**Baseline Report** 

# The situation and causes of plastic pollution in the Imus River, Cavite





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## I. Introduction

One of the initial components of the ASEAN-Norwegian cooperation project on local capacity building for reducing plastic pollution in the ASEAN region (ASEANO) is taking place in the Philippines. For this country, the Imus River basin has been identified as a suitable site for its pilot project. This river basin flows through areas on experiencing rapid urbanization as the metropolitan area centered on the Philippine capital expands.

Concern over plastic waste is not new for the Philippines. The link between waste management and sustainable development was enshrined into law in 2000, through Republic Act 9003: The Ecological Solid Waste Management Act. Local governments responded quickly; for example the town of Los Baños in Laguna Province banned single use plastic bags in 2008. The financial center of the country, Makati City, enacted the Solid Waste Management Code of Makati in 2003, which led to a single use plastic bag ban in retail and food establishments in 2013.

Such concern is likely driven by the amount of plastic used in the country, the product of a rapidly expanding economy and a large and growing population. Jambeck *et al.* (2015) identified it as producing the third-highest amount of marine plastic debris in the world. Around a quarter of the over 100 million inhabitants of the Philippines live within an urban area encompassing the National Capital Region (NCR) and parts of its surrounding provinces, leading to high levels of pollution in this area. Manila Bay, which this conglomeration abuts, has become highly polluted and a national symbol of the need for better environmental management.

The *Stemming the Tide* (2017) publication released by Ocean Conservancy and McKinsey Center in 2017 reported that the Philippines produces 2.7 million tons of plastic waste annually, of which half a million tons is thought to leak into the environment. The NCR by itself generates 560,000 tons annually, which equates to a plastic waste density of 900 tons per km<sup>2</sup>. The cause of plastic pollution in the Philippines was found not to be low collection as is usual (collection rates average a commendable high of 85% throughout the country, and remain as high as 40% even in remote and rural areas), but leakage of collected waste from the waste system, with 74% of total waste entering the environment (386,000 tons) originating from waste that had already been collected. This waste often leaks from poorly located dumps such as those near waterways, and from being dumped by hauliers to cut costs. The remaining leaked waste (135,000 tons) comes from littering and from informal waste piles.

Much of the plastic waste in the environment is from low quality and low value plastics, as waste which can be profitably and commercially recycled is often removed from the system by formal or informal means. *Stemming the Tide* found that polyethene bottle extraction was as high as 90%, compared to the extraction of low value plastics which neared 0%. Collecting bottles earns an informal waste picker seven times more than collecting plastic bags. Organized waste recovery, often by local governments, also removes recyclable material from the system, and informal and formal networks often occur together. Under RA 9003, waste collection is the responsibility of local authorities (barangays), although they sometimes work in coordination with municipalities (one level higher). Incineration is banned in the Philippines, with waste going to either a dump site or the less common sanitary landfill.

The increased global attention marine plastic pollution is receiving provides an opportunity for Philippine governments at all levels to obtain more support, knowledge, and cooperation for their initiatives to reduce plastic pollution. It also provides the opportunity to further test and develop the local solutions that have been developing for years, and present these as a model for other areas to follow.

# **II. Background and Rationale**

### Laws and regulatory bodies

Strong legislation regarding plastic pollution was put in place near the start of the century, and initiatives such as bans on single-use plastic bags in supermarkets have been put in place at various local levels throughout the country since the late 2000s. However, regulatory efforts to implement the law and control the issue have struggled to match the scale of the problem, especially within the context a growing population, economy, and urban area.

Given the long attention given to this issue at both national and local levels, a number of different national, provincial, and city laws, regulations, and programs, impact the waste situation in the Dasmariñas portion of the Imus river basin. Some of them are described here.

National	Ecological Solid Waste Management Act of 2000 (RA 9003)	
	Clean Water Act of 2004 (RA 9275)	
Provincial and regional	Manila Bay Rehabilitation Plan	
	Manila Bay Sustainable Development Master Plan	
	Imus-Ylang Ylang-Rio Grande Rivers Water Quality Management Area (IYRR-WQMA)	
	Cavite Provincial Solid Waste Management Plan 2019-2029	
	Cavite Integrated Water Resources Management Plan	
	Cavite Sustainable Development Strategy (Under development)	
	Cavite executive orders	
	• No. 003-2001	
	• No. 029-2003	
	• No. 001-2012	
	• No. 007-2012	
Municipal/City	Dasmariñas Solid Waste Management Plan	

#### Summary list of key legislation and strategies

#### Ecological Solid Waste Management Act of 2000 (RA 9003)

This act is the core legislation for solid waste management in the Philippines. It emphasizes the importance of solid waste management for the health of the Philippines, and assigns the responsibility to deal with solid waste to LGUs. It applies at both provincial and municipal level.

Under the provisions of the act, the final disposal site of solid waste must be a properly engineered sanitary landfill. The act also legislates the importance of segregation at source, segregated collection, and materials recovery. The city of Dasmariñas, Cavite, is currently considered compliant towards this act.

**Clean Water Act of 2004 (RA 9275)**: An Act Providing for a Comprehensive Water Quality Management and for Other Purposes

The Clean Water Act puts water quality under the responsibility of the Department of Environment and Natural Resources (DENR), which has both national and regional offices. While the DENR has overall responsibility, other national organizations are assigned roles and responsibilities under the act, including: Philippine Coast Guard (PCG); Department of Public Works and Highways (DPWH) and attached agencies, such as the Metropolitan Waterworks and Sewerage System (MWSS), Local Water Utilities Administration (LWUA) and other urban water utilities; Department of Agriculture (DA) and its Bureau of Fisheries and Aquatic Resources (BFAR); Department of Health (DOH); Department of Science and Technology (DOST); Department of Education (DepEd); Commission on Higher Education (CHED); Department of the Interior and Local Government (DILG); and the Philippine Information Agency (PIA).

