



# CLEAN CITIES, BLUE OCEAN

## Initial Solid Waste Management Assessment (ISWMA) | Indonesia



Submission Date: February 4, 2021

Resubmission Date: May 14, 2021

This assessment was produced for review by the United States Agency for International Development by Tetra Tech under the Clean Cities, Blue Ocean program.

This report was prepared by:



Virginia Becerra  
Project Manager  
Solid Waste Management Division  
Direct Line: 909.655.3284 Email: [Virginia.Becerra@tetrattech.com](mailto:Virginia.Becerra@tetrattech.com)

Bryan A. Stirrat, PE  
Managing Director Solid Waste Practice Group  
Direct Line: 951.235.9400  
Email: [Bryan.Stirrat@tetrattech.com](mailto:Bryan.Stirrat@tetrattech.com)

Tetra Tech Contacts:  
Jon Angin, Chief of Party  
Email: [Jon.Angin@cleancitiesblueocean.org](mailto:Jon.Angin@cleancitiesblueocean.org)

Gina Green, Project Manager  
Email: [Gina.Green@tetrattech.com](mailto:Gina.Green@tetrattech.com)

This assessment was produced for review by the United States Agency for International Development by Tetra Tech, through USAID Contract No. AID-OAA-I-14-00059/7200AA19F00016, USAID Clean Cities, Blue Ocean Program.

## **DISCLAIMER**

This publication is made possible by the support of the American people through the United States Agency for International Development (USAID). The contents of this publication are the sole responsibility of Tetra Tech and do not necessarily reflect the views of USAID or the United States Government.

# Table of Contents

- Table of Contents**..... I
- List of Figures and Tables**..... I
- Acronyms and Abbreviations**.....4
- Executive Summary** .....5
- Ringkasan Eksekutif**.....8
- 1. Introduction**..... 12
- 2. Current Status of Solid Waste Management in Indonesia**..... 13
  - 2.1 Indonesia’s National Laws and Regulations Impacting 3Rs and SWM..... 14
  - 2.2 Solid Waste Management Systems and Capacities in Indonesia..... 18
- 3. Current Status of 3R/SWM in CCBO Engagement Sites**..... 24
  - 3.1 ISWMA Summary .....24
  - 3.2 Kota Ambon .....28
  - 3.3 Kota Semarang.....37
  - 3.4 Kota Makassar .....53
- 4. Gender**..... 64
- 5. Additional Information/Data Required**..... 66
- 6. Recommendations and Next Steps**..... 67
- 7. Bibliography**..... 70
- 8. Glossary of Terms**..... 77

# List of Figures and Tables

- Figure 1. CCBO Engagement Site Map..... 13
- Figure 2. Wide Range of the Percentage of Waste Reported to be Transferred or Treated ..... 14
- Figure 3. Municipal solid waste (MSW) Composition (%) in Indonesia (2017)..... 18
- Figure 4. Estimated total plastic waste generation across Indonesia’s cities and regencies..... 19
- Figure 5. Percentage of total plastic waste generated in donesia and how its handled ..... 20
- Figure 6. Paths of waste recycling in Indonesia..... 22
- Figure 7. Open Dumping Percentages in Indonesia..... 23
- Figure 8. Map of Kota Ambon and Solid Waste Management..... 28
- Figure 9. Waste Generation per day (m<sup>3</sup>) in Ambon..... 30

Figure 10. Waste Composition in Kota Ambon .....	30
Figure 11. Kota Ambon cleaning officers collecting trash in Ambon Bay .....	32
Figure 12. PET bottle grades and buying prices (per kg.) in Jakarta and Ambon.....	33
Figure 13. Flow of Waste Processing in Kota Ambon.....	33
Figure 14. Junk Shop in Talake, Ambon.....	34
Figure 15. Site Map of TPA/IPST .....	34
Figure 16. Floating Parks created in Ambon by RIF.....	35
Figure 17. Trash Hero Ambon Clean Up.....	36
Figure 18. Map of Kota Semarang and Waste Management Operations .....	37
Figure 19. Organizational Structure of the DLH in Kota Semarang.....	38
Figure 20. Breakdown of Types of Waste Generated in Kota Semarang.....	42
Figure 21. Existing Waste Management System in Kota Semarang .....	43
Figure 22. Waste Tonnages in Kota Semarang.....	45
Figure 23. Local Informal Waste Collectors and Cattle in TPA Jatibarang .....	46
Figure 24. Map of Waste Bank Distribution in Kota Semarang.....	46
Figure 25. Breakdown (by %) of the types of recyclables in the waste stream .....	47
Figure 26. TPS 3R Dadi Resik .....	48
Figure 27. Recyclables and Windrow Composting at TPST Mijen .....	49
Figure 28. TPST Purwosari.....	49
Figure 29. Pemensanan Cakar Ayam (Junk Shop) .....	50
Figure 30. Aerial View of the Jatibarang Landfill.....	51
Figure 31. Site Map of Jatibarang Landfill DANIDA project.....	51
Figure 32. Map of Kota Makassar and Waste Management Facilities.....	54
Figure 33. Kota Makassar City Waste Generated.....	55
Figure 34. Flow chart of Makassar’s existing solid waste management system .....	57
Figure 35. Bank Sampah Pusat Kota Kota Makassar.....	58
Figure 36. Flow of Waste through Kota Makassar’s 3R/SWM System.....	59
Figure 37. Entrance to UD Sejahtera Jaya Mandiri .....	60
Figure 38. UD. Gassing Logam .....	61
Figure 41. UPTD TPA Tamangapa Raya.....	61
Figure 40. Aerial view and map of TPA Tamangapa Raya .....	62

Table 1. Indonesia’s Sub-National Levels of Government .....	14
Table 2. Types of Waste Management Facilities in Indonesia .....	15
Table 3. Baseline Waste Generation Estimates Across CCBO Engagement Sites .....	24
Table 4. Existing Operations/Facilities at CCBO Engagement Sites .....	25
Table 5. Solid Waste Management Efforts in Indonesia .....	27
Table 6. Types of Government SWM Equipment in Kota Ambon (2017).....	31
Table 7. Waste Collection Figures in Kota Ambon .....	32
Table 8. Waste Sources and Generation 2017-2018.....	42
Table 9. Organic Waste Source and Quantities.....	42
Table 10. Waste Management Equipment in Semarang.....	44
Table 11. Waste Treatment in Semarang City .....	49
Table 12. Waste Generators and Transported Waste in Kota Makassar City .....	55
Table 13. Solid Waste Composition in Kota Makassar City .....	56
Table 14. Equipment for Transportation of Waste in Kota Makassar .....	58

## Acronyms and Abbreviations

3Rs	Reuse, Reduce, and Recycle
APIK	Adaptasi Perubahan Iklim dan Ketangguhan – [USAID] Climate Change Adaptation and Resilience
ASEAN	Association of South East Asian Nations
CCBO	[USAID] Clean Cities, Blue Ocean
BUMD	Business enterprise owned by regional government/authorities
DANIDA	Danish International Development Agency
DLH	Dinas Lingkungan Hidup/Environmental Agency
IDR	Indonesian Rupiah (currency)
IPST	Integrated Waste Processing Site
ISWMA	Initial Solid Waste Management Assessment
JICA	Japan International Cooperation Agency
MoEF	Ministry of Environment and Forestry
MSW	Municipal Solid Waste
NGOs	Non-Governmental Organizations
UD	Usaha Dagang (Indonesian Trading Company)
UPTD	Unit Pelaksana Teknis Daerah/Regional Technical Implementation Unit
RDF	Refuse-derived Fuel
RIF	Recycled Island Foundation
RPJMD	Rencana Pembangunan Jangka Menengah Daerah (Regional Medium-term Development Plan - budget document for Mayor's 5-year term)
RT/RW	Rukun Tetangga/Rukun Warga (Neighborhood Associations/Community Groups)
SIPSN	Sistem Informasi Pengelolaan Sampah (National Solid Waste Management Information System)
SSK	Strategi Sanitasi Kota
SWM	Solid Waste Management
SWMP	Solid Waste Management Plans (Master Plan)
TPA	Tempat Pembuangan Akhir (Final Disposal Site)
TPD	Tons per day
TPS	Tempat Pembuangan Sementara/Temporary Disposal Sites
TPS 3R	Tempat Pembuangan Sementara 3R/Waste Treatment Facility applying Reduce, Reuse and Recycle concept
TPST/IPST	Tempat Pengolahan Sempah Terpadu (Integrated Waste Processing Site)
TPY	Tons per year
WWF	World Wildlife Fund

## Executive Summary

On August 28, 2019, Tetra Tech was awarded the Clean Cities, Blue Ocean (CCBO) Program, a five-year contract from the U.S. Agency for International Development (USAID) Bureau of Economic Growth, Education, and Environment. CCBO is the Agency's flagship program to respond to the global crisis of marine plastic pollution. The objectives of CCBO are to:

- Objective 1:** Promote reduce, reuse, recycle (3Rs) and strengthen local and regional markets for recycled plastics
- Objective 2:** Build social and behavior change (SBC) for 3Rs and sustainable solid waste management (SWM)
- Objective 3:** Increase capacity and effective governance of SWM and 3Rs systems; and
- Objective 4:** Support international fora, public-private partnerships, and multi-stakeholder alliances.

As a cross-cutting objective, CCBO also works to support and enhance the livelihoods of those working in the waste and recycling sectors, particularly women, as well as advance gender equality within the sector and opportunities for women's economic empowerment.

The following presents CCBO's Initial Solid Waste Management Assessment (ISWMA) for the program's three "engagement sites" in the Republic of Indonesia: Kota Ambon, Kota Semarang, and Kota Makassar.

The ISWMA is one of CCBO's first steps in its launch of in-field implementation and will support its engagement sites to create improvements that will lead to sustainable, integrated waste management systems that will help restore the region's natural environment, advance urban planning and management, and improve public health. The ISWMA's main objectives are to:

- Identify the existing components of the SWM systems in each of the engagement sites;
- Assess and determine those areas that are expected to need improvements;
- Identify additional information that is needed to support implementation for improved systems; and
- Provide recommendations that will ultimately inform the program's Year One and subsequent Works Plans.

