

INDONESIA

# MARINE DEBRIS

HOTSPOT



RAPID ASSESSMENT

## SYNTHESIS REPORT

APRIL 2018

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## ACRONYMS AND ABBREVIATIONS

BLH	Indonesian Provincial Environmental Agency
BPS	Indonesian National Statistics Agency
DANIDA	Danish International Development Agency
DINAS	Indonesian Agency or Department
DKPP	Indonesian Cleansing, Parks and Cemeteries Department at the Municipal Level
GDP	Gross Domestic Product
IDR	Indonesian Rupiah (currency of Indonesia)
IPRC	International Pacific Research Center
LISA	City of Makassar “ <i>See Waste, Take It</i> ” Program
LONGGAR	City of Makassar “ <i>Clean Alley Way</i> ” Program
MARPOL	The International Convention for the Prevention of Pollution from Ships 73/78
MSW	Municipal Solid Waste
NGO	Non-Governmental Organization
OECD	Organization for Economic Cooperation and Development
OSPAR	Abbreviation of the Oslo and Paris Conventions (Mechanism by which 15 governments and the EU cooperate to protect the marine environment of the North-East Atlantic)
PEEK	Polyether Ether Ketone Plastics
PELINDO	Indonesia Port Corporations
RPJMN	Indonesia National Five Year Medium Term Development Plan
RT	Indonesian Neighborhood Association
RW	Indonesian Community Association
SDN	Indonesian Public Elementary School
SMAN	Indonesian Public Senior High School
SNI	Indonesia National Standard
SWM	Solid Waste Management
TPA	Indonesian Final Disposal Sites (central open dump sites or landfills)
TPS	Indonesian Temporary Disposal or Dump Sites
TPST	Indonesian Intermediate Transfer Facilities
UPT	Indonesian Technical Implementation Unit

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## 1 INTRODUCTION AND RATIONALE

The Marine Debris Hotspot Rapid Assessment for Indonesia was conducted by the World Bank at the request of relevant Indonesia government agencies and research institutions, to provide an informed and focused analysis of land-based leakage of solid waste, particularly plastics, to the marine environment. The assessment was a rapid study carried out in two phases, providing up-to-date information from 15 cities in Western and Central Indonesia. The assessment aimed to support Indonesia's response to the growing crisis of plastics and debris in the country's and world's oceans.

### 1.1 Growing Crisis of Ocean Plastics Pollution

Five widening ocean gyres of plastics – floating fields of garbage -- offer the starkest images of the marine debris crisis – one that is also visible on the world's beaches, mangroves and waterways. It is estimated the about 300 million tons of plastics being produced annually.<sup>1</sup> The very qualities that make plastics useful – lightness, durability, strength, versatility and low production costs – have today resulted in a mounting global oceans pollution crisis.

There are currently 150 million tons of plastics in the world's oceans and another 250 million will be added if current trends in urbanization, production and consumption continue. A report by the World Economic Forum and Ellen MacArthur Foundation estimated that by 2050 there will be *“more plastics than fish (by weight),”* barring *“effective after-use pathways for plastics; drastically reducing leakage of plastics into natural systems, in particular oceans; and decoupling plastics from fossil feedstocks.”*<sup>2</sup>

#### Box 1: Primer on Marine Debris

Marine debris, also known as marine litter, has been defined by UNEP (2009) as “any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment”. Marine debris consists of items that have been made or used by people and deliberately discarded into the sea or rivers or left on beaches and shores; brought indirectly to the sea with rivers, sewage, storm water or winds; or accidentally lost, including material lost at sea (fishing gear).

Marine debris is present in all marine habitats, from densely populated regions to remote points far from human activities; from beaches and shallow waters to deep-ocean trenches. The density of marine debris varies among locations, influenced by anthro-pogenic activities, hydrological/meteorological conditions, geomorphology, entry point, and physical characteristics of debris items.

Marine debris can be classified into several distinct categories

- (a) **Plastics**, covering a wide range of synthetic polymeric materials, including fishing nets, ropes, buoys and other fisheries-related equipment; consumer goods, such as plastic bags, plastic bottles, plastic packaging, plastic toys; tampon applicators; nappies; smoking-related items, such as cigarette butts, lighters and cigar tips; plastic resin pellets; microplastic particles;
- (b) **Metal**, including drink cans, aerosol cans, foil wrappers and disposable barbeques;
- (c) **Glass**, including bottles, bulbs;
- (d) **Processed timber**, including pallets, crates and particle boards;
- (e) **Paper and cardboard**, including cartons, cups and bags;
- (f) **Rubber**, including tires, balloons and gloves;
- (g) **Clothing and textiles**, including shoes, furnishings and towels.

<sup>1</sup> Plastics Europe, op. cit. note 1: European House-Ambrosette, op. cit. note 7 cited in Gourmelon, G. (2015) Global Plastic Production Rises, Recycling Lags. Vital Signs. World Watch Institute.

<sup>2</sup> World Economic Forum, Ellen MacArthur Foundation, and McKinsey & Company, “The new plastics economy: Rethinking the future of plastics,” Jan. 19, 2016.

East Asia is the world's fastest growing region for waste production. Published research has shown that, of 192 countries globally that have been analyzed, five are responsible for more than 50% of total plastics waste in the oceans.<sup>3</sup> They are all in East Asia. They are China, Indonesia, Vietnam, Philippines and Thailand. A reduction of 75% of land-based waste leakage in just four countries, all in East Asia (China, Indonesia, Philippines and Vietnam), would reduce waste flowing into the oceans globally by 45%.<sup>4</sup>

A 2015 McKinsey study identified the two main drivers of plastics leakage as uncollected waste and the low value of certain types of plastics. This study found that 75% of land-based leakage sources originate from uncollected waste and 25% from formal municipal solid waste management systems.<sup>5</sup> And, that recycling is insufficient to reduce plastics leaking to the ocean, as only 20% of plastics have sufficient value to be recycled. Also, for every metric ton of uncollected waste near waterways, 18 kilograms of plastics enter the ocean and that for every metric ton of plastic waste collected, 7 kilograms are leaked to the ocean between collection and disposal; underscoring the importance of primary collection and highlighting the fact that, although ocean plastics pollution is a global challenge, its solution requires local action.<sup>6</sup>

## 1.2 Indonesia's Marine Debris Challenge

### 1.2.1 Coastal and Marine Ecosystems under threat

Indonesia is a marine-rich, mega-diverse country. It spans three bio-geographic regions and is a bounteous haven for marine life – home to 76 percent of coral species, vast mangrove forests and sea grass meadows. However, coastal deforestation, declining water quality, pollution as well as overexploitation of marine life have had a severe impact on these ecosystems. Indonesia's ecosystems are in great peril from the constant leakage of waste. With rapid urbanization and growth in coastal populations, the level of pollution entering and destroying these ecosystems will also increase; further exacerbating the current situation.

#### **Box 2: Learning from Global Experience**

Marine debris reduction programs in the United States, for example, have been effective in reducing debris using a combination of approaches involving policy reform, technological application, and public awareness and education campaigns.

The concept of a circular economy, promoting zero waste production, is being successfully spearheaded by Denmark. The Government of Denmark has prepared a toolkit for policy makers who wish to embark on a circular economy transformation. The toolkit shows which waste reduction initiatives can lead to an increase in GDP and employment while contributing to significant reduction of waste in coastal and marine environments

From among the top polluters, Indonesia ranks second behind China. In 2010, Indonesia had a coastal population of 187.2 million living within 50 km of the coast generating 3.22 million tons per year of mismanaged waste, leaking an estimated 0.48-1.29 million metric tons of plastics waste into the ocean annually.<sup>7</sup>

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<sup>3</sup> Jambeck et. al. (2015a) *Plastic waste inputs from land into the ocean*, Science, 13 February 2015, VOL 347 Issue 6223.

<sup>4</sup> McKinsey, 2015, *Stemming the Tide: Land Based Strategies for a Plastic Free Ocean*.

<sup>5</sup> Ibid.

<sup>6</sup> McKinsey (2015) *Stemming the Tide: Land-based strategies for a plastic - free ocean*, McKinsey & Company and Ocean Conservancy, September 2015.

<sup>7</sup> The 2015 Jambeck Science study examined volume of land-based plastics leakage in 192 coastal countries (93% of the global population) and estimated that 2.5 billion metric tons of municipal solid waste was generated in 2010 by 6.4 billion people living in these countries.

Marine litter is part of the broader problem of waste management. Solid waste management is becoming a major public health and environmental concern in many countries like Indonesia, where a lack of appropriate systems for the management of waste, from its source to its final disposal or processing, exists. (UNEP 2005). The waste management challenges facing Indonesia are formidable, but they are by no means insurmountable. The Government of Indonesia is addressing its marine debris challenge head-on, and can help turn the tide for East Asia. The bulk of Indonesia's challenge to halt marine debris leakage involves addressing its inadequate municipal waste management service provision.

### 1.2.2 State of Indonesia's Solid Waste Sector

The Government of Indonesia's Long-Term National Urban Development Plan, 2015-2045, sets targets of urban service standards and city waste management –demanding high sector performance. Solid waste management is high on the national agenda, as exemplified by the National Medium Term Development Plan's (RPJMN) "100-0-100" target of eliminating all slums and providing universal access to water and sanitation, including solid waste, by 2019.<sup>8</sup>

Also included is the Solid Waste Management Act (No. 18/2008) – which required the closure of all open dumping by 2013; and requires all three levels of government (national, provincial, kota/kabupaten) to contribute to financing the sector. This sets an ambitious goal for improvement of public service delivery given current estimates that only 45 to 50% of Indonesia's urban solid waste is collected, with significant variation in performance among cities. For example, from 98% collection and transfer to disposal sites in West Jakarta to as low as 15% transferred to disposal facilities in South Tangerang. While data quality remains an issue, collection rates seems to have improved modestly over time, with the former Ministry of Environment reporting 40% of solid waste collected in 2001.

In addition, the government has pledged to reduce plastic and other marine waste by 70% by 2025, which is strongly linked to overall 100% urban collection targets on land. The National Waste Management Policy and Strategy (*Jakstranas*) drafted by the Coordinating Ministry of Economic Affairs (KEMENKO) also proposes a target of 30% waste reduction and recycling by 2025.

Solid waste management is included as the third most important sector in Indonesia's Nationally Determined Contribution (INDC) prepared for the 2015 Paris Climate Change Conference (COP 21). In addition, per the Waste Management Law 2008, all opening-dumping sites should already have been closed by 2013 and all large cities should exclusively be sending their waste to sanitary disposal facilities.

Today, current estimates show that about 85,000 tons of waste is generated daily in Indonesia with an expected increase to 150,000 tons produced daily by 2025;<sup>9</sup> a 76% increase in the next 10 years alone. Approximately 40% of solid waste is generated by households.<sup>10</sup> Hence, not only does Indonesia need to increase collection of existing households, but it also needs to contend with the annual increase of 6,500 tons of waste produced due to urban population growth and associated increases in waste generation rates.

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<sup>8</sup> The "100-0-100" target refers to 100% household access to water supply; zero slums; and 100% household access to sanitation (including waste water treatment and solid waste collection).

<sup>9</sup> World Bank (2012): What a Waste: A Global Review of Solid Waste Management

<sup>10</sup> The remaining percentage is produced by a variety of sources, such as markets (20%), streets (9%), public facilities (9%), offices (8%), and industry (6%)

Current operational practices require significant strengthening. The waste management sector is strongly underfunded (both investments and operational). Local government allocations are small (average 2.6% of total APBD<sup>11</sup>) at \$5-6 per capita/per annum – a rate that compares poorly to international benchmarks (\$15-20 per capita/per annum). Waste management systems are heavily subsidized from local budgets. The lack of investment in the sector leads to severe inefficiencies and much higher operating costs. There is virtually no enforcement of solid waste laws and standards (from city-level violations to individual polluters). Recycling is largely an informal sector activity (15% of total waste) with formal recycling systems capturing less than 5% of waste generated. Lack of capacity in local government creates a lack of confidence and unreasonably high risks to the private sector - preventing additional investment from credible businesses.

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<sup>11</sup> Anggaran Pendapatan Belanja Daerah (regional expenditure budget)

## 2 SCOPE AND METHODOLOGY

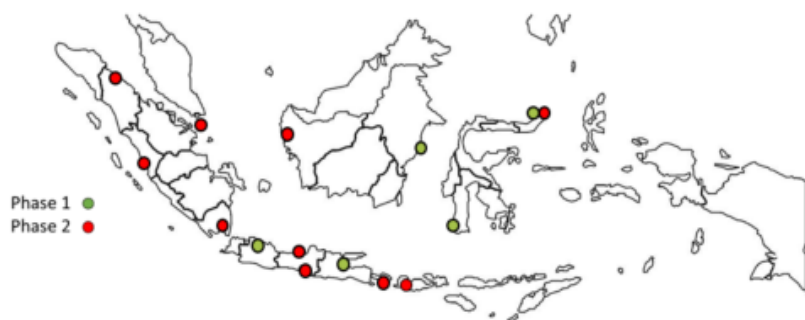
### 2.1 Overview

This synthesis report summarizes the results of a “rapid hotspot assessments” done at the city level to assist government officials, residents and other stakeholders understand the marine debris leakage profile of their city, as a basis for planning solutions at the local level. The assessment involved a series of rapid field surveys in the target cities. Fifteen coastal cities in Western and Central Indonesia were selected for the rapid assessment based on urbanization trends, proximity to the coast, population size and presence of container ports and/or tourism activities. The cities were selected to provide a broad and representative sample of different coastal city population densities and typologies in Indonesia.<sup>12</sup>

The 15 target cities and the islands on which they are located are:

- Bali: Denpasar
- Lombok: Mataram
- Java: Jakarta, Semarang, Surabaya, Yogyakarta
- Kalimantan: Balikpapan, Pontianak
- Sulawesi: Bitung, Makassar, Manado
- Sumatra: Bandar Lampung, Batam, Medan, Padang

**Figure 1: Indonesia Marine Debris Hotspots Assessment Target Cities**<sup>13</sup>



The assessment comprised desk reviews of legislation and regulations relevant to the problem of marine plastics; desktop analysis of waste generation information collected from each city to provide detailed estimates of volume and waste composition (where possible); desktop analysis of recent government data on waste management systems, processes and facilities; and field analysis of waste disposal and capture scenarios, to identify leakage points and related issues. Field sampling of waterway waste and mapping of leakage hotspots was carried out to help produce each city waste leakage profile. The hotspots show the main leakage points of municipal waste into the coastal and marine environments in each city.