LGUs are also assigned responsibilities under the act (eg. Chapter 3 Sec 20), and are tasked with managing and improving the quality of water within their jurisdiction. LGUs have the power and responsibility to monitor water quality, organize emergency responses, ensure compliance with the Water Quality Management Action Plan, and coordination with other government agencies and civil society in the implementation of water pollution prevention and control measures.

#### Cavite Provincial Solid Waste Management (SWM) Plan 2019-2029

While the Ecological Solid Waste Management Act of 2000 mandates that waste management is the responsibility of LGUs, the Cavite provincial government has synthesized the plans of each of its cities and municipalities to create one overarching plan that would work to ensure that each individual plan helped complement and bolster the others.

A previous Cavite plan aimed to bring the level of recyclable waste diverted from disposal facilities to reuse, recycling, composting, and other resource recovery facilities to 30%. The plan extending to 2029 targets an increase in this of 5% each year, leading to 75% diversion by 2028.

The combined plan envisions that every barangay will have at least a basic materials recycling facility (MRF\_ for initial segregation into biodegradable waste and other waste. 8 larger MRFs are intended to be distributed throughout the province, with the ability to handle more difficult materials.

#### Dasmariñas Solid Waste Management Plan

The SWM plan for Dasmariñas was approved relatively late by Cavite standards. Together with neighboring General Mariano Alvarez (GMA) municipality, Dasmariñas was one of the 2 LGUs which had their individual SWM plans approved in 2018 (leaving just 1 Cavite LGU without an approved plan at that time).

The city has mandated that each of its barangays develop an MRF, whether alone or in cooperation with nearby barangays, by 2025 (CLUP 2016).

#### Manila Bay Rehabilitation Plan and Manila Bay Sustainable Development Master Plan

The Philippine Supreme Court issued a Writ of Continuing Mandamus to clean up, preserve and rehabilitate the Manila Bay (General Register Nos. 171947-48) in December 2008, placing responsibility for this on a number of national government departments. At the beginning of 2019 a cleanup and restoration plan was implemented that would work to clean up the bay and the coastal areas that feed water into it. While early efforts in this campaign focus on Metro Manila, it is intended that in subsequent years the campaign will expand to the provinces surrounding the bay, including Cavite.

This campaign is closely complemented by the Manila Bay Sustainable Development Master Plan (NEDA 2020), which envisions progress and growth towards 2050. Both of these plans are focused on the coastal and near-coastal LGUs. Dasmariñas, being further inland, is not a priority focus of these projects, and so the ASEANO project is good initiative to complement these national efforts.

#### **Future legislation**

Coastal management is recognized as an important topic by politicians in the Philippines, and various initiatives have been proposed by the legislative and the executive regarding this area of focus. These include, but are not limited to:

- THE INTEGRATED COASTAL MANAGEMENT ACT was introduced to committee by Senator Loren Legarda on 8 September 2016. It seeks to adopt ICM as part of the national strategy for managing coastal areas in the Philippines. It remains at the committee stage.
- The current government under President Rodrigo Duterte has advocated for the creation of a Department of Water Resources that would consolidate various aspects of water management currently carried out by different government departments, allowing for an integrated approach to water resources to be implemented. The creation of such a department can be done through a law in the legislature.
- Various local bans on different forms of plastic have been passed for over a decade, from the provincial level to the municipal. National bans have been discussed. Currently, two bills banning single-use plastics nationally have been introduced to the Senate by Senator Francis "Kiko" Pangilinan and Senator Cynthia Villar, while Representative Alexie Besas Tutor introduced a bill to the house banning single-use plastics from tourist areas. The idea around such measures has received verbal support from the Executive. A bill to ban primary microplastics introduced by Representative Rodel Batocabe passed the committee stage in the House in September 2018, but has not yet been debated.

## The situation in the province of Cavite

Much of the current focus on marine plastic pollution is directly targeted at tackling plastic pollution in the ocean or along the coast, and this focus is reflected in the operational area for some provincial and national programs in the Philippines. However, a significant amount of plastic pollution flows into the ocean from rivers, and past studies have found that up to 74% of plastic pollution in the Philippines leaks from the waste management system (Ocean Conservancy and McKinsey Center for Business and Environment, 2017). The ASEANO project Philippine component pilot site is location in the upstream portion of the Imus River basin, specifically where it intersects with the city of Dasmariñas. The Imus river is one of the tributaries of Manila Bay, the primary focus of pollution cleanup under current Philippine efforts.

The Province of Cavite lies in region IV-A (also known as CABALARAZON), and borders Metro Manila to the north. As the urban area of Metro Manila expanded, much of Cavite has become part of this wider urban area, especially in the northern areas closest to the border. It thus shares in the challenges posed by being part of the urban hub of the Philippines, and being one of the areas into which this urban area is expanding.

Like other areas of the metropolis, Cavite's rivers flow into Manila Bay, one of the Philippines' pollution hotspots. The province has a 122,574.0560m coastline, and jurisdiction over 93,678.375ha of ocean. The pollution from Cavite generates national attention in addition to local focus, because of its impact on the wider bay area which is home to much of the Philippine population. Its challenges regarding urbanization, population growth, and economic development, are similar to those in other areas of the bay, and thus it can take and export lessons from and to these areas. The Pasig river, located north in the more heavily urbanized National Capital Region, is considered one of the most polluted rivers in the world (Lebreton *et al.*, 2017), which illustrates a potential future if the Imus river follows a similar path.

While Cavite relies heavily on groundwater to provide drinking water, current aquifers are low due to exploitation and the province imports water from elsewhere. Potential salt intrusion from rising sea levels risks further diminishing the water supply. The pollution in the rivers of Cavite, including the Imus river, make it difficult to use as drinking water.

