

Situation Assessment Report on
**PLASTICS LEAKAGE PREVENTION
FROM FORMAL AND INFORMAL
RECYCLING FACILITIES**



MANILA CITY AND ILOILO CITY, PHILIPPINES



RRC.AP
Regional Resource Centre for
Asia and the Pacific



Regional Knowledge Centre
for Marine Plastic Debris



Situation Assessment Report on **PLASTICS LEAKAGE PREVENTION FROM FORMAL AND INFORMAL RECYCLING FACILITIES** **Manila City and Iloilo City, Philippines**

This study was conducted for the Regional Knowledge Centre for Marine Plastic Debris (RKC-MPD), Economic Research Institute for ASEAN and East Asia (ERIA)

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List of abbreviations

UNCTADstat	United Nations Conference on Trade and Development
MRF	Material Recovery Facility
SWM	Solid Waste Management
NSWMC	National Solid Waste Management Commission
LGUs	Local Government Units
DAO	DENR Administrative Order
EMB-DENR	Department of Environment and Natural Resources-Environmental Management Bureau
WtE	Waste to Energy
NPoA-ML	National Plan of Action on Marine Litter
SCP	Sustainable Consumption and Production
DPS	Manila Department of Public Services
NCR	National Capital City
MMDA	Metropolitan Manila Development Authority
IPM-CDC	IPM Construction and Development Corporation
IEC	Information, Education, and Communication
WACS	Waste Analysis and Characterization Study
CPOA-ML	City Plan of Action on Marine Litter
CSWB	City Solid Waste Management Board
LTO	Land Transportation Office
DOH	Department of Health

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Chapter 1



Introduction

ASEAN Member States are working to develop solutions for the pressing challenges of marine plastic pollution through the formulation of both national and regional action plans. Yet, achieving the set objectives demands transformative and decisive action at local, national, and regional levels, transcending conventional approaches. Nonetheless, ASEAN Member States, characterized by burgeoning economies and developing waste management systems, face formidable challenges in managing plastic waste effectively.

1.1 Status of Plastic Waste Management in the Philippines

The Philippines is no exception to this global concern, ranking third among contributors to ocean plastic waste leakage, following China and Indonesia, who hold the first and second positions, respectively. This amounts to a staggering 0.28-0.75 million tons per year (Jambeck et al., 2015). The primary drivers behind these alarming statistics include the burgeoning numbers of consumers, influenced by factors such as economic status and population growth, alongside a shift toward increased single-use plastic consumption. Furthermore, inadequate policies, regulations, and enforcement mechanisms to safeguard the natural environment from plastic waste exacerbate the issue, coupled with a deficiency in waste infrastructure to accommodate the escalating volume of discarded materials. Additionally, historical efforts, disjointed between the private and public sectors, have contributed to the problem. However, since 2019, plastic waste pollution has become of paramount concern to the Philippine Government, presenting a significant opportunity to galvanize political will for change at the national, regional, and global levels.

Annual solid waste generation in the Philippines was estimated to be 14.6 million tons in 2016,^{1,2}

at a per capita range of between 0.32 and 0.71 kg/person/day (United Nations Centre for Regional Development, 2017). Of the total waste generated, the percentage of source contribution comprised 18% market waste, 12.1% institutions, 4.15% industrial waste, 9.1 commercial waste, and 56.7% household/residential market waste (Sapuay, 2018). Waste composition by material comprised 52.31% biodegradables, 17.98% residual waste, 1.93% special waste, and 27.78% recyclables. Of the recyclables, 8.7% were paper and cardboard, 10.55% plastics, 4.22% metals, 2.34% glass, 1.61% textile, and 0.37% leather and rubber (as illustrated in Figure 8) (Caanacan, 2020). Solid waste management (SWM) legislation does exist in the Philippines, including the current Republic Act 9003 (Ecological SWM Act of 2000), where cities, barangays, and localities are mandated to manage their respective SWM, including marine plastic litter.

1.2 Architecture of Plastic Waste and the Recycling Landscape at the National Level

1.2.1 Socio-Economic Demography of the Philippines

The Philippines is an archipelagic country with roughly 7,641 islands grouped into three main geographical clusters: Luzon, Visayas, and Mindanao. Situated in the western Pacific Ocean and Southeast Asia, it is flanked on the west by the South China Sea, on the east by the Philippine Sea, and on the southwest by the Celebes Sea

(refer to Figure 1). Spanning a land area exceeding 300,000 square kilometers, the country accommodates a populace of approximately 105 million people as of 2017 (UNCTADstat, 2018).

Bays and coastal waterways cover approximately 266,000 square kilometers of land, while expansive oceanic seas extend to over 1,934,000 square kilometers. The coastline, stretching an impressive 36,289 kilometers, exhibits an irregular contour adorned with numerous bays, gulfs, and islets.

1 Figure derived by multiplying the reported daily generation value by 365 days

2 Data from the National Solid Waste Management Commission (NSWMC), 2017.

Figure 1. Map of the Philippines



Source: https://www.worldometers.info/img/maps/philippines_physical_map.gif; accessed 20 June 2020

Among these coastal features, Manila Bay stands out as a sheltered harbor and the bustling epicenter of the country's commercial activities. Notably, coastal municipalities and cities constitute over 60% of all administrative units in the Philippines, with ten major cities situated along the coast. Collectively, these coastal urban centers and towns accommodate approximately 60% of the country's population.

1.2.2 Legislation and Regulatory Frameworks on SWM in the Philippines

The Republic of the Philippines has a presidential system of government comprising three pillars: legislative, judicial, and executive. The President and ruler of the national government, as well as the Commander-in-Chief of all Philippine military forces, is the Head of State. The President and Vice-President are normally elected in a direct election for a six-year term with no possibility of re-election (Philippine Government, n.d.). The House of Representatives and the Senate, consisting of roughly 250 members elected from legislative

districts in municipalities, cities, and provinces, make up the legislative branch.

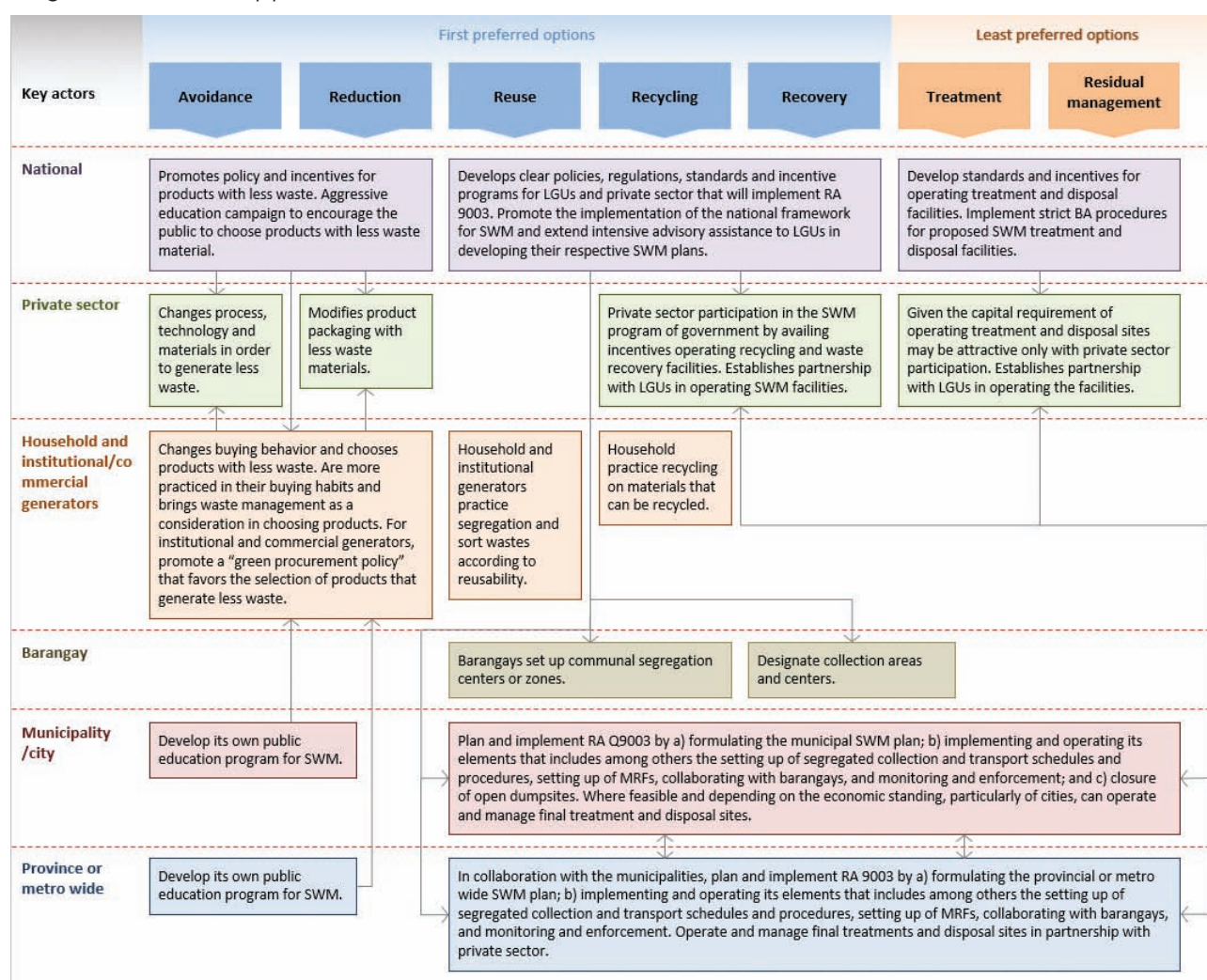
Provinces, cities, and municipalities are all divided into categories, comprising provinces, cities, and municipalities, except for Manila and Quezon City, which continue to be classified as special class cities (source: Department Order No. 23-08 of Bureau of Local Government Finance; July 29, 2009). The country's growing population expansion is partly due to coastal migration, with the 832 coastal municipalities and 25 coastal cities being home to roughly 60% of the Philippine population (DENR et al., 1997).

The Local Government Code (Republic Act 7160) directs local governments to exercise their powers and give out responsibilities and functions as needed or appropriate and "incidental to the efficient and effective provision of services and facilities linked to general hygiene and sanitation, beautification, and solid waste collection and disposal systems" (Philippine RA 7160, n.d.). Another related legal framework is the "Philippine Clean Air Act of 1999 (Republic Act 8749)," which offers an all-inclusive control policy on air pollution, as well as others. Section 20 bans the use of incinerators in burning municipal, bio-medical, and hazardous waste; however, it still allows traditional small-scale burning methods in communities.

Numerous legislation have been passed to ensure legal support for developing policies and policy actions on SWM in the country. The "2000 Ecological Solid Waste Management Act, or RA 9003" was passed to put in place a policy direction for all local governments in the Philippines to create an ecological solid waste management (ESWM) system. The RA 9003 Act is very important for developing the Philippines' crucial SWM framework since it provides for "a systematic, all-inclusive, and ESWM program" (Premakumara, Abe, and Maeda, 2011).

Figure 2 illustrates the Philippine Solid Waste Management Framework and the important provisions covered by RA 9003, including the establishment of a "Solid Waste Management (SWM) Board" with committees at the provincial, municipal/city, and barangay levels, a 10-year SWM Plan (city/municipal levels), and MRF formation in all barangays or clusters of barangays, including centralized city/

Figure 2. The Philippines ESWM Framework



municipal MRFs (*Congress of the Philippines* (2001) *Republic Act No. 9003*, 2001). The Climate Change Commission was established under the Climate Change Act as a self-governing and autonomous body in a similar position to a central government agency. The "Marine Pollution Control Law of 1976" aims at "preventing and controlling pollution of the oceans by prohibiting waste dumping and other matters that cause hazards to human health or endangers living resources and marine life."

1.2.3 Institutional Structure of SWM in the Philippines

The SWM initiatives in the Philippines are predominantly governed by the provisions of RA 9003, empowering Local Government Units (LGUs), encompassing cities and municipalities, to meticulously oversee SWM processes. This legislative framework mandates the formulation

of 10-year SWM Plans by LGUs, detailing strategies for the collection, transportation, and disposal of solid waste. Additionally, the establishment of the National SWM Commission (NSWMC) under the Office of the President underscores the commitment to effective waste management practices. Tasked with formulating policies aimed at achieving the objectives outlined in RA 9003, the NSWMC assumes responsibility for supervising the comprehensive implementation of SWM programs nationwide.

The NSWMC serves as the principal government body tasked with crafting SWM policies and supervising the implementation of both national and local SWM initiatives. The Republic Act (RA) No. 9003, also known as the ESWM Act of 2000, constitutes the cornerstone of SWM legislation and operational guidelines (refer to Figure 3) (Implementing Rules and Regulations of the Philippine ESWM Act of 2000, 2015). There are

also local ordinances pertaining to various aspects of waste management, in addition to the implementation of rules and regulations (see DENR Administrative Order (DAO) No. 2001–34).

The Secretariat, serving as the operational arm of the NSWMC, manages the commission’s day-to-day functions. Presently, the Department of Environment and Natural Resources (DENR)’s SWM Division, operating within the Environmental Management Bureau (EMB), assumes responsibility for the Secretariat’s operations. Meanwhile, the National Ecology Center, also under the purview of the DENR, plays a pivotal role in maintaining a comprehensive database on SWM and furnishing technical support to LGUs in implementing the RA 9003.

Local Government Units, comprising cities and municipalities, have the primary responsibility of executing the mandates of RA 9003. Their duties encompass formulating local SWM plans, enacting waste reduction regulations, overseeing the collection and disposal of various waste streams within their jurisdictions, establishing and maintaining materials recovery facilities (MRFs), and implementing revenue-generating initiatives to support local SWM endeavors. Waste segregation and landfill management fall under the purview of cities or municipalities.

Within the hierarchical administrative structure of the Philippines, cities and towns are further subdivided into barangays, constituting the lowest

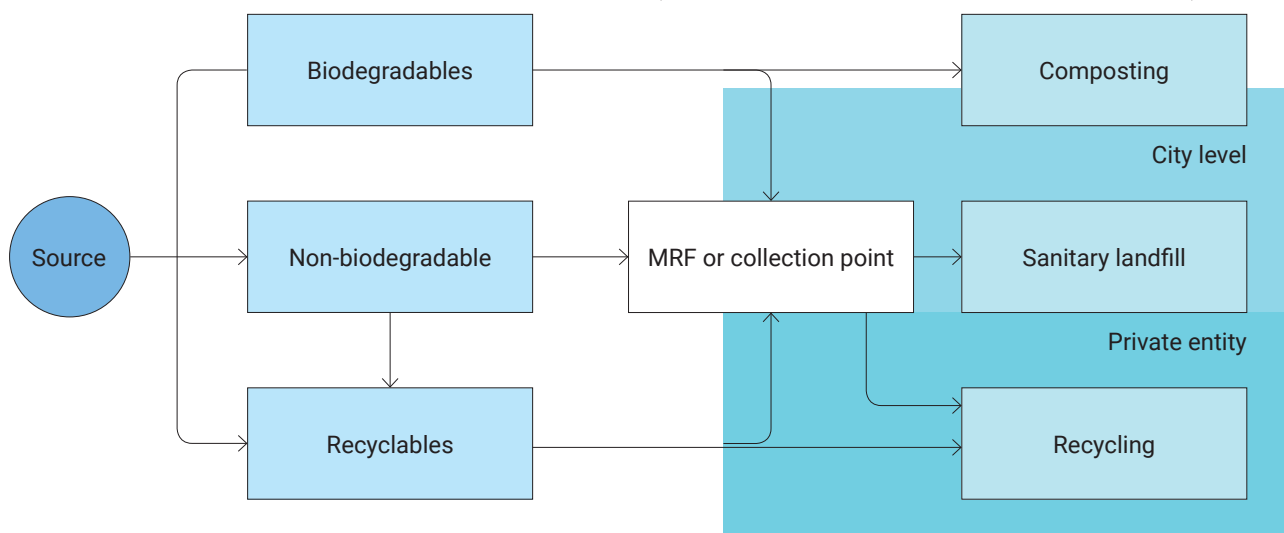
administrative units. Barangays are tasked with managing waste segregation, sorting, recovery, recycling, and composting activities within their boundaries. Coordination of barangay level activities is facilitated by cities and municipalities under their jurisdiction.

Provincial authorities play a coordinating role, integrating the SWM plans and actions of LGUs within their respective territories (excluding highly urbanized cities). In addition to overseeing national-level offices, provinces provide administrative, legal, and financial support to facilitate effective SWM practices at the local level.