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<sup>12</sup> Coastal cities in Eastern Indonesia were not selected for this exercise given that the bulk of municipal waste leakage is borne from urban centers in Western and Central Indonesia. Future assessments should include cities in Eastern Indonesia to monitor urban growth and waste leakage trends going forward.

<sup>13</sup> The hotspots assessments were conducted in two phases, with 5 target cities in phase 1 to apply the field survey methodology and refine it for application in the 10 phase 2 cities.

Each city report presents:

- Overview of methods used for the assessment, including survey location details;
- Summary of baseline conditions of waste management, including administration, and land-use;
- Estimates of waste generation from survey results;
- Findings of waste sampling and characterization;
- Findings on hotspots mapping, land use at the leakage points in waterways and coastal areas;
- Reflections on community profiles, and findings from community attitudes in hotspot locations; and
- Recommendations.

*Caveats and limitations:* It is important to note that this report presents synthesis results of 15 city-level rapid hotspot assessments, and is not meant to replace more rigorous assessments. A consistent methodology for qualitative/quantitative surveys were followed for 15 target cities for a range of seasons, with one field visit per city. Due to differences in cities, types of infrastructure, data and communities, target locations, and accessibility, comparisons between cities should be cautiously interpreted. Also, the focus of this assessment – especially waste sampling –was on plastics.

## 2.2 Detailed Field Survey Methodology

The field assessments were carried out in tidal and non-tidal zones of the target cities. For these field surveys, the two zones were defined as downstream (tidal) and upstream (non-tidal) of trash racks or other infrastructure barriers placed at the last station prior to the coastal environment in the cities' main waterways. The assessment's desk review and field survey findings from the non-tidal zones were used to prepare city waste profiles, documenting waste generation volume, collection rates and disposal mechanisms, municipal waste management budgets, staffing levels, equipment and infrastructure (and their functioning) in addition to documenting government and community-led activities to reduce overall waste, as well as identifying prevalent attitudes, behaviors and opportunities for improvement. Details of the rapid assessment methods are described in Annex 1.

### NON-TIDAL ZONES

The work completed in non-tidal zones focused on developing city waste management profiles, identifying and mapping of hotspots along the cities' main waterways and documenting municipal waste management services, infrastructure and equipment used in waste removal along and in the main waterways. A dedicated focus was placed on the cities' main waterways as they are considered the main arteries for waste leakage to coastal environments.

The work examined the composition of waste drawn from samples in each of the cities' main waterways at the last physical barrier (flood gates, litter traps, tidal gates) to waste discharging to the coastal environment above the tidal influence. The main waterways flowing to the coastal areas in each target city surveyed in this assessment are listed in the city reports. For waste composition analysis, the plastics classification developed by the Convention for the Protection of the Marine Environment of the North-East Atlantic (the 'OSPAR Convention') was used as it provides the most appropriate classification to the Indonesian context.<sup>14</sup>

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<sup>14</sup>OSPAR Commission - Beach Litter Statistical Analysis<sup>14</sup> OSPAR is the mechanism by which 15 Governments and the European Union cooperate to protect the marine environment of the North-East Atlantic.



**Desk review and semi-structured interviews** were used for collection of baseline information from local government offices on organizational structure of municipal waste management, waste management protocols, type and condition of waste collection equipment and waste management services related to waste extraction from urban waterways.

**Field surveys** were conducted by boat and, where boat transit was not possible, settlements selected for the surveys were identified by following the waterways on land. Settlements selected along city waterways were surveyed to identify waste leakage hotspots. Field surveys also included qualitative interviews with stakeholders in selected settlements to document local waste management practices and related household behaviors. Low-income areas were selected as a focus due to their high incidence of waste leakage into city waterways.

## TIDAL ZONES

The tidal zones were defined for the purposes of the assessment as coastal areas, including settlements, downstream of any trash rack or similar infrastructure and/or clearly positioned at the end of waterways that have tidal flows. Sub-catchments in selected tidal zones were defined by mapping the foreshore area based on administrative status, demographics and land use from government sources<sup>15</sup>. In each city, data were collected over 3-5 days, using the following qualitative research techniques:

**Desk Review:** Prior to field visits in each city, teams reviewed online sources on each city's waste management context, land use maps and neighborhood-specific scans using Google earth. The higher-income housing areas, tourism and recreation areas as well as harbor and industrial areas, have greater access to formal waste collection services and so were mostly inspected via desk cameras, to ascertain whether there was any evidence of illegal dumping or likely locations worth checking on the ground. Based on desk review, the field survey plan for foreshore mapping was developed, with a focus on informal settlements and fishing villages expected to have less regulated waste collection services.

**Field surveys and observations** to verify land use mapping and investigate pre-identified waste dumping areas in tidal zones, teams walked through settlement areas and conducted drive-bys on motorbike or canoe. Field observations were carried out by boat to reach less accessible coastal areas. Teams used an investigative approach to identify dumping areas and leakage hotspots. Photographic records were prepared for each hotspot; marked for mapping purposes.

**Semi-structured interviews** were carried out with residents, traders, waste collectors and local government authorities. The interview protocol was developed using the National Statistics Agency's Environmental Behaviors Survey, modifying select questions and including parameters to establish a community waste profile. Field reconnaissance work included transect analysis of slum housing areas, market places, industrial and unmarked buildings on the foreshore. Researchers used local community guides and approached respondents in situ, through formal appointments and follow up interviews.

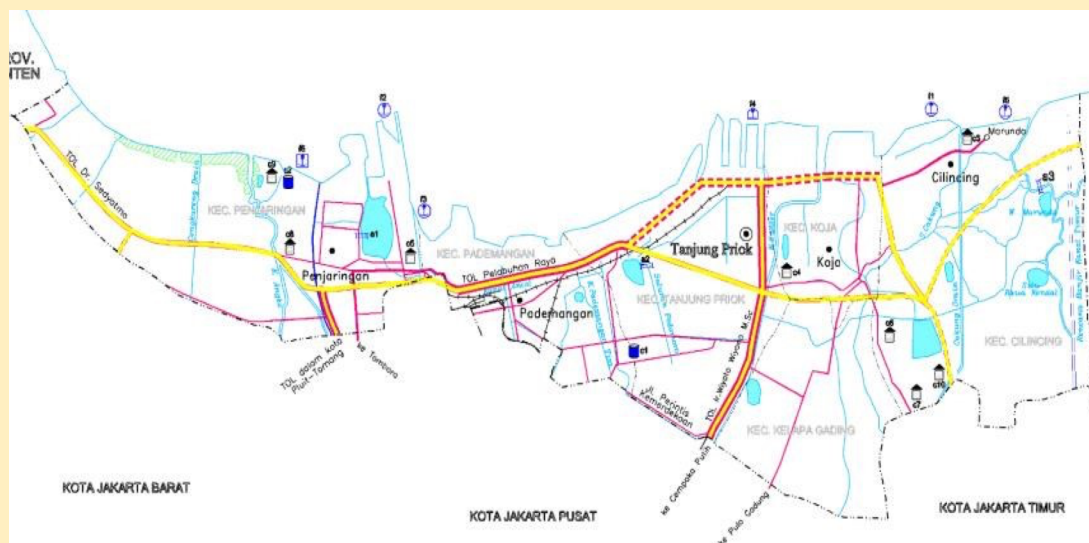
**Integrative analyses** were conducted upon completion of the field work. A field report was prepared for each city, data from tidal and non-tidal areas were cross-checked and identified hotspots were recorded on Google Earth maps, tying together various data streams and reflecting common social and cultural aspects of the communities surveyed, across settlement typologies and geographic areas.

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<sup>15</sup> Jakarta Utara Dalam Angka 2015, BPS (National Statistics Agency): 2014 and 2015; smartcityjakarta.go.id (Jakarta city administration site); peta.BPN.go.id (land agency sites with maps); Google Maps "street view" function.

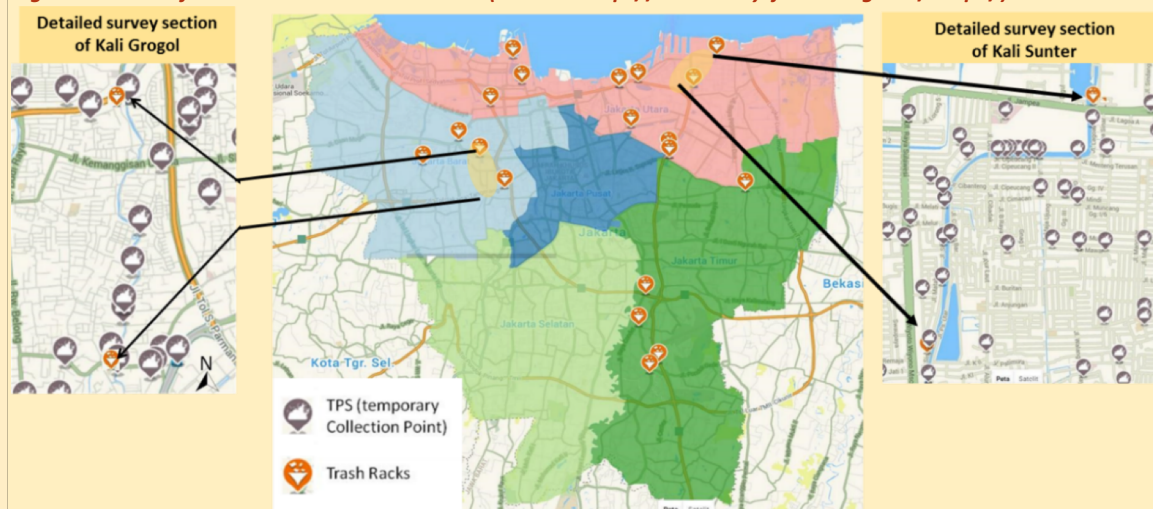
### Box 3: Example of Tidal and Non-Tidal Zone Survey Methods for Jakarta

Tidal zone surveys collected data in the tidally influenced foreshore area of North Jakarta. Data collection involved direct observations and targeted interviews with community members. Based on the foreshore mapping done using Google maps, Smartcity and BPN maps online, survey areas selected were Muara Kamal, Pluit/Penjarangan, Kali Baru and Cilincing/Cakung. These areas are spread from West to East, and characterized by informal settlements and fishing villages that have less regulated collection services.



For non-tidal zone surveys, waste sampling took place at the last major barrier on the main waterways entering Jakarta Bay (see Figure 3). Methods employed included (i) assessing the quantity and composition from at least 3 trash racks where a daily rate can be sampled; (ii) collating data on operations and maintenance for all trash racks; (iii) identifying potential waste leakage areas via direct observation; and (iv) undertaking detailed survey of 2 sections delineated by downstream and upstream trash racks: Kali Grogol and Kali Sunter.

**Figure 3: Identified Trash Racks in Jakarta (Source:<http://smartcity.jakarta.go.id/maps/>)**



### 3 WASTE MANAGEMENT: BASELINE CONDITIONS

#### 3.1 Agencies Responsible for Municipal Solid Waste

There are multiple ministries associated with waste management in Indonesia. Ministry of Environment and Forestry (MoEF) has the responsibility for developing policies, formulating regulations, and coordinating efforts in pollution control (waste collection & recycling). Ministry of Public Works and Housing (MPWH) is generally limited to providing technical advice, promoting pilot projects, and constructing/supervising large-scale off-site solid waste facilities (landfills). Although the ministries offer sectoral interlinkages across departments, persistent overlaps in their roles and responsibilities adversely affect efficiency and effectiveness of execution of mandates and institutional responsibilities. There is limited monitoring of local government performance (e.g. Adipura awards (MoEF), Green Cities Index (Bappenas), Kota Hijau (MPWH)). Enforcement is largely absent, both at community level and management of waste facilities.

In Indonesia, delineation is drawn between the collection, transfer and disposal pathway responsibilities of local government and communities. The Ministry of Home Affairs Regulation (Permendagri) No. 33/2010 addresses administrative aspects of waste management at the level of households, residential estates, commercial and industrial estates, as well as at public and social facilities.

City and district governments are ultimately responsible for solid waste management (Waste Management Act (No.18/2008). Local government regulations often fail to uphold national government laws & policies. The Municipal Planning Agency and Cleansing Services Unit are the main local government agencies responsible for planning and implementation of solid waste management. However, the finances available to local governments are insufficient to cover the high recurrent expenditures associated with collection and landfill maintenance. And, the transfer of solid waste responsibilities to local governments was not accompanied with transfer of necessary technical skills.

Responsibilities for specific stages of waste service provision are as follows:

- Collection and transport of household waste to Temporary Disposal Sites (TPS) or Intermediate Transfer Facilities (TPST) are the responsibility of the neighborhood and community organizations (RT/RW)<sup>16</sup>
- Transport of waste from the TPS/TPST to the Landfill (TPA) is the responsibility of local government
- Collection and transport of estate waste from source to the TPS/TPST, or directly to the TPA, is the responsibility of the estate management (residential, commercial or industrial). Collection and transport of waste from public and social facilities is the responsibility of local government.

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<sup>16</sup> RT/RW is the neighborhood organization (*rukun tetangga*- RT) within an urban village. The activities of several RT are coordinated by a community organization (*rukun warga*- RW). RT/RW are voluntary institutions, established through discussion and agreement among communities, whose role is to cooperate with the sub-district or village head to advance community empowerment. Each RT and RW has a head, secretary and treasurer. RT and RW activities are not salaried. Operational funding is through sub-district or village budget and from higher level grants.