Due to the coronavirus pandemic and resulting international travel restrictions, CCBO has developed this report through extensive desk research, using the websites of multiple governmental agencies (state, provincial, and city), institutions, non-governmental organizations (NGOs), news media, Google Earth, and other relevant websites. A full list of sources is included in Section 7. When international travel resumes and local lockdowns are lifted, CCBO plans to update and validate data and findings, as needed, to ensure accuracy and obtain the support and validation from its local partners. It should be noted, that because reported data could not be verified directly by the CCBO team, when data from different sources (including governmental agencies) appeared to contradict each other or were, in our experience, likely inaccurate, it is stated as such in the document.

As the world's largest island nation, Indonesia faces unique waste management challenges. The country has decentralized populations, steady population growth, and limited established governmental and structural frameworks to enable their waste management systems to keep pace with current trends and reduce generation of ocean-bound plastics.

The 3R/SWM systems in all three engagement sites are developing. Planning is the key to maintaining any momentum. There are multiple ministries associated with waste management in Indonesia under Waste Management Act No. 18/2008; however, enforcement of regulations within the local governments is largely absent. This is due to a lack of sufficient funding and high recurrent expenditures associated with collection and landfill maintenance. Unfortunately, this ISWMA was not able to find evidence of written solid waste planning documents with the exception of Kota Semarang where there was a reference to a Solid Waste Management Plan prepared by COWI (an international consulting group); however, a copy of the document could not be found. There was, however, evidence of planning in the form of assistance by many foreign NGOs. This is particularly apparent in Kota Semarang and Kota Makassar.

Improving universal collection and management of waste will be the foundation of reducing plastics from leakage and ocean pollution in the future. The promising news is that, in all three engagement sites, there appears to be some form of formal collection for waste. The three engagement sites utilize the TPS/TPA (transfer/recycle/disposal) system as seen in other Indonesian cities. Responsibilities for certain stages of waste service provision are as follows:

- Collection and transport of household waste to Temporary Disposal Sites (TPS) is the responsibility of the RT/RW (neighborhood associations/community groups).
- Transport of waste from the TPS to the landfill (TPA) is the responsibility of the local government.
- Collection and transport of estate waste from source to the TPS/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 the local government.

Unfortunately, the level of service is not consistent even in the larger engagement sites (i.e., Kota Semarang and Kota Makassar), resulting in large amounts of illegal disposal/dumping practiced in the cities, including open burning, dumping into the rivers, and burying in backyards.

While not entirely informal, waste banks, or Bank Sampahs, are a more informal alternative method for managing waste that can be recycled in Indonesia. A reported 5,000 waste banks exist across the country and allow community members a location to deposit their recyclable waste where people get to “bank” the value of the waste they deliver. The deposited materials are then sold to scrap dealers for recycling. The Indonesian government has reportedly endorsed the waste bank concept as “currently the best way of dealing with waste across the country.” All three engagement sites utilize waste banks.

Through the development of this report, CCBO has gathered significant baseline information and will build upon this knowledge as this program progresses. From this research and consultations, CCBO has developed the following recommendations for consideration in CCBO’s implementation:

- Continue to research and better understand the existing 3R/SWM systems in the engagement sites.
- Work within the communities to develop a network of government officials, civic society, citizens, workers, NGOs, private sector, and other entities that have been involved in the current systems and help improve them.
- Work with these stakeholders to increase their capacity to develop sound 3R/SWM systems.

- Learn more about the funding for the 3R/SWM systems and work with stakeholders to consider additional or alternative revenue generation and financing options to support improvements to their systems.
- Seek ways in which to expand and develop the markets for plastics (those that are currently valuable and those that are not) and bio-degradable materials.
- Support communities to develop and improve the services needed to create efficient collection, aggregation, and transport of materials as part of a sound 3R/SWM system.
- Support the communities in updating and revising their master plans to improve their 3R/SWM systems.
- Engage stakeholders and the private sector to seek mutually beneficial means of building the infrastructure needed in improved 3R/SWM systems (MRFs, compost facilities, anaerobic digestors, waste to energy (WTE) systems, sanitary landfills, or other appropriate technologies.)
- Learn more about existing social behavior of Indonesians within the 3R/SWM systems, what they are able to and desire to do to increase 3R practices (such as material separation at the source), and seek appropriate ways to create awareness (if this is what is needed).
- Evaluate the potential use of the residual waste materials (not economically recyclable) to produce Refuse Derived Fuels (RDF) for cement kilns and other WTE systems.
- Determine how environmentally secure the TPAs (landfills) are in each engagement site and make recommendations for improvements as applicable for each TPA.
- Consider conducting operations research, if possible in collaboration with other donors, to learn the effectiveness of waste banks, the circumstances under which waste banks are maximally effective, those conditions that inhibit optimal functioning of waste banks and, for each engagement area, who utilizes waste banks and why, similarly identify populations that do not patronize the waste banks and their reasons.
- Conduct a gender analysis of women and youth regarding SWM and 3Rs in the engagement sites and work with women's organizations and government to include women and youth's interests and perspectives as part of the 3R/SWM planning process.
- Review existing laws, policies and regulations pertaining to 3R/SWM systems and support additions or revisions that would support the 3R/SWM planning and implementation process.

## Ringkasan Eksekutif

Pada 28 Agustus 2019, Tetra Tech dianugerahi Program Clean Cities, Blue Ocean (CCBO). CCBO adalah program dengan kontrak lima tahun dari Biro Pertumbuhan Ekonomi, Pendidikan, dan Lingkungan, Badan Pembangunan Internasional AS (USAID). CCBO adalah program unggulan Badan ini untuk menanggapi krisis global pencemaran plastik di laut. Tujuan dari CCBO adalah untuk:

**Tujuan 1:** Mempromosikan pengurangan, penggunaan kembali, daur ulang (3R) dan memperkuat pasar lokal dan regional untuk plastik daur ulang

**Tujuan 2:** Membangun perubahan sosial dan perilaku (SBC) untuk 3R dan pengelolaan sampah (SWM) yang berkelanjutan

**Tujuan 3:** Meningkatkan kapasitas dan tata kelola SWM dan sistem 3R yang efektif; dan

**Tujuan 4:** Mendukung forum internasional, kemitraan publik-swasta, dan aliansi multi-stakeholder.

Sebagai tujuan lintas sektoral, CCBO juga bekerja untuk mendukung dan meningkatkan kehidupan para pekerja sektor limbah dan daur ulang, khususnya perempuan, serta memajukan kesetaraan gender dalam sektor tersebut, dan peluang untuk pemberdayaan ekonomi perempuan.

Dokumen ini menyajikan Kajian Awal Pengelolaan Sampah/ *Initial Solid Waste Management Assessment* (ISWMA) CCBO untuk tiga kota di Indonesia: Kota Ambon, Kota Semarang, dan Kota Makassar.

ISWMA adalah salah satu langkah awal CCBO dalam memulai penerapan di lapangan dan akan mendukung kota-kota tersebut untuk menciptakan perbaikan yang akan mengarah pada sistem pengelolaan sampah yang terpadu dan berkelanjutan yang akan membantu memulihkan lingkungan alam kawasan, memajukan perencanaan dan pengelolaan kota, serta memperbaiki kesehatan masyarakat. Tujuan utama ISWMA adalah untuk:

- Mengidentifikasi komponen sistem pengelolaan sampah yang sudah ada di setiap kota dampingan;
- Menilai dan menentukan bidang-bidang yang diperkirakan akan memerlukan perbaikan;
- Mengidentifikasi informasi tambahan yang diperlukan untuk mendukung penerapan sistem yang lebih baik; dan
- Memberikan saran yang pada akhirnya akan menginformasikan program Tahun Pertama dan Rencana Kerja berikutnya.

Karena pandemi virus corona dan pembatasan perjalanan internasional yang diakibatkannya, CCBO telah mengembangkan laporan ini melalui penelitian pustaka yang menyeluruh, menggunakan situs web berbagai lembaga pemerintah (nasional, provinsi, dan kota), badan-badan, lembaga swadaya masyarakat (LSM), media berita, Google Earth, dan situs web lain yang terkait. Daftar lengkap sumber disertakan dalam Bab 7. Saat perjalanan internasional sudah diperbolehkan dan pembatasan perjalanan dicabut, CCBO berencana untuk memperbarui dan memeriksa kebenaran data dan temuan, sesuai kebutuhan, untuk memastikan keakuratan dan mendapatkan dukungan dan pembenaran dari mitra lokalnya. Perlu dicatat, bahwa karena data yang dilaporkan tidak dapat diperiksa secara langsung oleh tim CCBO, ketika data dari sumber yang berbeda (termasuk lembaga pemerintah) tampak saling bertentangan atau, menurut pengalaman kami, kemungkinan tidak akurat, maka dinyatakan seperti itu dalam dokumen-dokumen yang kami gunakan sebagai sumber dalam kajian ini.

Sebagai negara kepulauan terbesar di dunia, Indonesia menghadapi tantangan pengelolaan sampah yang unik. Negara ini menghadapi populasi yang terdesentralisasi, pertumbuhan populasi yang stabil, dan kerangka kerja pemerintah dan struktural yang terbatas untuk memungkinkan sistem pengelolaan limbah mereka mengikuti tren saat ini dan mengurangi produksi plastik yang terikat di lautan.

Di ketiga kota dampingan CCBO, saat ini sistem 3R/SWM nya sedang berkembang. Perencanaan adalah kunci untuk mempertahankan perkembangan ini. Ada beberapa kementerian yang terkait dengan pengelolaan sampah di Indonesia berdasarkan Undang-Undang Pengelolaan Sampah No. 18/2008; namun, penegakan peraturan di dalam pemerintah daerah sangat kurang. Hal ini disebabkan kurangnya dana yang cukup dan pengeluaran berulang yang tinggi terkait dengan pengumpulan dan pemeliharaan TPA. Sayangnya, ISWMA ini tidak dapat menemukan bukti tertulis dokumen perencanaan persampahan kecuali Kota Semarang yang memiliki referensi Rencana Pengelolaan Sampah yang disusun oleh COWI (sebuah kelompok konsultan internasional); namun, salinan dokumen tidak dapat ditemukan. Namun, ada bukti perencanaan dalam bentuk bantuan oleh banyak LSM asing. Hal ini terutama terlihat di Kota Semarang dan Kota Makassar.