Municipal solid waste (MSW), inclusive of packaging, falls under the jurisdiction of all levels of government. By law, waste must undergo segregation at its source, distinguishing between biodegradable and non-biodegradable materials. The biodegradable fraction is slated for composting at the barangay level. Within sanitary landfills, only the disposal of residual waste is permitted. Private entities operating as consolidators are tasked with receiving recyclable materials (Refer to Figure 3. SWM at the city level).

In the Philippines, as previously defined, MSW encompasses waste generated from various sources within local government jurisdictions, comprising commercial, domestic, industrial, institutional, and street litter (ESWMA 2000). This definition encompasses discarded agricultural waste, commercial waste, household waste, non-hazardous

Figure 3. SWM at City Level in the Philippines (Source: WWF Philippines Report 2021)



institutional waste, port and harbor waste, industrial waste, construction debris, street sweepings, and other non-hazardous/non-toxic solid waste. (Borongon and Okumura, 2010).

The use of incineration and open burning for garbage disposal is largely prohibited in the Philippines. Incineration, defined as the burning of municipal, bio-medical, and hazardous waste that emits poisonous and toxic vapors, is expressly banned under Section 20 of Republic Act No. 8749, also known as the Philippine Clean Air Act of 1999.

In a move toward sustainable waste management practices, the government has turned its attention to waste-to-energy (WtE) solutions. The NSWMC, through Resolution No. 669, Series of 2016, has established guidelines governing the installation and operation of WtE technology for MSW management. Additionally, the DENR recently issued DAO 2019–21, outlining the Guidelines Governing Waste to Energy Facilities for Integrated MSW Management.

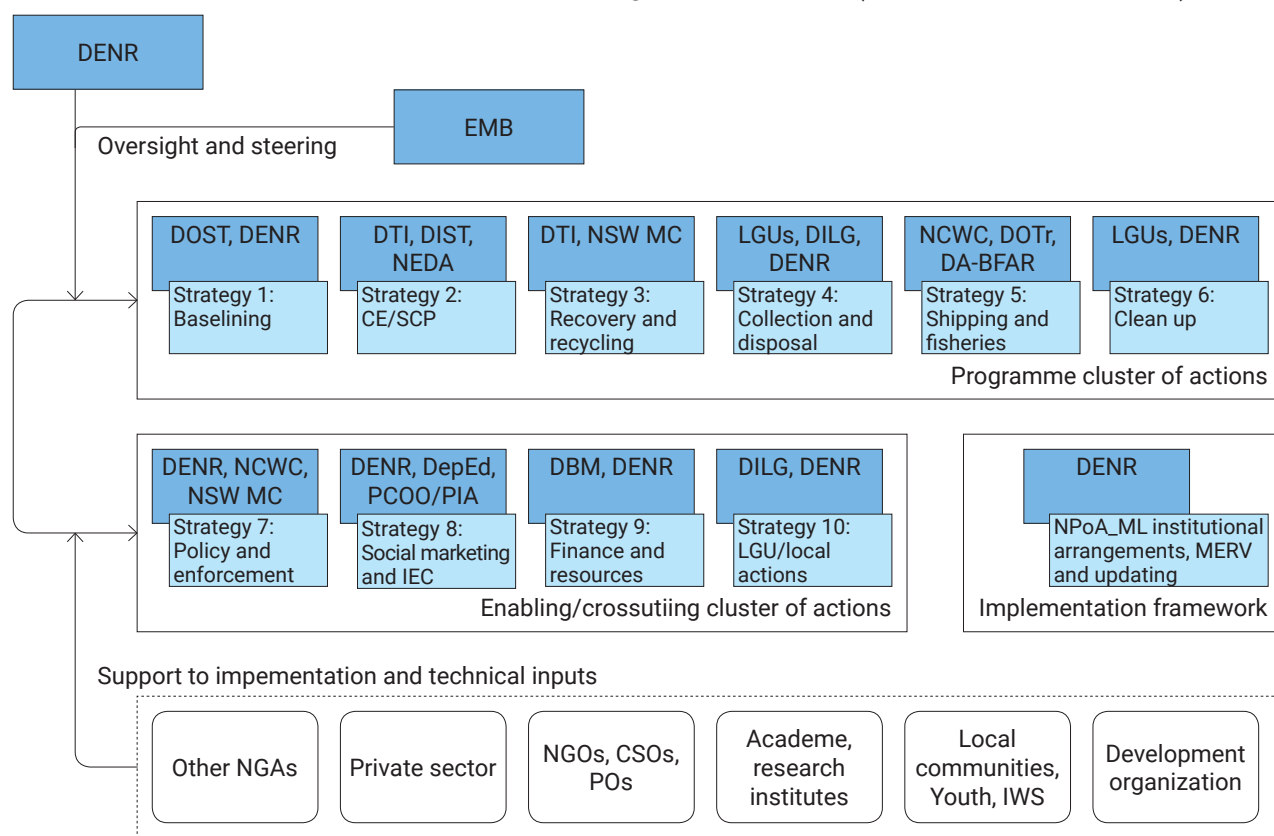
Furthermore, there are several Senate Bills currently under consideration in the 18th Congress aimed at institutionalizing WtE initiatives. These bills seek to develop environmentally sustainable waste management systems, including the establishment of WtE facilities. These facilities would contribute to waste reduction, segregation, recycling, re-use, disposal, and conversion into valuable resources, fostering a more sustainable approach to waste management in the country.

1.2.4 Inter-Agency Mechanisms to Reduce Marine Plastic Litter

The Philippine Government approved the National Plan of Action on Marine Litter (NPoA-ML) on August 5, 2021, to effectively tackle the challenges posed by marine plastic litter. This comprehensive plan outlines various strategies and actions, including:

1. Establishing science- and evidence-based baseline information on marine litter

Figure 4. Inter-agency Mechanisms to Reduce Marine Plastic Litter. Source: National Marine Litter Prevention, Reduction & Management Council (NPoA-ML, DENR, 2021)



2. Promoting a circular economy and supporting sustainable consumption and production (SCP), with extended producer responsibility (EPR) as one of the key methods
3. Enhancing recovery and recycling coverage and markets
4. Preventing leakage from collected or disposed waste
5. Implementing a sea-based litter prevention and management program
6. Institutionalizing a management program for litter already existing in the marine/riverine environment

Furthermore, the plan advocates the adoption of national-level laws and policies to address marine litter, focusing on improving recycling and waste management operations.

To ensure the effective implementation of the NPoA-ML, the Philippine Government has established a well-defined institutional organization as a monitoring and reporting mechanism. Lead agencies are required to coordinate with collaborating agencies within their respective clusters, refining work plans for each strategy, specifying precise targets, and overseeing the implementation and monitoring of activities and work programs. Lead agencies may also organize themselves and involve other stakeholders as necessary.

Operating under this framework, an inter-agency collaboration is under establishment in the

Philippines to reduce marine plastic litter. As depicted in Figure 4, an overarching multi-stakeholder organization led by strategic cluster leads is envisioned to provide oversight and direct implementation on a regular basis.

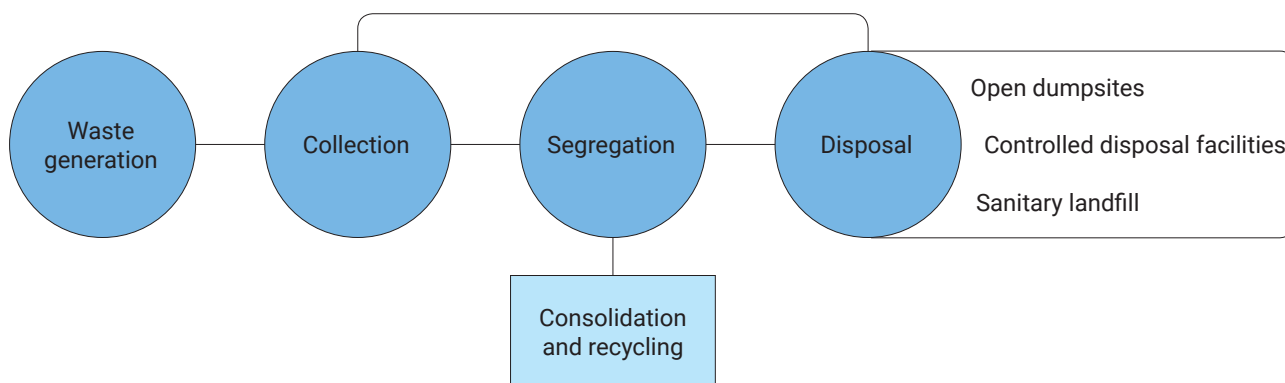
1.2.5 Philippine SWM Infrastructure and Operationalization

The infrastructure and operationalization of SWM involve the collection, segregation, and disposal, as depicted in Figure 5 and explored in more detail in the following sections.

Source Reduction: Waste avoidance and reduction are at the top of the RA 9003 waste management hierarchy. Cities and towns have established rules prohibiting the use of specific types of plastic in commercial premises to reduce waste output. The bulk of these come with teaching materials to urge people to waste less. Several local organizations have also been promoting a plastic-free lifestyle by encouraging people to adopt reusable products.

Collection: The city or municipal administration, the barangay's capabilities and available equipment, and the jurisdiction's physical and geographical characteristics all influence collection and disposal. A private garbage hauler is hired for some heavily populated areas, such as Metro Manila, to collect MSW from residents. Some municipalities have their own collection vehicles and staff. This waste is delivered to a designated landfill, which may or may not be owned by the transporter (where it is also sorted and treated). Waste collection in these cities is frequently conducted door-to-door in easily accessible neighborhoods or at pickup facilities

Figure 5. SWM Infrastructure (Source: NSWMC, 2018)



in areas with narrow or challenging roads. The barangay arranges waste collection with the city or municipal government in their respective regions, regardless of the mode of collection. Most barangays gather both biodegradable and non-biodegradable rubbish. Whenever practical, most barangays encourage inhabitants to compost their own biodegradable waste or feed food waste to pigs, for example..

Waste recovery: Waste materials collected from barangays are first transported to MRF, where biodegradable and recyclable waste is separated. The MRF may be operated by the barangay or city. After passing through the MRF, or if no MRF is available, the waste is disposed of at a designated landfill, either public or private, where final sorting or treatment may take place. Different strategies have been used by other LGUs with rural barangays.

According to the NSWMC, MSW collection rates in the country range from 30 to 99%, the highest being primarily in metropolitan regions. Table 1 illustrates the collecting efficiencies of each area in the Philippines, calculated using the population share

living in urban barangays as a proxy for urbanization (PSA, 2015).

The efficiency of collection varies depending on the sort of development in each area. Cities and municipalities are categorized in this report based on their garbage collection efficiency and generation. Other obstacles to waste collection include budgetary constraints for waste management (collection and disposal), as well as accessibility. In densely populated but inaccessible areas where suitable garbage collection is not in place, communities might discharge waste in surrounding bodies of water such as rivers, estuaries/tributaries.

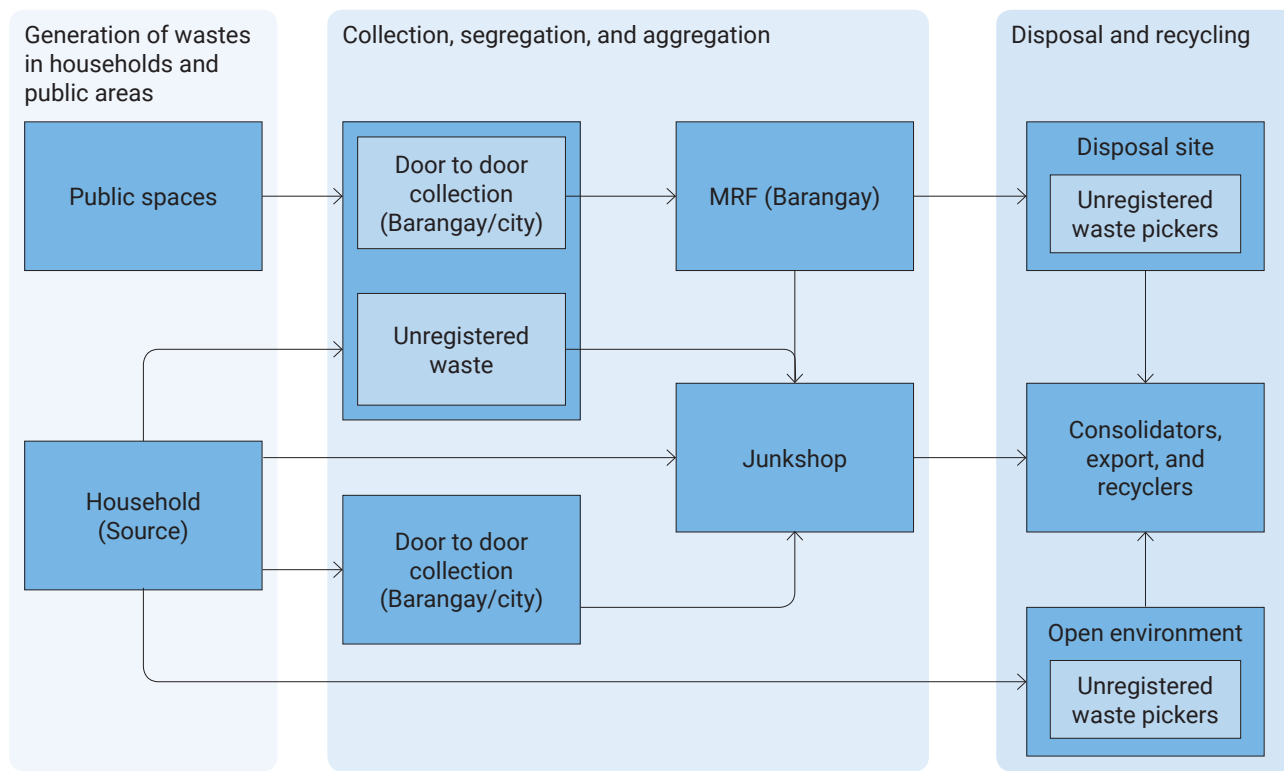
Segregation: Local governments are required by RA 9003 to ensure that each barrio/town or cluster of barangays has its own MRF. Solid waste is sent for final sorting, segregation, composting, and recycling, with the remainder going to a sanitary landfill. "A transfer station or sorting station, a drop-off center, a composting facility for biodegradable waste, and a recycling facility should all be included in the MRF." The law does not give LGUs any explicit instructions for the establishment of MRFs, allowing

Table 1. Collection Efficiencies per Region in the Philippines

Region		Degree of urbanization (%)	Collection efficiency (%)
NCR		100	95
CAR		30	23
I	Ilocos	20	12
II	Cagayan	19	10
III	Central Luzon	62	56
IV A	CALABARZON	66	61
IV B	MIMAROPA	31	23
V	Bicol	23	15
VI	Western Visayas	38	31
VII	Central Visayas	49	43
VII	Eastern Visayas	12	30
IX	Zamboanga Peninsula	38	31
X	Northern Mindanao	48	42
XI	Davao	64	58
XII	SOCSEKARGEN	52	46
XIII	CARAGA	33	26
ARMM		23	15

Source: NSWMC, 2018

Figure 6. Stakeholders Participating in Waste Collection. (Source: WWF, 2020)



them to be as creative as they want with the MRF's setup and activities. MRF operationalization ranges from inadequate, with only sheds serving as storage areas, to excellent, with many waste diversion activities. As of 2018, there were "10,730 MRFs across the country [NSWMC, 2018], catering to only 33.3% of the barangays."