As of the last Philippine census in 2015, Cavite had 3,660,832 people and a total of 887,283 households. The expected population growth rate was 3.37%. The population is quite young, with only 389,611 over the retirement age of 60 in 2015, and around 90% total under the age of 50. In 2012, the human development index of the province was 0.773. Around 43% of the province is thought to count as urban space. The precise population numbers are difficult to ascertain as they may not account for informal settlers. There is significant movement of population daily and weekly, for example into and out from Metro Manila.

#### **Industrial sites in Cavite**



GDP of the province is around PHP 42,000 per capita. The poorest 10% of the province have a per capita GDP of PHP 17,308, with the richest 10% have PHP 89,019. For households, the average annual income is PHP 308,000. Cavite's economy includes significant agriculture and fisheries sectors, as well as an industrial sector. While it does not have a plastic manufacturing industry, there is a plastic retailing industry.

Being fully cognisant of these challenges, the Government of Cavite is very supportive of sustainable development. This has meant and has been a long-term partner of PEMSEA. Coastal LGUs of Cavite are part of the national Manila Bay Clean-up Program, and the province is included in the long-term Manila Bay Sustainable Development Master Plan. The coasts of Cavite are managed under an ICM system, which in its holistic approach includes consideration of water pollution, including solid waste.

Administratively, Cavite is divided into 23 3<sup>rd</sup>-tier administrative districts, which are separated into 16 municipalities and 7 cities. For some purposes, these are divided into 7 districts, they are not evenly distributed between districts, which can contain as few as 1 3<sup>rd</sup>-tier district. These cities and municipalities are in turn divided into a total of 829 barangays.

As mandated by RA 9003, solid waste management is the responsibility of the cities and municipalities, together with their component barangays. Almost all households in the province have a garbage collection service, organized by their respective administrative division. Total waste generation is around 1,514,759.83 kg/day, just under half of which is thought to be household waste. 52% of Cavite's solid waste is biodegradable, while 27% is recyclable. Of this recyclable waste produced by the province, around 7% is plastic.



Administrative Divisions in Cavite

In some instances, there is public skepticism about segregation, due to beliefs that waste will simply be mixed when dumped by waste collectors in trucks or landfills. Some designated segregation bins are effectively non-functional. A lack of waste discipline is disheartening for officials and collectors, and segregation rules are sometimes ignored to decrease workloads.

## Waste in the City of Dasmariñas

The City of Dasmariñas lies roughly in the middle of the Imus river, downstream of the agricultural areas and upstream of other cities. Cavite's most populous city, Dasmariñas had a population of 659,019 people in 2015. Its population results in it being classified as its own district, Cavite's District IV. Its 82.34km<sup>2</sup> is divided between 75 Barangays. Relatively wealthy compared to other LGUs in Cavite, it is considered among the 1<sup>st</sup> tier of Cavite's administrative divisions as classified by average income. 56.78km<sup>2</sup> of the city is considered built up area (as of 2000) with population density being 7,312 people per km<sup>2</sup> (as of 2015).

The Imus River watershed takes in much of west Dasmariñas, flowing through Dasmariñas's official industrial parks before passing through its dense urban areas. A total of 181 Industrial Establishments (SWM 2019) exist with the city. Water is sourced from 115 deepwells (CLUP 2016).

#### **Cavite waste composition**



#### Dasmariñas waste composition



Barangay	Recyclable waste (kg/day)	Total Waste (kg/day)	kg/ person/ day
Bautista (Sampaloc IV)	3538.22	11022.48	0.28
Burol I	3170.97	9878.40	0.60
Burol II	724.12	2255.84	0.46
Burol III	60.06	187.10	0.02
Emanuel Bergado I	400.82	1248.65	0.17
Emanuel Bergado II	266.58	830.48	0.28
Fatima I	850.73	2650.24	0.41
Langkaan I	1738.95	5417.28	0.36
Langkaan II	628.89	1959.16	0.07
Luzviminda I	371.19	1156.34	0.34
Luzviminda II	462.05	1439.40	0.30
Paliparan I	190.44	593.28	0.09
Paliparan III	3817.29	11891.88	0.18
Sabang	472.51	1472.00	0.10
Salawag	5443.84	16959.00	0.25
Salitran IV	212.08	660.70	0.10
Salitran I	575.98	1794.32	0.44
Salitran II	641.31	1997.85	0.19
Sampaloc I	549.71	1712.48	0.28
Sampaloc II	1153.44	3593.28	0.32
Sampaloc III	142.38	443.55	0.05
San Agustin II	1150.01	3582.60	0.35
San Agustin I	540.00	1682.24	0.16
San Agustin III	996.95	3105.76	0.28
San Andres I	288.60	899.08	0.26
San Andres II	70.05	218.22	0.06
San Antonio de Padua I	129.81	404.40	0.12
San Antonio De Padua II	265.40	826.80	0.26
San Dionisio	966.49	3010.86	0.43
San Francisco II	1095.32	3412.20	0.94
San Lorenzo Ruiz I	205.96	641.63	0.19
San Lorenzo Ruiz II	168.51	524.94	0.13
San Luis II	128.94	401.67	0.09
San Manuel I	54.87	170.94	0.06
San Manuel II	87.45	272.43	0.09
San Nicolas II	48.85	152.19	0.03
San Roque (Santa Cristina II)	539.18	1679.68	0.58