Meningkatkan pengumpulan dan pengelolaan sampah secara universal akan menjadi dasar untuk mengurangi kebocoran sampah plastik dan pencemaran laut di masa depan. Berdasarkan berita yang beredar, di ketiga kota dampingan, nampak adanya pengumpulan sampah secara resmi. Ketiga lokasi keterlibatan menggunakan sistem TPS/TPA (transfer/daur ulang/pembuangan) seperti yang terlihat di kota-kota lain di Indonesia. Tanggung jawab untuk tahapan tertentu dalam penyediaan layanan persampahan adalah sebagai berikut:

- Pengumpulan dan pengangkutan sampah rumah tangga ke Tempat Pembuangan Sementara (TPS) menjadi tanggung jawab RT/RW.
- Pengangkutan sampah dari TPS ke Tempat Pembuangan Akhir (TPA) menjadi tanggung jawab pemerintah daerah
- Pengumpulan dan pengangkutan sampah perkebunan dari sumbernya ke TPS/TPA, menjadi tanggung jawab pengelola perkebunan (perumahan, komersial, atau industri).
- Pengumpulan dan pengangkutan sampah dari sarana umum dan social adalah tanggung jawab pemerintah daerah

Sayangnya, tingkat layanan tidak konsisten bahkan di lokasi yang lebih besar (yaitu, Kota Semarang dan Kota Makassar) yang mengakibatkan sejumlah besar praktik pembuangan/pembuangan ilegal di kota-kota, termasuk pembakaran terbuka, pembuangan ke sungai, dan penguburan di tanah.

Meskipun tidak sepenuhnya resmi, Bank Sampah, adalah metode alternatif untuk mengelola sampah daur ulang di Indonesia. Ada sekitar 5.000 bank sampah di Indonesia, dan memungkinkan anggota masyarakat untuk menyetorkan sampah daur ulang mereka, sehingga dapat “menyimpan” nilai sampah daur ulang yang mereka kirim. Bahan yang dikumpulkan kemudian dijual ke lapak barang bekas untuk didaur ulang. Pemerintah Indonesia dilaporkan telah mendukung konsep bank sampah sebagai “cara terbaik saat ini untuk menangani sampah di Indonesia”. Ketiga kota dampingan juga telah menerapkan bank sampah.

CCBO telah belajar banyak melalui pengkajian secara daring dan akan membangun pengetahuan ini seiring dengan kemajuan program ini. Namun demikian, ada beberapa langkah yang menurut tim kami harus segera

dilakukan dan merekomendasikan hal-hal berikut untuk dipertimbangkan dalam fase awal program CCBO di Indonesia.

Rekomendasi:

- Melanjutkan penelitian dan lebih memahami sistem 3R/SWM yang ada di kota dampingan.
- Bekerja dalam komunitas untuk mengembangkan jaringan pejabat pemerintah, masyarakat sipil, warga negara, pekerja, LSM, sektor swasta, dan entitas lain yang telah terlibat dalam sistem saat ini dan dapat membantu meningkatkannya.
- Bekerja dengan para pemangku kepentingan terkait untuk meningkatkan kapasitas mereka dalam mengembangkan sistem 3R/SWM yang baik.
- Pelajari lebih lanjut tentang pendanaan untuk sistem 3R/SWM dan bekerja dengan pemangku kepentingan untuk mempertimbangkan tambahan atau alternatif pendapatan dan opsi pembiayaan untuk mendukung perbaikan sistem mereka.
- Mencari cara untuk memperluas dan mengembangkan pasar sampah plastik (baik yang memiliki nilai maupun yang tidak) dan bahan yang dapat terurai secara alami.
- Mendukung masyarakat untuk mengembangkan dan meningkatkan layanan yang diperlukan untuk menciptakan pengumpulan, pengepulan, dan pengangkutan material yang efisien sebagai bagian dari sistem 3R/SWM yang baik.
- Mendukung masyarakat dalam memperbarui dan memperbaiki rencana induk mereka untuk meningkatkan sistem 3R/SWM mereka.
- Melibatkan pemangku kepentingan dan sektor swasta untuk mencari cara yang saling menguntungkan dalam membangun infrastruktur yang dibutuhkan dalam sistem 3R dan pengelolaan sampah yang lebih baik (MRF, Komposting, Anaerobic Digestors, WTE, Sanitary Landfill atau teknologi lain yang sesuai.)
- Pelajari lebih lanjut tentang perilaku sosial masyarakat Indonesia yang ada dalam sistem 3R dan pengelolaan sampah, apa yang mereka mampu dan ingin lakukan untuk meningkatkan praktik 3R (seperti pemisahan materi pada sumbernya), dan mencari cara yang tepat untuk menciptakan kesadaran (jika memang demikian apa yang dibutuhkan).
- Mengevaluasi potensi penggunaan bahan sampah sisa (yang tidak dapat didaur ulang secara ekonomis) untuk menghasilkan *Refuse Derived Fuels* (RDF) untuk kiln semen dan sistem *waste to energy* (WTE) lainnya.
- Menentukan seberapa aman lingkungan TPA (Tempat Pembuangan Akhir) di setiap kota dampingan dan membuat rekomendasi untuk perbaikan yang berlaku untuk setiap TPA.
- Melakukan riset operasi, jika mungkin bekerja sama dengan donor lain, untuk mempelajari keefektifan bank sampah, keadaan di mana bank sampah efektif secara maksimal, kondisi yang menghambat fungsi optimal bank sampah dan, untuk setiap area keterlibatan, siapa yang memanfaatkan bank sampah dan alasannya, sama-sama mengidentifikasi populasi yang tidak mengkurui bank sampah dan alasannya.

- Melakukan analisis gender terhadap perempuan dan pemuda mengenai pengelolaan sampah dan 3R di kota dampingan dan bekerja dengan organisasi perempuan dan pemerintah untuk melibatkan kepentingan dan perspektif perempuan dan pemuda sebagai bagian dari proses perencanaan 3R/SWM.
- Meninjau undang-undang, kebijakan, dan peraturan yang ada terkait dengan sistem 3R dan pengelolaan sampah, serta mendukung penambahan atau revisi yang akan mendukung proses perencanaan dan implementasi 3R dan pengelolaan sampah.

# I. Introduction

On August 28, 2019, Tetra Tech was awarded the Clean Cities, Blue Ocean (CCBO) Program, a five-year contract from the U.S. Agency for International Development (USAID) Bureau of Economic Growth, Education, and Environment. CCBO is the Agency's flagship program to respond to the global crisis of marine plastic pollution. The objectives of CCBO are to:

- Objective 1:** Promote reduce, reuse, recycle (3Rs) and strengthen local and regional markets for recycled plastics
- Objective 2:** Build social and behavior change (SBC) for 3Rs and sustainable solid waste management (SWM)
- Objective 3:** Increase capacity and effective governance of SWM and 3Rs systems; and
- Objective 4:** Support international fora, public-private partnerships, and multi-stakeholder alliances.

As a cross-cutting objective, CCBO also works to support and enhance the livelihoods of those working in the waste and recycling sectors, particularly women, as well as advance gender equality within the sector and opportunities for women's economic empowerment.

The following presents CCBO's Initial Solid Waste Management Assessment (ISWMA) for the program's three "engagement sites" in the Republic of Indonesia: Kota Ambon, Kota Semarang, and Kota Makassar.

The ISWMA is one of CCBO's first steps in its launch of in-field implementation and will support its engagement sites to create improvements that will lead to sustainable, integrated waste management systems that will help restore the region's natural environment, advance urban planning and management, and improve public health. The ISWMA's main objectives are to:

- Identify the existing components of the SWM systems in each of the engagement sites;
- Assess and determine those areas that are expected to need improvements;
- Identify additional information that is needed to support implementation for improved systems; and
- Provide recommendations that will ultimately inform the program's Year One and subsequent Works Plans.

Due to the coronavirus pandemic and resulting international travel restrictions, CCBO has developed this report through extensive desk research, using the websites of multiple governmental agencies (state, provincial, and city), institutions, non-governmental organizations (NGOs), news media, Google Earth, and other relevant websites. A full list of sources is included in Section 7. When international travel resumes and local lockdowns are lifted, CCBO plans to update and validate data and findings, as needed, to ensure accuracy and obtain the support and validation from its local partners. It should be noted, that because reported data could not be verified directly by the CCBO team, when data from different sources (including governmental agencies) appeared to contradict each other or were, in our experience, likely inaccurate, it is stated as such in the document.

As the world's largest island nation, Indonesia faces unique waste management challenges. The country faces decentralized populations, steady population growth, and limited governmental and structural frameworks to enable their waste management systems to keep pace with current trends and reduce generation of ocean-bound plastics.

## 2. Current Status of Solid Waste Management in Indonesia

To reduce its environmental leakage and create healthier cities and seas, Indonesia is committed to establishing more robust waste systems. This includes improving collection, waste segregation for recycling, and establishing environmentally sound disposal systems. Achieving this will require strengthened local government capacities and resources, enhanced infrastructure, greater public participation and awareness, and enhanced markets for reusable and recyclable waste products.

CCBO’s engagement in Indonesia comes at a pivotal time for progress on plastic pollution. The country has established national solid waste management strategies/plans and has committed to addressing the problem of ocean plastics. CCBO’s support can greatly advance the enabling environment required for systemic, sustainable change.

CCBO has selected three engagement sites in Indonesia (Figure 1) to implement, test, and scale solutions.