1.3 Market Dynamics and Plastic Recycling

In 2010, households were the primary contributors to MSW, accounting for the majority of waste tonnage at 56.7%, as illustrated in Figure 7. Commercial sources, including general merchandise stores and

Figure 7. Sources and percentage contribution in tons of MSW (DENR-EMB, 2014)

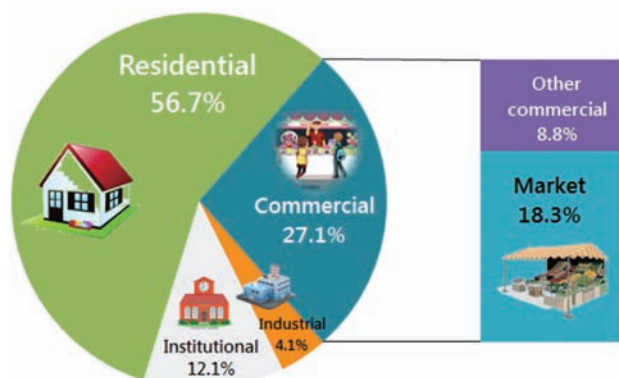
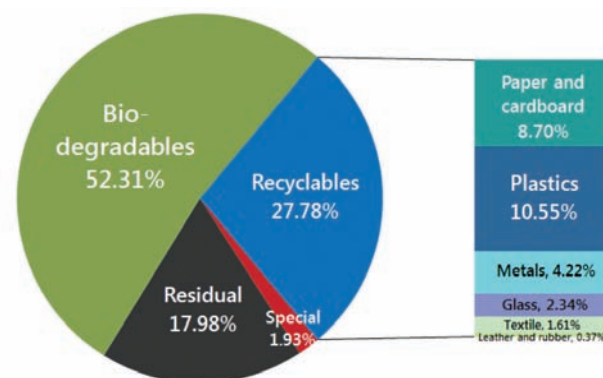


Figure 8. Composition of MSW in the Philippines by weight (Source: DENR-EMB, 2014)



restaurants, contributed to 27.1% of the waste, with public or private markets comprising two-thirds of this share. Institutional sources, such as government offices, educational institutions, and medical facilities, contributed 12.1% to the waste, while the industrial and manufacturing sector accounted for the remaining 4.1% of municipal waste.

1.4 Market and Economic Forces Influencing the Prioritization of Plastic Types and Technology Choices for Plastic Processing in the Philippines

The Philippine economy suffers a significant loss of 78% in the material value of plastics annually, amounting to USD 790–890 million. The potential

material value that could be unlocked from plastic recycling stands at USD 1.1 billion per year if all four resins achieve a 100% collection rate and attain the highest market value. However, the current statistics depicted in Figure 1 reveal that only 22% of the total plastic material value, equivalent to USD 246 million per year, is being realized. This glaring disparity results in a substantial annual loss of USD 790–890 million in potential material value for the Philippine economy.

Addressing this market opportunity will necessitate significant investment from both the public and private sectors in waste collection and sorting infrastructure, as well as the creation of an enabling environment to enhance recycling economics and implement systemic interventions.

Figure 9. The Philippines recycled about 28% of the key plastic resins in 2019 (Source: World Bank, 2021)

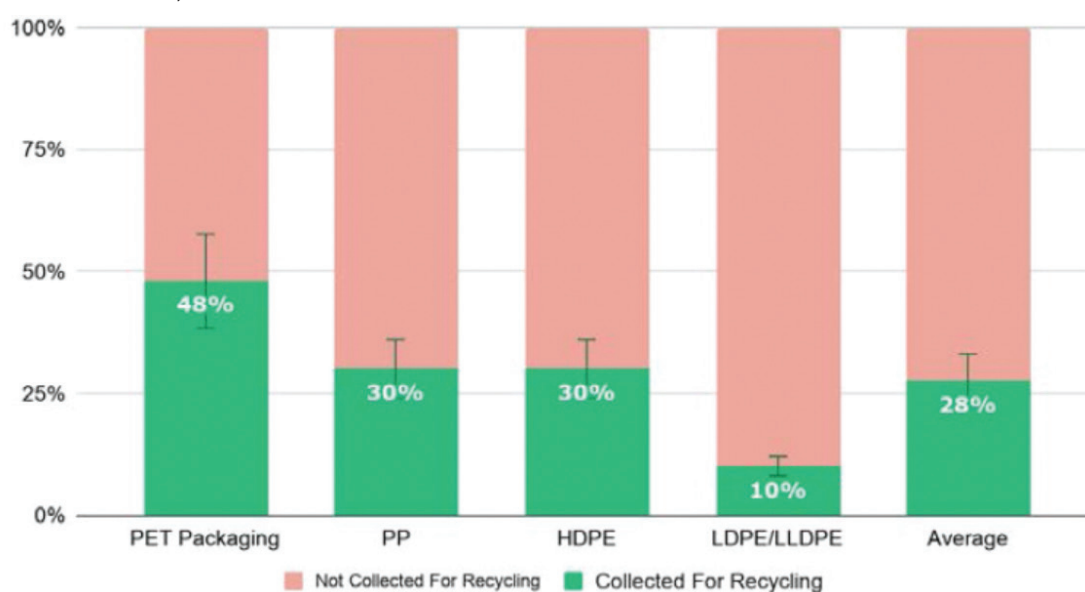


Table 2. Fall In Demand for the Value Chain Stakeholders across the resins in the Philippines

	Average remand reductions experienced by recyclables interviewed (Pre-COVID compared to post lockdowns)				
	All resin	PET	HDPE	LDPE	PP
Informal collectors	78%	90%	69%		70%
Junkshops	56%	41%	46%	-	77%
Aggregators	38%	50%	27%	-	27%
Recyclers	53%	20%		63%	

Source: GA Circular XXXXXXXX

Significant Reductions in Demand Throughout the Value Chain

The COVID-19-induced lockdowns, continued restrictions, and poor economic outlook have further reduced demand for recycled plastic, which was already suffering from low virgin prices. The drop in demand affects all resins and value chain stakeholders. According to Table 2, demand and volumes traded in the Philippines decreased by 20–90% depending on the material and stakeholder. Since a greater number of informal collectors were still in operation, they experienced the greatest volume reductions.

The decline in demand is significant for all resins and all participants in the value chain. According to Table 2, depending on the commodity and stakeholder, the demand and volumes traded in the Philippines decreased by 20–90%. The volume of informal collectors was reduced the most since more of them were still in operation. Informal players have lower costs and can purchase materials at a better price since they can undercut the formal players by stealing electricity, paying workers less, etc.





Chapter 2



Manila City Architecture of Plastic Waste and the Recycling Landscape

2.1 Socio-Economic Demographic Profile

Manila, the Philippine capital, is a densely populated metropolis. On the east, it is bordered by the Philippine Sea and the Pacific Ocean. Manila is located on the eastern bank of Manila Bay, near the mouth of the Pasig River, which runs east-west through the city's heart and splits it into two halves. The city shares its borders with "seven other cities and municipalities in Metro Manila: Navotas and Caloocan in the north, Quezon City in the northeast, San Juan and Mandaluyong in the east, Makati in the southeast, and Pasay in the south" (refer to Figure 9. Map of the City of Manila) (Manila Department of Public Services (DPS), 2021).

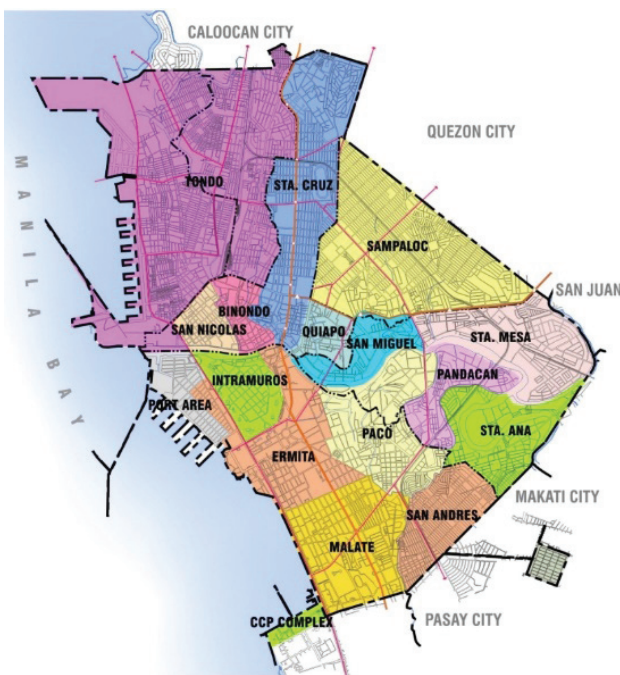
Manila has a land area of 35,966,479.65 square meters. Manila's land area is likely to grow due to upcoming reclamation initiatives. The overall land area of Manila is 38,552,613.18 square meters,

which includes all reclaimed territory along Manila Bay. Manila's land area represents only 6.50% of Metro Manila's total land size of 636 square kilometers (Manila Department of Public Services (DPS), 2021).

According to international sources, Manila was the world's second densest metropolis in 2013; it was the world's densest city in 2007, with a population density of 43,079 persons per square kilometer (111,576 people per square mile). Official country data, on the other hand, suggest that Manila's population density in 2010 was 66,140 persons per square kilometer, up from 63,294 in 2000. The population of Manila was 1,651,892 in 2010, up 0.44% from 1,581,082 in 2000 (Manila Department of Public Services (DPS), 2021).

The city is divided into "896 urban barangays, the smallest unit of local government in the Philippines. Each barangay has its own chairperson and councilors. For administrative purposes, all of Manila's barangays are divided into 100 zones, subsequently divided into 16 administrative districts. In these zones and districts, there is no local government."

Figure 10. Map of the City of Manila (Manila Department of Public Services (DPS), 2021)



2.1.1 Climate

Manila has two different seasons: the dry season, which runs from December to April, and the wet season, running from May to November. During the months of April and May, the dry season corresponds with the southwest monsoon, and the coolest days are normally in December and January. The maximum daytime temperature, which usually occurs in the early afternoon, is 31.2 °C, while the minimum temperature, which normally occurs in the early morning before sunrise, is 24.8 °C. The average temperature is 28.0 °C.

2.1.2 Economic Profile

The city's leadership in trade and commerce is unquestionably due to the following factors: first, the country's prime harbors; second, the economies of agglomeration; third, the underground economy, or informal sector; and last, the city's large human resource potential. The so-called economies of agglomeration, in which enterprises of the same or related products are grouped in a specific region, are one of the built-in potentials of the local economy. According to records, wholesale and retail trading (Manila is established as the country's trading capital) account for more than 52% of registered establishments in the city, earning it the moniker "bagsakan center." In the grand scheme, each congressional district has its own distinct set of products, services, or industries that it provides and/or delivers. The City of Manila, in general, is a "one-stop food, work, study, retail, and leisure" region, where millions of visitors come to visit and stay for a while every day. .

2.1.3 Land Use

Land use policy (as enacted through zoning, development limits, and construction regulations) has had a minimal impact on the type, pattern, and intensity of urban development activities in Manila thus far. While the zoning ordinance allocates space for various urban activities (residential, commercial, industrial, and so on), it does not establish clear regulatory requirements for the intensity of those activities (Manila Department of Public Services (DPS), 2021). Apart from the ordinance's intrinsic flaws, it is also plagued by an ineffective enforcement system. As a result, the ordinance's goals are frequently overshadowed by real estate market mechanisms and the demands of the market economy. As a result, the ordinance's environmental goals are compromised in favor of more pragmatic private-sector initiatives. The City of Manila must be able to respond to the problem of fast urbanization by enacting an up-to-date and more responsive zoning policy.

2.1.4 Geographical Features

Manila and the rest of the NCR are on a shelf principally produced to the west by a ridge of volcanic rocks. The river's sand, gravel, and clay

deposits surround the crest. Similar deposits, transported by the Marikina River, top a valley produced by a downward and slanted fracture or fault to the east of the ridge. A large portion of Manila is surrounded by marshes and swamps. It is a crucial site for trade and business because of its closeness to the sea and important waterways. Since the city's geography is rather flat, with some areas below sea level, seawater travels roughly two kilometers inland up the Pasig River to its source, the Laguna de Bay (illustrated in Figure 10), a freshwater lake, during high tides. Manila's physical makeup can be separated into two parts: North Manila, located on the upper portion of the Pasig River, and South Manila, on the bottom portion of the river. The Pasig River, which is around 25 kilometers long, connects Manila Bay with Laguna de Bay. Along the river's banks are over 2,000 factories and 70,000 families living in improvised shelters. For simple political identification, the city is divided into six congressional districts. There are 100 zones and 896 barangays in each of the six districts (the smallest political unit in the city). Some barangays from the then-administrative districts of Sampaloc were divided, leading to the formation of Sta. Mesa, which is now part of the sixth congressional district. Additionally, some barangays from Sta. Ana have been reorganized to become part of the fifth congressional district.

Figure 11. Land use Map of Manila (Manila Department of Public Services (DPS), 2021)



2.1.5 Waterways and Esteros

The city has begun a “parcellary and relocation survey of all main esteros and their tributaries (refer to Figure 10. Land Use Map),” outlining the proposed estero (estuary) line, easement, and service road right of way through the Department of Engineering and Public Works. During the study, however, it was discovered that some portions of the tributaries were titled and occupied by some officials and mostly informal citizens of the city. Manila has relocated 3,914 out of 13,153 families living along the Pasig River and some of its tributaries. There are 30 waterways and esteros in Manila (Manila Department of Public Services (DPS), 2021).

2.2 Existing Legal and Regulatory Framework in Manila

2.2.1 Legal/Institutional Framework

All municipal rules and ordinances related to SWM and other environmental problems in the City

of Manila are implemented and enforced by the Department of Public Services (DPS). The City Legislators created and approved the necessary City Ordinances in accordance with the Ecological Solid Waste Management Act of 2000 (RA 9003) over the years since its approval. Executive Orders issued by the mayor (past and current) have acted as a backbone to enjoin the city and Barangay authorities’ involvement and commitment to implement, enforce, and support all local legislation related to SWM and environmental preservation. The ordinances pertaining to SWM in Manila are shown in Table 3.

2.2.2 Permitting Procedures for SWM Facilities

The City of Manila relies on the permitting required for the operation of SWM facilities, based on EMB-DENR criteria, and part and parcel of the application for a business permit/permit to operate. The only transfer/transport station owned and maintained by PHILECO is located at Pier 18, Tondo, Manila, and covered by a DENR-EMB-NCR Environment Compliance Certificate (ECC).

Table 3. Manila Ordinances on SWM

No.	Ordinance No.	Title of Ordinance
1	8572 (2019)	“An ordinance strictly requiring all residential and commercial establishments within the City of Manila to maintain the cleanliness and orderliness of their immediate surroundings and frontage, and providing penalties for violation thereof or otherwise known as ‘Tapat Ko Linis Ko Ordinance’”
2	8371 (2014)	An ordinance providing an environmental code for the City of Manila.
3	8282 (2012)	An ordinance banning “the use of any form of plastic bags on dry goods and regulating its utilization on wet goods, as well as the use of polystyrene and similar materials as containers for “food, goods and other products” and providing penalties for violation thereof and for other purposes”.
4	8194 (2009)	“An ordinance amending section 3 ordinance no. 7404 entitled “an ordinance covering solid waste disposal practices, including prohibition of open dumping in vacant lots or properties, in estero’s and other water courses”
5	7924 (1997)	An ordinance prohibiting the dumping and discharging of garbage, refuse, sewer waste, debris, toxic waste and other pollutants from vessels, factories, commercial and industrial establishments, residential houses and other structures into the Manila Bay, the Pasig River and other waterways and bodies of water within the territorial jurisdiction of the City of Manila.
6	7853 (1994)	“An ordinance requiring the provision of garbage receptacles in all public utility vehicles in the City of Manila, providing for penalties for violation thereof, and amending/repealing for the purpose of ordinance no. 6747 and ordinance no. 7436”.