### Waste of Dasmariñas per barangay: (CLUP 2016)

Santa Cristina II	1137.87	3544.76	0.92
Santa Cruz II	118.11	367.95	0.15
Santa Cristina I	91.78	285.92	0.08
Sanata Cruz I	297.51	926.82	0.18
Santa Fe	221.97	691.50	0.10
Santo Niño I	152.69	475.68	0.16
Santo Cristo (Barangay 3)	1055.60	3288.48	0.68
Zone 1A	325.79	1014.93	0.27
Zone I (Poblacion)	977.38	3044.79	0.81
Zone II (Poblacion)	82.17	255.99	0.21
Zone III (Poblacion)	181.81	566.4	0.16
Zone IV (Poblacion)	167.13	520.64	0.16
Burol	945.27	2944.76	0.28
San Jose	1365.46	4253.76	0.36
Datu Esmae	611.36	1904.56	0.19
Saint Peter I	133.07	414.56	0.16
San Esteban (Barangay 4)	274.34	854.64	0.18
San Francisco I	154.90	482.56	0.16
San Isidro Labrador I	697.40	2172.58	0.46
San Juan I	162.20	505.31	0.13
San Luis I	532.90	1660.12	0.44
San Mateo	47.98	149.46	0.03
San Miguel	882.29	2748.56	0.68
San Simon (Barangay 7)	125.72	391.65	0.05
Santa Lucia (San Juan II)	878.15	2735.66	0.43
Santa Maria (Barangay 20)	695.30	2166.03	0.41
Fatima II	123.24	383.94	0.09
Fatima III	129.65	403.90	0.10
Paliparan II	377.90	1177.26	0.07
Saint Peter II	71.39	222.39	0.09
Salitran III	3121.85	9725.40	0.60
Sampaloc V	334.45	1041.9	0.30
San Isidro Labrador	118.54	369.28	0.16
San Miguel II	123.98	386.24	0.16
Santo Niño II	236.44	736.58	0.26
H-2	520.69	1622.08	0.16
Victoria Reyes	3111.26	9692.40	0.60

Ma	ajor Sources	Waste (kg/person/day)	Total Waste (kg/day)	Recyclable waste (kg/day)
	Food Establishment	2.65	188.31	95.19 (50.55%)
	General Stores	3.77	1735.45	415.64 (23.95%)
Commercial	Public Market	3230.00	3230.00	773.59 (23.95%)
	SUB TOTAL		5153.76	1284.42
	Schools	26.05	547.06	160.12 (29.27%)
	Hospitals	5.54	49.83	26.20 (52.58%)
Institutions	Clinics	1.42	28.34	14.49 (51.13%)
	Financing	1.46	45.11	27.34 (60.61%)
	SUB TOTAL		670.34	228.16
TOTAL			5824.10	1512.57 (25.97%)

#### Dasmariñas waste from non-household sources

(CLUP 2016)

Major Sources		Total Waste	Type of Waste to be Diverted (kg)		
		Diverted (kg)	Biodegradables	Recyclables	Residuals with Potential for Diversion
Residential (	urban)	41069.70	15710.89	14622.20	10736.61
Commercial	Food Establishment	47.08	12.23	33.07	1.79
	General Stores	433.86	260.36	111.55	61.95
	Public Market	807.50	484.6	207.66	115.23
	SUB TOTAL	1288.44	757.19	352.28	178.97
Institutions	Schools	136.77	27.16	45.91	63.69
	Hospitals	12.46	0.01	7.43	5.01
	Clinics	7.09	1.42	3.73	1.93
	Financing	11.28	1.85	7.07	2.37
	SUB TOTAL	167.59	30.44	64.133	73.01
TOTAL		42525.72	16498.52	15038.61	10988.59

#### Diverted waste in Dasmariñas

Major Sources		Total Waste	Recyclables (kg)	Residual Wastes (kg)	
		Disposed (kg)		For Diversion	For Disposal
Residential (u	urban)	123209.09	38111.29	27983.9	13914.41
Commercial	Food Establishment	141.23	62.12	49.08	5.14
	General Stores	1301.59	304.09	168.87	114.89
	Public Market	2422.5	565.92	314.03	214.15
	SUB TOTAL	3865.32	932.14	531.98	334.18
Institutions	Schools	410.3	114.22	158.47	67.23
	Hospitals	37.37	18.77	12.65	2.78
	Clinics	21.26	10.76	5.59	0.69
	Financing	33.83	20.28	6.81	1.10
	SUB TOTAL	502.76	164.02	183.52	71.81
TOTAL		127577.17	39207.45	28699.40	14320.40

### Disposed waste in Dasmariñas

### **III. Landscape of the Imus River**

The Cavite Watershed covers an area of 235,774ha. Cavite has a number of rivers that all flow in a northwest direction, from the more mountainous interior towards Manila Bay. Wet season from May to December sees high rainfall, with the highest for Dasmariñas being 420.0 mm each July. In contrast, only 10.5 mm of rainfall occurs in April (CLUP).



#### Major watersheds and rivers in Cavite

The upriver areas of the drainage basin is mostly agricultural land, with the surrounding landscape getting more urbanized as the river moves downstream. The upstream areas are thin and very shallow, often less than half a meter deep. The slopes here are deep and steep, and building are occasionally built at the very top of the ridges. At at least one location these slopes have been modified to provide walking paths alongside the water. In downstream areas the river is broad and slow, with the banks being very short. Buildings downstream are often built directly adjacent to, or over, the river.

Some combined statistics are available through the IYRR-WQMA, although it combines the Imus River with the others in the WQMA. This includes that the combined WQMA drainage basin includes 18,140ha of agricultural land, predominantly in upstream areas. Within this large area is produced 148 metric tons of fish and prawns annually through aquaculture, with some pens being placed directly in the rivers.

These rivers are sampled for water quality in regards to contaminants and nutrient loading by DENR Region IV, but there is not capacity yet for regular sampling of solid waste. It is likely that the more upstream agricultural areas leak more yard and field waste into the river system, while the urban areas leak more household waste, including plastics. Drains flow directly into the river at various points. Floating plastic waste is visible throughout the river.

Plastic pollution is one of many issues facing the Imus River. The water quality of the river is not only affected by solid waste, but by other pollutants. As mentioned above, some of these pollutants are already monitored by DENR Region-IV. Upstream agricultural areas are expected to input yard waste into the river, and discolored water is visibly entering some areas of the river from drain pipes. Aquaculture may introduce nutrient pollution into the river. A small number of industrial sites also lie within the drainage basin. Houses that abut the river may leak other pollution directly into the river, and waste may enter the river from Manila Bay. As the Imus River is a major river near the capital, the Philippine Government plans for the river to reach a high level of quality. This is partially based on the MANDAMUS judgment in which the Philippine Government is tasked with ensuring Manila Bay is viable to use for recreation.