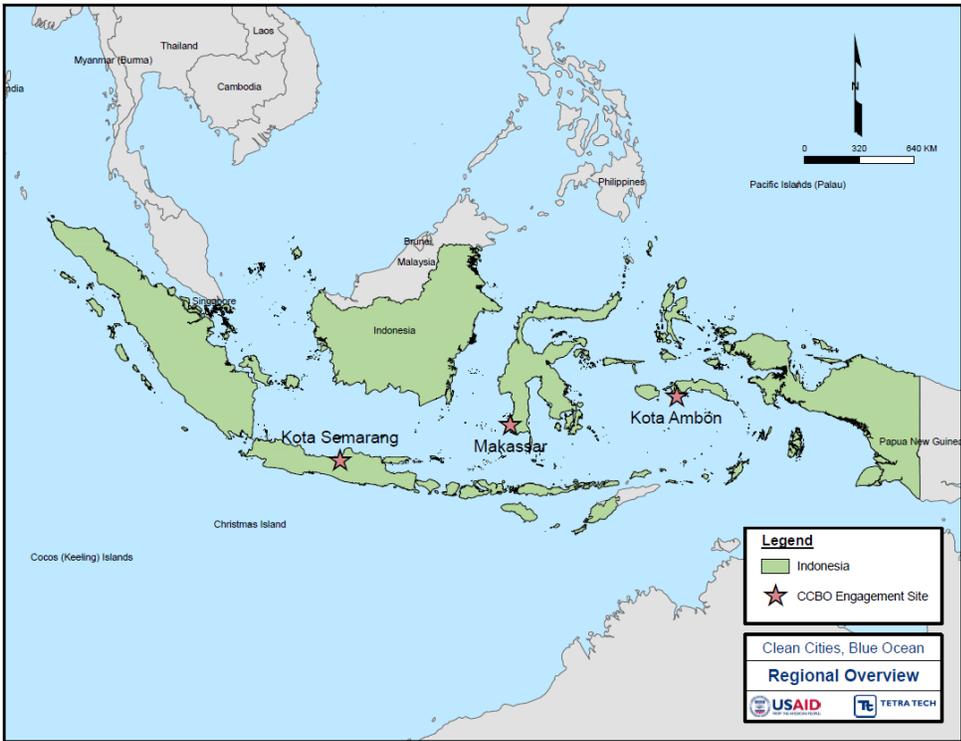


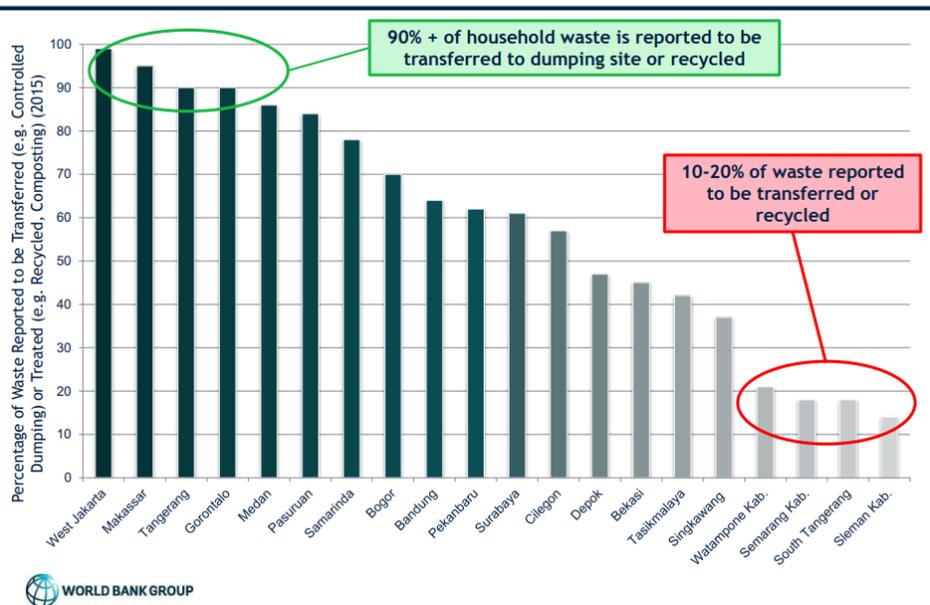
Figure 1. CCBO Engagement Site Map

The engagement sites represent a range of opportunities, positioning the program to test solutions in a variety of conditions and learn how they can be adapted and scaled to additional sites. In each of its sites, CCBO will engage with and build from previous and ongoing initiatives to leverage progress and avoid duplicative efforts. The sites have been identified on the map in Figure 1.

It is difficult to provide a general summary of the level of progress of

Indonesia’s solid waste system, due to the country’s vast geography, variety of population densities, and resources. As Figure 2<sup>1</sup> indicates, some cities report that 90 percent of their household waste is transferred for disposal or recycling while others report less than 15 percent.

<sup>1</sup> World Bank Group, “Solid Waste.”



Indonesia’s policies, capacity development, and infrastructure investments aim to raise the level of all communities to the highest levels. This section describes an overview of the efforts made toward this end.

Figure 2. Wide Range of the Percentage of Waste Reported to be Transferred or Treated

## 2.1 Indonesia’s National Laws and Regulations Impacting 3Rs and SWM

National laws and policies have had a significant impact on the progress Indonesia has made to contain and manage land-based sources of ocean pollution and improve sanitation and environmental protection. These measures impact all the levels of government. Table I shows relevant sub-national levels of government.

Table I. Indonesia’s Sub-National Levels of Government<sup>2</sup>

Level	Type (Bahasa Indonesian)	Type (English)	Head of government (Bahasa Indonesian)	Head of government (English)	Number
I	<i>Provinsi</i>	Province	<i>Gubernur</i>	Governor	34
II	<i>Kabupaten</i>	Regency (often also referred to as District)	<i>Bupati</i>	Regent	416
	<i>Kota</i>	City	<i>Wali Kota</i>	Mayor	98
III	<i>Kecamatan, distrik, kapanewon, or kemantren</i>	District	<i>Camat, kepala distrik, panewu, or mantri pamong praja</i>	Head of district	7,024
IV	<i>Desa or kelurahan</i>	Village/subdistrict	<i>Kepala desa or lurah</i>	Head of village/subdistrict	81,626

The most prominent law impacting SWM in Indonesia is the Waste Management Act (No. 18/2008). This Act, known as the Law on Solid Waste Management, established the foundation for improvements to the country’s SWM system. Some of the key elements of this legislation are that it:

- Covers the management of household and household-like wastes from commercial areas, industrial areas, special areas, social facilities, public facilities, and / or other facilities.

<sup>2</sup> Wikipedia, “Subdivisions of Indonesia.”

- Requires Regency/City governments to develop a master plan document and a feasibility study for managing household and household-like waste (i.e. solid waste management plans (SWMP));
- Requires Regency/City governments to provide waste sorting facilities for biodegradable, and recyclable wastes;
- Requires the closure of dumps;
- Requires that waste be segregated at the source and into at least five (5) categories: Hazardous and toxic waste; Biodegradables; Reusable waste; Recyclable waste; and Other trash;
- Requires final waste processing to be done in a controlled landfill, sanitary landfill or by an environmentally friendly technology - Acknowledges waste to energy as an option;
- Establishes the need for permits/licenses/certifications for waste transport or facility operation;
- Establishes that District/City governments will collect fees to cover the cost of waste management;
- Encourages Producer responsibilities;
- Established a nomenclature for the various types of facilities within 3R/SWM to establish a framework for discussion and operation (see Table 2 for a list of these facilities).

Table 2. Types of Waste Management Facilities in Indonesia<sup>3</sup>

<b>TPS (Temporary Shelter)</b>  <b>Tempat Penampungan Sementara</b>	<b>TPS 3R (3R Waste Management and Processing Site)</b>  <b>Tempat Pemrosesan Sampah 3R</b>	<b>TPST (Integrated Waste Management Site)</b>  <b>Tempat Pengolahan Sampah Terpadu</b>	<b>TPA (Final Processing Site)</b>  <b>Tempat Pemrosesan Akhir</b>
Waste that is generated will go into the first processing site, namely the TPS, where waste is transported before it is moved to either the recycling site, processing site, TPST, or TPS 3R.	Waste is managed at TPS 3R which is conceptualized as Reduce, Reuse, and Recycle, and carried out to serve a community (including in low-income community areas) consisting of at least 400 households. The main concept of waste processing in TPS 3R is to reduce the quantity and/or to improve the characteristics of the waste, which will be further processed in the landfill (TPA). TPS 3R is expected to play a role in ensuring the increasingly critical land requirements for the provision of municipal waste landfills. This is in line with the national policy, which is to place landfill at the lowest hierarchy, thus minimizing the residue that will end up in the landfill.	TPST is a place for collecting, sorting, reusing, recycling, processing and final processing of waste. If analyzed by the process level, TPST has a more complex waste processing system compared to TPS 3R because TPST manages the final processing of waste so it is safe to be returned to the environment.	TPA is a place to process and return waste to the environment safely, both for humans and the environment. The significant difference between TPST and TPA is in the waste management system policy. TPST carries out various waste management activities such as collection, sorting, reuse, recycling, processing, and final processing of waste, while TPA conducts landfill methods which are developed into controlled landfills and sanitary landfills.

<sup>3</sup> Zuraida, "Let's Get to Know."

Since the Law on Solid Waste Management was created, a series of laws and regulations have helped to shape SWM in Indonesia, including the:

- Government Regulation No. 81/2012 which addressed management of household and household-like waste;
- Ministerial Decree No. 13/2012 regarding 3R and Waste Banks;
- Ministerial Decree No. 53/2016 which established the Adipura Program;
- Ministerial Decree No. 59/2016 establishing leachate standards;
- Ministerial Decree No. 70/2016 establishing emission standards for incineration of SW; and
- Presidential Decree No. 35/2018 regarding the acceleration of the Construction of Environmentally Friendly Waste-Processing Electrical-Energy Installations.

In addition to establishing laws regarding 3R/SWM, Indonesia also has been strategic in its planning for 3R/SWM and improving the ocean environment. For example, in 2015 the National Medium-Term Development Plan 2015-2019 (The Rencana Pembangunan Jangka Menengah Nasional (RPJMN)) was developed that set a goal for establishing 100% SWM urban services (collection, treatment, or disposal) by 2019.

This was followed in 2017 with the National Municipal Solid Waste Management (MSW) Policy and Strategy. This is known as Jakstranas and was codified as Presidential Regulation No. 97/2017 of the Coordinating Ministry of Economic Affairs (KEMENKO). Jakstranas is the national policy and strategy for household waste management and similar types of waste that is to occur at the provincial, district, and city level. This is a strategy that covers the period of 2018-2025, with the objective of promoting the 3Rs and proper handling of household waste.

The Jakstranas established reduction and collection goals. To achieve these Jakstranas targets, provincial governments, and district/city governments must prepare a Jakstrada document (Regional Strategy Policy) that describes how they plan to achieve the goals set by the Jakstranas.<sup>4</sup> In support of this policy, the Ministry of the Environment and Forestry has defined guidelines for formulating regional policies and strategies for household solid waste management. These guidelines provide direction for provincial, district, and city governments in preparing their Jakstrada.