Continued next page

Table 3 continued

No.	Ordinance No.	Title of Ordinance
7	7866 (1994)	"An ordinance penalizing the disposal of garbage, debris and other waste materials in rivers, creeks, canals and waterways; providing penalties for violation thereof; allocating to the barangays 20% of the fine collected therefrom and for other purposes".
8	7876 (1994)	"An ordinance requiring all residents of, and business establishments within, containers with which to segregate biodegradable and non-biodegradable garbage for composting and recycling, for the purpose of achieving and complying the objectives and methods of a "zero-waste technology" and providing penalties for violation thereof."
9	7721 (1990)	An ordinance prohibiting garbage truck, hauler truck, dump truck, gravel and sand hauler truck or any open vehicle or truck carrying chemical, petroleum products or other construction material to pass through, go over, or pass over in the streets, avenues, lanes or thoroughfares and the like within the city of Manila with the garbage or contents thereof not properly covered, providing penalties for violation thereof; and for other purposes.
10	7695 (1989)	"An ordinance prohibiting the disposal of garbage, trash, rubbish and refuse in an open, uncovered, or unsealed container, providing penalty for violation thereon, and for other purposes."
11	7510 (1974)	An ordinance prohibiting scavenging and providing penalty for violation thereof.
12	7545 (1974)	An ordinance amending ordinance no. 7516, imposing an annual tax collectible on the different businesses in the City of Manila; ordinance no. 7424; prescribing new rates of garbage fees for business, trade, occupational, residential and other establishments, and ordinance no. 7521, requiring permit and service fees in the City of Manila.
13	7484 (1973)	"An ordinance covering solid waste disposal practices, including prohibition of open dumping in vacant lots or properties in esteros and other water courses."
14	7444 (1973)	An ordinance regulating and controlling the discharge of industrial and other wastes into the atmospheric air or body of water within the territorial limits of the city of Manila for the purpose of abatement and prevention of pollution, providing penalties for its violation, and for other purposes.
15	7436 (1973)	"An ordinance requiring the owners and/or operators of passenger, buses and other public conveyances operating in the City of Manila to install garbage receptacles in said conveyances; and providing penalty for violation thereof".
16	7404 (1973)	"An ordinance covering solid waste disposal practices, including prohibition of open dumping in vacant lots or properties in esteros and other water courses."
17	7397 (1973)	"An ordinance prohibiting the dumping of waste, refuse, garbage materials, papers, cigarette butts and the like, in any place in the streets and other places not otherwise designated as a dumping place; and providing penalty for violation thereof".
18	7368 (1973)	"An ordinance authorizing the creation of a Manila anti-pollution commission" under the Office of the Mayor to regulate and control environmental pollution in the city and coordinate its work and function "with the national water and anti-pollution control commission in consonance with R.A. 3931".
19	7319 (1973)	An ordinance imposing a penalty of twenty pesos (p20.00) fine, exclusive of court costs and/or imprisonment for two (2) days at the discretion of the court, on all persons convicted of violating the anti-littering ordinances of the City of Manila.
20	7197 (1972)	An ordinance amending sections 1 and 2 of Ordinance No. 7173 which prescribes payment of garbage fees on fixed schedules for business, trade, occupational and other establishments in the City of Manila.
21	7179 (1972)	"An ordinance further amending section 930 of the revised ordinance of the City of Manila relative to the time to place receptacles on sidewalks, large quantities of rubbish, removal; fees."

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Table 3 continued

No.	Ordinance No.	Title of Ordinance
22	6747 (1968)	"An ordinance requiring public conveyances operating in or through the City of Manila to carry rubbish containers, providing penalty for violation thereof; and for other purposes."

Source: Manila Department of Public Services, 2020

2.2.3 Capacity Building of DPS Personnel

Apart from mandatory administrative and performance enhancement training provided by the City Personnel Office of the City of Manila, DPS staff and personnel rely on NGOs, Civic/Community Organizations, the DENR, NSWMCS, EMB-DENR, MBOA, MMDA, and other government agencies for seminars and workshops on environmental concerns and SWM sponsored activities.

2.2.4 Current SWM Situation in Manila

The city is working to make its SWM system more RA 9003 compliant and environmentally friendly under the current administration. The Information, Education, and Communication (IEC) strategy of Manila involves actively conducting a campaign on waste segregation at source and waste diversion activities through resource recovery and recycling. Small-scale composting in barangays and public schools is highly recommended to support the projected waste diversion target prescribed by the City of Manila's 10-Year SWM Plan. As of now, the city is working closely with barangays, public schools, community groups, and private organizations to improve its garbage collection and disposal system. Through a private contract with the private sector, the City of Manila has a 100% coverage clean-all solid waste collection and disposal system (Manila DPS, 2020).

2.2.5 Manila City 10-Year SWM Plan

Each type of waste collection for each sector is the responsibility of this entity. The Manila DPS, through the City Contracted Waste Hauler, collects waste from families and barangays, as required by RA 9003. The main thoroughfares, city roads, side roads, and stationary sources must all be used by the private hauler. Collection in residential areas is conducted door-to-door.

2.2.5.1 Private Collection Service

The private sector (IPM-CDC) collects clean, solid trash and hauls it from all sites within the City of Manila's territorial jurisdiction under a "clean-all" contract. In addition, the IPM-CDC deploys 400 street sweepers and offers IEC materials to ensure the cleaning of specified important areas.

2.2.5.2 Segregation Strategies

To promote source separation at the barangay level. As mandated by RA 9003, the DPS conducts IEC in every barangay with the goal of encouraging source segregation and waste reduction. The BSWC assigns an eco-aide collector/street sweeper to collect separated garbage from every dwelling on a door-to-door basis. As a type of incentive, collected factory returnable garbage is handed to the allocated barangay door-to-door eco-aide collector.

For the monitoring and enforcement of the start-up, the barangay will implement a no-door-to-door collection policy for unsegregated rubbish as soon as the DPS conducts an IEC campaign. Similarly, the city-authorized hauler will not collect or dispose of waste that has not been separated. The DPS will send out teams to monitor and enforce the law (E-Police) and conduct ad hoc inspections in any barangay to assess the manner and system of solid waste collection. Barangays found in violation of section 10, Chapter 2 of RA 9003 are to be issued with a stern warning that any subsequent violations will result in a fine or the filing of a case in the proper court against the violator, with the barangay chairman held liable for failure to implement the Act. The DPS will give technical help in the implementation of WACS to guarantee all people of the barangay are knowledgeable about segregation and composting.

2.2.5.3 Recycling Plan

The City SWM Board, in collaboration with the DPS, has developed a Memorandum of Agreement between the City and chosen junkshop owners, allowing factory returnable rubbish to be collected by the barangay's designated eco-aide collectors. The city's 10-year trash diversion plan will be validated by recording, tabulating, and submitting the delivered waste to the DPS for validation. The DPS will perform a demonstration of WACS to guarantee all people of the barangay are aware of how to undertake segregation and composting.

The DPS will organize a one-day training/seminar to give technical assistance by increasing stakeholders' awareness of the waste categories that can be accommodated and processed. Similarly, correct waste tracking and tabulation will be discussed to ensure the report's accuracy.

The cluster of barangays in each zone will also be encouraged to recover possible refuse-derived fuel (RDF) resources such as tires and styro packaging materials, as well as coordinating with the NSWMCS via the DPS for a possible extra income-generating program for the barangay. Manila City provides a cutting/shredding machine to improve the program's financial viability. Beginning in 2016, the city implemented a continuous recycling program, due to last until 2023..

2.2.5.4 Composting/Management of Biodegradable Waste

Since most homes in Manila have pets, kitchen waste and food leftovers are often handled properly in every barangay. Plant and tree cuttings, as well as market garbage, are left for door-to-door collection and disposal by the barangay. The BSWM Committee is required to conduct composting activities to meet the requirements of RA 9003 on waste diversion. If all barangays optimize their potential to segregate compostable trash from the daily collection system, an average of 2 kilos per barangay per day will be diverted from the garbage mainstream. The Manila DPS supplies shredding equipment to help the above-mentioned garbage decompose more quickly. In 2016, composting training activity was conducted, as well as the launch of the program at the barangay level.

2.2.3.5 Recycling

The City SWM Board has been giving lectures and actual classes on recycling by turning soiled clothing materials into "edopa" rags, soft drinks straws into decorative curtains, pet bottles into decorative house accessories, and other materials that can be made into by-products in collaboration with the Manila DPS, Division of City Schools, and NGOs.

2.2.3.6 Disposal

At the Navotas Sanitary Landfill, solid waste collected daily from the City of Manila is delivered by barge. The Philippine Ecology Corporation transformed the land from a former fishpond into a two-phased Category 4 Sanitary Landfill (PHILECO). Both landfill cells are covered by ECCs granted by the EMB-NCR and DENR in April 2006 and October 2007. The Metro Manila Development Administration (MMDA) and the City of Navotas endorsed the above-mentioned SLF to the City of Manila and other LGUs as an alternate disposal facility in accordance with the provisions of the RA 9003 policy framework.

2.2.3.7 Information, Education, and Communication (IEC) Campaign

A substantial IEC campaign was launched to raise the level of awareness among the City's inhabitants. The

Manila DPS aims to achieve 100% coverage every year, which will include 896 barangays, 103 public schools, 6 local government hospitals, 59 clinics, and 70,015 commercial establishments. In addition, open letters were delivered to business and commercial enterprises to encourage their respective management to exercise waste minimization segregation and keep the establishment and its immediate surroundings clean and sanitary. A large IEC effort was made to raise the level of awareness among Manila residents. In 2015, the city aimed to achieve 20% IEC coverage of 896 barangays, 71 primary schools, 32 high schools, 6 city hospitals and medical facilities, and 70,015 listed commercial establishments. The Department of Public Services (DPS) continues to send open letters to businesses to encourage them to practice source separation and support the city's environmental awareness program by maintaining the cleanliness of their surroundings

Figure 12. Top 10 Plastic Waste collected during the 36th International Coastal Cleanup 2023 (Source: Manila DPS, 2023)



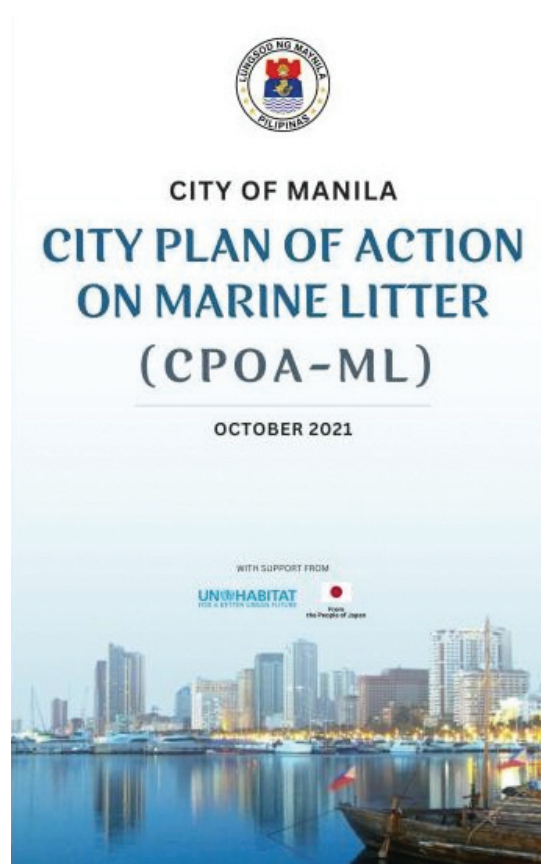
and ensuring that no waste produced during their operations is disposed of in canals or esteros (estuaries) leading to the Pasig River.

As part of the IEC, Manila, along with the aligned agencies in the Philippines, organized the 37th International Coastal Cleanup 2023. This coastal cleanup was conducted at the site where the top 10 trash is collected in the Baseco and Baywalk, as depicted in Figure 12.

2.2.6 City Plan of Action on Marine Litter

Manila is the first city in the Philippines to implement the City Plan of Action on Marine Litter (CPOA-ML). Mirroring the Philippine NPOA-ML's overarching goal, the City of Manila shall likewise endeavor to achieve "Zero waste contribution of the City of Manila to Philippine waters by 2040." Several of the city aims for the CPOA-ML include the following:

- Maintain the per capita MSW generation rate through a circular economy, e.g., product redesign, waste avoidance, green consumerism, etc., at 0.93kg/capita/day from 2021 to 2025;



- Improve MSW diversion through recycling, composting, and other resource recovery activities from 48% in 2021 to 54% by 2025;
- Maintain 100% daily waste collection coverage within 2021 to 2025;
- Improve daily waste collection efficiency from 95.76% in 2021 to 100% by 2025;
- Improve the behavior, knowledge, attitudes, and practices toward a circular economy, SWM, and MPL by 20% by 2025;
- Recover and properly manage (e.g., recycle/upcycle or safely dispose of) 100% of riverine/marine litter from trash traps and cleanup drives in esteros, creeks, and coastal areas by 2025.

2.2.6.1 Programmatic Cluster of Actions

- The city will establish science- and evidence-based baseline information on marine litter through the conduct of WACS among barangays and markets.
- The city will provide a platform for dialog with the private sector (including MSMEs, semi-informal and informal sectors) to reduce waste through workshops on CE.
- While CE promotes the avoidance and minimization of waste, the management of post-consumer goods and packaging materials should be further enhanced as mandated by RA 9003.

2.2.6.2 Prevent Leakage From Collected or Disposed Waste

Contrary to the popular belief that only uncollected waste ends up in the marine environment, according to various existing studies, the majority of marine litter supposedly comes from already collected or disposed of waste. The leakage of waste from these land-based sources can be prevented with proper monitoring and the enforcement of waste collectors and operators of waste management infrastructure. This will be achieved through the daily operation of the DPS, such as mopping, clearing operations,

garbage collection, flushing, and sweeping operations.

2.2.7 Manila SWM Recognition

Manila has been awarded the following:

- The City of Manila was recognized as the grand champion for the Estero de San Miguel in the DENR GAWAD TAGA-ILOG 2.0: SEARCH FOR THE MOST IMPROVED ESTERO IN METRO MANILA 2021–2022.
- Plaque of Recognition: 2022 Recognition Ceremony for NCR Stakeholders in Celebration of the Philippine Environment Month.
- Plaque of Recognition: Best Practices on Upcycling during the SWM Summit.

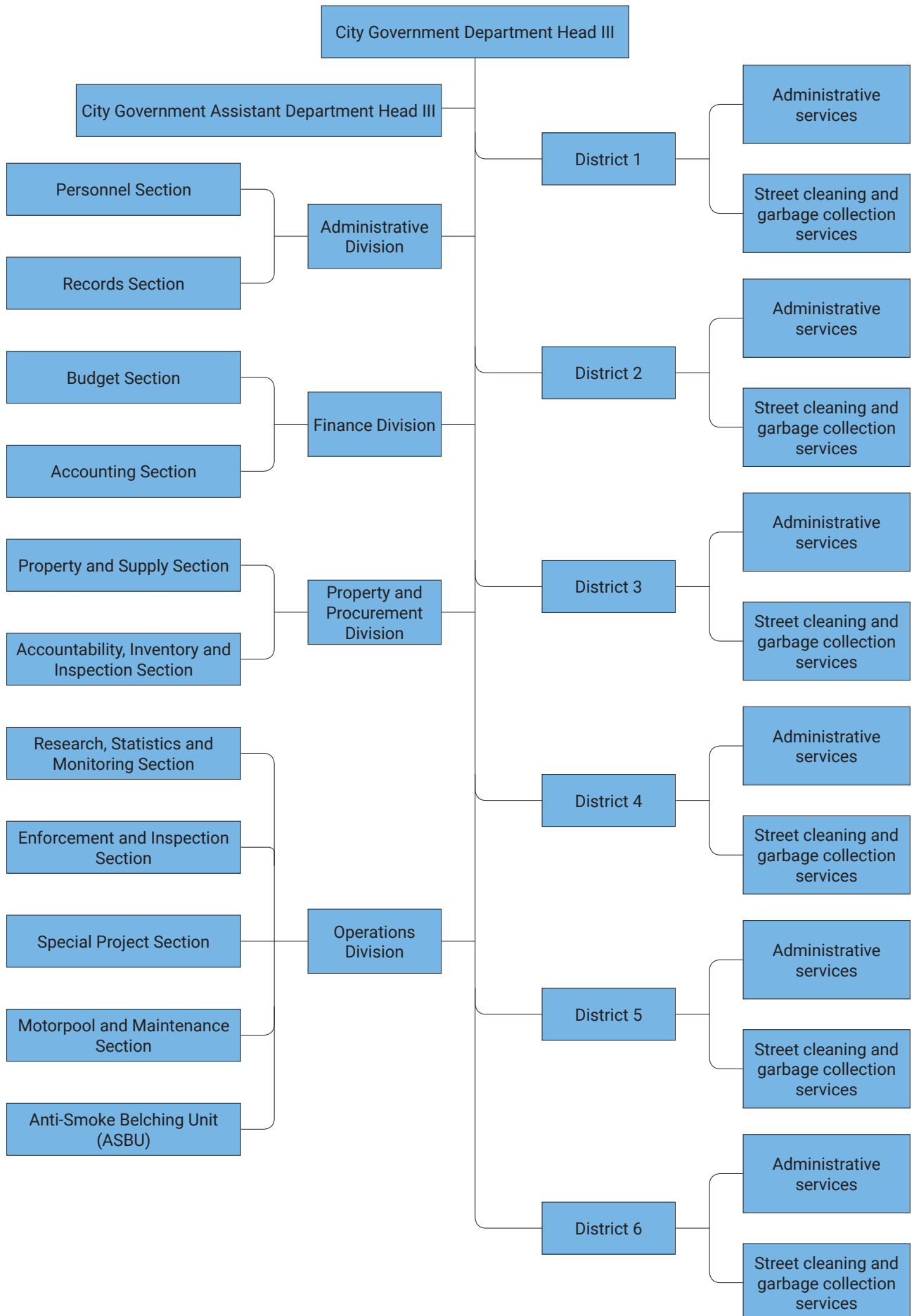
2.3 Institutional framework

2.3.1 Governance Structure of the City of Manila

The DPS is responsible for the city's SWM and environmental sanitation under the direct supervision of the Department Head. The organizational structure of the DPS comprises four (4) divisions and six (6) district offices to enhance the efficient dispensation of DPS activities. The individual responsibilities and functions of the divisions are as follows:

- Administrative Division – responsible for the administrative, personnel, and record requirements of the Department.
- Finance Division – responsible for the budget and accounting requirements of the Department.
- Property and Procurement Division – responsible for the management and procurement of property and supply requirements of the Department.
- Operations Division – responsible for the research, statistics, monitoring, enforcement, inspection, special projects, motor pool, and maintenance requirements of the Department.