### 3.2 Agencies Responsible for Waste Management in Waterways

In Indonesia, institutional oversight differs for the management of the solid waste from household and in waterways. Municipal solid waste (MSW) management is typically done by the Cleansing Department (*Seksi Kebersihan*) of each district, with household level collection delegated to the lowest levels of government. On the other hand, managing MSW in waterways is handled by different departments, depending on the city. Some examples follow below.

**JAKARTA:** In DKI Jakarta, the Waterways Management Unit (UPK Badan Air) within the Cleansing Department is responsible for removing floating waste from waterways, including management of trash racks and trash trap/net/buoy locations in streams. Waste collected from waterways is then transported, using small and medium trucks, to the emplacement location (transfer station). There are 3 transfer stations in DKI Jakarta viz. Waduk Pluit Emplacement, Perintis Kemerdekaan Emplacement, and Marunda Emplacement. Waduk Pluit Emplacement accommodates MSW from waterways in North Jakarta and West Jakarta, while Perintis Emplacement receive MWS from waterways in South Jakarta, East Jakarta, Central Jakarta, and North Jakarta.

**MAKASSAR:** Waste management in waterways of Makassar City is managed by Park and Cleansing Department in collaboration with Public Works Department and Marine, Fisheries, Agriculture, Animal Husbandry Department (DKP3 – Dinas Kelautan, Perikanan, Pertanian, Peternakan). The Public Works Department (Drainage Division) is responsible for waste management in all streams and canals – collection of waste from the waterways, transfer to the PWD trucks, and transport to the FDS at Tamangapa. DKP3 is responsible for waste management around the shore –using 3 boats called *Pattasa'ki* to handle waste sweeping and collection particularly along the Losari beach water front. The waste needs to be bagged prior to transfer to land collection points for the Park and Cleansing Department truck fleet to transport it to the FDS.

**BALIKPAPAN:** Balikpapan's waterways are diverse in size. Although there are no mechanical screens or trash racks installed on the city's main waterways, the Public Works Department is responsible for maintaining water flow in the city's canals and removing waste from the waterways which it does by means of manual stemmed nets. For waterways with a width of less than 1 meter, cleansing activity is conducted by DKPP, while the cleansing activity for waterways with a width of more than 1 meter is the responsibility of Public Works Department under the Drainage Technical Implementation Unit (UPT). Most all the primary channels (those emptying to the sea) are more than 1 meter in width and therefore the responsibility of the UPT.

**MANADO:** DKP Manado has a Coastal and River Cleansing Division responsible for drains, rivers and canals. Survey results found no trash trap system appears to be installed in the city's waterways. The only activity in relation to trash collection and cleaning of drains / river appears to be in the estuary of Kuala Jengki, from upstream at Megawati Bridge downstream in the direction of Soekarno Bridge. According to the field team officer interviewed, they are divided into two teams. Each team uses a motor boat equipped with hand tools (stemmed nets). Waste is collected in the boat and then taken toward the riverbank to be loaded into a waste truck belonging to DKP Manado then taken to the Sumompo landfill.

**Key findings:** Responsibilities for waterways waste management vary widely between cities –and require some clarification of roles and responsibilities.

### 3.3 Considering City Tiers for Supporting Solid Waste Management

As part of the preparation of an upcoming solid waste management World Bank loan, a comprehensive evaluation of 104 cities and urban districts with populations over 100,000 people was done to identify the different levels at which national resources will be focused. The immense challenges, shortages of financing and the wide ranges in performance and commitment to improve solid waste management across Indonesia's cities and districts necessitates a process to prioritize resources to the most impactful interventions. From the very beginning, there was strong consensus amongst government leaders that the loan program activities should be structured to focus resources on cities/districts that possess the most promise to implement waste management systems that can be a role model for all other Indonesian cities.

The cities were divided into three tiers depending on their current performance and commitment to solid waste management improvements. The marine hotspot assessment and the loan preparation align in several areas, including the focus on cities in different tiers, where 11 of 15 cities in the hotspot assessment were identified under tier 1 and 2 for potential investments under the solid waste management program loan.

Tier 1 cities and districts are those that demonstrated the highest levels of past performance and commitment. These cities are deemed to have demonstrated sufficient capacity in solid waste management to justify large investments in complex systems and advanced treatment technologies. Tier 2 cities and districts were those that were found to have average past performance and possessing medium potential for future improvement. They were considered to have strong potential for smaller or incremental type investments, but not full systems initially. The remaining cities and districts were classified as Tier 3, which indicated that past performance and current perceived commitment made these areas a low priority and would not likely be included in the program considering the low levels of resources currently available.

#### **Box 4: Methodology for Identifying City Tiers**

To identify these cities and districts, both a top-down and bottom-up selection process was undertaken. The bottom-up selection process entailed collection of all available data from the Indonesian Government, World Bank and private sector sources. The database contained population, waste stream, collection estimates, existing waste management infrastructure, financing aspects, planned investments, and document availability (e.g. existence of waste management strategies, feasibility studies, and detailed engineering design). From this database, each city and district was given a score of past performance and commitment. The top-down selection process entailed MPWH and MoEF independently giving each city and district a score of priority based on both past performance and current readiness – with the score calculated by averaging the two rankings.

The final score that each city and district received was based on both the top-down and bottom-up selection processes. The final breakdown of the scoring system was as follows, with weights in brackets:

- a) Landfill Capacity and/or Land Available to 2025 (5%)
- b) Solid Waste Collection Performance (10%)
- c) Alternative Funding Sources for Investments (Donor or Private Sector Projects) (10%)
- d) MoEF Adipura Assessment (15%)
- e) MoEF and MPWH expert priority ranking (30%)
- f) Percentage of Local Budget (APBD) Allocated for Waste Management per Tonne of Waste (30%)

Hotspots were identified in three land use types: beach and recreation areas; human settlements; and light industrial zones and urban areas. Each of these types of land use and hotspot locations have different patterns of waste disposal.

**Beach and recreation areas** These areas are well-known local destinations, mostly for local recreation where city residents spend time, particularly on weekends and public holidays. Nearly all cities surveyed have such recreation zones. These areas typically have a limited number of waste bins, often inadequate in number, poorly located, and/or not emptied at the required frequency given the volume of use. As such, much of the waste generated does not get disposed of in the bins available, which are often overflowing. In some locations, local cleaning personnel bury the waste in the sand, which is then dug up by dogs or uncovered by tides, and washed to sea.

**Human settlements** Across all cities surveyed, plastics waste hotspots were identified in settlements in the tidal zone. These are mainly densely populated, low-income housing areas and/or informal housing areas with semi-permanent housing and limited facilities. While elite housing complexes are also located in some coastal areas (e.g., north Jakarta Pluit area), provision of waste management services in those locations was found to be adequate. It is the poor settlements that are more widespread, have greater population densities and higher waste volumes that suffer from less frequent waste removal service provision. The identified hotspots are often located on the edge of these settlements, at locations residents can easily access and which may or may not be 'out of sight', such as over a culvert or under a bridge. Floating settlements – housing areas suspended over the water - were found in many cities and, while these may appear as obvious hotspots since residents can throw their household waste straight through their floor boards into the sea, these settlements often do have sufficient collection services.

**Light industrial zones and common urban areas** Along shorelines, in most cities, there are sections zoned for light industry, closed or with limited public access and managed by a private or government entity, such as the port authority. Fish markets are often located in these zones. The survey also noted common areas demarcated for public use within urban precincts, where people congregate, eat and trade. The industrial zones are harder to access and could contain hotspots, but limited access during the survey period made it difficult to ascertain. Conversely, open public areas are easily accessed and were not found to have large accumulations of waste. However, the surveys did confirm waste disposal over boardwalks direct into the sea. While there were fewer hotspots identified in such areas, they are noted as one of the principle land uses in the tidal zones of the surveyed cities.



### 3.5 Waste Management Infrastructure in Target Cities

Findings presented herein are a synthesis of the target cities surveyed, with examples highlighting common points and unique features that can be replicated.

#### 3.5.1 Waste Banks<sup>17</sup>

Waste banks are informal community-based establishments for collecting sorted inorganic waste that has economic value. Waste banks are set up in neighborhoods typically for about 1000 residents and are usually run by poorer people who wish to increase their income. Bank customers bring all non-organic waste to the banks where it is treated like a deposit. Transactions are recorded preferably in a bank book that the customer holds or alternatively in lists kept by the bank. Some banks also accept organic waste however most do not as their physical space is too limited. The waste banks sell the deposited material to mobile agents for reuse or recycling. Thus, the waste deposits are transformed into money that can be withdrawn when needed after a contribution of about 15% is deducted for the bank's operating costs.

The assessment identified several good practice examples, highlighted below, that can be replicated to promote further community-led waste reduction, recycling and reuse efforts in Indonesia.

#### Box 5: What are Waste Banks?

Decentralized waste banks, trash banks, garbage banks or *Bank Sampah* as they are called in Indonesia are a new convincing concept for waste management. The Ministry of Environment of Indonesia promotes Waste Banks as a strategic program to involve informal community-based efforts to collect sorted inorganic waste that has economic value. Per the ministry, the positive impacts of the waste bank development program is inseparable from the participation of people, especially at the grassroots level.



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<sup>17</sup> Note: Of the 15 target cities, the City of Manado is the only one that does not yet have active Waste Banks. During the rapid assessment, a waste bank program had been introduced in Manado, but it was not yet under implementation.

### GOOD PRACTICE IN LAMPUNG: PARTNERING WITH NGO ON GREEN VILLAGES

Currently, in partnership with Lampung's Environment Facility, Mitra Bentala supervises four Waste Banks (which together handle approximately 0.05 tons of waste per day). The collaborative nature of this NGO's efforts with the government have yielded positive results and the waste banks initiative in Lampung have since led to the development and promotion of "green villages" which support communities to prioritize clean neighborhoods and proper waste disposal and recycling practices.

Specifically, Mitra Bentala's objectives are to:

- Disseminate community-level waste management best practice;
- Establish waste banks;
- Deliver education and training programs on waste management for government, the private sector and schools;
- Work with local government to develop policies to improve waste management in Lampung; and
- Assist community groups to raise awareness on proper waste management practices and the importance of environmental health.



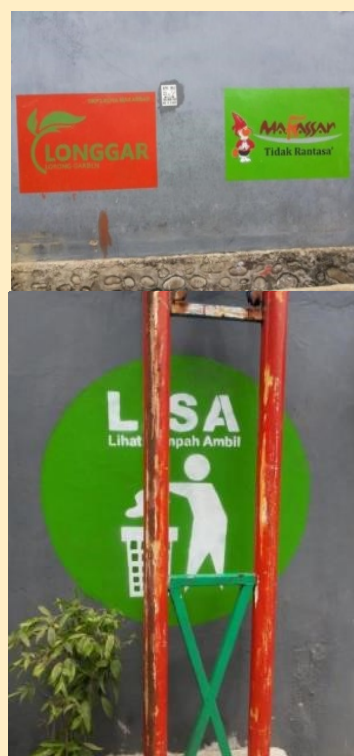
### GOOD PRACTICE IN MAKASSAR: LONGGAR PROGRAM

The City of Makassar launched several interrelated initiatives to improve waste management that build on the success of the city's waste banks.

**First**, the City of Makassar prohibited private companies and city residents from:

- Mixing household waste with hazardous and toxic waste;
- Burning plastics waste and waste that contains elements of plastics;
- Disposing waste in rivers, ditches, irrigation canals, drainage channels, parks, open spaces, public facilities and roads;
- Burning garbage in the open which could cause pollution; and/or
- Using unoccupied land as open dumps.

**Second**, the city eliminated TPS. In their place, Makassar's Park and Cleansing Department has placed waste containers in every sub-district and district along with provisions to collect waste from households via dump trucks, motorized carts and waste bins.



**Third**, the Mayor launched the LONGGAR program to promote clean and healthy environments in the city's alleys through alleyway gate cleaning, graffiti removal, installation of pergolas, wall paintings and horticulture plants in addition to siting 90 x 40 cm waste bins with steel stands. The program has been successfully established in 42 alleys in 14 districts since 2015; an additional 28 alleys were under development in 2016 at the time of this assessment.

**Fourth**, the LONGGAR program is aligned with the city's LISA program (Lihat Sampah Ambil – See Waste Take It). Together, these steps have functioned to promote the Mayor's 'Makassar Tidak Rantasa' (Makassar is Not Dirty) program further complementing the efforts promoted by the city's waste banks.

#### **Waste Reduction through Waste Banks in Makassar**

Period	Category		
	Plastics (Kg)	Paper (Kg)	Metal (Kg)
Jul - Dec 2015	22,002	27,014	7,691
Jan - Aug 2016	152,689	206,148	21,287
Total	174,691	233,163	28,978

*Source: DPK of the City of Makassar*

### **3.5.2 Waterway Waste Infrastructure and Operations**

Use of waterway infrastructure is an important way to halt waste leakage to coastal and marine environments. The assessment sought to identify municipal waste management infrastructure and collection services related to urban waterways to ascertain whether a city has a waterway waste collection system including staff, infrastructure and appropriate equipment to extract waste from waterways and transfer it to the city's final disposal site (FDS).

Functionality and effectiveness of the infrastructure and methods employed by cities to halt waste leakage to coastal environments was important to understand through the field survey. Specific city surveys also recorded sedimentation blockage of waterways, which coupled with waste, lead to frequent flooding (e.g., Jakarta and Pontianak) and further waste leakage to coastal areas.

**Jakarta** was found to be one of the few cities surveyed that actively measures the volume of waste extracted from its waterways. City data show that approximately 165 tons of waste are extracted daily from Jakarta's main waterways, 41 tons (25%) of which are plastics. Capturing such data and using it monitor progress on efforts to reduce plastics consumption and disposal into the city's waterways is an effective step in halting land-based leakage of waste and plastics, particularly, to the coast and sea.