The Jakstranas is divided into two categories: MSW reduction and MSW handling. There are seven (7) MSW reduction strategies:

1. Implement norms, standards, procedures, and criteria in reducing MSW;
2. Strengthen coordination and cooperation between the Municipal Government and the Central Government and / or the Provincial Government;
3. Improve capacity of leadership, institutions, and human resources in an effort to reduce MSW;
4. Develop information systems;
5. Strengthen community engagement through communication, information, and education;
6. Implement and develop incentive and disincentive systems in MSW reduction; and

---

<sup>4</sup> Ministry of the Environment and Forestry, “Ministry of the Environment and Forestry Holds Technical Guidance for Regional Policy and Strategic Formulation (Jakstrada) in Waste Management”

7. Strengthen private sector commitment in MSW reduction.

There are ten (10) MSW handling strategies:

1. Strengthen coordination and cooperation between municipal government with the national government and the provincial government;
2. Strengthen the municipality's executive institution and parliament commitment in providing the MSW management budget;
3. Improve leadership, institutional, and human resource capacity in MSW management;
4. Develop information systems;
5. Strengthen community engagement through communication, information, and education;
6. Implement and develop investment, operational, and maintenance schemes;
7. Strengthen law enforcement;
8. Strengthen private sector engagement through partnership with local governments;
9. Implement environmentally friendly and appropriate MSW treatment technologies; and
10. Implement and develop incentive and disincentive systems in MSW reduction.

In 2017, there were two other significant documents developed: the Indonesian Ocean Policy and Indonesia's Plan of Action on Marine Plastic Debris 2017-2025. Indonesia's National Action Plan on Marine Debris sets the goal of reducing marine debris leakage 70% by 2025 using five pillars of action: namely, improving behavioral change, reducing land-based leakage, reducing sea-based leakage, reducing plastics production and use, and enhancing funding mechanisms, policy reform, and law enforcement.<sup>5</sup>

The most recent document that relates to improving 3R/SWM and thwarting plastics from polluting the ocean is the National Plastic Waste Reduction Strategic Actions for Indonesia 2020. This document lays out government and private sector actions. With the establishment of these guiding documents, Indonesia hopes to not only prevent land-based leakage of plastics into the ocean, but also encourage cleaning of rivers and beaches.

Building upon the RPJMN 2015-19, Indonesia recently adopted RPJMN 2020-2024. This policy establishes a nationwide goal of 30% solid waste reduction by 2025 through the practice of the 3Rs and 70% of solid waste through sorting, collection, transportation, treatment, and disposal of solid waste. Urban areas must achieve a 20% reduction with 80% collection and management of the remaining waste. These Jakstranas goals are used for each local Jakstrada as guidance to meet reduction and collection goals. Evaluations are conducted each year to determine to what extent the goals have been reached.

This plan also prioritizes the accelerated development of human capital, improvement of infrastructure and connectivity, simplification of regulations and bureaucracy, and promotion economic transformation.<sup>6</sup> Under RPJMN 2020-2024, the Indonesian government plans to mobilize \$450 billion in infrastructure development supporting Indonesia's Jakstranas.

---

<sup>5</sup> Deputy for Human Resources, "Marine Plastic Debris 2017-2025."

<sup>6</sup> Asian Development Bank, "Indonesia, 2020–2024 —Emerging Stronger."

## 2.2 Solid Waste Management Systems and Capacities in Indonesia

### 2.2.1 Solid Waste Generation and Characterization

In 2017, Indonesia’s population of 250 million generated around 65.8 million tons of solid waste, of which 6.8 million tons were plastic waste.<sup>7</sup> Indonesia’s average per capita waste generation rates are estimated to be around 0.68 kg/person/day (1.5lbs/person/day), falling below East Asia’s regional average.<sup>8</sup> Another study shows that by 2025, Indonesia’s solid waste generation per capita is predicted to grow to 0.85 kg/person/day (1.87lbs/person/day).<sup>9</sup>

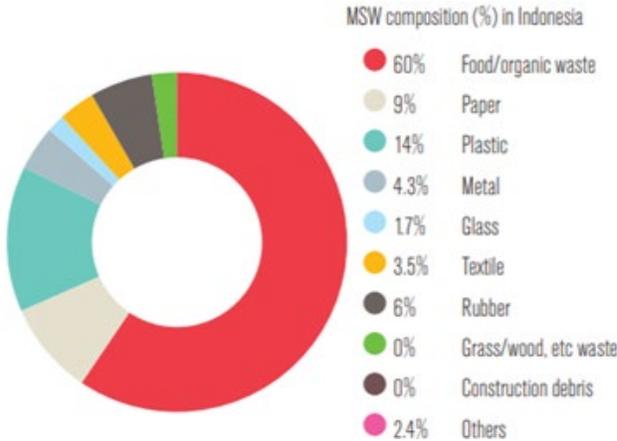


Figure 3. Municipal solid waste (MSW) Composition (%) in Indonesia (2017)

Indonesia produces roughly 64 million tons of municipal waste per year, with 60% estimated to be organic food waste, 14% plastic waste, 9% paper waste, and the remainder composed of metal, glass, textiles, rubber, and others.<sup>10</sup> This can be seen in Figure 3.<sup>11</sup>

Across the region, there is significant variation in plastic waste generation (Figure 4).<sup>12</sup> The island of Java, for example, houses 56% of Indonesia’s population but produces an estimated 64% of the country’s mismanaged plastic waste.<sup>13</sup>

Higher levels of waste generation are generally seen in more urbanized and higher income areas; as income and consumerism increase, so do waste generation rates.<sup>14</sup> Around half of Indonesia’s population (125 million people) live in cities.<sup>15</sup> A 2019 study finds that Indonesian urban areas produced closer to 105,000 tons of solid waste daily, and this number is expected to increase by 45% over the next 12 years, meaning that urban areas will generate 150,000 tons of waste per day by 2031.<sup>16</sup>

<sup>7</sup> Ratnawati et al., “National Plastic Waste.”  
<sup>8</sup> Kaza, Yao, Bhada-Tata, and Van Woerden, “What a waste 2.0.”  
<sup>9</sup> Hoornweg and Bhada-Tata, “What a waste.”  
<sup>10</sup> UNEP, “Summary report.”  
<sup>11</sup> Ibid.  
<sup>12</sup> World Economic Forum, “Radically Reducing Plastic.”  
<sup>13</sup> Ibid.  
<sup>14</sup> Hoornweg and Bhada-Tata, “What a waste.”  
<sup>15</sup> World Bank, “East Asia.”  
<sup>16</sup> World Bank, “Project appraisal document.”

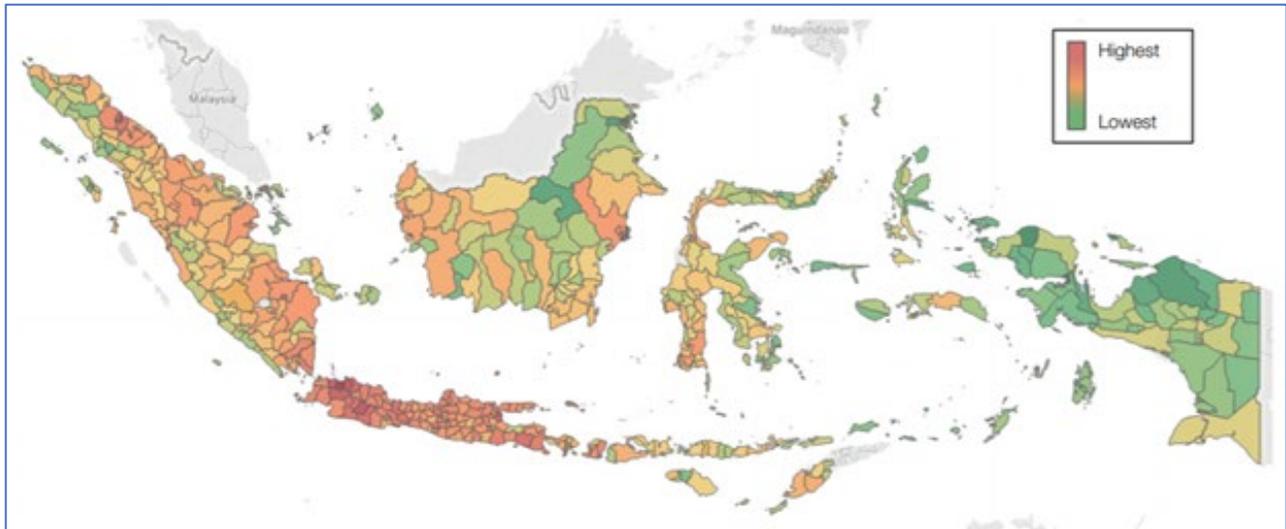


Figure 4. Estimated total plastic waste generation across Indonesia’s cities and regencies

*2.2.2 Plastics Management*

Only about 30% of the plastics generated in Indonesia are managed, with approximately 10% recycled and 20% placed into a managed disposal system. Only about an additional 9% is even formally collected. The rest is not collected and is handled either by open burning or land dumping, or it is leaked in the sea, lakes, and rivers. As shown in Figure 5,<sup>17</sup> this leads to nine percent of the plastic generated flowing into the ocean.

It should be noted that the COVID-19 pandemic has increased the amount of plastic waste that is generated. According to the data shown in SIPSN, the plastic waste generation in Indonesia increased during the covid-19 pandemic for about 3% compared to the previous year in 2019.<sup>18</sup> The need for stricter sanitation has led to the increase use of plastic personal protective equipment (masks, gloves, etc.), single-use utensils, and other plastics to maintain the health of communities. It is anticipated that this will further complicate 3R/SWM issues in Indonesia and will present challenges to environmental sustainability that the CCBO team will need to address throughout the course of the program implementation.

*2.2.3 Collection Systems*

Currently, approximately 39% of urban solid waste is collected in Indonesia, leaving about 40% of existing urban households without access to waste collection services.<sup>19</sup> The low overall collection rate, insufficient funding, and irregularity of the collection services provided have led to wide variation across municipalities in organizational structure, collection, disposal, and payment mechanisms, resulting in inconsistent waste and financial data.<sup>20</sup>

---

<sup>17</sup> World Economic Forum, “Radically Reducing Plastic.”  
<sup>18</sup> Ministry of Environment and Forestry “SIPSN”  
<sup>19</sup> World Bank, “Project appraisal document.”  
<sup>20</sup> Ibid.