Figure 13. DPS Organizational Structure



- District Offices – responsible for monitoring the garbage collection systems and street sweeping operations in its respective district jurisdictions.

The Manila City Council passed City Ordinance No. 7770 in 1992, establishing the Department of Public Service (DPS), with the primary responsibility of managing the city's solid waste and other environmental concerns (see Manila DPS Structure in Figure 12) (Manila DPS, 2020).

2.3.1.1 City Solid Waste Management Board

Under the Manila Executive Order No. 76, Series of 2014, the City SWM Board was established to ensure effective compliance with the Philippine Ecological Solid Waste Management Act of 2000 (RA 9003) through the implementation of the City of Manila's 10-Year SWM Plan (CY 2015–2024). The CSWB's specialized responsibilities and functions necessitate active participation and dedication from the following members:

- Chairman: City Mayor
- Vice-Chairman: City Administrator
- Co-Chairman: Head, Department of Public Services
- Members Director, Manila Barangay Bureau
- City Legal Officer
- Superintendent, Division of City Schools, Manila Head, Market Administration Office
- Head, Urban Settlements Office
- Director, Youth Development and Welfare Bureau Director, Bureau of Permits
- City Engineer, Department of Engineering and Public Works Head, Manila Health Department
- Executive Director, NGO Program Secretariat
- City Council Chairman of the Committee on Environmental Protection and Ecological Preservation

- President, Liga ng mga Barangay

- A representative from NGOs to promote recycling representatives from the Manufacturing and Packaging Industries

In accordance with the City SWM Board's responsibilities and powers, the following plans, programs, and activities started in 2015 are stated below (Manila DPS, 2020):

- Implementation of the MOA between the city and junkshop owners – No MOA, no renewal of business permits/licenses to operate business;
- IEC campaign for all public schools, markets, and other institutions – all public schools and institutions are enjoined to strengthen the practice of segregation from source, resource recovery, and small-scale composting;
- Coordinating with RDF users to accommodate foil-lined and styro packaging materials as an alternative fuel source;
- Creation of business establishment operators/ owners' association to practice segregation from source waste reduction, diversion, and sanitation in the vicinity;
- Monitoring of barangays and the implementation and enforcement of SWM Local Laws to conduct deterrent action to mitigate illegal disposal pending collection;

Training and deputation of selected DPS personnel as "E-Police" to effectively enforce and implement all laws and ordinances in concurrence with RA 9003.

2.3.1.2 Roles and Responsibilities of the Manila SWM Board

The City SWM Board, the city, the barangays, private entities and institutions, citizens, NGOs, and recycling companies all have roles to play as generators, citizens, NGOs, or recycling companies. The City SWM Board must enjoin the active participation and support of all stakeholders/waste generators to ensure the success and sustainability of Manila's

10-Year SWM strategy. It is all part of the 10-year SWM Plan, which aims to get all the city's departments involved (Manila DPS, 2020) through the following:

- The barangays are required to guarantee that their constituents follow the Barangay SWM Committee's Ordinance to conduct trash segregation at the source and discourage the illegal/late disposal of household waste.
- Schools, hospitals, and other institutions are encouraged to practice trash reduction, segregation, recycling, and composting, depending on space and manpower.
- Waste reduction, segregation, recycling, and composting are encouraged in schools, hospitals, and other institutions, depending on space and manpower.
- Companies that accept/accommodate plastic/foil-lined packaging and styro-based packaging materials, particularly those that use refuse-derived fuel (RDF), to maximize the city's waste reduction initiative.
- Finally, the City SWMB Board will oversee the implementation and enforcement of all SWM-related legislation and ordinances.

2.4 Stakeholder Participation

The following commitments of stakeholders are required to ensure the success and sustainability of the City of Manila's 10-Year SWM Plan: the establishment of a multi-sector association among business establishment owners to practice waste reduction, segregation from source and sanitation of their surroundings and vicinity; officers/members of the SWMB to guide, support, and provide technical assistance to all stakeholders in relation to effective implementation and enforcement of the plan; and the City Council to enact an ordinance providing minimum requirements and standards in the establishment and operation of businesses.

2.5 Waste Diversion Initiatives for Manila

Manila City, through its various stakeholders, has a number of initiatives for the Incentivized Collection Program to Recover Plastic Waste:

2.5.1 Kolek Kilo Kita Para Sa Walastik Na Maynila

With established accredited junkshops in the City of Manila, this incentivized program by Unilever Philippines involves the collection of flexible plastic waste and enables communities to keep plastic waste out of the environment. Every kilo of soft plastics can be exchanged into PHP 3 pesos. A total of 700 metric tons/700,000 kilograms of flexible plastics have been diverted since October 2019.



Ang programang ito ay buong pagmamalaking inihahandog sa inyo ng pamunuan ng **Lungsod ng Maynila**, sa pangunguna ni **Mayor Isko Moreno Domagoso** #IskoMorenoDomagoso #BagongMaynila #LinSKOMaynila at ng **Unilever Philippines** #UnileverPhilippines, kasama ang **Cemex at Republic Cement**.

Isang paalala mula sa



2.5.2 Alaskalikahan Wrapper Redemption Project

This program implemented by the Alaska Milk Corporation aims to reduce the amount of residual plastics going into the waterways and landfill, while at the same time providing nutrition at the grassroots level. In this program, partners from different barangays in the city can exchange 3 kg of flexible plastics for 165 grams of Alaska-fortified milk. A total of 98 barangays participated in the Alaskalikahan Wrapper Redemption Project.



Weight of Plastics Collected (mt) in 2020	Weight of Plastics Collected (mt) in 2021	Weight of Plastics Collected (mt) in 2022
24.24 mt	28.69 mt	16 mt
GRAND TOTAL = 68.93 metric tons		

ALASKAlikasan
- Wrapper Redemption Program -

KASALING ITEMS

Empty sachets at wrappers ng gatas, sabong panalaba o pangungunang, shampoo, toothpaste, chips, biscuits, instant noodles, kape, candy, straw, plastic sando.

HINDI KASALING ITEMS

Lahat ng uri ng plastic bottles, lata at takip ng softdrinks tanza.

MECHANICS

1. Linisin, patuyuin at gupitin ng isang (1) inch size ang mga nakolektang flexible plastics.

2. Kolektahin at ipagpalit ang **TATLONG (3) KILONG FLEXIBLE PLASTICS** sa **165 G ALASKA FORTIFIED POWDERED MILK**.

3. Maaaring makipag-ugnayan sa Department of Public Services (DPS) at Manila Barangay Bureau (MBB) para sa iba pang detalye.

Para sa iba pang katanungan, maaaring tumawag sa mga sumusunod na numero:
Department of Public Services: (5) 310 12 61
Manila Barangay Bureau: (5) 338 88 85

2.5.3 Aling Tindera: A Waste to Cash Program

Aling Tindera is a program of PCX that provides an avenue where people can monetize plastic waste and encourage discipline in the treatment of post-consumer plastics. It aims to reduce leakage into the environment and educate future generations about the benefits of co-processing, recycling, and other high-level waste management processes. Partners with women micro-entrepreneurs who own sari-sari stores serve as community collection points where individuals can bring and sell their plastics in exchange for cash. There are 15 container vans that were already installed in the City of Manila. A total of 264,632.92 kilograms of plastics were collected.

Aling Tindera

MGA PLASTIK NA PWEDENG IBENTA!

BOTE

PANGKAIN

MGA SACHET

PANLIGO

SANDO BAG

GULONG AT IBA PA

WASTE-TO-CASH PROGRAM

PLASTIC CREDIT EXCHANGE

City of Manila

CITY OF MANILA

THESE LOCATIONS ARE MANAGED BY OUR PARTNER ALING TINDERAS WHO SERVE AS COLLECTION POINTS FOR POST-CONSUMER PLASTIC.

2.5.4 Tapon to Ipon Project (PET Bottle Collection)

Another city initiative at the barangay units is the Tapon to Ipon Project (PET bottle collection). A total of 730 kilograms of PET bottles were collected: 309 kilograms in Kartilya ng Katipunan from June 2021 to March 2022 and 421 kilograms from community-based projects.



2.6 Market Dynamics and Plastic Recycling

2.6.1 Markets for Recyclables

Junkshops operating within the city's territorial authority serve as markets for recyclable or industrial returnable rubbish. Factory returnable garbage, on the other hand, is sold to an accredited/authorized junkshop as a MRF. Residents or private garden contractors buy compost produced by schools or barangays. Compost is utilized for urban gardens and growing organic produce in barangays with sufficient area. Bags made from used tarpaulins to replace non-biodegradable bags, day pack bags and slipper making, ornamental goods like plant hangers,

artificial flowers from straw, and rags and potholders from used clothes materials are all presented by the Manila City Social Welfare Department. The finished products are sold at school fairs and flea markets throughout the city. In Manila, there are 58 junkshops with permits dispersed among their different barangays/zones and 59 junkshops without permits.

2.7 Plastic Value Chain and Network Configuration

2.7.1 Land-Based Solid Waste Generation and Composition

Based on the results of the 2021 WACS conducted by WWF Philippines, Inc. and AMH Philippines, Inc., the total waste generated per day in the City of Manila is 1,750.51 tons, equating to a total volume of 638,935.42 m³ per year, while the weighted average density of waste generated is 238.05 kg/m³ (2021 baseline data, Manila DPS 2021). The per capita waste generation rate (WGR) in 2021 was 0.93 kg/person/day, higher than the findings in 2014, where each person in the City of Manila generated about 0.607 kg/person/day, and higher than the Metro Manila average in 2021 at 0.61/person/day (DENR-EMB, 2018).

In 2021, about 1,676.43 tons/day was collected by the Department of Public Services (DPS) and the third-party waste contractor, while about 74.08 tons/day of MSW was considered as uncollected based on the difference between tons of waste generated and tons of waste collected. Therefore, the waste collection efficiency in the City of Manila in 2021 was 95.77%. Meanwhile, 48% of waste generated is recovered by recycling and composting, with the remaining 4.23% assumed to be either burned or going to the city's land, water, and drains as leakage. About 64% of the waste comes from residential sources, while 29% is from commercial establishments. The remaining 7% constitutes the contribution from industries, institutions, and street sweeping. Furthermore, 70% of the solid waste comes from households, followed by shops (20%) and restaurants (6%).

In terms of composition, the at-source WACS shows that kitchen waste is the largest (47%), followed by paper (8%) and plastics (7%), varying from the

Table 4. Specific Composition of the Recyclable Plastic Waste in the City of Manila based on the WaCT conducted in 2021

Plastic Waste Composition (percentage by weight)	Percentage
Polyethylene terephthalate (PET, PETE)	37.5
High-density polyethylene (HDPE)	11.5
Low-density polyethylene (LDPE)	11.5
Polypropylene (PP)	25.0
Polystyrene (PS)	14.0
Others	5.0

2014 WACS findings, which reveal plastics to be the second largest at 18%. For physical composition, more than half (53%) of the waste is biodegradables, while non-biodegradables consist of one-fifth (21%), and around 4 % of special waste is generated by the city. The specific breakdown of plastic waste fractions is shown in Table 4.

2.7.2 Problems, Issues, and Needs (PIN) on Solid Waste Management

Although most PINs regarding waste management are satisfied in their barangays, those raised include the following:

1. Dumping of waste at the creek or estero;
2. Constituents do not comply with ordinances on proper waste management;
3. Insufficient knowledge of constituents on the proper handling of wastes; and
4. Insufficient cleaning materials and garbage bins.

2.7.3 Recommendations to Further Improve Waste Management in the Barangay

The respondents proposed the following recommendations to improve waste management in the barangay:

- Infrastructure: Provision of additional bigger trash bins with proper labels to be stationed in strategic places around the barangay.

- Information, Education, and Communication (IEC) Campaign: Conduct an information drive on proper handling and segregation and the harmful effects of waste on human health.

- Ordinance:

- Stricter implementation and support of ordinances on proper waste management;
- Maintain daily waste collections and closely monitor the arrival and haulage of waste by the
 - Contractor in the barangay;
 - Stop the use of plastic bags; and
 - There should be a separate system for hauling biodegradables and non-biodegradables.

- Program and Activities:

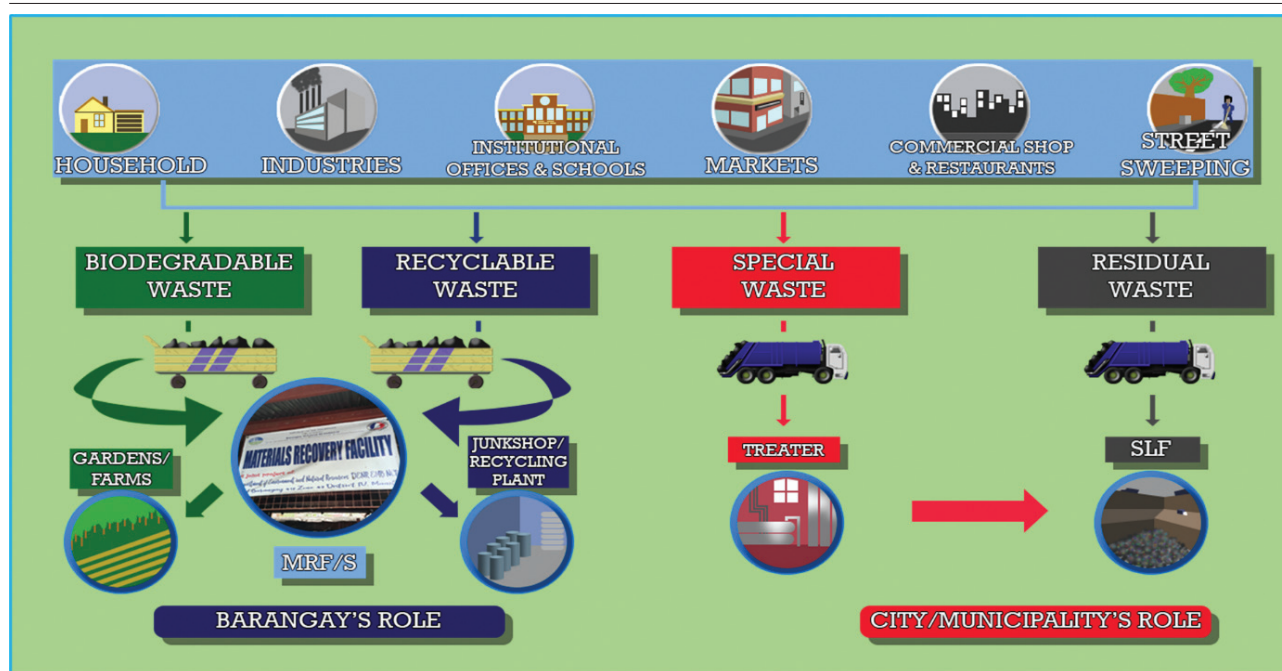
- There should be a barangay program on the recovery of recyclables and how the community can benefit from it.

Several efforts have been made by the DPS, the primary office in the City of Manila responsible for functions related to SWM and environmental sanitation. The frontline services of DPS-Manila are as follows: 1) collection, hauling, clearing, and flushing of waste from different places; 2) conducting IEC campaigns on Ecological Solid Waste Management in barangays, schools, and commercial establishments; 3) regular cleanup drives; and 4) establishing and operating 11 MRFs and 686 materials recovery systems (MRS). Executive Order No. 23, s. 2022 was also created to reorganize the City SWM Board as the general policy-making body for the operation of SWM in the city.

Challenges encountered in SWM.