#### **Box 6: What are TRASH RACKS?**

A trash rack is a wooden or metal structure, frequently supported by masonry, that prevents water-borne debris (such as garbage, logs, boats, animals, masses of cut waterweed, etc.) from entering the intake of a water mill, pumping station or water conveyance.

In waterways with large amounts of floating debris, various permanently installed "trash rakes" may be required to reduce the labor required for regular cleaning.



In **Pontianak**, another city that systematically collects data on waste extracted from its waterways, it was confirmed that 24 m<sup>3</sup> of waste are extracted daily from the city's waterways and transported to the Batu Layang landfill. City staff extract waste from waterways using waste catchers or barriers such as bar screens, trap nets and bamboo stick traps. With an average of 283 working days per year, the amount of waste collected from Pontianak's waterways and transported to landfill annually is 6,792 m<sup>3</sup>.

In **Manado** and **Balikpapan**, both cities that do not have trash rack infrastructure installed in their waterways, waterway waste is collected manually by boat, but the volume and composition is not recorded. In other cities where there are no racks in place or operating, such as in Yogyakarta, Medan, Bitung and Batam<sup>18</sup>, waste leakage flows direct to the coast with limited opportunities for municipal agents to remove the waste before it reaches the coast.

Each of the city reports presented in the technical volume include an assessment of the status and condition of all trash racks in place on the city's main waterways. For example, in Jakarta, data collected on the location, condition and function of trash racks is presented in Table 6 to inform local government where maintenance work is needed to ensure that all of Jakarta's trash racks are brought back to full functionality to support waste leakage prevention efforts to Jakarta's coastal area and Java sea.

**Table 6: Jakarta Trash Rack Location, Condition and Function – SUNTERRIVER**

#	Location	Area		Trash Rack Condition	% Function
		Sub-District	District		
1	Pump Station and Trash Rack IKIP (Pintu Air 8)	Kelapa Gading Barat	Kelapa Gading	2 MEH Robots, Work: 1, Bamboo	MEH Robot: 50% Bamboo Screen: 70%
2	Pasar Ular	Rawa Badak Utara	Koja	6 MEH Robots, Work: 1	MEH Robot: 16.7%
3	Sunter Kresek	Koja	Koja	18 Trash trap screen, No Robot	Screen: 80%
4	Perintis Emplacement	KelapaGading Timur	Kelapa Gading	Bar screen, Excavator Amphibious	Screen: 50%

*Source: Extracted from Indonesia Marine Debris Rapid Hotspots Assessment Non-Tidal Zone Field Survey, 2016*

<sup>18</sup> Note: Batam has one rotary screen installed but only on a trial basis and it is in a private residential area so for the purpose of this assessment, it is not considered a fully functioning trash rack managed by the city on a main waterway.

## Observed Methods for Collecting Waterborne Debris



**For cities that do not have waterway infrastructure in place,** monitoring the volume of waste leaked into waterways and flowing to coastal areas can be used to determine if installing trash racks or investing in improved collection and disposal practices specifically at the identified hotspots are a good near-term investment to reduce leakage to their coastal environments.



#### 4.1 Municipal Solid Waste (MSW) Generation Rates: Modelling

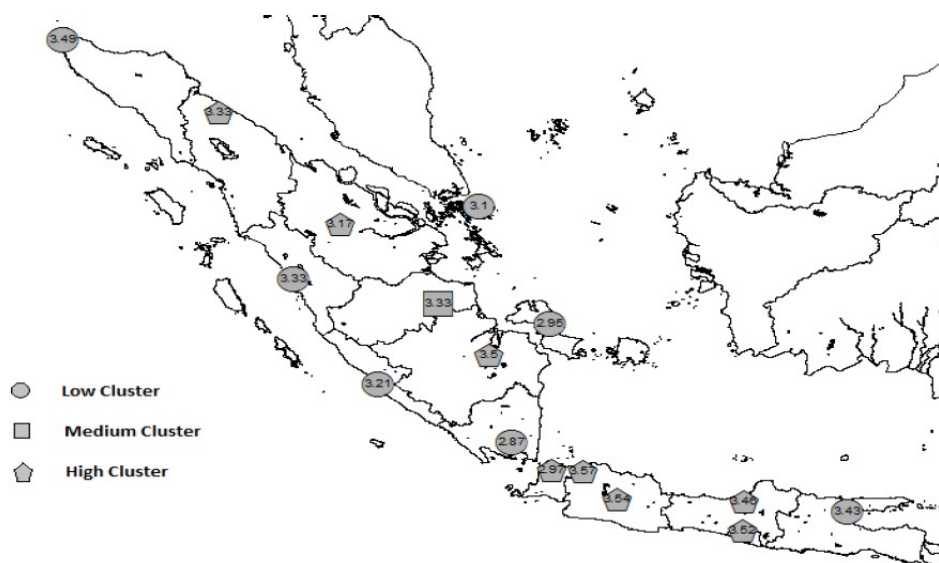
Municipal solid waste (MSW) generation rates, sources and composition are influenced by number of variables, including economic growth, Gross Domestic Product, type of economic activity, total population and population density. The standard approach for calculating MSW generation rates in Indonesia for small and medium size cities is outlined in the Indonesian Standard SNI (Table 3). For large cities, generation rates are estimated to be greater than 0.80 kg/capita/day. A study by Benno et al (2015) determined that generation rates could be estimated through the modelling of the aforementioned variables in individual cities in Indonesia (Figure 9). For this study, estimates of the waste generation rates in the assessed cities uses 3.57 litre/capita/day equivalent to 0.87 kg/capita/day<sup>19</sup>. These are different rates than those used or referred to in other studies, such as Jambeck et al (2015) the World Bank's *What a Waste* study

**Table 3: SNI MSW Generation Rates for Small and Medium Size Cities in Indonesia**

City Classification	MSW Generation Rate	
	Volume (L/person/day)	Weight (kg/person/day)
Medium (pop. 100,000 to 500,000)	2.75 – 3.25	0.70 - 0.80
Small (pop. < 100,000)	2.5 – 2.75	0.625 – 0.70

Source: SNI (1995)

**Figure 9: Modelling of Generation Rates for Cities in Java and Sumatra**



<sup>19</sup> SNI (1995) conversion factor of 0.246 kg/litre



**Sources of MSW:** Domestic MSW typically accounts for upwards of 75% of urban waste generation in Indonesia (Table 4). In larger cities, like Jakarta and Surabaya, domestic waste is expected to be lower relative to commercial/industrial sources. For smaller cities, like Manado and Padang, the opposite is expected; higher domestic and lower commercial waste volumes.

**Table 4: Typical MSW Sources in Indonesia**

Source	%
Domestic Waste	60 – 75
Markets	5 – 10
Commercial Waste	4 – 12
Institutional	1 – 6
Street Sweeping	0.5 – 2

## 4.2 Waste Generation and Collection Rates: Survey Results

Data on collection rates were compiled using a combination of field inspection and information provided by the Cleansing Departments. In some cities, the cleansing department handles waste collection to the landfill as well as composting and waste banks; while in other cities, these departments only handle garbage collection taken to TPA. Table 5 provides data on waste generation and collection provided by city authorities, waste banks, waste collectors; and estimates by the survey team.

**Table 5: Waste Generation and Collection in 15 target cities**

City	Population <sup>(i)</sup>	Waste generation <sup>(ii)</sup> (tons/day)	Handled waste to FDS <sup>(iii)</sup>	Other handled waste <sup>(iv)</sup>	Unhandled waste <sup>(v)</sup>	% of unhandled waste
<b>Tier 1</b>						
Balikpapan	615,574.00	535.6	375.7	26.9	133	<b>24.80%</b>
Bitung	205,675	178.9	133.1	0.1	45.8	<b>25.60%</b>
Surabaya	2,853,661	2482.7	1477.7	84.5	920.5	<b>37.10%</b>
Makassar	1,449,401	1261	1163.9	1.6	95.5	<b>7.60%</b>
Jakarta	10,075,310	8765.5	6484.7	-	2280.8	<b>26.00%</b>
<b>Tier 2</b>						
Denpasar	880,600	766.1	638.5	-	127.6	<b>16.70%</b>
Padang	902,413	785.1	375.4	8.1	401.7	<b>51.20%</b>
Manado	425,634	370.3	326.6	-	43.7	<b>11.80%</b>
Medan	2,210,624	1923.2	1564.7	0.3	358.2	<b>18.60%</b>
<b>Others</b>						
Pontianak	607,438	528.5	371.5	4.8	152.2	<b>28.80%</b>
Semarang	1,595,267	1387.9	1087.2	-	300.7	<b>21.70%</b>
Yogyakarta	412,704	359.1	267.2	30.4	61.5	<b>17.10%</b>
Batam	1,037,187	902.4	798	3.3	101.1	<b>11.20%</b>
Mataram	450,226	391.7	230.6	2.3	158.8	<b>40.50%</b>
Bandar Lampung	979,287	852	789.1	1.3	61.6	<b>7.20%</b>

Sources: <sup>(i)</sup>From BPS Statistics Office Data; <sup>(ii)</sup>Estimated using 0.87 Kg/Capita/Day Waste Generation Rate; <sup>(iii)</sup>Data Provided By City DKP/DK/DP; <sup>(iv)</sup>Available data from waste banks, waste collectors; <sup>(v)</sup>Calculated by survey team

**Data limitations:** It is important to note that data collection and reporting methods differed across cities (such as units of measure and source of data, e.g., estimates by truckload or weigh-station) making it difficult for aggregate comparisons. The robustness of local government data, in certain instances, was difficult to ascertain and, therefore the findings should be used cautiously (e.g. waste collection rates in some cities appear to be higher than what other official data /studies have indicated). In this rapid assessment, the numbers should therefore be interpreted as giving an indication of the magnitude of the waste generated, unhandled, and potentially leaking to the marine environment, rather than as an accurate point estimate.

## 5 WASTE SAMPLING AND CHARACTERIZATION

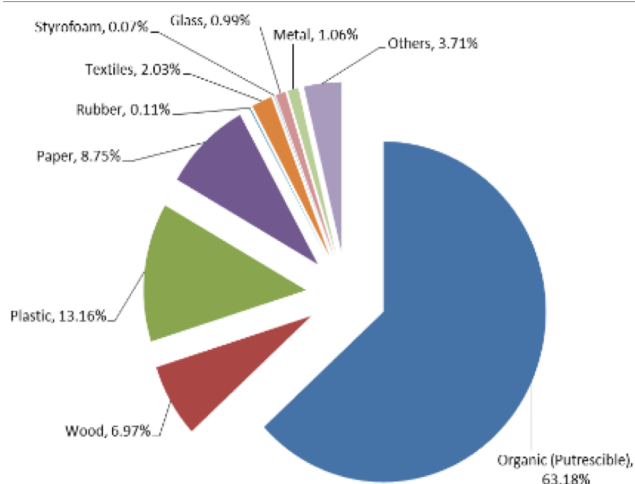
### 5.1 Municipal Solid Waste Composition

The composition of municipal solid waste in Indonesia is primarily organic, and is dependent on key economic and social variables. Cities with high GDP and economic growth would be expected to have a lower organic composition (55 to 60%) and higher plastics and paper content. In contrast, cities with lower GDP and slower growth, the organic composition is expected to be higher (65 to 75%) accompanied by a lower plastics and paper content overall.

While the survey does not provide details of the MSW composition mix for each category, it does demonstrate that managed MSW (i.e., waste disposed to TPS/TPA) provided by local government and community agents to urban populations is only 48.38%.

The Government of Indonesia's ambitious plans for improved solid waste management relies heavily on household participation to achieve its target of 30% reduction (through reduction, reuse and recycling, or "the 3R policy") in waste collected by 2019. With only 1.6% of households exhibiting active participation in 3R activities, and of this, less than 0.5% attributed to plastics recycling and reuse, achieving the RPJMN target will require far greater engagement at the household level.

Figure 10: Average MSW Composition in Indone



**Key Finding:** There is potential for addressing waste through building capacity/awareness about recycling, reuse and reducing and improving household collection systems.

### 5.2 Waterway Waste Sampling and Characterization

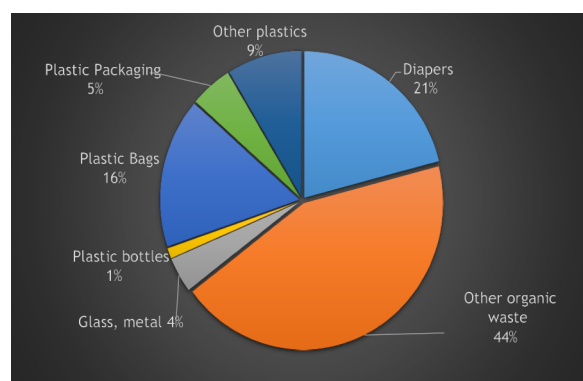
Complementing the desktop work on waterway waste extraction, the field surveys also sampled waste from the main waterways in the non-tidal zones. Sampling of mixed municipal waste from waterways was used to calculate composition of waste, particularly plastics composition. Waste samples were taken from the last trash rack along the waterway nearest the coast and closest to the tidal zones for cities without trash racks or other installed barriers. A waste sample of approximately 1 m<sup>3</sup> was extracted at the trash rack and sorted into 65 different types of waste, including different types of plastics. The waste was manually sorted and each type was weighed to calculate composition type by weight. The results (Table 7) and in city reports are averages of all samples collected in each city.

**Plastics Content in City Waterway Waste Streams:** The Jambeck et al (2015) studies assume an 11% plastics composition in waste for Indonesia, while the World Bank's (2012) *What a Waste* study estimates that the share of plastics in East Asia and the Pacific Region is 13% and 12% in Indonesia. Indonesian statistical data on waste composition in Jakarta shows a 14.5% content (by weight) of plastics, including rubber and artificial leather. Findings from this assessment show that the plastics content in city waterways has an average plastics composition in city waste streams of upwards of

31%, ranging from 20% to 38% (Table 7). However, this estimate is based on samples extracted at the last physical barrier to the coast in the cities' main waterways and not from generation point source, TPS facilities or landfills. Due to the concentrations of plastics in waste extracted from waterways (heavy materials sink, organics dissolve), these figures do not contradict the plastic fractions of 11-15% found in mixed waste generation.