Household waste is typically collected door-to-door by private companies or recycler associations contracted by community or “neighborhood” organizations (RT/RW, or rukun tetangga/rukun warga) using primarily handcarts, motorcycles, and trucks primarily.<sup>21</sup> Informal waste collectors (IWC) (pemulung) work within these recycler associations as well as collect from other locations in the city as well as landfills. Maids and servants also collect recyclables from households. Waste buyers are also part of this informal sector and purchase recyclables door-to-door.<sup>22</sup>

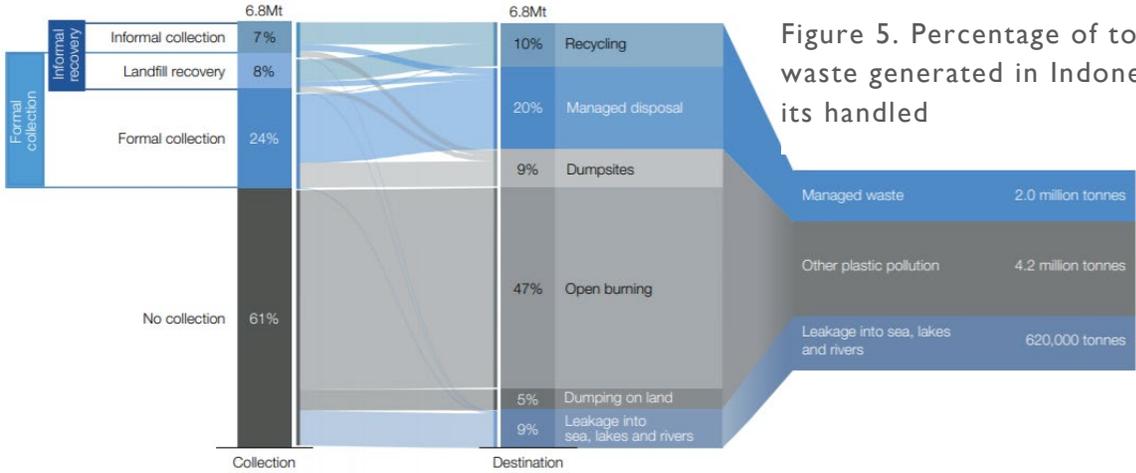


Figure 5. Percentage of total plastic waste generated in Indonesia and how its handled

Source: NPAP analysis

Waste is generally first brought to temporary shelters (TPS) for temporary disposal by residents themselves. In municipal areas where residents are unable to carry their waste to TPS themselves due to topographical challenges, neighborhood organizations tend to hire haulers (i.e., the afore-mentioned private companies or recycler associations) to collect waste door-to-door to transport to the TPS. The Cleansing Department (Seksi Kebersihan) of each district typically oversees SWM, with household level collection delegated to the lowest levels of government.<sup>23</sup>

Formal collection of recyclable waste is uncommon and what is collected is mainly handled by informal waste collectors through collection services or scavenging. While not entirely informal (some are recognized or supported by communities), waste banks (bank sampah) provide a method for managing recyclable waste. A reported 11,330 waste banks exist across the country,<sup>24</sup> which enable community members a location to deposit their recyclable waste for a reward (either cash or products – gold has also been used.) In this scheme, individuals get to “bank” the value of the waste they deliver.<sup>25</sup> The deposited materials are then sold to scrap dealers (pengepul) for processing. In Indonesia, the private sector has supported waste banks, too. For example, Unilever has provided resources to some waste banks.<sup>26</sup> The

<sup>21</sup> Lestari and Trihadiningrum, “The impact of improper.”  
<sup>22</sup> Colombijn, “Secrecy”; Sasaki, Araki, Tambunanm, and Prasadja, “Household income”; Sembiring and Nitivattananon, “Sustainable.”  
<sup>23</sup> World Bank, “City.”  
<sup>24</sup> Ministry of Environment and Forestry “SIPSN”  
<sup>25</sup> Ni’mah and Keller-Bischoff, “Java’s waste banks.”  
<sup>26</sup> Unilever Indonesia Foundation, “Environment Programme.”

Indonesian government has also reportedly endorsed the waste bank concept as “currently the best way of dealing with waste across the country.”

#### 2.2.4 Recycling Systems

Of the 6.8 million tons of total plastic waste generated in 2017, 10% was recycled in about 1,300 “recycling centers” in Indonesia.<sup>27</sup> In 2018, 15% of total waste was recycled by the informal sector, whereas formal recycling systems captured less than 5% of the total waste generated.<sup>28</sup>

After sorting at the TPS and waste banks, recyclable waste is transported by the local government agencies BAPPEDA (municipal planning agency) and Dinas Lingkungan Hidup (DLH) (environmental services unit) to a reduce-reuse-recycle waste management and processing site (TPS 3R) or an integrated waste management site (TPST).<sup>29</sup> There it is sorted for reuse or recycling to minimize the quantity sent to the landfill. It is estimated that the government-run TPS 3R centers process roughly 1% of collected waste before transfer to TPST or landfills (TPA).

Some TPS 3R are informal sorting and recycling centers called junk shops (*pengepul*), which must be licensed as such by the local government according to the Waste Management Act (No. 18/2008) Article 17. *Pengepul* comprise a complex network of scrap dealers who buy and exchange a wide range of waste items for sorting into specific categories to then be sold to respective processing centers or factories.<sup>30</sup>

#### 2.2.5 Reuse and Reduction Programs

In addition to its commitments regarding recycling, the Indonesian government has also committed to limiting waste disposal through reuse and material reduction actions.

In 2016, the Ministry of Environment and Forestry (MoEF) issued “Circular Letter Number: S.1230/PSLB3-PS/2016 on Pricing and Mechanism of Implementation of Paid Plastic Bags” to discourage consumers from using single-use plastic bags and reduce plastic waste generation. A trial implementation of the policy in 23 cities resulted in 25-30% reduction in plastic bag use, but later reports found the policy to be nationally ineffective due to lack of enforcement, private sector commitment, and weak pricing mechanisms.<sup>31</sup> In the same year, the government proposed a new plastic bag excise tax policy to continue its plastic waste reduction plan, but as of 2019, plans for implementation have been delayed by opposition from plastic manufacturers.<sup>32</sup>

In 2017, to increase reuse of discarded plastic, the government carried out several plastic tar road pilot projects where plastic was incorporated into asphalt road materials. This program aimed for implementation in 5-15% of all new roads and 100% of all repairs, with some reported success in Bali, Kota Makassar, Surabaya, and Jakarta.<sup>33</sup>

---

<sup>27</sup> Aqil, “Ineffective recycling.”

<sup>28</sup> World Bank, “Indonesia Marine Debris Hotspot.”

<sup>29</sup> World Bank, “Project appraisal document.”

<sup>30</sup> Colombijn, “Secrecy.”

<sup>31</sup> Colombijn, “Secrecy.”

<sup>32</sup> Suroyo, “Indonesia’s parliament.”

<sup>33</sup> Maruf, “Indonesia Response.”

## 2.2.6 Markets/End Uses for Plastics

Polyolefins in the application of plastic packaging constitutes the largest section of the plastics market in Indonesia. The Indonesian Olefin, Aromatic, and Plastic Industry Association (Inaplas) estimates a 2020 growth rate of 5.2%.<sup>34</sup> This growth reflects the nation’s increasing consumption habits, as well as heightened demand for raw materials and reliance on imported plastic (primarily propylene and polyethylene) from countries such as Singapore, Malaysia, Thailand, and the United States. Roughly 40-50% of the petrochemicals used for plastics manufacturing in Indonesia are imported, adding approximately 220,000 tons (3%) to plastic waste generated domestically.<sup>35</sup>

Following the People’s Republic of China’s 2018 ban on all imported waste, waste exports to Southeast Asia surged. Indonesia’s 2018 plastic waste imports increased 141% to 283,152 tons, according to the Central Statistics Agency (BPS).<sup>36</sup> In an effort to strengthen monitoring of scrap imports and after a temporary moratorium on the imports, in 2020 the government announced a new imported waste policy to tolerate a maximum of 2% contamination of plastics and scrap paper.<sup>37</sup> The new policy also limits scrap import ports to eight locations: Tanjung Priok (Jakarta), Tanjung Emas (Semarang), Tanjung Perak (Surabaya), Soekarno Hatta (Makassar), Belawan (Medan), Batu Ampar (Batam), Teluk Lamong (Surabaya), and Merak (Cilegon).<sup>38</sup>

Figure 6<sup>39</sup> demonstrates the long distances that post-consumer waste materials travel to become feedstock for new products from Indonesia. It also shows how much activity is centralized around Jakarta and Surabaya as domestic processing sites for recycled waste. This 2008 map traces the paths of plastic, metal, and paper waste generated from Batam City, Bogor City, Magelang City, Makassar City, and Pontianak City.<sup>40</sup>

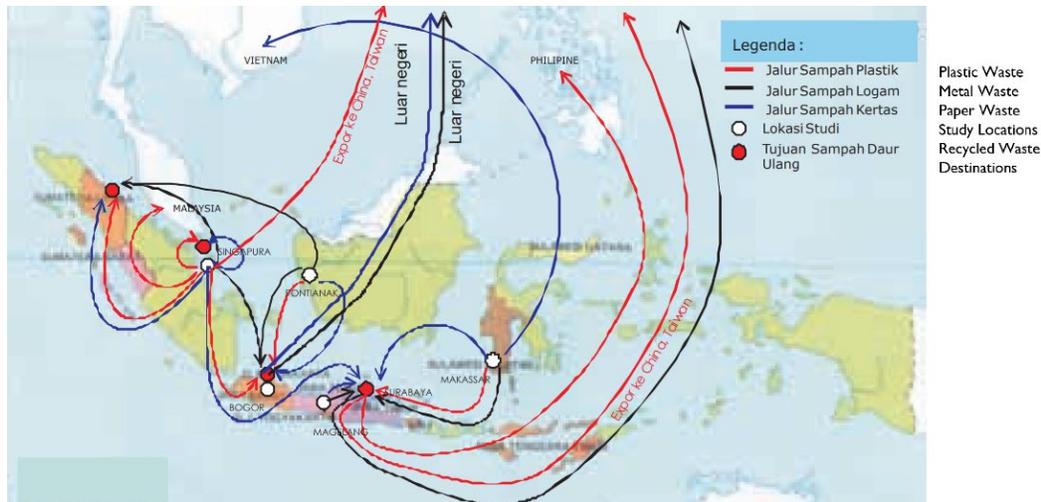


Figure 6. Paths of waste recycling in Indonesia

<sup>34</sup> IDN Financials, “Inaplas.”

<sup>35</sup> Global Business Guide Indonesia, “Indonesia’s Plastic.”

<sup>36</sup> Soba, “Meski Dilarang.”

<sup>37</sup> MacAulay, “Indonesia.”