- Limitation of available land to construct materials recovery and recycling facilities
- Geographical location

Material flow of plastic in the city



- The regulation of junkshops and recycling plants within the city
- Absence of the City Environmental and Natural Resources Office (CENRO)
- Enforcement of laws and ordinances regarding SWM
- The residents have little awareness and lack discipline toward SWM
- Limited access to the latest technologies and equipment

2.8 Plastics and Resin Pellet Leakage Prevention From Factories and Informal/Formal Recycling

Operational activities and potential leakage hotspots

Consolidators in Manila

- **Collection:** Informal waste pickers, waste collection groups, and scrap dealers are key players in the collection of plastic waste, which is the first stage before entering the recycling process. Some of these key players are also sorting unrecyclable plastic items based on

plastic code at this stage to increase revenue from selling to the next step.

- **Sorting:** This is the most important because sorting is the start of the actual plastic recycling process. The process may use manual methods or specially designed machines to sort different plastics based on color, resin content, and plastic recycling code. Sorting aids in the identification and elimination of contaminants.
- **Shredding/extruding:** Following the sorting process, the plastic is shed by a shedder to grind and cut it into tiny pieces. Heavier and lighter plastics are separated after shredding using specially designed machines. This separation aids the separation of various plastics.
- **Cleaning:** The sorting and shredding process ensures that the correct types of plastic are used. After cleaning, the flakes or chunks are thoroughly washed with detergents to remove any remaining contamination. The plastic flakes are then dried through exposure to moderate heat.
- **Melting:** Following the removal of contamination through the cleaning process, the plastic flakes are melted down at a controlled temperature. Temperature regulation ensures that the plastics melt without being destroyed. These plastics

are extruded and resized after melting to be processed into granules and then compressed into pellets.

- **Pelletization:** To make the plastics reusable, the granules are compressed into tiny pellets. Nurdles are another name for these pellets. Pellets also allow for the storage of similar types of plastics based on color and resin type, as well as easy distribution.
- **Re-Using:** It should be noted that pellets recycled from specific types of plastic cannot be reused to make the same type of plastic. They are instead repurposed and redesigned into other useful products.

2.9 Best available technologies

2.9.1 Co-Processing of Plastic Waste: Manila Materials Recovery Facility

- City MRF in Manila Zoo was inaugurated on July 18, 2023. The city MRF consists of equipped with bioreactor for plastic shredding and bio composter.
- Soil Conditioner/compost can be used for ornamental plants, backyard gardening, landscaping, and greening programs of the city.
- Waste Segregation-at-Source and Segregated Collection

Waste Segregation-at-Source and Segregated Collection



- Accelerating Nationally Determined Contribution (NDC) through Circular Economy in Cities (ACE) Project

The mobile MRF consists of a glass pulverizer machine, plastic melter machine and shredder machine.



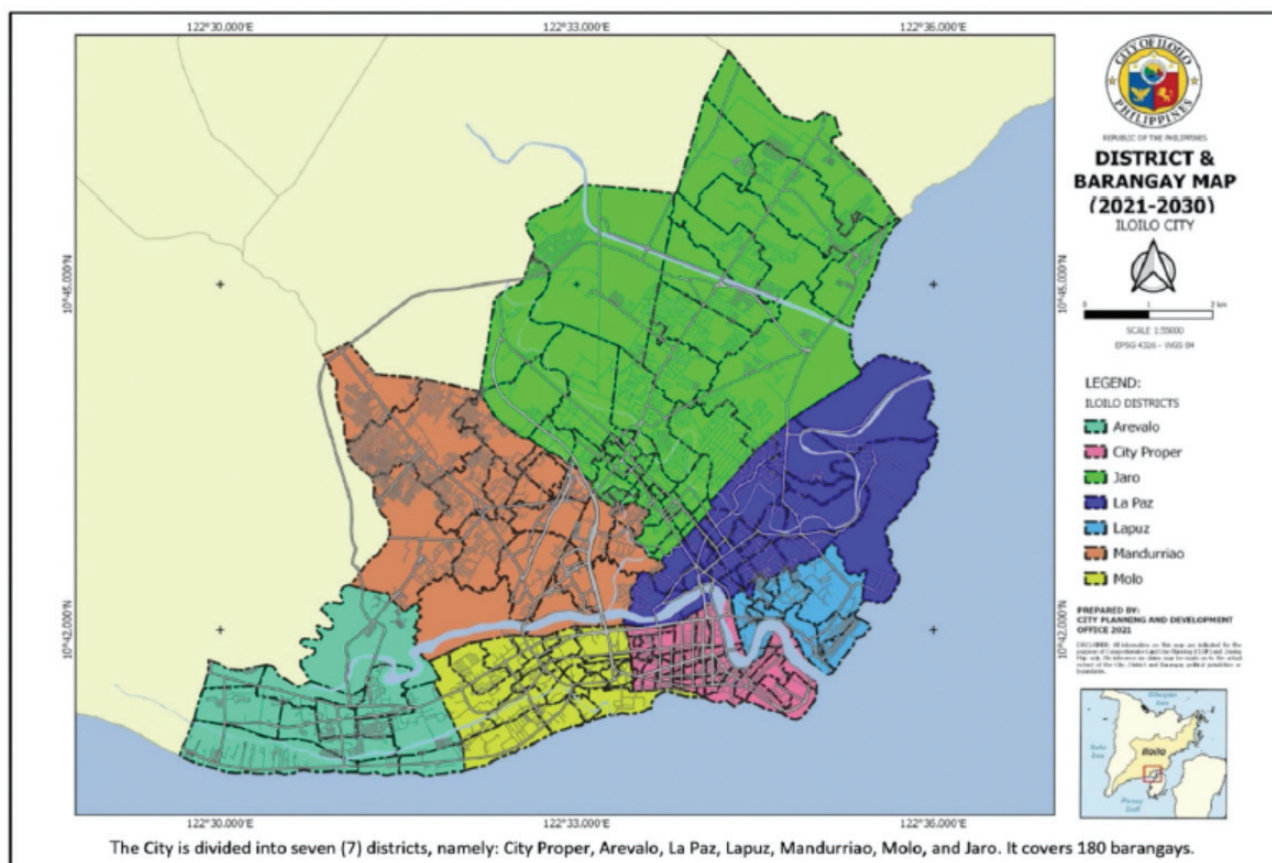
2.10 Iloilo City Socio-Economic Demographic Profile

Iloilo is in the Western Visayas region of the Philippines. Its capital and CCBO engagement site, Iloilo City, is a highly urbanized area situated on the southeastern tip of Panay Island and comprised of 180 barangays with an estimated population of 450,000 (Philippine Statistic Authority, 2015). Its total land area is 7,834 ha.

According to its Comprehensive Land Use Plan (CLUP), Iloilo City is mostly residential, covering 57.35% of its land area. Followed by commercial areas at 8.21%, parks and open spaces at 5.50%, institutions at 4.78%, and agriculture at 4.37%. As a coastal city, fisheries and aquaculture is one of the major sectors covering a land area of 4.01%.

Within the city lies the Iloilo River, an estuary 15 kilometers (9.3 miles) long and home to several rare and important marine species. The Iloilo River wharf is a natural harbor, serving as a port for ferries and a drop-off destination for fishing

Figure 14. Iloilo City Comprehensive Land Use Plan



vessels bringing seafood to be sold at the local markets. Land use along the Iloilo River consists of residential, commercial, institutional, and open space. Port facilities, storage facilities, commercial buildings, and offices, in combination with residential structures, surround the river.

In response to gaps and challenges in the implementation of RA 9003 in the Philippines, the German Federal Ministry for Economic Cooperation and Development appointed the German Technical Operation to launch a support project called Solid Waste Management for Local Government Units (SWM4LGUS). The project's objective was to enable LGUs to establish integrated SWM systems in an economically and environmentally sustainable manner. According to a 2011 technical report, a large MRF (to accept unsegregated waste) and pilot composting site was established at an open dumpsite in Calahunan in 2004. The MRF consisted of a trommel screen, input conveyor belt, and final conveyor belts for combined

mechanized-manual sorting capable of processing approximately 25 tons of the 170 tons of waste delivered at the Calahunan site daily (Paul et al., 2011).

However, the MRF was not operational at the time of the study. The recovery of marketable materials such as cardboard, metals, and hard plastics was largely influenced by over 300 waste pickers at the local dumpsite. Still, a large portion of valuable materials, such as organic and alternative fuels and raw materials (AFR), were disposed of. In 2007, the DENR issued an authority to close the open dumpsite (Paul et al., 2011).

2.11 Existing Legal and Regulatory Framework in Iloilo City

The local policy, ordinances and regulations of Iloilo City is illustrated in Table 5.

Table 5. Iloilo City Ordinances on SWM

	Legal Policy No.	Title
Regulatory	Regulation Ordinance No. 2013-403	An ordinance regulating the use of nonbiodegradable plastic shopping bags as wrapping, bagging, and/or packaging materials for establishments within the jurisdiction of Iloilo City
	Regulation Ordinance No. 2004-149	Iloilo City Environment Code of 2004
		Anti-Littering Ordinance of 1976
Institutional	Regulation Ordinance No. 00-161	Creation of the City Environment and Natural Resources Office
	Executive Order No. 46, s. 2002	Creating the Task Force Clean and Green in the City of Iloilo
	Executive Order No. 43, s. 2005	Expanding the membership of the technical working group (TWG) of Iloilo City Solid Waste Management Board (ICSWMB)
	Executive Order No. 34, s. 2005	Creating the Iloilo River Development Council (IRDC) and defining its organizational structure, scope of functions and membership
Institutional	Executive Order No. 13, s. 2006	Creating the Sanitary Landfill Project Planning Team and defining the scope of its compositions and functions
	Executive Order No. 65, s. 2004	Executive Order creating the Joint Venture Selection Committee (JVSC) for the Integrated Waste to Energy Facility and Medical & Septage Waste Management
		Recomposing the Iloilo City Solid Waste Management Board (ICSWMB), amending executive order no. 47, s. 2001

Continued next page

Table 5 continued

Legal Policy No.	Title
Stakeholder Partnership	Memorandum of Agreement between GTZ-AHT, EMB Region 6, HOLCIM, Phils., Uswag Calahunan Livelihood Association, Inc. (UCLA, Inc.) and Iloilo City Government (Processing of residual wastes to be sold 24 to HOLCIM as a fuel for existing WTE processing cement)

2.12 Programs, Projects, and Activities on Plastic Recycling, Management, and Disposal

The current programs, projects, and activities related to plastic recycling, management, and disposal encompass various facets. Existing solid waste management (SWM) initiatives include endeavors such as behavioral/sustainable product development and the reduction of plastic waste in Iloilo City through sustainable consumption, production, and waste management of plastics and their alternatives, facilitated by

GIZ. These efforts are supplemented by informational campaigns conducted both in schools and barangays (neighborhoods) aimed at raising awareness and fostering responsible waste management behaviors. Additionally, the initiative “Mainstreaming Clean Cities, Blue Oceans in Iloilo City,” supported by USAID, underscores the importance of integrating sustainable practices into urban development. Infrastructure enhancements are also underway, with plans for a waste-to-energy facility to further address waste disposal challenges. Furthermore, in terms of regulation and planning, there is a focus on the Development of Voluntary Guidelines on Sustainable Packaging, particularly aimed at reducing marine litter and promoting the use of alternative materials in packaging, an initiative led by GIZ with a market-based approach. These combined efforts reflect a comprehensive approach to addressing the complexities of plastic waste management within the region.

2.13 Institutional Framework

In June 2019, the Iloilo City Roadmap “WHEELS” was launched by the Iloilo Mayor, who served as Mayor of Iloilo City from 2001–2010 and was reelected in May 2019. WHEELS was designed

as an inclusive development for all Ilonggos to combat the challenges faced by Iloilo City. WHEELS stands for Welfare, Health and Sanitation, Education, Environmental Management, Livelihood, and Sustainability. The aim of the program was to rationalize the Esplanade operations, improve public plazas, and initiate closer engagement with the DENR, Land Transportation Office (LTO), Department of Health (DOH), the academe, and other stakeholders to improve waste management. The new administration planned to prioritize tree planting and coastal cleanup activities to mitigate global climate change.

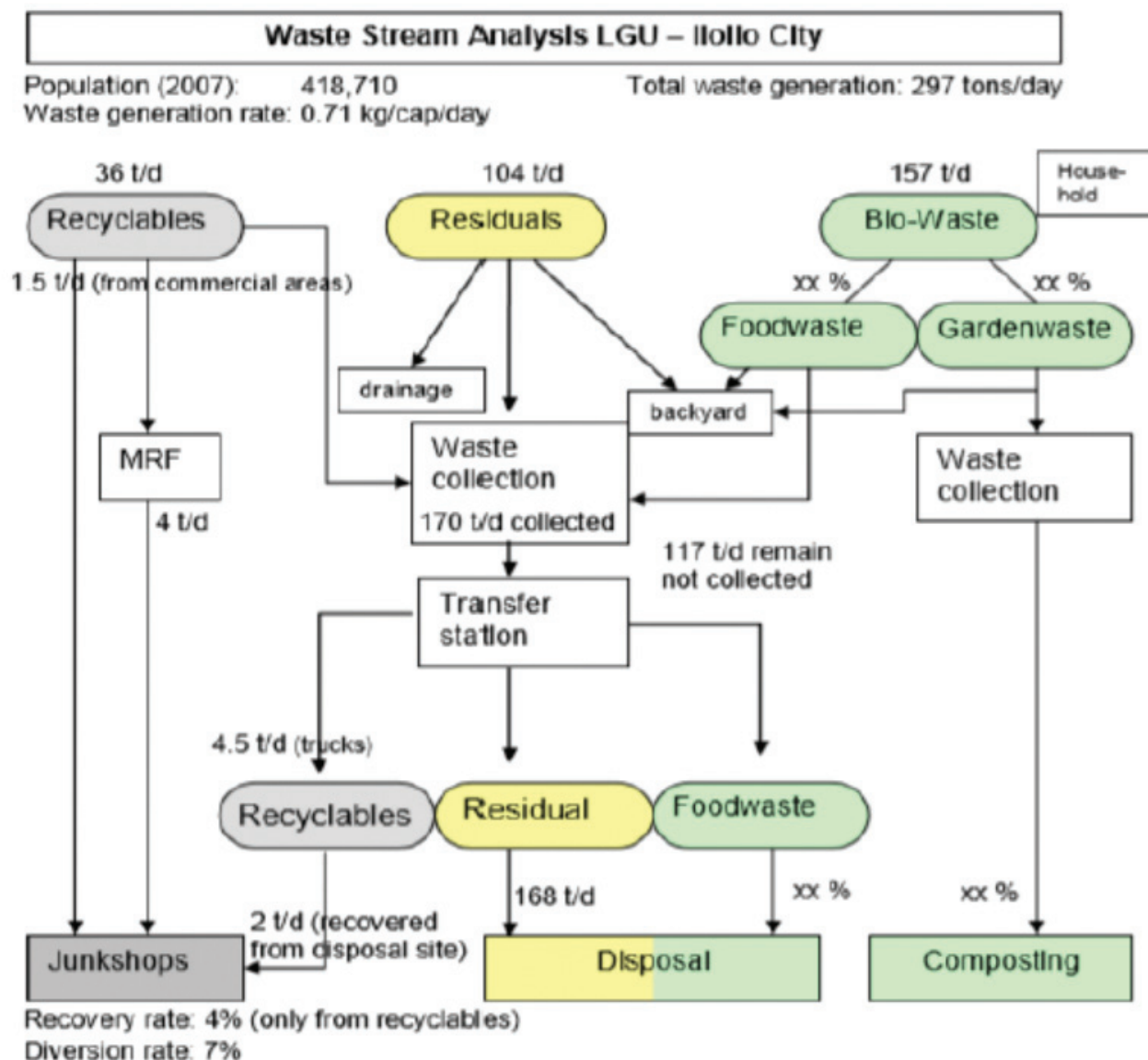
In a recent memorandum order, the mayor stated that single-use plastics have been banned from City Hall and public parks in an effort to reduce waterway pollution, marine life endangerment, and solid waste. According to the report, the mayor noted that a considerable volume of trash is typically collected from the Iloilo River Esplanade and public plazas. The recent ban is part of the government’s solid waste avoidance and minimization strategy. This order came after the issuance of Resolution No. 1363-2020 from the NSWMC, which ordered the DENR to make and enact clear guidelines to restrict single-use plastics in government offices.

Iloilo City is one of several LGUs in the province to have an approved SWMP, but it is not publicly available on any government agency website. The CCBO will continue to locate the SWMP to evaluate the city’s identified SWM approach.