Plastic bags, packaging and other types of plastics, such as rubber sandals, toys, and cups were identified in the waste sampled from the waterways, with the most prevalent type of plastics found in the samples being plastic bags, at an average across all cities of 16% (see Figure 12). This high percentage was due, in part, to the fact that waste is often disposed of inside plastic bags. Plastic bottles were, on average, represented at only 1% of plastics waste in the samples, which is likely due to their higher recycling value relative to single use plastic bags. Balikpapan, Makassar, Semarang, Surabaya and Yogyakarta had the highest percentage of plastics content in their waterway waste relative to other cities sampled.

**Figure 12: Waterway Waste Composition Average for Hotspots Target Cities Sampled**



Another interesting finding was the significant volume of disposable diapers in the waste samples. On average, 21% of waste content was comprised of disposable diapers, which while not considered “plastics” for purposes of this assessment, do contain plastics components. Makassar, Manado and Surabaya showed a percentage upwards of double or more of the average percent diaper content found in the waterway waste stream of other cities.

**Table 7: Non-Tidal Zone Survey Waste Composition Findings**

Categories/ Cities	Jakarta	Makassar	Manado	Balikpapan	Surabaya	Semarang	Medan	Yogyakarta	Bitung	Batam	Denpasar	Padang	Mataram	Pontianak	Bandar Lampung	Average
Diapers	12.9	23.7	26.4	7.7	31.1	10.2	14.9	0.4	16.3	15.9	11.9	0.8	8.7	12.8	9.5	13.5
Other organic waste	52.1	29.9	50.4	55.4	33.3	54.2	57.9	60.9	45.4	49.5	59.4	83.0	55.2	64.1	50.6	53.4
Glass, metals, inert	5.39	1.7	4.7	2.9	2.1	0.2	4.6	4.4	13.0	7.8	4.6	2.6	3.5	2.6	1.7	4.1
Plastic bottles	2.4	0.3	3.1	1.0	0.4	0.6	0.4	0.0	2.3	0.6	1.2	0.6	0.4	0.6	0.1	0.9
Plastic cups	0.6	2.6	1.6	0.5	0.6	1.3	0.7	0.0	1.4	2.2	0.93	1.1	0.3	0.7	0.1	1.0
Plastic bags	21.6	25.4	7.6	14.1	17.9	14.0	6.3	7.2	9.4	15.2	13.4	4.1	12.4	10.8	22.5	13.5
Plastic Packaging	4.1	14.4	3.3	10.7	14.2	17.1	12.4	3.3	7.4	6.4	7.1	6.3	13.5	6.3	2.3	8.6
Other plastics	0.9	2.1	3.2	7.8	0.5	2.4	2.9	23.8	4.8	2.5	1.7	1.6	6.0	2.2	22.9	5.7
<b>% Plastics</b>	<b>29.5</b>	<b>44.7</b>	<b>18.5</b>	<b>38.8</b>	<b>33.5</b>	<b>35.3</b>	<b>22.7</b>	<b>39.3</b>	<b>25.3</b>	<b>26.7</b>	<b>24.2</b>	<b>13.6</b>	<b>32.6</b>	<b>20.6</b>	<b>29.4</b>	<b>29.0</b>

**Validation of Jambeck estimates:** It was difficult with the available data and collected data to assess total volumes of plastics that enter the ocean from Indonesia's coastline and waterways. Jambeck estimates these amounts for Indonesia at 0.48-1.29 million tons/year. The hotspots assessment estimated this figure based on expert judgment at 55,000 tons for Jakarta (12% of total waste plastics). Extrapolating this amount for total urban population in Indonesia would put the national figure at roughly 900,000 tons/year. Another approach is that in Indonesia on average around 30% of

urban waste (total 105,000 tons/year) is not collected, resulting in leakage of 15-20% as between 10-15% of uncollected waste does not enter the formal systems due to informal collection of recyclables.

Expert judgment puts the fraction of uncollected waste being discharged to waterways between 30-50%. This for the urban population in Indonesia with a plastics fraction in mixed waste around 11-14% would give a plastic to waterways estimate of 400,000 tons/year. These outcomes are in the range of the Jambeck estimates. They discard waste from rural areas but these areas have much lower waste generation levels per capita and in addition a lower plastics fraction.

#### EXAMPLE: BANDAR LAMPUNG PLASTICS PROCESSING

With respect to plastics collection and recycling, in the City of Bandar Lampung, the field survey identified a unique example of small and medium collectors aggregating plastics waste to a bulk waste collector who operated a processing plant for pressing and crushing plastics. The plant handles 1.2 ton/day of plastics waste and, after processing, sends it to a bulk plastics buyer in Jakarta.



**Key Findings:** Findings from this assessment show that plastics is a significant portion of debris extracted from waterways in all cities, ranging from 20 to 38 percent (concentrated compared to fractions of waste before it enters waterways, with plastics ranging from 11 to 15 percent). The most prevalent type of plastics found in the samples from waste extracted from waterways are plastic bags, at an average across all cities of 16%. Important to note that as much as 21% of waste content was comprised of disposable diapers, which in and of itself has plastics components.

## 6 WATERWAY HOTSPOTS MAPPING

The assessment identified the main waste leakage points or ‘hotspots’ along each cities’ central waterways. Mapping of city-specific hotspots included documenting waste collection infrastructure and waste disposal guidance signage along the same trajectory and where, despite these efforts, waste is still disposed of in and alongside waterways. For each city surveyed, the detailed hotspots maps are included in the technical volumes accompanying this report.

Overall, survey data show that despite provision of waste containers and signage guiding residents about proper disposal practices, significant gaps remain in several locations across all cities where provision of appropriate waste collection receptacles (and frequency of service) and signage are not available or insufficient, and where community sensitization and behavioral change campaigns are needed to halt illegal dumping and development of waste hotspots along waterways. The findings also underscore the need to tailor remediation strategies to city-specific operating environments.

### 6.1 Summary of the Tidal Zone Area Hotspots

In the target cities surveyed, there were numerous waste leakage hotspots identified –mostly located along the riverbanks, but also present in the residential areas that have a drainage channel connected to the flow of the river or canal. Table 11 shows the number of hotspots identified just in the tidal zone of each city. Several more hotspot locations were found in non-tidal zones. Settlements on the banks of streams and channels are most likely to pollute the water flow of the river or canal with trash, that eventually empties into the sea.

**Table 11: Waste Hotspots (Tidal zone) identified**

City	# Hotspots	City	# Hotspots
Jakarta	3	Makassar	9
Balikpapan	10	Surabaya	3
Denpasar	3	Semarang	4
Mataram	5	Manado	4
Bitung	6	Batam	9
Pontianak	10	Padang	6
Bandar Lampung	13	Medan	10

*Note: These are not all hotspots but ones that the survey team considered to be serious concerns in terms of volume and frequency of waste pollution.*

The hotspot location details and many photographs are found in the city technical reports; they serve as an indication of the level of waste mismanagement by the community / residents, and of the shortcomings of relevant local authorities in addressing the problem. Some examples follow below:

In **Jakarta**, hotspots in Sunter River stream are found along the canal, from Trash rack Pasar Ular (upstream) to Trash rack Sunter Kresiek/Koja (downstream). The main hotspots of plastic leakage to the marine environment in the tidal areas of Jakarta are located at Kamal Muara in the west, Kali Baru-Cilincing and Marunda in the east.

In **Makassar**, the most critical hotspots were identified as CPI (rivermouth of Jongaya canal and Rajawali canal which flows from the fish market and low-middle class settlement area in Rajawali, Pannambungan urban neighborhood area); Paotore Harbour and Sabutung street (rivermouth for Pannampu Canal, where people dispose of waste directly into the canal); and Pattingalong and Tallo neighborhood (downstream of trash rack where sizeable riverbank communities dispose their trash to the Tallo river).



## CASE STUDY: CITY OF BITUNG

The city of Bitung has two rivers –the Girian and Sagerat –within its administrative territory. The survey examined the waste leakage conditions of both rivers as well as the downtown drainage channels of the city.

**Girian River:** The general condition of the Girian River is clean, but some hotspots were identified in the form of illegal waste disposal and burned waste (at Lingkungan 1 Girian Weru) along with sedimentation. The hotspot areas were overgrown with aquatic plants covering the surface of the river further blocking upstream waste.

Communities along the Girian River were noted to believe that the river is an open and acceptable location for direct waste disposal. The absence of TPS within close proximity of the majority of houses and lack of waste collection services at the household level further exacerbate the direct disposal practices held by the Girian River communities. Waste burning was also evident among these communities.

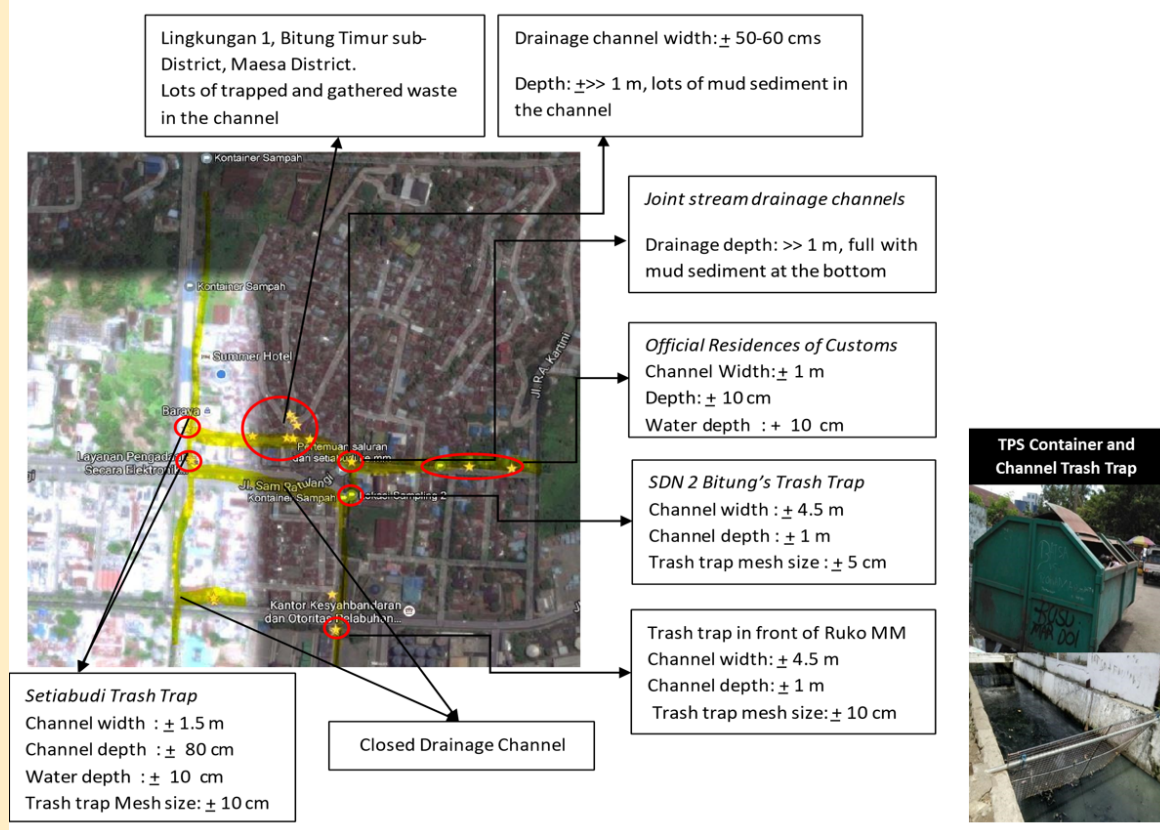
At the Manembonembo Sub-District of Matuari District section of the Girian River, one TPS is available, but residents still dispose of their waste into the river because the TPS is located in an area too steep for residents to access on a regular basis. At the Pinokalan Sub-District of Ranowulu Section of the Girian River, there is no TPS and residents burn their waste along the riverside. Furthermore, during heavy rains, the river rises and flushes riverside waste into river and out to sea.

**Sagerat River:** Along the city's Sagerat River at the Lingkungan 5 RT 02 Manembo Nembo Sub-District of Matuari District area sampled during the survey, waste burning and dumping is common practice when TPS and associated waste collection services are not available.

**Bitung's Drainage Channels:** Most of the City of Bitung's drainage channels are in the Sub-District of Bitung Timur, District of Maesa). The survey found that residents in this area tend to burn and dump waste in vacant lots alongside channels. Although the city does provide a TPS in front of Elementary School SDN 2 Bitung, it is located 200 meters from the residential area and residents prefer to dispose of their waste on the vacant lot near their home rather than at the TPS.







The City of Bitung was shown to provide signs and banners in visible locations outlining the rules against littering and the specific hours during which residents can dispose of their waste. However, the survey confirmed that the signs have had little to no influence on household waste behavior. In addition, the city has installed trash traps in the channels to prevent waste blockage and subsequent flooding. These were found to be fairly well maintained.