<sup>38</sup> Ibid.

<sup>39</sup> World Bank Group, “Solid Waste.”

<sup>40</sup> Ministry of the Environment, “Panduan.”

## 2.2.7 Disposal

There continues to be a lack of environmentally sound options for waste disposal in Indonesia. Open dumping and burning of waste continue to be common practice across the country. Deficiencies in both existing urban and rural SWM infrastructure leave both populations with no choice but to dispose of waste in ways that are harmful to the environment.

In 2008, the Waste Management Act (No. 18/2008) required landfill operators to replace open dumps with sanitary landfills within five years of its enactment, but a 2014 MoEF analysis reported 43% of landfills still operating as open dumps and the remaining 57% operating at “controlled” landfills (those with some but limited covering of waste)—neither of which qualify as sanitary landfills.<sup>41</sup> Tens of thousands of IWCs sort through landfill waste as their primary source of livelihood. Figure 7 illustrates a decrease in open dumping from 2015 to 2016.<sup>42</sup>

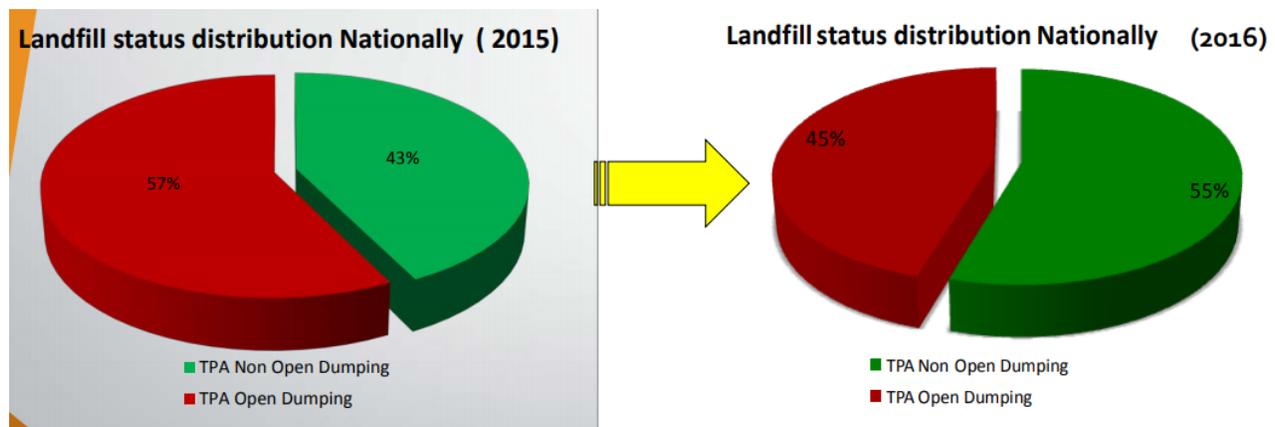


Figure 7. Open Dumping Percentages in Indonesia

The waste-to-energy (WTE) industry is slowly emerging in Indonesia, with the development of WTE power plants classified as national strategic projects.<sup>43</sup> After the 2018 enactment of Presidential Regulation No. 35 on the Accelerated Development of Waste Processing Installation into Electricity Based on Eco-Friendly Technology, a number of WTE projects have been under way, including operations in Surakarta City set to begin in 2020, and 12 plants expected to be constructed and operating by 2022.<sup>44</sup> These new plants are projected to produce in total 234 megawatts of electricity using 16,000 tons of waste per day.<sup>45</sup>

<sup>41</sup> World Bank, “Project appraisal document.”

<sup>42</sup> Ratnawati, “The 3Rs and Clean Land.”

<sup>43</sup> Rakhmani, “Indonesia's approach.”

<sup>44</sup> Nugroho Adi, “Surakarta”; The Jakarta Post, “Indonesia.”

<sup>45</sup> Diela, “Indonesian.”

# 3. Current Status of 3R/SWM in CCBO Engagement Sites

## 3.1 ISWMA Summary

Through this ISWMA, high-level information has been gathered on each of CCBO’s engagement sites in Indonesia, covering governance, waste generation, waste segregation, resource recovery, disposal, and supporting education and outreach as it pertains to the cities’ current SWM systems. The ISWMA provides information not only on current capabilities but identifies critical gaps to be filled, informing CCBO recommendations in Section 6. The following summary provides a brief overview of the system capacities and gaps found across CCBO’s three engagement sites.

### Waste Generation and Processing

Across each of the sites, annual waste generation per person ranges from 1,000 to 1,270 tons per day (TPD), with waste generation increasing in line with population. As shown in Table 3, per capita waste generation is similar for Kota Semarang and Kota Makassar, with Kota Ambon difficult to compare due to data limitations; however, it is noted that Ambon’s waste generation appears to be less than the two larger engagement sites. This would be expected based on its smaller population and tourism/commerce industries.

It should be noted that when multiple data sources were found, there was significant variation in estimates, projections, and calculations. Therefore, in those cases, the Tetra Tech Team calculated projection estimates based on the most recent and consistent data available.

Table 3. Baseline Waste Generation Estimates Across CCBO Engagement Sites

CCBO Engagement Sites	Administrative Districts (#)	Population	Waste Generation	Per Capita <sup>1</sup>	Annual Waste Generation Projections <sup>2</sup>
Kota Ambon	5	384,000 (2019)	270 TPD	1.5 lb./day (0.7 kg/day)	99,000 tons per year (TPY)
Kota Semarang	16	1,676,000 (2017)	1,270 TPD	1.5 lb./day (0.7 kg/day)	464,000 tons per year (TPY)
Kota Makassar	15	1,580,000 (2020)	1,000 - 1,200 TPD	1.25-1.5 lb./day (0.6-0.7 kg/day)	365,000 – 440,000 TPY

Notes:

1. Per Capita waste generation data was not found for these engagement sites. Per Capita generation was calculated using reported total waste generation per day divided by reported population.
2. Waste Generation Projections were calculated using reported daily waste generation multiplied by 365 days.

Because CCBO was unable to travel to the sites, many of the operations/facilities listed below were found using Google Earth and Maps, which provided visual examples of waste management facilities in each of the engagement sites. *Note: Facilities/operations listed in Table 4 are only those that were identified as formal and/or established facilities/operations.*

Table 4. Existing Operations/Facilities at CCBO Engagement Sites

CCBO Engagement Sites	TPS (#)	TPS 3R (#)	TPST/IPST (#)	Junk Shop (#)	Composting (#)	Waste-to-Energy Facility (#)	Landfill/TPA (#)
Kota Ambon	(0)	(5) - Amaory - IAIN - BTN Passo - Airlouw - Air Sakula	(0)	(2) - Takale - Passo, Baguala	(3) - Yonadap Thenu - Soeleman Lumpira - Mateis Sahertian	(0)	(1) - TPA-ISPST Toisapu
Kota Semarang	(13) - Karangingas - Boom Lama - Gedawang Asr - Kali Asin - Kelurahan Ngesrep - Kembangsari - Pasar Gayamsari - Patriot - Perum Brigif - Pudukpayung - Rumpun Perwira - Tulus Harapan - Sampahmuda	(23) - Dadi Resik - Serdaducacat - Mukti Asih - Kelurahan Gemah - Ngudi Kamulyan - Ngudi Lestari - PT. Krayadeka Alam Lestari - Siudo Rahayu - Others (unidentified)	(4) - Dan Bank Sampah - Purwosari - Universitas Diponegoro - Mijen	(344) - Rosok Pak Tris - Sumber Nikmat - Permak Mas Tompell - Woro Jual Beli Berang Bekas/Rosok - Pemesanan Cakar Ayam - Others (unidentified)	(3) - Pasar Johar - Pasar Mrican - Pasar Pedurungan	(1) - Landfill Gas Power Plant in TPA Jatibarang	(1) - TPA Jatibarang
Kota Makassar	(2) - Rappokalling - Terminal Sampah Paccerrakkang - Unnamed TPS	(5) - Darul Aman - Sambungjawa - Rusun Mariso - Tamalanrea - Bulurokeng	(0)	(6) - Gudang UD <sup>46</sup> Salodong 2 - Kapal Katakan Laut - UD Gassing Logam - UD Sejahtera Jaua Mandiri - UD Tahira Beli Barang Bekas Besi Tua Di - Rongsokan Kota Makassar	(0)	(0)	(1) - TPA Tamangapa Antang

<sup>46</sup> UD = Usaha Dagang (Indonesian Trading Company)

The national, regional, and local governments in CCBO's engagement sites have worked with a number of international, local organizations and private sector donors to develop and improve their 3R/SWM systems. Organizations that CCBO has engaged with include:

**The [World Bank Blue Economy Portfolio](#)** has approximately \$5.6 billion in active projects ranging from large regional fisheries programs in Africa and the Pacific, to tackling all sources of marine pollution, and supporting coastal development around the world. The World Bank has committed to spend \$100M between 2020 and 2025 and leverage an additional \$225M to improve solid waste management services for urban populations in selected cities across Indonesia ([more information](#)).

**[Clean Oceans Initiative](#) - KfW** Group on behalf of the German Federal Government, the **European Investment Bank (EIB)** and the **Agence Française de Développement (AFD)** launched the Clean Oceans Initiative to support the development and implementation of sustainable projects that will reduce pollution in the world's oceans over the next five years. This partnership will provide long-term financing for projects aiming at reducing marine litter, especially plastics, as well as untreated wastewater discharge, with a view to crowding-in private sector investment. The institutions are providing EUR 2 billion (~\$2.4B USD) for projects aimed at reducing marine litter, especially plastics, and the discharge of untreated wastewater.

**[Circulate Capital](#)** is a \$106M impact investment fund to identify, incubate, and invest in circular recycling solutions to combat ocean plastic. They announced their first investment in Indonesia in April of 2020 to Tridi Oasis an Indonesian, female-led company recycling PET bottles into rPET flakes, and they are looking to expand their impact.

The **[Alliance to End Plastic Waste](#)** (AEPW) established a partnership with USAID in June of 2020 to address global ocean plastics pollution by implementing local solutions across rapidly urbanizing cities in Asia. AEPW is membership organization of roughly 50 companies that make, use, sell, process, collect and recycle plastics, including chemical and plastic manufacturers, consumer goods companies, retailers, converters, and waste management companies. AEPW and its members are committed to investing \$1.5 Billion globally to end plastic waste.