2.14 Plastic Value Chain and Network Configuration

A study conducted by Paul et al. (2011) provides insight into waste stream analysis in Iloilo LGU, revealing a total waste generation of 297 tons per day. This waste stream consists of residuals

Figure 15. Status of Solid Waste Generation and Processing in Iloilo City (Source: Paul et al. 2011)



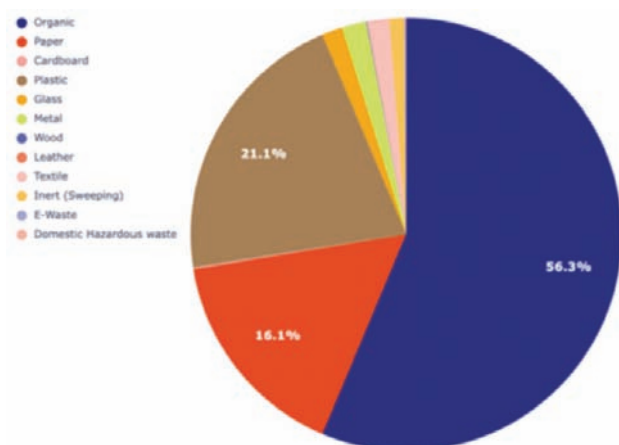
amounting to 104 tons per day, biowaste totaling 157 tons per day (comprising food waste and garden waste), and 36 tons per day of recyclables.

2.15 Waste Generation and Composition

In Iloilo City, the per capita solid waste generation stands at 1.08 kg/day. In 2022, the city's average daily waste generation amounted to 523 metric tons. A 2005 report indicates that Iloilo City's per capita waste generation rate was 0.8 kg (1.8 lbs) per day in 2002. According to the General Services Office, the city generated approximately 300 metric tons

(331 tons) per day. Waste generation projections developed by the NSWMC in 2015 estimated around 122,000 tons of waste for Iloilo City in 2020. Figure 16 offers an approximation of the waste composition in 2003. A study conducted in 2011 revealed that Iloilo City's waste comprised 60% organic waste and 20% plastics. This underscores the considerable potential for resource recovery through composting or anaerobic digestion, given the substantial portion of organic waste. Moreover, with plastics constituting 20% of the collected waste, an opportunity for recovery exists in alternative fuels and raw materials (AFR).

Figure 17. Waste Composition in Iloilo City



collection to households along the main roads of Santo Niño Sur and Barangay Santo Niño Norte. According to a 2019 report, the trucks collect 170 tons of waste each day.

2.17.2 Recycling System

Material Recovery Facilities - In Iloilo City, biodegradable waste is segregated and made into compost for use as fertilizer, leaving recyclables to be sent to the closest MRF. Google Earth identified three MRFs in Iloilo City: Brgy. Buntala Jaro I.C, Brgy. Buray, and Brgy. Baybay Tanza in the City Proper. These operations seem to be aggregation points only.

Junkshops - In total, four junkshops in Iloilo City have been identified as part of the ISWMA's online review. These include N.D. Junkshop and Ben Junkshop.

Recycling Center - Two recycling centers have been identified in Iloilo City, including YLJ Plastics – PET Bottle Scrap Buyer and San Roque Scrap and Surplus Center C&D.

2.17.3 Processing

In January 2020, the PPP Center gave the green light to the Iloilo City Integrated SWM Facility Project. The project recently secured support from the Project Development and Monitoring

2.16 Solid Waste Characterization

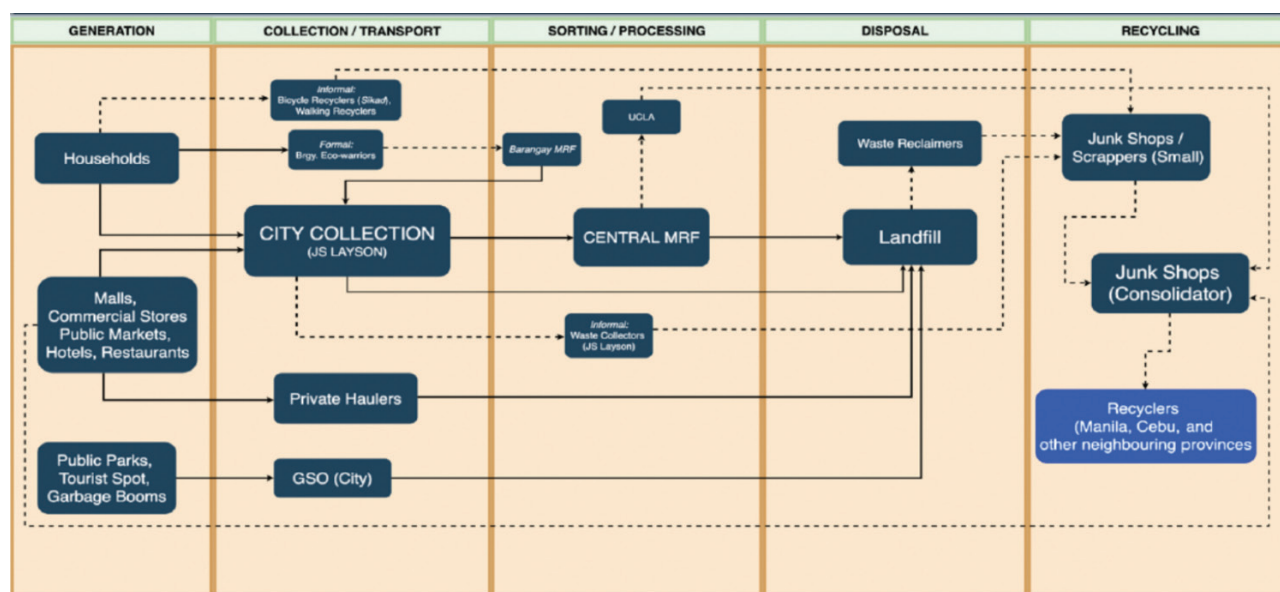
Based on the Waste Analysis Characterization Study (WACS), 110 Metric Tons (21.15% of 523) is the estimated plastic waste generation of Iloilo City per day.

2.17 Solid Waste Process Flow in Iloilo City

2.17.1 Waste Collection

A private waste collection company is currently contracted to provide weekly municipal waste

Figure 16. Solid Waste Flow in Iloilo City



Facility (PDMF) for project structuring, feasibility studies, tender document preparation, bid process management, and ongoing assistance until financial closure. The funding, directed to the Iloilo City Government, aims to provide a sustainable SWM solution for the city, encompassing waste treatment and disposal to address present and future SWM challenges. The Iloilo Solid Waste Project aims to prolong the lifespan of the Calajunan Sanitary Landfill and enhance its capacity. It will involve any or all components of the SWM value chain, including segregation, recovery, recycling, treatment, and remediation, potentially incorporating the development of a waste-to-energy facility.

2.17.4 Waste Disposal

Iloilo City has one sanitary landfill, a 23-hectare engineered facility located in Barangay Calajunan, Mandurriao District. The Calajunan Sanitary Landfill was constructed with the aid of a loan from the Development Bank of the Philippines and opened and inaugurated by Secretary Gina Lopez of the DENR in August 2016. It is a safe site for the disposal of residual waste. No waste disposal tonnage reports have been found as part of CCBO's online research. The facility currently accepts an average of 393 metric tons of waste per day.

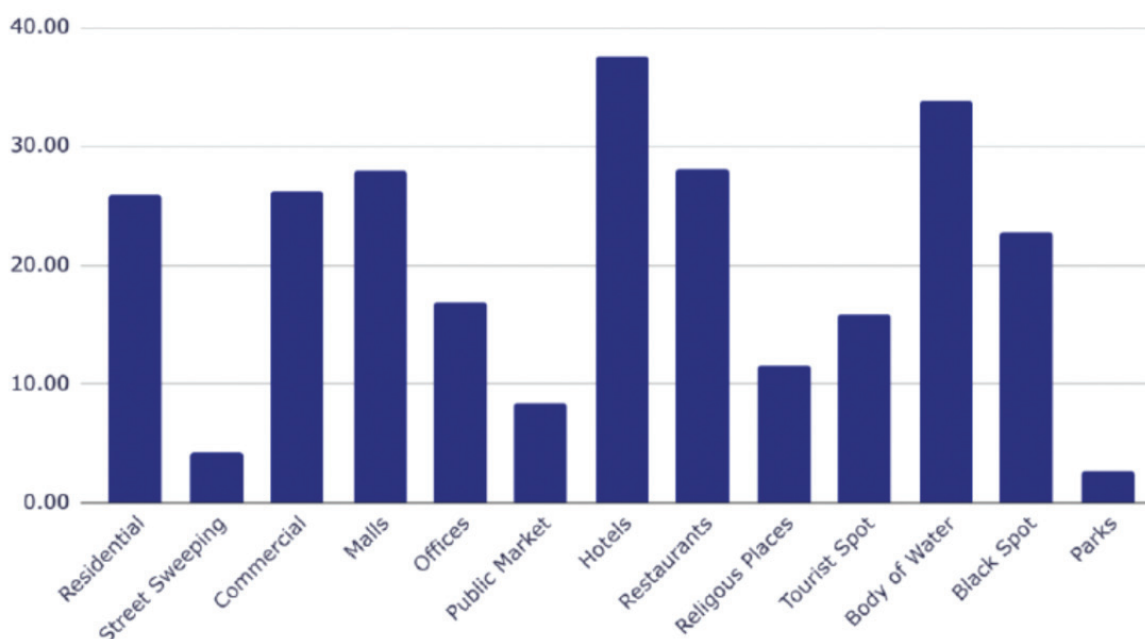
2.17.5 Education and Outreach

To support the implementation of RA 9003, the majority of elementary and secondary schools in Iloilo City have established waste management systems to reduce the amount of solid waste generated by schools, enforce SWM programs, encourage students and community members to participate, and teach students the value of recycling waste. For example, with technical assistance from the LGU, the Division of Iloilo City began the implementation of an Eco-Saver program. Five schools participated in June 2009. CCBO has been unable to determine if this program is still operating.

Although there have been efforts to promote SWM in Iloilo City schools, several issues continue to hinder environmental education. For example, some schools do not have proper waste bins to segregate waste streams. As a result, students continue to mix biodegradable and non-biodegradable waste, challenging their interest in practicing new waste segregation strategies. A lack of funding has also prevented the implementation of proposed SWM and recycling projects.

Figure 18. Plastic Industry situation for the city or any data on the use of plastic and the production of plastic

Plastic waste generation per source (kg)



2.18 Iloilo City Material Flow of Plastic and Waste Generation

In the waste composition analysis of Iloilo City, it is evident that a significant portion, accounting for 56% of the municipal solid waste, comprises organic materials. Regarding plastic waste, a substantial 94% of the total plastic waste generated consists of single-use plastics. Additionally, there is a notable presence of multilayer plastics, constituting 6.1% of the plastic waste stream. This breakdown emphasizes the urgent need for targeted strategies to address the prevalence of disposable plastics in Iloilo City's waste profile.

Figure 19. Municipal Solid Waste Composition of Iloilo City.

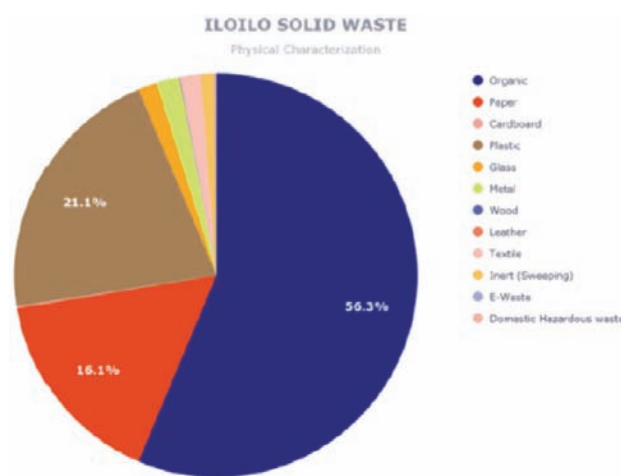
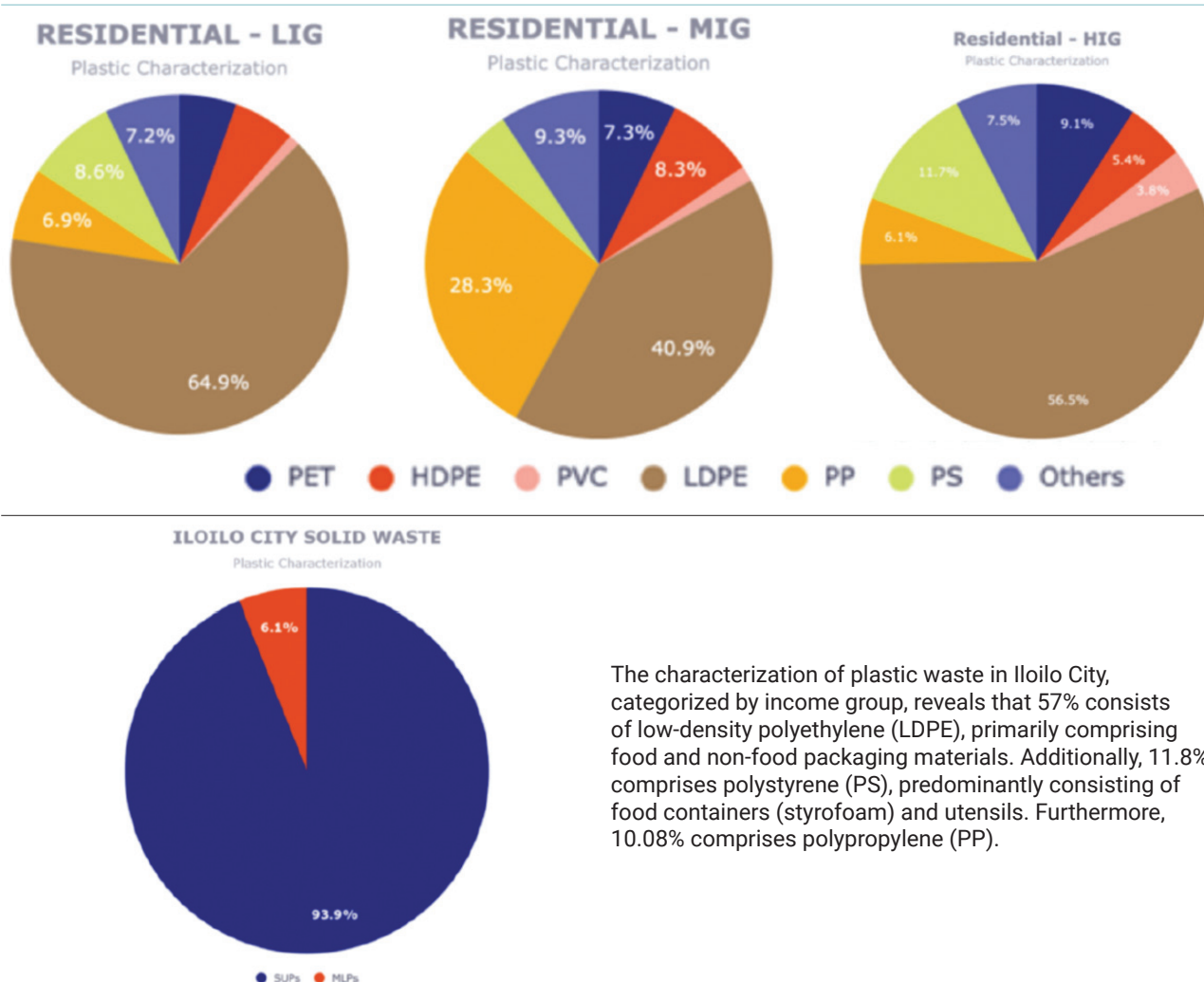


Figure 20. The characteristics of plastic waste generated by residential households across different income groups.

Plastic waste characterization (residential according to income group)



The characterization of plastic waste in Iloilo City, categorized by income group, reveals that 57% consists of low-density polyethylene (LDPE), primarily comprising food and non-food packaging materials. Additionally, 11.8% comprises polystyrene (PS), predominantly consisting of food containers (styrofoam) and utensils. Furthermore, 10.08% comprises polypropylene (PP).

MOBILE MRF



2.18.1 Mapping of Technological Processing and Systemic Factors Contributing to Leakage

This section delves into the technological processing and systemic factors contributing to environmental leakage. These key players encompass processors, junkshops, and consolidators.

Processors

The MRFs in Iloilo City are illustrated below, some equipped with mobile MRFs to enable access to most of the inaccessible barangays using garbage trucks. Some of the MRFs are equipped with mini-garbage trucks to collect waste from respective barangays.

2.18.1.1 Material Recovery Facility (MRF)

Some junkshops in Iloilo City maintain good housekeeping practices, while others require improvement. Additionally, several junkshops are situated near water bodies, posing a potential risk of plastic waste leakage into the riverine environment.