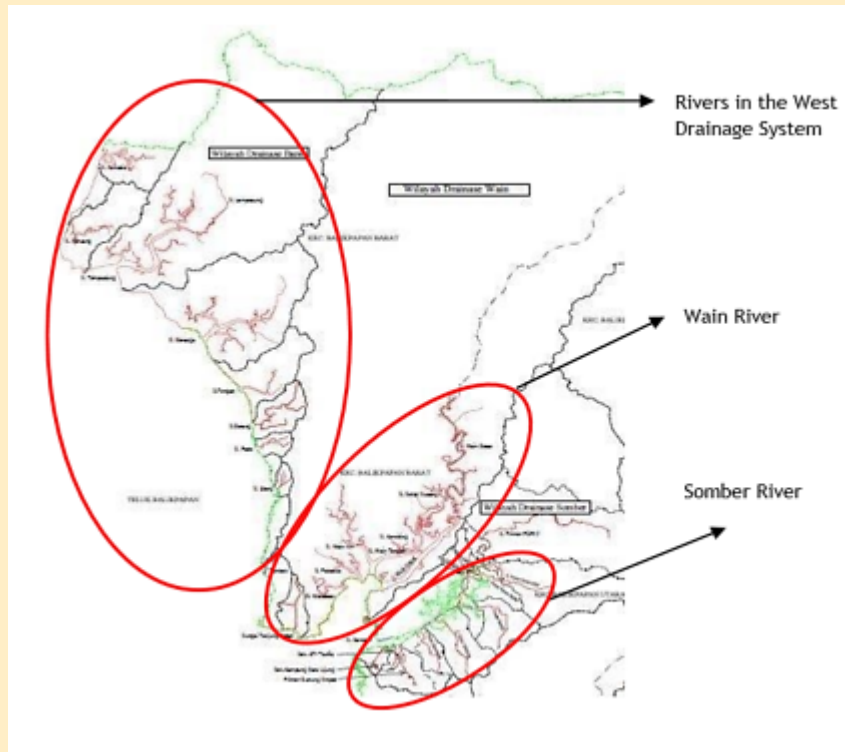
The City of Bitung's Cleansing Department is the only agency handling waste management and it has limited tools to carry out its mandate. Although the survey documented some efforts to reduce waste leakage to the sea through installation of trash traps in the drainage channels which are cleaned on a regular basis, bulk numbers and overall location placement and servicing of the TPS are not optimal and tend to become hotspots for waste leakage into adjacent waterways.

The survey also found that local regulations are not enforced and that cultural habits of local communities play a fundamental role in waste disposal and littering in the city's waterways. Measures to engage communities in supporting and promoting proper waste disposal along with investments to provide additional and well located TPS will serve to reduce Bitung's marine debris challenge.

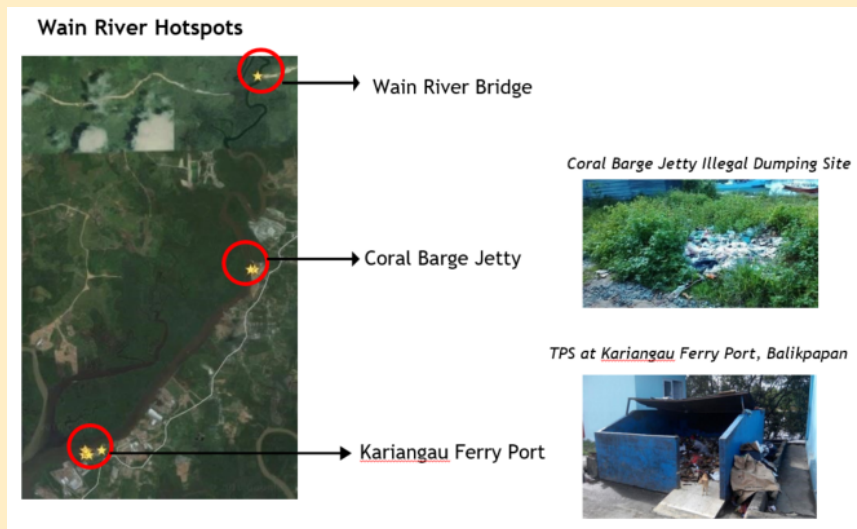
## CASE STUDY: WAIN AND SOMBER RIVERS OF THE CITY OF BALIKPAPAN

In Balikpapan, detailed surveys focused on two main rivers, the Wain and Somber, given that the city's rivers in the west drainage system are inaccessible (Figure 14).

**FIGURE 14: SCHEMATIC OF THE MAIN RIVER STREAMS OF THE CITY OF BALIKPAPAN**



The municipal waste bin at the Wain River Kariangau Ferry Port was found to be in poor condition exacerbating improper waste disposal in this hotspot. And, the TPS condition at the Port is frequently surrounded by waste. In addition to the hotspot identified at the port, the survey

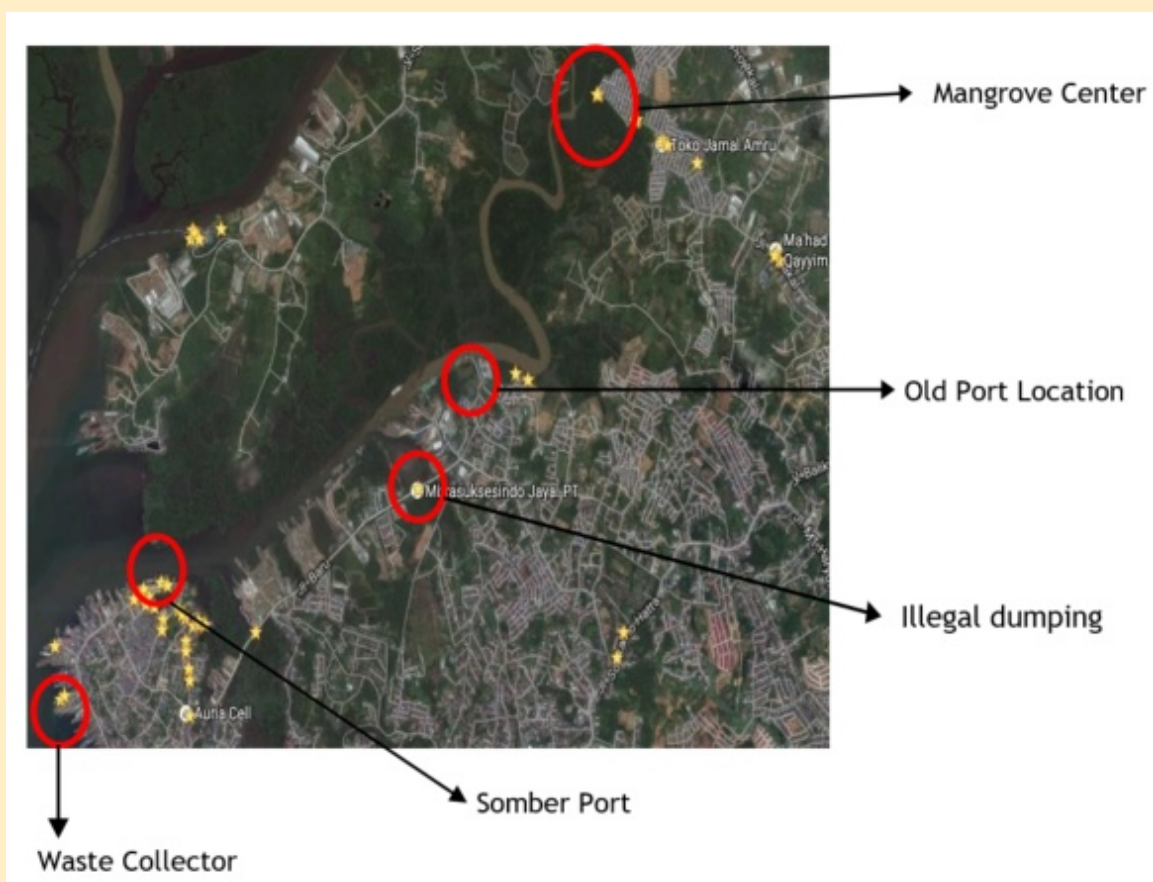


found illegal dumping at the entrance to the Coral Barge Jetty. The survey found that although the Wain River appears to be clean, floating waste such as plastic bags, plastic packaging and disposable diapers were readily observed along this waterway from the Wain River Bridge.

At the Mangrove Center, the Sember River condition is clean. The survey noted that at this location, volunteers responsible for managing conservation of the mangrove forests (at Graha Indah Residence) actively collect waste from the mangrove area. In this area, wildlife, such as crocodiles and proboscis monkeys, are readily observed. In addition, two types of waste bins are provided for Mangrove Center visitors, one for wet waste (organic) and one for dry waste (inorganic). The Mangrove Center waste management conditions are exemplary.



However, several other survey areas along the Sember River were listed as hotspots including locations where waste is illegally dumped in the Sember River or at hotspots along the riverside that will lead to waste leakage into the river.



Priority attention through investment in the provision of collection services and more frequent collection and transfer services as well as cleanup activities and campaigns to raise awareness and promote proper waste disposal at these sites should help halt land-based leakage of waste into Balikpapan's coastal areas.



## 6.2 Summary of Hotspot Characteristics

An analysis of the main characteristics identified in each of the surveyed cities, show several common elements viz. poor access to, and infrequent solid waste collection; inadequate and ill-functioning waterways infrastructure; deficiencies in community and household awareness and waste management behaviors; and lack of appropriate financing and institutional mechanisms. Examples from the 15 cities are summarized in the paragraphs below.

Waste Infrastructure:  
Accessibility,  
frequency

Waterways  
Infrastructure: Type,  
functioning

Financing,  
Institutional  
mechanisms

Community,  
Household Behavior,  
practices

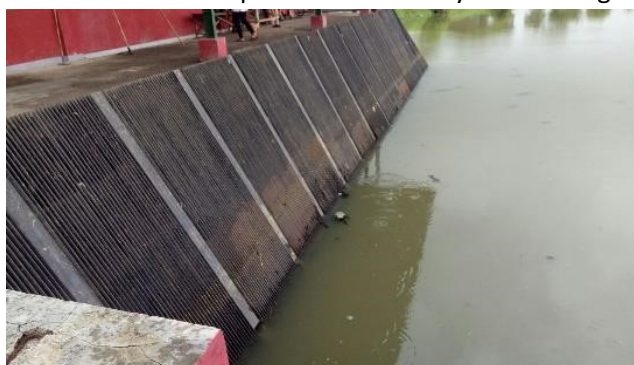
### Waste Infrastructure: Accessibility and Frequency

In some city surveys – such as in Makassar – the lack of waste management equipment (bins, trash carts) and inadequate facilities in neighborhoods were noted. In most cities, the location of the TPS were far from residential areas and resulted in households disposing their waste by other means, often illegal dumping, burning or disposing waste directly into waterways adjacent to their houses. For example, cities of Jakarta, Makassar, Balikpapan and Surabaya reported the distance of TPS' more than 100 meters from the settlements, and were therefore not optimally utilized. Some tidal zone neighborhoods (eg. Terboyo Wetan in Semarang) do not yet have access to TPS and develop informal waste disposal sites that leak to waterways. In other cases, settlements particularly along rivers (eg. Tondano River, Manado) or coastal areas (e.g. Malayu Bangsa in Mataram) were inaccessible to trash or motor carts, leaving residents to dispose of waste directly into waterways. Floating settlements (e.g. Segara Pasar Baru, Kampong Baru Ulu in Balikpapan) posed unique waste management challenges. In addition to accessibility, the frequency of waste collection was also noted as a constraint. In dense settlements, such as Kali Anak in Surabaya, waste collection is only twice a week, with residents disposing waste directly into the waterways on other days.



### Waterways Infrastructure: Type and Condition

The types of infrastructure to capture waste on waterways include barriers, trash racks and other types of traps. Many city surveys revealed some rivers had no barriers or trash racks—e.g. on the Deli River, Medan's main river, or on any of the six main rivers of Padang. Manado is the only city surveyed that does not have trash racks or trash barriers on any of its five rivers that flow to the sea; waste in all waterways flows directly out to Manado's coastal and marine environment. And where there is waterway waste infrastructure, they are often found not to be adequate or effectively functioning. For example, several rivers in Pontianak do not have trash racks or traps; and only have nylon rope barriers (and in poor condition) that are inadequate for the volumes of waste leaking into these waterways. Where found to exist, several trash racks were not fully operational; some operate at 50% capacity leading to waste leakage out to sea (e.g. in Ranga, Denpasar).



In some cases, trash racks are not optimally located in terms of preventing waste leakage to the sea. In Makassar, waterway trash racks are often located further upstream from settlements, so

waste leakage to waterways occurs downstream from the racks; in Surabaya, they are located in side streams so they halt leakage entering the main rivers, but they are not placed in the main rivers. Some cities cited access constraints for fishing boats to be stationed in estuaries if trash racks are installed along waterways.

### Community Behavior and Household Practices

Across the spectrum, there is significant room for improvement in community awareness and local capacity for waste disposal practices. Burning household waste is common along riverbanks across Manado and Padang and unburnt waste leaks into the rivers and flushes out to the coast and sea. In Medan, for example, residents were found to frequently burn waste along the city's riverbanks, leading to subsequent leakage into the waterways. There are many settlements along the Kapuas River in Pontianak where residents throw their waste in the river due to limited awareness of (and access to) proper disposal practices. The surveys, like those in Lampung, also found residents to be reluctant to pay for collection and opt to dispose of their waste directly to the sea. Community and government priorities are focused on more urgent issues such as flooding. There is also a lack of incentives to change household and community waste disposal perceptions, attitudes and behaviors.



### Financing and Institutional Mechanisms

Some of the underlying reasons cited for poor waste management in the target cities were the lack of regulations and/or coherence and specificity in and between regulations. As mentioned earlier, there is a lack of coordination for waste management among responsible parties at the local levels – with institutional mechanisms differing across cities.

Poor management is seen across many surveys. In Denpasar, the regional government has difficulty obtaining land for TPS placement. Local neighborhoods are responsible for waste management but many have no budget or inadequate systems in place to execute this role effectively. Similarly, due to the lack of land availability in Pontianak, TPS are located along riverbanks and become high waste leakage points. Weaknesses in enforcement also result in leakage to the sea. In Pontianak, for example, leakage also occurs due to poor waste management services at Dalam Bugis Market and Kapuas Indah Harbor; in Bitung, waste management systems are not enforced at the traditional harbor and Pasar Ruko coastal market –leaving them prone to leakage into the sea.