While there has not been a detailed study of the Imus River, studies of nearby watersheds (Canas, Pasong Camachile, Timalan) reflect a roughly decreasing vegetation density as the river moves downstream, except for the head in Tagaytay City which is not densely forested. These nearby basins support over 30 species of trees. The rivers supported less than 20 identified species of fish, along with shrimp and crab species.

### Socioeconomic conditions

The Imus River begins in Tagaytay City and then flows through the Municipality of Silang, Dasmariñas City, and Imus City, and through the coastal Bacoor City and Municipality of Kawit, before emptying out into the small Bacoor Bay which lies between the Cavite City peninsula and the mainland. In total the river extends 36.7km, and drains a basin of 168.1km<sup>2</sup>. CvSU estimates the population with the 214 barangays that at least partially fall within the drainage basin is about 1.3 million people. This population is expected to grow, especially as the urban area expands. Dasmariñas is an area of acute population growth, in part due to resettlement of informal settlers from Metro Manila, with its 2015 population being 659,019, of which 555,932 were considered urban and 155,901 rural (Cavite Ecological Profile 2018).

Large numbers of people are drawn to the urban area around Manila for work, leading to large numbers of informal settlers living in Cavite. Despite Philippine law prohibiting the construction of buildings within a certain distance (3m in urban areas) from rivers, many informal settlers live on these embankments, often in crude shacks. These informal settlements are often not serviced by waste disposal services, and/or residents may be unable to afford those services which are available. This means waste is often deposited directly in the river, although it is unknown how much of the overall pollution this produces. In Dasmariñas alone, there are 950 families living within river easement areas, many directly alongside the main body of the Imus River (CLUP 2016).

Low and even middle income households are also more likely to depend on buying household goods in small plastic sachets. Thus sachet culture has been posited as one of the causes of the Philippine's high rate of plastic usage. Those living along the river system are likely to use the waterways to dispose waste, and even those living away from the river system may litter in areas from which waste eventually enters the waterways. Relocation programs often face challenges due to moving people away from their places of work, with public transport often being slow and inefficient. The overall poverty incidence in Cavite was 11.4% in 2015, a rate that had been rising from the previous decade (PSA 2015), even relative to the growing population.

### Waste management

Most LGUs in Cavite outsource waste to private companies which transport it to landfill in nearby provinces. Many LGUs, on barangay or municipal level, maintain their own MRFs. For example, both Silang and Imus, which lie directly upstream and downstream of Dasmariñas respectively, have their own MRFs. These MRFs seem to have been developed ad-hoc by each municipality, and so each deals with waste in a unique fashion, handling different types of waste and producing different products.

Pursuant to Section 17 of RA 7160, Dasmariñas local government is responsible for waste and garbage disposal within its area. This means it should have a baseline assessment of the waste stream, and produce an SWM ordinance. This ordinance should define relevant terms, handle waste generation and storage, waste processing and resource recovery, waste collection and transportation, solid waste disposal, and details and regulations regarding user fees. The most recent waste composition data from Dasmariñas comes from the 2015 Cavite Solid Waste Management study. In total, the city is estimated to produce 219,762.6kg of solid waste per day, which is expected to rise to 296,436.6 kg per day over the next decade.

Dasmariñas has its own City Environment Natural Resources Officer (C-ENRO). Barangays (village) also have SWM responsibilities, working together with the Dasmariñas city administration. The city practices some waste segregation and runs a dedicated composting center, but it lacks a centralized materials recovery facility (MRF). Daily rubbish collection, handled by the City Environment and Sanitation Unit (CESU) as a utility, is funded through an annual PHP 51 million SWM budget. A sanitary landfill is run by the city government. Dasmariñas has an existing biogas, bioreactor, and shredder. 3 500kg bioreactors convert biodegradable waste into soil conditioner. Technologies they are further interested include a granulator to reduce waste size, and are awaiting approval for a new sanitary landfill.

Currently, 20% of recyclable waste is diverted to junkshops (CLUP 2016). The city targets 55% waste diversion by 2020. Its priority issues surrounding SWM also include waste segregation not being followed, and barangays not all having MRF facilities (CLUP 2016). As of 2012, 128,879 households, or 99.04% were served by the waste management system. This left 1,243 households unserved (CLUP 2016).

One of the city's development goals include "Effective Infrastructure", which aims to be able to meet the city's growing demand, and "Sensible Industrialization", which includes a desire to reduce water pollution. They also aim to develop a "Dasmariñas River Park", which would include some rehabilitation of the Imus River (CLUP 2016).

2020 waste diversion target	55%
Households served	128,879 (99.04%) in 2012
Barangay landfills	1
Junkshops	~64

Of its Barangays, San Agustin III, Salitran 1, in Zone IV, has a private 6ha landfill and its own MRF. Throughout the city

there are junkshops that recycle high value recyclables (numbers provided differ, but a list of 64 is available in the CLUP 2016), including high-value plastic like that found in bottles. These junk shops play important roles in the informal waste collection sector, which removes a high proportion of high value plastics, such as plastic bottles, from the waste management system. This means much of the plastic that ends up in the environment is low value or hard to recycle plastic, such as the thing plastic used for single-use plastic bags, straws, and cling-film.

Various operations are run by the city and barangays to clean rubbish from various areas of the river, with river-pickers clearing up rubbish by hand tool. The waste collected by such efforts is intended to be reported to CENRO, which serves as a central point for data. However, doubts were raised by some stakeholders about the accuracy of much of this data given gaps in reporting and a lack of verification. Jurisdiction over certain areas of the river is sometimes unclear. Subdivision boundaries often coincide with the stream, and small creeks and easements may be paved over. Informal settlers occupying land on or near the river further reduces jurisdictional clarity.