2.18.1.2 Junkshops



2.18.1.3 Consolidators

In certain plastic recycling/consolidation facilities in Iloilo City, the plastic recycling process involves multiple stages, presenting a significant risk of microplastic leakage and contributing to environmental pollution. These stages encompass material reception (such as unloading, weighing, and transfer processes), collection (sorting/screening and aggregation), baling, grinding, washing, flake drying, packaging, loading, storage, transport, and disposal.

The recycling process harbors intricate potential leakage points, exacerbating microplastic pollution to the environment. Effective management and mitigation strategies are imperative for curtailing

macro and microplastic seepage. The following comprehensive guide delineates the essential factors for consolidator recycling facilities, encompassing infrastructure, machinery, and operational protocols to forestall and contain plastic losses and leakage. From the layout of storage spaces to machinery setup, sorting methodologies, and the prevention of microplastic discharge, emphasis must be placed on minimizing material losses and mitigating environmental repercussions in plastic recycling operations.

Storage Space and Infrastructure

- Adequate storage space with insulation and ventilation is crucial for preventing ecologically harmful substance leakage.



Plastic material reception



Sorting



Sorting / screening



Washing / cleaning



grinding / shredding / flacjing



Sorting / storage area



Baling area



Loading / packaging / loading storage

- The facility structure should minimize dust and noise levels for environmentally friendly operation.
- The consideration of improved equipment and technology should align with regulatory compliance.

Recycling Facility Design

- The layout of MRFs and recycling facilities should maximize the usable space for recycling operations and storage areas.
- Effective plastic pollution/material loss containment mechanisms should be implemented to minimize unwanted losses.
- Material losses are economically undesirable and should be mitigated for the benefit of recycling facility owners.

Machinery and Equipment Configuration

- Some recycling machinery and equipment configurations are outdated, resulting in high maintenance costs and risking operational hiccups leading to material losses.

Sorting Process

- Workers (primarily female) spend hours sorting plastic packages.
- The sorting process involves separating plastics based on color and polymer, often conducted under sheds close to storage areas.
- Advanced skills and knowledge are needed to identify, isolate, and eliminate particle pollutants during the sorting process.
- The use of conveyor belts can enhance efficiency, reduce labor-intensive tasks, and improve worker well-being.

Shredding and Grinding

- Proper containment is essential during shredding and grinding to prevent the generation of microplastics.

- Uncontrolled release of microplastics into the environment must be avoided.

Washing Process

- Friction during the washing process may result in the release of microplastics.
- Large quantities of microplastics released into wastewater treatment systems contribute to environmental contamination.

Transport and Storage:

- Microplastics may be released during transit and storage due to friction between plastic materials, machinery wear and tear, and exposure to weather conditions.
- Poor housekeeping practices can lead to the spread of microplastics within recycling plants and their release into the environment.

2.18.2 Market and Economic Forces Influencing the Prioritization of Plastic Types and Technology Choices for Plastic Processing

In Iloilo City barangays, a burgeoning upcycling movement is transforming plastic waste into valuable resources through MRFs. These facilities serve as hubs for creative initiatives and programs aimed at repurposing plastic materials into useful items. From accessories to decorations, bricks, and plant pots, local artisans and community members are harnessing their ingenuity to repurpose discarded plastic waste. Through workshops and training sessions, residents are equipped with the skills to craft these innovative products, fostering both environmental stewardship and economic empowerment within the barangays. By embracing upcycling practices, Iloilo City barangays are not only diverting plastic waste from landfills but also fostering a culture of sustainability and resourcefulness that benefits both the community and the environment.

Several barangays in the city have adopted commendable upcycling initiatives and programs, wherein plastic materials are transformed into accessories, clothing, decorations, pots, and various

Upcycling initiatives/programs



Good practices

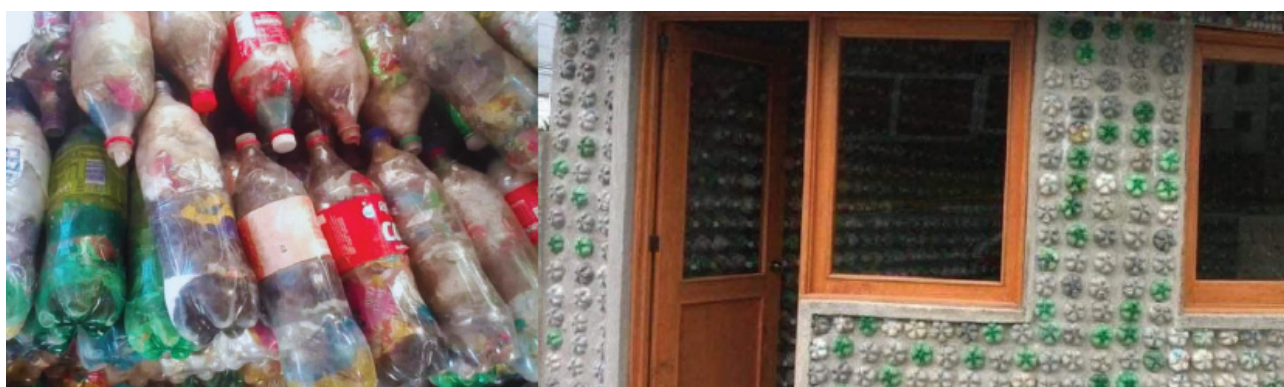
other upcycled products. These practices are not only being showcased within the barangays but also actively promoted in other barangays within the city and neighboring cities.

2.18.3 Best Available Technologies

2.18.3.1 Converting Discarded Plastics and Waste Into Construction Materials

Iloilo City is taking a pioneering step toward sustainable housing solutions with the unveiling

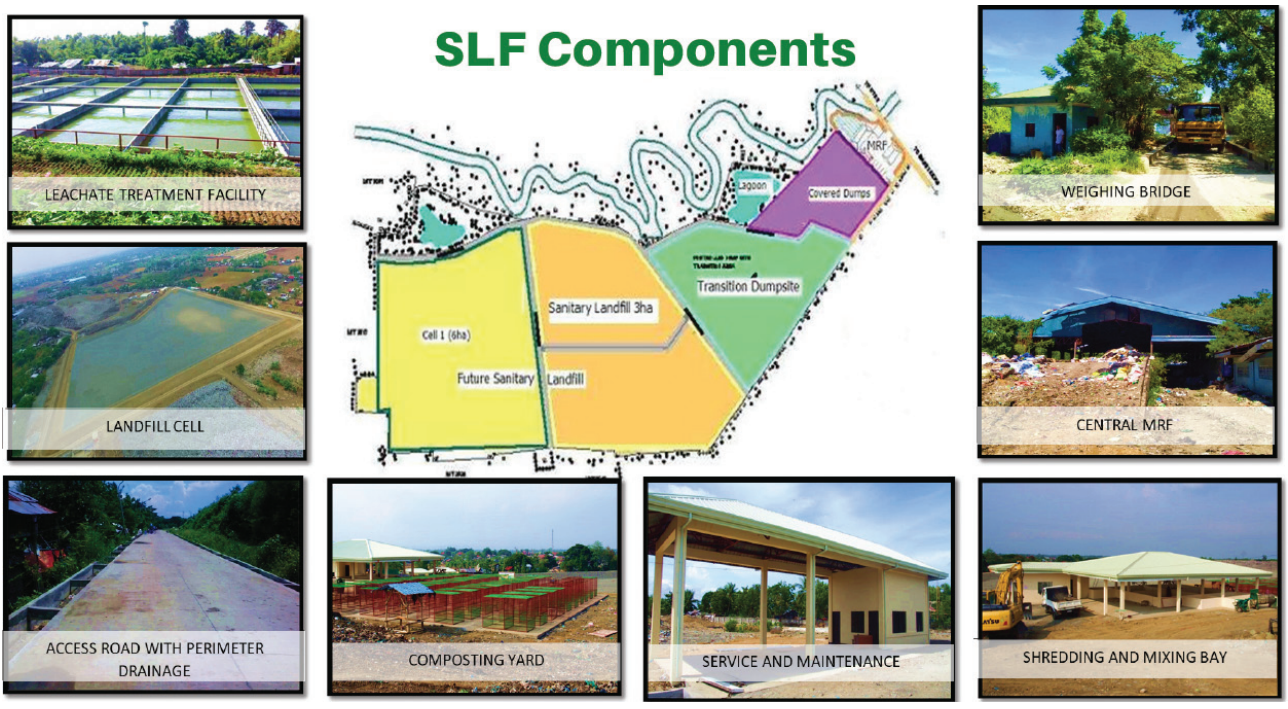
of an innovative project: the ECO Brick initiative by St. Therese MTC Colleges. This groundbreaking endeavor aims to construct housing units utilizing ECO Bricks, a sustainable building material that repurposes plastic waste. By addressing both environmental concerns and housing needs, the project showcases the city's commitment to innovation and sustainability. Through the collaboration between St. Therese MTC Colleges and local stakeholders, this endeavor not only offers affordable housing options but also contributes to the reduction of plastic pollution, marking a



Iloilo City showcase an ECO Brick, a project of St. Therese MTC Colleges to build housing units using ECO Bricks.



Source: Iloilo City CENRO, 2023



significant stride toward a greener, more resilient future for Iloilo City and beyond.

2.18.3.2 Controlled landfill

Iloilo City Sanitary Landfill

The 23-hectare engineered facility located in Brgy. Calahunan, Mandurriao, stands as a vital infrastructure for responsible waste management in Iloilo City and neighboring municipalities. Serving as a designated site for the disposal of residual waste, it ensures the safe containment of refuse from both the city and two town municipalities within Iloilo Province. Presently, the landfill operates at a capacity of 70%, indicating its significant role in waste management efforts. Equipped with solid cover systems, the facility effectively mitigates odor and emissions, curtails disease vectors, and manages moisture and percolation. In the first quarter of 2023 alone, a total of 16,119 units of waste were processed and managed within the facility, underlining its crucial function in maintaining environmental integrity and public health standards within the region.

During the scoping exercise and field visits conducted in the city, it became evident that a significant portion of the plastic pellets and flakes generated by consolidators were being transported and sold to recycling facilities located on the outskirts of Metro Manila. This observation underscores a critical aspect of the plastic waste management ecosystem, where the disposal and repurposing of plastic materials often extend beyond local boundaries. However, due to time constraints, unfortunately, the project team did not have the opportunity to visit these recycling facilities, resulting in their exclusion from the assessment process. This omission highlights a limitation in the comprehensive understanding of the entire plastic recycling chain within the country under study. While the focus was primarily on local processors, junkshops, and consolidators and their operations, the downstream processes and facilities responsible for transforming plastic waste into recycled products were regrettably overlooked. Consequently, future assessments and initiatives may benefit from a more holistic approach that encompasses all stages of the recycling process, including the facilities beyond the immediate vicinity and jurisdiction of the city.

2.19 Summary of Findings

The current policy and regulatory landscape of Philippine cities/municipalities toward plastic recycling exhibit notable gaps, particularly concerning provisions, monitoring mechanisms, and support systems for both informal and formal recyclers aiming to mitigate plastic leakage. In terms of institutional arrangements, there is a need for enhanced structures that oversee regulatory compliance, monitor activities, and provide adequate support to recyclers operating within both formal and informal sectors. Furthermore, technology assessments have revealed significant gaps across various stages of the recycling process, encompassing collection, recycling operations, pelletizing, and transportation. These technological deficiencies are observed to vary according to the type and scale of recycling facilities, particularly those situated on the outskirts of urban areas. Additionally, deficiencies in processes related to prevention, containment, and cleanup, affecting both informal and formal recycling practices, have been identified as areas requiring urgent attention and improvement.

2.20 Suggestions and Recommendations

To enhance the primary sorting process, both manual and semi-mechanized operations must adhere to several key guidelines. Firstly, ensure that working areas designated for primary sorting are consistently maintained in a clean and uncluttered condition, free from extraneous materials, tools, and equipment. Additionally, these working facilities should be strategically located away from drains, vegetation, puddles, watercourses, and slopes to mitigate potential hazards and losses due to flooding or inclement weather. Implementing proactive measures, such as installing safeguards against flooding and wind damage, is essential. Establishing rigorous housekeeping protocols is imperative for ensuring diligent adherence to prevention and containment measures. Protocols must be established for the proper handling and disposal of rejects in strict accordance with relevant national regulations. Furthermore, improving the shredding and grinding processes is crucial for preventing the release of plastics into the environment. Enhancements to recycling facilities, particularly

in the washing and flotation separation processes, are necessary. Integrating technology-based sorting systems can optimize secondary sorting procedures, including color sorting for blue, yellow, and natural materials. Strengthening waste disposal methods to align with national and municipal regulations for recycling factories and industries is paramount. Providing upgraded waste segregation

bins, adequately labeled and strategically placed throughout the facility, promotes effective waste segregation practices among workers. Finally, prioritizing effective wastewater management at recycling factories is essential for minimizing the environmental impact and ensuring regulatory compliance.



Bibliography

- Bhargavi N. Kulkarni, V. A. (2020). Repercussions of COVID-19 pandemic on municipal solid waste management: Challenges and opportunities. *Science of the Total Environment*. <https://doi.org/10.1016/j.scitotenv.2020.140693> This
- Borongan, G., and Okumura, S. (2010). *Municipal waste management report: status-quo and issues in Southeast and East Asian countries*. Asian Institute of Technology. http://www.rrcap.ait.asia/Publications/MW_status_quo.pdf
- CAANCAN, J. A. (2020). Country Report: the achievements by the Philippines. *Seventh Regional 3R Forum in Asia and the Pacific*. https://www.uncrd.or.jp/content/documents/7386Philippines_Country_Report+Front_page.pdf
- Congress of the Philippines (2001) Republic Act No. 9003. (2001). Eleventh Congress. Third Regular Session. Republic Regular Session. <https://emb.gov.ph/wp-content/uploads/2015/09/RA-9003.pdf>
- Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., Narayan, R., & Law, K. L. (2015). Plastic waste inputs from land into the ocean. *Science*, 347(6223), 768–771. <https://doi.org/10.1126/science.1260352>
- Klemeš, J. J., Fan, Y. Van, Tan, R. R., & Jiang, P. (2020). Minimising the present and future plastic waste, energy and environmental footprints related to COVID-19. *Renewable and Sustainable Energy Reviews*, 127(April). <https://doi.org/10.1016/j.rser.2020.109883>
- Manila Department of Public Services (DPS). (2021). *Socio-economic demography of Manila city*. Manila DPS.
- Manila DPS. (2020). *Manila City 10-year SWM Plan*. Manila DPS.
- Philippine Government. (n.d.). *The Philippine Government*. Retrieved March 5, 2020, from <https://www.gov.ph/philippine-government>
- Paul, J.G., Acosta, V., Ricaña, V.M. (2011) Solid Waste Management for partner municipalities in the Visayas Region, Philippines: Facts and Figures. Technical Report. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
- Philippine RA 7160.
- Premakumara, D.G.J, Abe, M, Maeda, T. (2011). Reducing municipal waste through promoting integrated sustainable waste management (ISWM) Practices in Surabaya City, Indonesia. In C. . Villacampa, Y, Brebbia (Ed.), *Eco System and Sustainable Development VIII* (pp. 457–470). WIT Press.
- Sapuyay, G. P. (2018). *Solid Waste Management and Sustainable Development: The Case of Philippine Cities*. https://conference.surp.upd.edu.ph/downloads/ICURP_2018_Downloads/SE07_Solid_Waste_Management_SAPUAY.pdf
- UNCTADSTAT. (2018). *Country Profile: the Philippines*. <https://unctadstat.unctad.org/CountryProfile/GeneralProfile/en-GB/608/index.html>

United Nations Centre for Regional Development. (2017). *Country Report: State of the 3Rs in Asia and the Pacific. Seventh Regional 3R Forum in Asia and the Pacific*. [https://www.uncrd.or.jp/content/documents/6777\[full document\] State of the 3Rs in Asia and the Pacific.pdf](https://www.uncrd.or.jp/content/documents/6777[full document] State of the 3Rs in Asia and the Pacific.pdf)

Implementing Rules and Regulations of the Philippine Ecological Solid Waste Management Act of 2000, (2015). <https://www.elaw.org/content/philippines-implementing-rules-and-regulations-philippine-ecological-solid-waste-managemen-0>

World Bank Group 2021. Market Study for the Philippines: Plastics Circularity Opportunities and Barriers. Marine Plastics Series, East Asia and Pacific Region. Washington DC.

