dasmariñas. As one of her colleagues would say that 'DLSU-D is the Lasallian campus where nature meets history', she felt blessed to be part of this University for almost 18 years now. She is a Biologist by profession and taught subjects in Biology and Environmental Science for two years as part-time Faculty at the Biological Sciences Department in the same university. Currently, she is working full-time in the University's Environmental Resource Management Center (ERMaC) as Faculty Assigned to Office, to handle the solid waste management and other sustainable programs.



She is also part of the DLSU-D Research Team actively involved in environmental research such as water quality assessment and solid waste collection efficiency of the selected barangays. Some of her completed research works, in collaboration with colleagues, mentors/advisers and undergraduate students, were presented in the national and international conferences as well as published in a Scopus-indexed journals. Moreover, their research on bioluminescent bacteria as indicator of water quality was featured in PTV and Goodnewspilipinas.com. At present, she is completing her academic requirements in PhD Biology Program at De La Salle University, Manila Campus.



Cristina G. Cabanacan-Salibay is a Full Professor at the Biological Sciences Department and the Graduate School of College of Science and Computer Studies of De La Salle University-Dasmariñas (DLSUD). She is currently the Dean of the College of Science and Computer studies. Dr. Salibay has been in the academe for 35 years and taught subjects in Parasitology, Virology, Immunology and Cell and Molecular Biology, among others. Her research interests include parasites in the tropics focusing on zoonosis. Her research interests include parasites in the tropics focusing on zoonosis, environmental health and microbial interactions with the environment (Environmental Health) and impact of microbial infections in the economy (Health Economics).

She has co-authored six laboratory manuals in Comparative Embryology, Introductory and General Biology and Fundamentals of Zoology. She is also the main author of Chapter 11 Natural product-derived drugs for the treatment of inflammatory bowel diseases (IBD) of the book titled “Inflammation and Natural Products” published by Academic Press of Elsevier. She has accomplished a number of researches that consequently have been converted to journal articles. To date, she has authored/co-authored 39 peer reviewed articles, 27 of which are indexed in Clarivate- and Scopus-indexed journals, and 12 in institutional professional journals. Dr. Salibay is the editor in chief of the *LASALIJSIK* journal, the official publication of Science and Mathematics of DLSUD.

Ma.Luisa Vasallaje-Cuaresma graduated with a degree of Bachelor of Science in Biology at Adamson University in Manila. She is a Licensed Professional Teacher. She took her 21 units in Certificate of Teaching Program (CTP) at the Philippine Normal University where she earned her Master of Arts in Education major in Science Education also. She is a Ph.D Biology student in De La Salle University, Taft Avenue, Manila.

Currently, she is an Associate Professor in De La Salle University-Dasmariñas, under the Biological Sciences Department. She holds various coordinatorships under the College of Science and Computer Studies. She served as the Botanical Garden Supervisor, and as Intro to De La Salle coordinator. She has presented her researches related to Solid Waste Management and Phycology in various Seminars and Fora in both National and Regional level.





Josephine R. Lejos-Cruz obtained her Master of Arts in Teaching Social Sciences and Bachelor of Arts in Political Science at De La Salle University-Dasmariñas (DLSU-D). Her teaching career which includes both primary and tertiary levels has been dedicated mainly in social sciences-related subjects. Moreover, she teaches Political Science major courses such as Public Policy Analysis, Comparative Government and Politics, and Seminar in Political Development. She also engages in speakership and trainings on the area of gender development and good governance.

Ersyllen S. Biñas is a Senior High School teacher in De La Salle University-Dasmariñas. She graduated with the degree Bachelor of Secondary Education Major in History from De La Salle University-Dasmariñas. She is taking up Master of Arts in Teaching Social Sciences (Thesis writing). She is teaching Humanities and Social Sciences specialized and core subjects. She is the focal person of the Community Engagement at the same time the LMS Co-Chair for Training and Monitoring in DLSU-Dasmariñas Senior High School. Currently she is one of the Authors of KRONIKA Textbook Series of Salesiana Books by Don Bosco Press Inc.





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