### **IV. Environmental and socioeconomic impacts**

The connection of these rivers to the tidal Manila Bay leads to high levels of environmental risk. Lower portions of the river are tidal, reflecting the changes in water levels in Manila Bay. During the rainy season flooding is not uncommon. Seasonal changes in river flow may also cause significant issue, as the quantity of waste exiting rivers for the ocean has been shown to vary throughout the year (Lebreton *et al.* 2017).

Times of heavy rainfall have caused flash floods that inundate low-lying areas of Cavite, with water reportedly reaching as much as 2m high. These floods have included downstream areas of the Imus River drainage basin, including cutting Cavite City off from the mainland near where the Imus River enters Bacoor Bay.

Flooding is classified into two types, "River Overflow" and "Inland". The city of Dasmariñas has developed flood risk profiles for each barangay, with areas of critical risk often being near rivers. (CLUP 2016). It is thought that solid waste clogging up waterways is part of the cause of such flooding by preventing water flowing efficiently and reducing the capacity of the Imus river and its tributatries. There are ongoing projects to dredge and remove solid waste from the river, and construction works to create holding ponds for overflow water.

Despite the pollution, the rivers are still used for recreation. Locals who live nearby continue to use the river for swimming. It is likely many use the river for household needs such as bathing and washing clothes as well. Such use will disproportionately fall upon the worse off, such as the informal migrants.

The "sachet culture" of the Philippines has become a fixed part of life for many in the country. Goods are often sold in small single-use quantities, including items such as shampoo, food additives, and foodstuffs. These are cheap and thus affordable for poorer individuals, but result in significant levels of waste, especially as manufacturers use cheap materials to ensure that the costs of the products remain low, and these materials are not easily recycleable.

Plastic pollution is likely to directly impact on some economic activities, such as aquaculture. The impact on tourism on this river is likely to be relatively low, as most tourist activity takes place in the highlands where pollution is likely to be at its lowest, but lessons learnt here may be easily applicable on other rivers with significant tourism areas downstream.

# V. Existing policy and programs

### Programs and initiatives

#### DENR (Region IV-A)

DENR and its subagencies, such as the Environmental Management Bureau (EMB), have active projects in the region. EMB Region IV-A has studied the challenges of SWM, and identified the following challenges:

- Many LGUs have no access to sanitary landfills,
- SWM remains a low priority in LGUs budgets,
- Mixed collection discourages segregation,
- There are limited recycling markets,
- Waste-to-energy is too expensive in upfront cost,
- IEC is insuffecient for household SWM,
- There are limited financial opportunities and incentives for SWM.

Their recommendations for SWM include creating a centralized disposal facility for every province, instituting incentives for LGUs that consider SWM as a top priority, strengthened links with the Office of the Ombudsman to deal with non-complying LGUs, exploiing markets for recyclable materials, and tapping televisions for improved IEC results.

#### Cavite Province executive orders and initiatives

There are a number of executive orders issued within the province of Cavite that affect solid waste management. These include:

- No. 003-2001: Creating the Solid Waste Management Board of the Province of Cavite
- No. 029-2003: Requiring the cities and municipalities in the Province of Cavite to establish waste reduction and recovery schemes, and convert their open dumpsites into controlled dumpsites.
- No. 001-2012: Reconstituting the Provincial Solid Waste Management Board of Cavite
- No. 007-2012: Prohibiting, regulating, prescribing uses of plastics for good and commodities that end up as residual wastes. (A selective plastic bag ban that promoted ecobags. PG-ENRO started monitoring compliance of this in February 2020.)

The Cavite government has a number of specific programs targeted at reducing the amount of solid waste generated. It has specific goals to:

- Promote the use of refillable containers,
- Eliminate redundant packaging,
- Regulate the use of plastic bags and thus promote the use of eco-friendly bags and boxes,
- Reduce the usage of plastic straws,
- Reduce paper wastage through encouraging double sided printing and using email over letters,
- Encourage the donation of unwanted goods,
- Increase reuse of wooden pallets,
- Increase liquid product concentrations,
- Increase appliance durability and the repair and reuse of appliances.

To complement these efforts, the government runs an information dissemination campaign on ecological solid waste management in its cities, municipalities, and barangays. There is a focus on coastal areas in these programs as well, which again makes a project in Dasmariñas a useful complement.

Cavite hosts a semi-annual Water Summit, which expanded in 2019 to include a Solid Waste Summit. The Cavite government is has developed a Cavite Integrated Water Resources Management Plan and a Cavite Sustainable Development Strategy (CSDS).

#### Dasmariñas City

The city's waste reduction schemes mean it recycles most of its segregated biodegradeable waste. For other solid waste, there are specific ordinances regarding the use of plastics. Ordinance No. 03-S-2012, "Ordinance Regulating the Use of Plastic Bags and Styrofoam's in the City of Dasmarińas", aims to reduce plastic waste in the city's waterways and protect fresh water supplies. City Ordinance No. 06-S-2011, "Ordinance enacting the Environment Code of the City of Dasmarińas", covers all ordinances aimed as conserving natural resources such as water, and includes a requierment for segregation and proper waste treatment and disposal.

The *Bisita Eskwela* program is an IEC campaign run by CENRO to spread information about RA 9003. It operates in elementary and secondary schools, and teaches students about the impacts of pollution on the environment. More widely, a recycling and reuse campaign was begun in 2015 to encourage residents to recycle and reuse themselves.

The city runs 29 "conveyances" to carry waste, which through 2 trips each collect from each barangay daily. Segregation takes place during collection, with unsegregated waste not picked up. The city purchased its own equipment and hires its own waste personnel, so waste collection operates as a utility rather than under private contracts (however, commercial waste sometimes operates thround private contractors where they do not pay the city a garbage fee). Residual waste is places in a 6.8094 ha sanitary landfill marked for the exclusive use of the city. Buy-back centers near this site take in some recyclabe waste (CLUP 2016).