Inadequate funding and the lack of incentives are found to be important limitations. In Kampung Rawa Laut, Lampung, for example, garbage collectors' incomes are considered inadequate and fail to motivate optimal collection services in coastal areas. Persistently low prices for recyclable items further compound this. As a result, residents tend to use illegal dumps to dispose of their waste. In some areas (e.g., at Rengas Pulau in Medan), informal TPS "keepers" demand fees for residents wanting to deposit waste at the TPS. Competition between informal and formal waste banks are also resulting in lowered incentives.

## 7 SOCIO-BEHAVIORAL FINDINGS

Qualitative socio-behavioral interviews carried out in the target cities were analyzed to elucidate waste production and disposal practices and to assess community perceptions related to waste management. Community input was elicited through semi-structured and targeted interviews applying the standard framework used for Government's BPS survey of 2015.<sup>20</sup> Findings presented herein are a synthesis of the cities surveyed, with examples to highlight common points.

### 7.1 Community Profiles

The population in the hotspot areas tend to be diverse in terms of ethnicity, occupation and duration of residency.<sup>21</sup> Occupation, education and income levels of survey respondents varied with the majority being housewives, fisher-folk, small-scale traders, waste collectors and local government employees. Across cities, most tidal zones were found to have collection and disposal systems – however, **communities of lower economic status were associated with poorer facilities and inadequate waste service provision.** In these areas, the waste management infrastructure and services are offered, but are limited and residents do not have access to information or awareness of proper waste disposal.

**In most cases, services are locally managed,** with the lowest level of government, the RT/RW or neighborhood and community association, responsible for providing and overseeing waste management. Neighborhoods have different systems depending on their characteristics, with main considerations being access – width of laneways between houses – and the ability of residents to pay for waste collection services.



**In areas where access is difficult, the typical approach is to place common dumpsters in the area** and require households to dispose of their waste in them, which should then be emptied on an established schedule by entities from the next level of government (village, sub-district or district) depending on the city's waste management system. In areas where there is access suitable for a manual (human-drawn) waste carts to pass, collection systems are organized on a fee-for-service basis collected by the head of the RW or RT on a weekly or monthly cycle.

**However, despite these efforts, in all areas surveyed, a persistent lack of local leadership, monitoring systems and law enforcement to halt illegal dumping and burning was documented.** The role of local leaders in determining the neighborhood waste collection system is technically within the formal system. Decisions about household collection at the local level rely on leaders who are informed, attentive and reliable. Local residents noted that when neighborhood leaders have initiative and show commitment, residents are more compliant and reduce incidences of open dumping. Better quality service and systems require local champions.

**Overall, there is little or no consistent public information or campaigning about waste management in the tidal and non-tidal areas where hotspots were identified.** There are some efforts at signage in certain locations, however enforcement and efforts to clean up those sites are rare. At the wider city

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<sup>20</sup> BPS 2013, Survei Indikator Perilaku Peduli Lingkungan

<sup>21</sup> Detailed population data of the districts and sub-districts in the tidal zones surveyed are presented in the technical volume. However, these data serve as a general reference because population data for the sub-district represent the entire sub-district and not just the subset population resident in the hotspots survey areas.



level, there is limited effort at public awareness raising about waste management and the initiatives noted are restricted to placing banners forbidding open dumping and quoting regulations and fines. Lack of general awareness, and rules without enforcement are evident in all locations surveyed.

**In both tidal and non-tidal areas, there is limited awareness about recycling and the existence and purpose of waste banks.** Recycling and household separation of waste are not standard practice, although the survey did find a few instances where local residents salvaged valuable items from riverbeds and waterways to exchange for credit at waste banks or sell to collectors. Tidal zone as well as non-tidal zone residents do not separate their waste, due to a lack of information and awareness; a perception that separated waste will be mixed by garbage collectors; concerns that stockpiled items will attract pests; and the perception that the purchase price for recyclables is too low and therefore not worth the effort.

## 7.2 Community level attitudes and practices

The practice of waste disposal varies depending on the community situation, waste management system and the other factors including economics and education. Cultural values and customs often play a role in behavior relating to waste disposal. Some anecdotes from the surveys:

- Examples from Cumpat Settlement Areas in North Surabaya, for example, still throw their waste into the sea particularly, domestic and fish scales waste, because their garbage collectors only operate once every 4 days. According to some informants, DISPOSING their waste to the ocean is much more effective because the trash will be taken by the waves.
- In Jakarta, residents in dense and poor housing areas typically like to keep their immediate small area of space as clean as possible, sweeping frequently and keeping a clear path to their doorstep. However, there is not space in the narrow laneways of slum areas, so people are nevertheless living amongst the waste they try to sweep and tidy unless, or until, it is collected. It is often swept into a nearby drain or waterway to create a cleaner area in front of homes/doorways.
- Curbside recycling bins are provided in Margasari urban neighborhood, West Balikpapan but people still mixed their waste because the bins are too small and fill up quickly, i.e. before they are emptied. Furthermore, the community garbage collector always mixes the trash when emptying the bin, so the separation by residents is perceived as pointless.

### Box 6: Building Social Capital to Improve Waste Management

Opportunities related to improving waste management conditions in the tidal zones by building on social capital, include: expanding the success of existing community organizations active in waste management (e.g., Woman's Associations and NGOs in Semarang and Mataram) and nascent waste banks such as in Medan; strengthen existing organizations as entry points to improving community awareness and action; for example, Pagubuyan Warga Stren Kali in Surabaya and waste volunteers in Padang. Social capital opportunities also include: identifying and supporting local champions; increasing local awareness raising events; scaling up and replicating existing routines, such as: (i) the 'Friday Neighborhood Tours' in Mataram for waste monitoring, and (ii) the Makassar sub-district leaders compulsory recording of community aspirations and aligning these with targets and timeframes set by the Mayor. Additional opportunities include: expanding use of social media to support coordination and reporting (e.g., Pontianak and Makassar). Collaboration with Corporate Social Responsibility programs can also be scaled up and applied to the waste sector.

## 8 DISCUSSION AND RECOMMENDATIONS

The assessment has been an important first step in acquiring the evidence base for waste leakage and the connections between waste management and marine debris in key cities in Indonesia. Findings from this assessment can provide important inputs to national level programs in solid waste management, and the marine debris action plan.

Based on the findings of the assessment, near-term entry points to address Indonesia's marine debris challenge were identified and are presented in this section. The entry points identified are organized by national level policy and investment recommendations applicable across the board as well as city specific actions tailored to addressing conditions assessed during the field surveys and directed at complementing and strengthening each city's municipal solid waste management services.

### 8.1 Linkages to Related Government Programs

#### 8.1.1 Government Program for Improving Solid Waste Management:

The Government of Indonesia is currently preparing a national platform program for Improving Solid Waste Management to be implemented by the Ministry of Public Works with support from Ministry of Environment and Forestry, the Ministry of Home Affairs and Bappenas. Support to the cities of Indonesia would entail investment planning, system improvement, operational capacity building, financial management and investment support to achieve 100% collection service access and disposal and reduce waste volumes through more advanced technologies. It would also need the development of national innovative and inclusive models and methods for community based collection and improving waste reduction (3Rs / Waste Bank). Accompanying this would be the development of a suite of incentive and enforcement mechanisms for improving sector performance across local governments. Finally, it would require the development of policies and programs for waste-to-energy, recycling/composting, and land-based marine debris.

**Box 7: Complementary investments considered under the proposed World Bank loan  
IMPROVEMENT OF SOLID WASTE MANAGEMENT TO SUPPORT REGIONAL AND METROPOLITAN CITIES**

Under the proposed loan (\$100 million) being prepared, there are investments of more than \$ 1.0 billion to be leveraged that enable necessary improvements in solid waste, including activities targeting recycling and plastics leakage. The Project Development Objective (PDO) for this loan is to improve solid waste management services for urban populations in selected cities across Indonesia and the project will have a dedicated result indicator for reduction of waste leakages to waterways.

Strategic studies will focus on key impediments to enhancing the solid waste sector's overall performance. Identified studies for program implementation: (a) household waste reduction support (including 3Rs (reduce, reuse, recycle) and "Waste Bank" ; (b) mechanisms for incorporating the informal waste workers and wider communities in formal waste collection and recycling systems; (c) a roadmap for transitioning Dinas Kebersihan to BLUD institutions; (d) policy and legal frameworks for promoting waste-to-energy investments; (e) strategies for leveraging additional private and public financing for solid waste management; and (f) development of policy measures to reduce land-based marine pollution and prevent plastic waste from entering waterways and the ocean.

*The marine debris hotspot assessment serves to inform the types of policies and investments, as well as the city level needs for waterways infrastructure, improved waste management, and strategies and measures for behavior change.*

### 8.1.2 Government of Indonesia's Marine Debris Action Plan

In June 2017, Indonesia launched the National Action Plan on Marine Debris, which calls for efforts to control plastic waste leakage/marine debris and raise awareness of the issue. It notes that improving municipal solid waste in coastal areas could reduce plastics leakage to the ocean by as much as 80%, and prioritizes efforts to collect and safely dispose of solid waste, including through a National Solid Waste Management (NSWM) Program (see Box 7), financed primarily with national resources and complemented by World Bank funding.

The Marine Debris Action Plan is developed around four main pillars – which are briefly described below. For each pillar, the specific linkages from findings of the marine debris hotspot assessment, are provided.

#### Box 8: A European Strategy for Plastics in a Circular Economy

In December 2015, the Commission adopted an EU Action Plan for a circular economy. There, it identified plastics as a key priority and committed itself to 'prepare a strategy addressing the challenges posed by plastics throughout the value chain and taking into account their entire life-cycle'.

In 2017, the Commission confirmed it would focus on plastics production and use and work towards the goal of ensuring that all plastic packaging is recyclable by 2030. To move towards that vision, this strategy proposes an ambitious set of EU measures.

#### Improving the economics and quality of plastics recycling

*Design for recyclability*

*Boosting demand for recycled plastics*

*Better and more harmonised separate collection and sorting*

#### Curbing plastic waste and littering

*Preventing plastic wastes in our environment.*

*Establishing a clear regulatory framework for plastics with biodegradable properties*

*The rising problem of microplastics*

#### Driving innovation and investment towards circular solutions

#### Hamessing global action

**Reduce land-based waste leakage:** Specifically, work under this pillar would include support for preparation and roll-out of a Comprehensive National Marine Debris Management Strategy and Action Plan including design and implementation of a National Marine Debris Monitoring Framework and roll-out of a National Public Awareness and Household Behavioral Change Campaign.

*The marine hotspot assessment provides key information and data relating to the attitudes and public awareness in key hotspot locations for land-based leakages into rivers, canals and ultimately to the sea. These results can be used to help inform the proposed Campaign. In addition, the government's comprehensive program to improve solid waste management would also directly support this pillar. It will be important to closely align this Strategy and Action Plan with the National Solid Waste Sector Program and sector strategies prepared by MPWH and MoEF.*

**Reduce sea-based leakage of solid waste and other pollutants:** To address this aspect of waste leakage it is important to ensure necessary investments in the development of "green ports" and enforcement of the International Convention for the Prevention of Pollution from Ships 73/78 (MARPOL Convention) at all Indonesian ports. The aim with this work would be to reduce illegal discharge of waste from ships at sea and design an efficient ship waste handling system at each port. Additional efforts should be invested in working with the Ministry of Marine Affairs and Fisheries to address ghost nets and discarded fishing gear.

#### Box 9: Buyback Program for Fishing Gear and Marine Litter from Fishery Activities in Korea

South Korea's marine debris buyback program is an incentive program to encourage fishermen to bring to port entangled derelict fishing gear and other marine debris encountered while fishing. The program pays a small incentive fee for marine debris brought to port.

Since its start in 2003 by the Ministry of Maritime Affairs and Fisheries (now the Ministry of Land, Transport and Maritime Affairs) this program has been implemented in 51 local areas of 38 cities/towns within South Korea as of 2009.

*The marine hotspots assessment did not cover sea-based leakage of waste –which is estimated to be at least 20% of waste leaked into Indonesia’s marine environments. However, information from some of the cities surveyed pointed to waste management concerns in harbor areas, pointing to need for cleanup.*

**Reduce accumulated coastal and marine pollution:** Under this pillar, the Action Plan aims to reduce the adverse impacts of accumulated marine debris on human health, tourism, shipping, fisheries and coastal and marine ecosystems. Specific investments would include assessment and promotion of relevant and cost-effective technologies to remove and properly dispose of accumulated debris in coastal and marine areas as well as establish mechanisms to facilitate removal, and roll out education campaigns on impacts of marine debris on health and environment.

*The marine hotspots assessment provides evidence for the need to expand community led engagement for clean-up efforts to further promote community awareness and commitment to proper waste disposal. In addition, it also points to areas for future research into the human, environmental and economic costs of marine debris, such as an assessment of the impacts of anthropogenic debris in Indonesia’s seafood supply to inform public health risks and seafood safety advisories related to bioaccumulation of pollutants and hazardous chemicals.*

**Reduce plastics production and use:** The work under this pillar of the Action Plan places a primary focus on private sector engagement and responsibility in helping to address Indonesia’s marine debris challenge. Actions envisioned under this pillar include support for nationwide scale up of Indonesia’s plastic bags tax pilot to include bottles as well as plastics packaging and promotion of green procurement policies. Further actions recommended include roll-out of producer ‘cradle to cradle’ responsibility principles, scaling up and promotion of private sector-led plastics reduction action.

*The marine hotspots assessment details some good practice initiatives of waste management, including those in collaboration with the private sector and NGOs. Future research proposed further below points to the need for policies and investments relating to plastics reduction, and exploration of alternatives. The waste stream analysis would also help to identify specific products (such as types of single use plastics) to target as a first priority.*

## 8.2 Recommendations for Addressing Indonesia’s Plastic Waste

Drawing from the results from this rapid assessment, there are several recommendations for addressing the growing problem of plastic waste / marine litter in Indonesia. With 80 percent of leakage coming from land-based sources, many recommendations are systemic – and part of (or should be made part of) the overall solid waste management strategy (revolving around improved collection, recycling, source segregation, and final disposal options). This section includes some of systemic recommendations for inclusion or further emphasis in the integrated SWM agenda, but also narrows in on the marine litter/ plastics waste pollution which may not be fully covered yet by current waste sector strategies. In other cases, the recommendations relating to technology, upstream policies etc. are specific to addressing plastic waste.

### 1. REDUCE INSTITUTIONAL FRAGMENTATION

Due to the multi-sectoral and cross-cutting nature of the plastics waste agenda, there is a strong need for clear institutional responsibility. Importantly, the institutional framework for the government’s marine debris actions needs to be firmly embedded into the national solid waste management strategy and action plans. Evidence from this rapid assessment, points to several institutional strengthening measures at the city level on overall waste management. These include:

- **Strengthening city-level master planning** to include high leakage locations, including informal settlements. This would include the formation of inter-departmental teams for managing waste in an integrated and comprehensive manner. Since current waste strategies focus on urban areas, these may 'miss' more rural areas along waterways that are relatively high contributors to the ocean plastics problem.
- **Establish clear responsibilities for collection, disposal and maintenance of infrastructure.** Ensure public sanitation agencies and cleansing departments have sufficient capacity for waste collection and disposal (access to sanitary landfills). For plastic waste, this includes attention to responsibilities for maintaining trash racks in waterways, and developing addition waste banks, as examples.

#### **Box 10: A Responsible Management System to Address Land-based Litter from the Nakdong River basin**

Much of marine litter in South Korea comes from land-based sources through large rivers during the rainy season. Much of the damage from land-based litter is caused once the litter reaches the marine and coastal environments.

Several municipalities along the Nakdong River as well as ministries of the central government joined to solve this problem. They agreed to share the treatment cost of the debris at the mouth of the river. Studies were conducted on the input of debris by each municipality. Utilizing those results along with several other variables, the cost-sharing percentage was calculated for each municipal.

By May 2009, this type of responsible management system was applied to the five main rivers in South Korea. The Polluter- Pays- Principle was successfully applied through this system. Additionally, this system resulted in the voluntary control of land-based litter in the inland municipalities.

## **2. ADOPT UPSTREAM POLICES AND STRENGTHEN LEGISLATION**

There are numerous measures that can be taken in Indonesia to reduce the unnecessary generation of plastic waste, especially waste from single-use items or over-packaging, and to encourage the reuse of packaging. With anecdotal evidence from some cities and communities in Indonesia, there is potential for strengthening the scope and mandate of pollution legislation, and well as other related upstream policies on product design, and plastics packaging.

Given the results from the rapid assessment, there is a clear need at a national level to consider various fiscal and incentive mechanisms that may help to reduce the extend of marine debris and plastics pollution therein. These include policies such as Extended Producer Responsibility schemes -- an approach whereby consumer goods companies pay some or all of the costs for managing packaging materials. Additional options such as targeted deposit schemes can help reduce littering and boost recycling, and have already helped several countries achieve high collection rates for beverage containers.



## **3. IMPROVE THE METRICS FOR MEASUREMENT**

This rapid assessment has evidenced the complexities of developing metrics to monitor and estimate the magnitude and locations of the plastics wastes leakage. Rough estimates arrive at figures for between 500,000 and 1,000,000 ton/year for Indonesia, in line with estimates in international literature based on population figures and broad indicators (Jambeck). Development of metrics for assessment of waste and plastics leakages to waterways and the ocean remains an exercise that needs to improve its methodologies, strengthen its robustness, define standard parameters for plastic wastes against which to benchmark, and develop indicators to track progress.

Even while the government –at the city and national levels –works to improve the overall integrated solid waste management (collection, recycling, disposal), it is critical for the plastics waste fraction to be addressed through a phased strategy to reduce plastics, re-use and recycle, find alternatives, and innovate on post-use solutions.

#### 4. TARGET CITY LEVEL INVESTMENTS

The rapid assessment highlights the need to prioritize SWM in the parts of the cities where the leakage hotspots are located. Applying the same city tier system of the proposed Solid Waste Management loan to the marine litter problem, would help to identify the types and locations of critical investments. These might include the following actions.

- **Establish easily accessible waste collection points in all local communities and consider increasing collection frequency as needed.** Cooperate with local communities and NGOs to identify the best collection points and the design of the most effective collection mechanisms. Relocate TPS located near waterways to reduce waste leakage into the waterways, improve the design and functionality of TPS facilities to halt leakage and incorporate separation/recycling practices at TPS facilities.
- **Improve maintenance and operation of existing trash racks and traps in waterways.** The assessment found that most cities have some type of infrastructure placed in their main waterways to trap and halt waste leakage –including plastics –out to coastal areas. The assessment also found that even though some cities have such traps placed along their waterways, many are not fully functional or regularly maintained.

#### 5. CUSTOMISE THE TECHNOLOGY

Around the world, new technologies are unlocking new solutions for plastics pollution in areas such as material design, separation technology, reprocessing technology and renewably sourced and biodegradable plastics. These technologies are often customized to the types of plastics, its composition and level of additives, and the degree of contamination. In developing countries like Indonesia, high value plastics are often extracted from the waste stream by the large informal sector. Much of the remaining, low-value, plastic waste (e.g., single-use food service packaging, thin film convenience items, and sophisticated packaging designs that are difficult to disassemble) does not yet have sufficient value in local markets to justify its collection given current virgin material prices and the existing waste management infrastructure.



Recognizing the magnitude of its plastic pollution, Indonesia is working to pilot potential technological solutions and measures –ranging from encouraging manufacturers to maximize recycled plastics as input materials, to producing more biodegradable plastics from cassava, seaweed and palm oil, to experimenting with plastic tar roads, to waste to energy options. However, given the diversity of cities in terms of their waste, capacities, financing etc., it becomes imperative to customize the technological solutions to the city (and plastic waste) context.



## 6. EXPLORE INNOVATIVE FINANCING

At the system level, ensure budget allocations for proper collection; and then for maintenance and repair of equipment to ensure system optimization functions of waste catching and removal in waterways in target cities. This would help find solutions to ensure that (i) local fees or taxes that can cover solid waste collection or disposal; or ii) with adequate central or provincial government transfers.

- **Increase effort and financial allocation for collection facilities** TPS; repair broken racks and install barriers in waterways that do not have them, and institute a regulation for appropriate fee levels and regular fee collection to cover costs of improved and more frequent service.

- **Establish adequate financing and capacity for proactive surveillance and enforcement** of penalties for illegal disposal of waste. Working with local community groups and NGOs, establish a neighborhood watch system to dissuade illegal dumping and improper waste disposal. This action will function to improve enforcement of anti-littering regulations.

- **Explore opportunities for blended finance.** The role of private sector finance is critical in terms of technology, R&D, and innovation, as well as waste management solutions. Different types of funding models – which bring in private sector and public sector finance – can be used to inject funds at critical points in the waste supply chain to stimulate desired market behaviors and waste management results.

### Box 11: Singapore's Sustainable Packaging Agreement

In 2007, Singapore's National Environment Agency (NEA) launched the Singapore Packaging Agreement (SPA). The SPA is a joint initiative by government, private sector enterprises and CSOs to reduce packaging waste. The agreement is voluntary, so as to provide flexibility for the industry to adopt cost-effective solutions to reduce waste.

As of July 2016, 177 signatories had signed the agreement. Through the SPA, the NEA consulted more than 140 representatives from 100 organizations across the manufacturing, food and beverages, and other sectors. SPA signatories are invited to attend meetings, events and sharing sessions to learn about packaging best practices and find out how other companies have cut business costs by reducing packaging waste. Companies that make notable achievements in reducing packaging waste may also stand to receive one of the annual 3R Packaging Awards, and they have the opportunity to be profiled in the media for their packaging reduction initiatives.

## 7. STRENGTHEN EDUCATION, PUBLIC AWARENESS:

Strengthen communications and approaches to raise awareness, targeting hotspot areas and the wider population with differentiated strategies.

- **Roll out a series of national and local public awareness campaigns** to improve understanding and secure engagement of local government, NGOs, community leaders, residents and local businesses and schools to improve proper waste disposal practices. Engage local NGOs to support development and promotion of such campaigns.
- **Roll out school programs on proper waste management practices at primary and secondary schools.** As part of public awareness campaigns, develop structured learning programs for students on good waste disposal practices. Incorporate good behavior and attitudes toward waste and recycling at the grass roots community level.

- **Introduce regular community-led voluntary clean up campaigns** at local beaches, river banks and mangrove forests to reduce accumulated waste gathering in these areas. This will not only reduce waste leakage to the sea but also work in tandem with the public awareness campaigns and reinforce the school programs on proper waste management. Community-level initiatives to protect and conserve the environment, existing in some cities, can be supported by the government.
- **Broaden the dissemination of local regulations on waste management** (beyond warning signs and banners throughout the city area); imposition of penal sanctions also started, but indifference and lack of care also underlies the ineffectiveness of the regulation.

#### **Box 12: Campaigns that Teach: Diving deeper into marine debris education**

In response to a mandate from the Marine Debris Research, Prevention and Reduction Act of 2006, the National Oceanic and Atmospheric Administration (NOAA) Marine Debris Program (MDP) has worked with its partners to create a Web- based educational campaign for marine debris awareness and prevention.

This campaign includes resources designed specifically for several target audiences, including boaters/mariners, students/educators, beachgoers, fishers as well as the public. Each product provides information on the impacts of marine debris and suggestions on how to become part of the solution.

### **8.3 Informing the Marine Plastic Debris Management Roadmap**

Findings of this assessment as well as inputs received during key national and global knowledge events<sup>22</sup> help to provide inputs to the government roadmap for marine plastics debris management. This would include critical analytical work, policy dialogue, communications strategy design and blue print, financing plan, and supporting pilot city plans for marine debris reduction. The activities articulated in this draft five-year road-map will be addressed through various measures, including support from the World Bank SWM project being prepared, as well as the financing through the Indonesia Oceans, Marine Debris and Coastal MDTF.

#### **8.3.1 Systemic Support through the Solid Waste Management Project**

This project will support 30 or more cities to improve waste management services and introduce integrated (full) systems which integrate waste collection at the community level and city run system for waste transport, treatment and disposal. Much emphasis is put on strengthening management capacity to run and sustainable finance waste management operations. It is expected that these cities with currently an average collection rate of 70% will improve collection to 90% and more, thus reducing land-based leakages to waterways. To stimulate special attention to reducing these leakages, a results indicator has been included for this purpose. An interesting impact of this will be that waste accounting systems and special metrics will be developed under the project to monitor waste management performance across the waste chain from household level waste generation and recycling through central treatment and disposal, including waste leakages (reduction) to waterways.

The project puts much emphasis on improvements in primary waste collection at household level, involving communities both in waste collection but also waste recycling and outreach to reduce and ultimately eliminate waste leakages.

<sup>22</sup> E.g. National Marine Debris Workshop in Makassar in May 2016, National Marine Debris Summit in Jakarta in November 2016, World Ocean summit in Bali in February 2017 and UN Oceans Conference in New York in June 2017

### 8.3.2 Targeted Support through the Indonesia Oceans, Marine Debris and Coastal MDTF

Under the MDTF, component 2 on marine debris will finance analytical and pilot investment support – aligned specifically to support and strengthen the implementation of the National Action Plan on Marine Debris, and aimed at reducing plastic debris in Indonesia’s coastal areas, managing plastic in the sea, and increasing research and innovation in handling of marine debris. Under the draft work plan are the following activities:

#### Research, Analytical Studies

- **Replicate and Expand Rapid Hotspots Assessments:** The specificity afforded by the assessment is evident in the city specific insights and overall broader lessons it provides. The findings allow for development of a comprehensive national response with local granularity. Replicating the assessment in coastal cities, especially in Eastern Indonesia, would help create a national baseline of waste leakage to coastal environments, and an accompanying national monitoring framework to track progress on national and local scale.
- **Mainstream and Deepen Hotspots Assessments:** Develop a follow up study designed to assess seasonal and annual fluctuations in waste leakage from waterways to coastal areas. Design robust protocols and modelling to estimate volume of waste leakage; and to measure/monitor marine debris on coastal shores and document origin. Undertake deep-dive assessments into solutions to reduce waste leakage for specific river segment.
- **Assess Plastics Content in Seafood Supply Chain:** Expand initial research on plastics content in domestic fish supply. Indonesia targets increased fish consumption as the major source of protein; understanding the extent of plastics contamination in domestically consumed seafood is critical for this strategy, as well as for wider seafood safety compliance.
- **Accumulated Waste Clean Up Technologies:** Conduct research on the costs and benefits of different coastal and marine waste clean-up technologies to determine the most appropriate for Indonesia and in specific cities/coastal areas depending on waste volume, costs and viability (operation, maintenance, transport, associated equipment and infrastructure needs).

**Communications/ Behavior change:** Design and test the implementation of awareness, communications and behavior change campaigns for primary waste collection and recycling in priority cities (“champion cities” to combat local marine debris). Work with local communities to customize campaigns at the local level.

**Policies, Regulations, Incentive Mechanisms:** Activities to inform national level policies, incentive mechanisms, and regulations to halt waste leakage into rivers and the ocean. Analysis of potential for taxes on plastic bags/ plastics packaging; ban on select single-use plastics; enhanced research on biodegradable alternatives; deposit systems for plastic bottles and containers; and regulations on producer responsibility for product packaging.

**Technical Assistance, Pilots, Investments:** Using the tier system for cities proposed under the Bank-financed SWM project, identify areas for technical assistance to support city-level planning for marine debris reduction, including conceptual development, data bases, strategies, monitoring and evaluation; developing a model that can be replicated. With information from the technology and cost-effectiveness studies, provide inputs to feasibility studies for customized pilots and investments.

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