### Existing MRFs

#### **Dasmariñas City**

Dasmariñas can produce biogas, and has a bioreactor and a shredder for plastic waste. They also have an engineered sanitary landfill. As a next step, they wish for a granulator to increase the effective capacity of their sanitary landfill.

Unlike nearby MRFs, the current Dasmariñas MRF handles only biodegradable waste, without the capacity to repurpose other waste such as plastics. However, the city has invested in shredders to convert plastic into products such as throw pillows, to expand their MRF capacity (CLUP 2016).

#### **Silang Municipality**

The Silang MRF is equipped with a variety of equipment to recycle materials. A densifier boils plastic in waste cooking oil, and produces an eco-brick fit for pavement. Ecobricks for buildings are produced by mixing shredded plastic with ash and sand. Charcoal is also produced from burnable materials. In sum, the equipment used to create the ecobricks cost a total of P3,000,000.

#### **Imus City**

The Imus Ecology Center recycles plastics and other materials into products for sale. Plastic is converted via shovel into eco-bricks, and other plastics, such as from tetra packs, is converted into handbags by hand. Each bag can take a day to make. Products are sold directly from the MRF.

Imus also runs a recycling point scheme. Points are gained by depositing recyclable material, and can be redeemed to obtain household goods. A raffle is also conducted with each kg of residual plastic earning the recycler one ticket.

#### **General Mariana Alvarez City**

GMA has distributed its MRFs among different locations, with each location producing a different product. In addition, it has a mobile biogas unit.

#### Barangay San Jose, Tagaytay City

Barangay San Jose in Tagaytay City is a model for community solid waste management, serving a population of over four and a half thousand. A barangay waste amount and characterization study found that plastics made up 9.74% of household waste. The barangay issued executive orders in 2015 and 2016 to establish a waste council and to implement a segregation policy respectively. It is one of 15% of Cavite's Barangay's that comply with RA 9003.

The barangay's MRF recycles plastics and other mateiral into a variety of products, including plant pots, pillows, biogas, and charcoal. These are sold to generate income, and the barangay further charges to collect waste from elsewhere. In total, the MRF earns around P104,260 per month.

To encourage recycling within the community, the barangay issues eco-pamphlets and organizes an ecobook system through which each household records their recyclable waste in a points system, and trades this waste in for household goods or school supplies.

#### **Cavite PG-ENRO**

The PG-ENRO office runs its own recycling efforts, coverting old sachets and similar packaging into handbags. Using a sowing machine, a bag can be produced each hour.

### VI. Stakeholders of the Imus River and of waste management

#### National Solid Waste Management Commission (NSWMC)

The NSWMC is a government organization which is tasked with reviewing SWM efforts. It has significant private sector representation to ensure that its guidelines are practical. The NSWMC reviews the SWM management plans submitted by LGUs, and is tasked with establishing national and ecology centers.

#### **Provincial Solid Waste Management Board**

This Cavite board includes representatives from the provincial government, various government bodies, Cavite's Cities' mayors, congressional representatives, NGOs, the recycling industry, and the manufacturing industry. This body developed the provincial SWM plan, and oversees Cavite's sanitary landfill, while considering the proposals for additional sanitary landfills. The board helps coordinate the actions of various LGUs, and reviews its plan every 2 years.

#### **Provincial Government of Cavite**

The provincial government is responsible for assisting municipal governments prepare their SWM programs under the Cavite Solid Waste Management Plan. It facilitates links between multiple LGUs, and between LGUs and other government and private sector bodies. It conducts significant capacity development activities for SWM capabilities in LGUs, and plans to create a pollution monitoring system.

The development, implementation, and regular review of the Provincial Solid Waste Management Plan is the responsibility of the Solid Waste Management Division of the Provincial Government-Environment & Natural Resources Office (PG-ENRO). This body also sets guidelines for waste avoidance and volume reduction, researches improved methods of waste reduction, collection, segregation, and recovery, and provides logistical and operational support to cities and municipalities. It also undertakes IEC campaigns.

PG-ENRO Cavite has an annual budget of just under PHP 20 million, and around 50 staff. This includes the Eco-Aide division, which cleans roads.

#### Association of Cavite Environment and Natural Resource Officers

The C-ENRO and M-ENRO officers of each LGU in Cavite are brought together in this association in order to ensure coordination and knowledge sharing.

#### Imus-Ylang Ylang-Rio Grande Rivers Water Quality Management Area (IYRR-WQMA)

The Imus River, together with the nearby Ylang-Ylang and Rio Grande Rivers, have been put into a joint water quality management area. Pursuant to DENR Administrative Order No. 2013-02, a governing board and 10-year action plan were instituted from January 2013. Under WQMA guidelines, rivers should be upgraded to "B" or "SB" cleanliness guidelines, although most in Cavite are currently "C".

The governing of IYRR-WQMA is based on implementing the rules and regulations of the Clean Water Act of 2004. This governance is intended to not only ensure the effective and efficient management of the waters within IYRR-WQMA, but to aid in the reduction of pollution levels within Manila Bay. The latest action plan, from 2016-2025, includes solid waste as a pollution category that the IYRR-WQMA management is seeking to tackle.



WQMA has a number of sampling points spread throughout the Imus river basin.

#### **Coca-Cola Philippines**

The Coca-Cola company has a very significant presence in the Philippines, and as a significant producer of a variety of products which include plastics, it is looking into ways to reduce its waste footprint in the country.

In Cavite, Coca-Cola is working with PEMSEA and Caritas (below) on an Ecological Solid Waste Management project. It focuses on 6 LGUs, which do not include Dasmariñas. However, experiences gained in this project may be usefully applied to work done in **Dasmariñas**, and vice versa.

#### **SM Dasmariñas**

SM malls within Dasmariñas city run a "trash to cash" program. The company keeps data on its waste generation and recycling.

#### Villar Foundation

The Villar foundation advocated the use of ecobags and other reusable alternatives to single use plastic bags in poorer communities.

#### **Philippine Economic Zone Authority**

PEZA has a MOA with DENR on the implementation of environmental policies, including on the management of solid waste within the economic zone. It has developed SWM Plans which includes recycling and waste reduction measures, and PEZA conducts regular monitoring and provides the PEZA environmental performance award as incentive to companies. Some locations have partnerships with the Villar Foundation and with ABS-CBN on plastic recycling.

#### Caritas

The Caritas Diocese of Imus Foundation carries out charitable and development work on behalf of the Catholic Church. Caritas runs a program called Sustaining Empowered and Resilient Communities through Holistic Development (SEARCHDev), which it began in 2017 as a 3-year project. SEARCHDev aims to improve the competencies of Caritas' Diocesan Social Action Centers, who are tasked with helping to improve the neighborhoods they are found in.

The primary focus of Caritas is on building neighborhood resilience, for example through disaster risk reduction and preparation. However, its holistic understanding of resilience has led it to engage in SWM programs, as solid waste pollution and improper waste disposal aggravates disaster risk and it deleterious for human health. The Diocese of Imus runs a zero waste public awareness campaign, promoting a circular economy.

The on the ground project work done by Caritas supports the diversion of recyclable plastic waste, converting it into armchairs and tables. These are to be sold at nominal prices, first to local schools that would need them. One armchair is made from 20kg of soft plastic, and lasts for 20 years.

Secondary impacts include enhancing capacity building, promoting IEC, and increasing livelihood opportunities. The long-term goal is to have a sustainable project that can be replicated and upscaled.

#### **Clean Technology**

Clean Technology is a company which collects residual waste, especially plastic, and mixes it with concrete to form hollow blocks and tiles. This form of recycling creates materials that are equivalent in durability to the same material without plastic, thus reducing plastic waste while using less of other concrete ingredients. Current production is around 1000 bricks per day, with production based in the municipality of Imus, just downstream of Dasmariñas.

### Capacity and experience

#### **Cavite State University**

CvSU has existing involvement and experience in coastal management and in water management. It is currently in the final stages of constructing a water testing laboratory, and is also finishing a 5-story interdisciplinary laboratory. Its AquaBEST center is dedicated to coastal management.

Its established GIS lab has already developed various geodatasets for Cavite, including some for watershed, barangays, and land use. They note that further ground-truthing could continue to refine these datasets.

#### De La Salle University Dasmariñas

DLSU-D has the capacity to test for bacteriological parameters and heavy metal in water. They have a UV-visible spectrophotometer, an Atomic absorption spectroscotometer, high performance liquid chromatography machines, and their medical school has an IR spectrometer.

DLSU-D has previously undertaken a wide variety of social science research in Cavite, and maintains significant capacity in this regard.

An existing DLSU-D project made in cooperation with USAID is studying plastic pollution in Manila Bay. It may have lessons and techniques that can be transferred and replicated in new sites.

#### **Environment Management Bureau**

EMB-Kawit Laboratory has capacity to test for basic water quality parameters, and is building capacity for metals and organics. There are eight monitoring stations along the Imus river, and delivered samples are tested quickly.

## VII. Recommendations

Plastic pollution is a longstanding and widely acknowledged issue in Cavite. This is especially true in its relation to water pollution, both riverine and marine. Water pollution is a high visibility and high impact issue, compounding upon increasing water stress in the province. That a high level of waste is produced is known and understood, hence the existing legislation and measures to tackle the problem. Despite this awareness, data remains limited. The last significant provincial-level analysis of waste composition took place in 2015. Other information relevant to marine plastic pollution, such as the hydrology of the river, physical characteristics of the drainage basin, and local socioeconomic use and understanding of plastic remain relatively unexplored.

New baseline assessments would help address these gaps in knowledge. Better quantification of plastic's impacts regarding industry, flooding, microplastic and macroplastic pollution, environmental impacts, and others areas would also be of assistance. Various LGUs within and nearby the target river basin engage in a variety of recycling and material recovery methods, and these should be compared with other examples of best practice from elsewhere to examine how improvements might be made whilst taking into account local factors.

There is existing infrastructure that can be utilized for this project. For example, there are currently two "trash traps" in the city, one in Barangay Burol Uno, and one in Barangay Salitran (upstream of Orchard golf course). These would be useful locations for waste sampling. The local familiarity with plastic waste and existing waste management practices can be taken into account to develop more advanced socioeconomic studies than might be viable in an area with less experience with the issue. A full inventory of local capacity,f or example the number of existing MRFs in the city and nearby, should also be taken.

There is scope to expand the study beyond Dasmariñas, where possible, to better account for changes between upstream and downstream areas. However, even within Dasmariñas it is expected that there will be a significant difference between its upstream and downstream boundaries, as it is the first urban area the river flows through after leaving its source.

Research should endeavour to include previously under-represented groups, such as housewives, who are thought to play significant roles in waste disposal but are often hard to reach. The impacts of poverty, especially with regard to sachet culture, are also something that should be kept in mind during various avenues of research.

According to many local stakeholders involved in plastic policy, recent waste-related efforts in the province had shifted from IEC towards a technology focus, as this is currently viewed as a more productive strategy. Such thinking may indicate a stronger faith in material changes rather than socioeconomic ones. It was also noted that outright plastic bans were difficult and perhaps infeasible to implement in Cavite. Part of this is due to the ingrained sachet culture present in the Philippines, which is a product of culture and economic necessity. An advisory group connecting the project and local stakeholders of some form set to be established to provide input into the project will provide further insight into these issues.

### Sources

Much of the information in this document was derived from interviews and discussions with individuals from the Imus River basin and the rest of Cavite. These individuals include provincial and LGU government and civil society representatives, members of local academia, small and large business representatives, and members of NGOs, among others. For the rest of the information, some was in documents provided by these individuals, and where possible these have been listed below:

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