**[Norwegian Government/NORAD](#)** has committed to spend roughly \$200M USD between 2019 and 2022 to combat marine litter and microplastics is to prevent and greatly reduce the extent of marine litter from large sources in developing countries. While these investments extend beyond Indonesia, investments in initiatives like WWF's No plastic in Nature Program (an investment of 96M NOK ~\$11.5M USD) which will be active in Makassar, Avfall Norge's Clean Oceans Through Clean Communities Initiative (39M NOK ~\$4.6M USD) to improve waste management through with a focus in East Java and other investments may complement CCBO's efforts and amplify its impact to improve SWM practices reduce ocean plastic pollution.

**[Asosiasi Daur Ulang Plastik Indonesia \(ADUPI\) or Indonesia Plastic Recycling Association](#)** was founded by plastic recycler entrepreneurs in 2015. This organization aims to create a conducive recycling business by cooperating with all the players involved. In total, 149 members were registered in 2020 from finished-goods manufacturers, pelletizing processors, flake and chip producers, waste banks, and scavengers. CCBO coordination ADUPI may facilitate engagement from organizations across the waste value chain.

The **Packaging and Recycling Association for Indonesia’s Sustainable Environment (PRAISE)** is an industry effort to strengthen and encourage the creation of packaging waste management in Indonesia. It has prioritized advocacy, research and education, and collaboration. In August of 2020, PRAISE members including PT Coca-Cola Indonesia, Danone-Aqua, PT Indofood Sukses Makmur, PT Nestle Indonesia, Tetra Pak Indonesia and Unilever Indonesia, initiated the Packaging Recovery Organization (PRO) to speed up the implementation of the circular economy.<sup>47</sup> CCBO is exploring opportunities to work with PRAISE and its member companies.

**Asosiasi Bank Sampah Indonesia (ASOSBI) or Indonesia Waste Bank Association** was founded by waste bank operators in 2017. This organization aims to improve environmental quality through waste bank operation, especially on managing waste sources. CCBO should coordinate closely with ASOSBI to become familiar with waste bank operations and their influence on Indonesia’s waste and materials market.

There are also a number of local organizations that are active within the CCBO engagement sites. Table 5 presents a list of programs and organizations that the CCBO team has become aware of through its research. CCBO will work with these like-minded supporters to engage and build-upon (but not duplicate) their efforts. This initial list will continue to be developed through the implementation period.

Table 5. Solid Waste Management Efforts in Indonesia

Program/Organization	Background
BINTARI Foundation (The Indonesian Association for Sustainable Development)	The BINTARI Foundation is engaging government officials and businesses to in solid waste management and recycling by promoting various recycling practices, including the collection and recycling of lower-value, single-use plastics. <sup>48</sup>
The Plastic Collective - Certified Ethical Plastic Program	Seeks to educate and train businesses on recycling and engage community members in a circular economy. <sup>49</sup>
Kelurahan Ramah Lingkungan (Environmentally Friendly Village) program	Promotes community engagement, outreach, and education regarding waste management. <sup>50</sup>
WWF - No Plastics in Nature	Aims to prevent the leakage of plastics in hotspots around the coasts of Indonesia and other southeast Asian countries. <sup>51</sup>
Recycled Island Foundation	A Dutch organization that seeks to reduce pollution through litter traps and cleanups. <sup>52</sup>
The Better Green People - Scavenger Program	Operates through a mobile application that connects restaurants, offices, schools, shopping centers, and individuals with scavengers who will collect the recyclables for free. <sup>53</sup>
Trash Hero Ambon	An organization of volunteers that lead clean-ups,

<sup>47</sup> Aqil, A. Muh. Ibnu. 2020. "The Jakarta Post." *Companies establish organization to combat growing plastic waste.* August 27. <https://www.thejakartapost.com/news/2020/08/27/companies-establish-organization-to-combat-growing-plastic-waste.html>

<sup>48</sup> Urban Links, "MWRP Indonesia."

<sup>49</sup> Plastic Collective, "Certified Ethical Plastic Program."

<sup>50</sup> Hekmatyar, "Analisis Peran Aktor Dalam Implementasi Program Kelurahan Ramah Lingkungan Di Kecamatan Banyumanik."

<sup>51</sup> WWF, "Global Environmental Conservation."

<sup>52</sup> Tech That Matters, "Recycled Island."

<sup>53</sup> Scavenger.id, "A Recycling Revolution."

	environmental education programs, and other long-term sustainable projects to clean and reduce waste. <sup>54</sup>
(Various) Waste Banks	An initiative that encourages communities to segregate and/or collect their household recyclables for credits that can be exchanged into cash and other services. <sup>55</sup>
Waste4Change	Organizes waste management services using 3R methods and other programs to enhance national solid waste management. <sup>56</sup>

## 3.2 Kota Ambon

Kota Ambon is the capital, as well as the largest city, of the Indonesian province of Maluku. The city of Ambon is located on Ambon island. It is more urbanized than its surrounding areas and has an active tourism economy. The coastal city covers a land area of approximately 115 square miles (359 km<sup>2</sup>) and has a population of 405,000 as of 2015.<sup>57</sup> The city is divided into five administrative districts (kecamatan), which include:

- Baguala
- Leitimur Selatan (South Leitimur)
- Nusaniwe
- Sirimau
- Teluk Ambon (Ambon Bay)

There are 20 sub-districts (Kelurahan) and 30 Villages.

### 3.2.1 Governance

The City of Ambon has recognized the importance of environmental protection and its connection with sound 3R/SWM practices. This is reflected in the structure and policies that have been established.

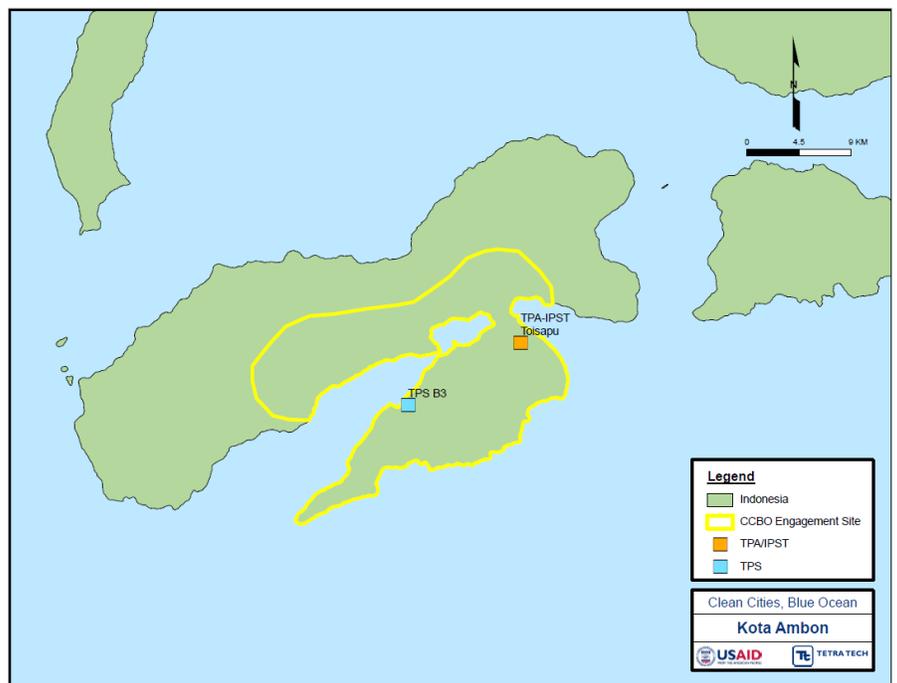


Figure 8. Map of Kota Ambon and Solid Waste Management

<sup>54</sup> Trash Hero, “Our Mission.”

<sup>55</sup> World Bank, “Project Appraisal Document.”

<sup>56</sup> Bahraini, “Program Improvement.”

<sup>57</sup> World Bank, “Project appraisal document.”

The Ambon City Environment and Waste Management Agency was established under the Ambon City Regulation No. 4 of 2016.<sup>58</sup> The Kota Ambon Environmental Agency is responsible for:

- Formulating technical policies regarding the environment and waste;
- Implementing policies related to the environment and waste;
- Implementing the evaluation and reporting of the environment and solid waste;
- Implementing Administrative Services; and
- Implementing other functions provided by the Mayor in relation to the Mayor's duties and functions.

The city has passed legislation to promote improved 3R/SWM. The Ambon Mayor Regulation No. 43 of 2018 is the City's Jakstrada. This is required by national law and outlines a local strategy policy related to household waste management, which includes plans for the City of Ambon's government to build waste banks in every village in Kota Ambon.<sup>59</sup> Only about 1.4% of the total annual budget is allocated towards solid waste management in Kota Ambon.<sup>60</sup> A copy of this plan is available [here](#).

In November 2015, USAID began Adaptasi Perubahan Iklim dan Ketangguhan (APIK), the Climate Change Adaptation and Resilience project, to support the Indonesian government, businesses, and communities in addressing climate and weather-related disasters<sup>61</sup>. Together, APIK and the Ambon City Government launched the Ambon Bay Coastal Clean-Up Campaign to protect the Ambon bay from plastic pollution and reduce the threat of floods along the coast. As part of the initiative, local community members and students have rallied together to collect and clean the pollution in the Ambon bay. In addition to cleaning the Ambon bay, these campaigns are raising awareness, educating people, and promoting behavioral change.

### 3.2.2 Waste Generation and Composition

According to the World Bank, Kota Ambon generates approximately 210 tons of waste per day (0.34 kg/inh/day).<sup>62</sup> It is estimated that by 2025, its waste generation will reach approximately 290 tons per day. Kota Ambon, however, does not weigh the waste disposed at its landfill. Therefore, the statistics are maintained by volume of cubic meters. Figure 9 presents the annual volume of waste generation in Ambon from 2010-2014.<sup>63</sup>

As is the case in most other Indonesian locales, the waste generated in Kota Ambon is mostly biodegradable organics. Figure 10 shows the results of a waste characterization study for Kota Ambon (it is undetermined without further research why the percentages do not add up to 100). According to this data, organics are significantly higher than other materials in the waste stream.

---

<sup>58</sup> Rahawarin, "Controlling."

<sup>59</sup> BeritaBeta, "Setiap."

<sup>60</sup> World Bank, "Project appraisal document."

<sup>61</sup> USAID, "APIK Project."

<sup>62</sup> World Bank, "Project appraisal document."

<sup>63</sup> Ibid.

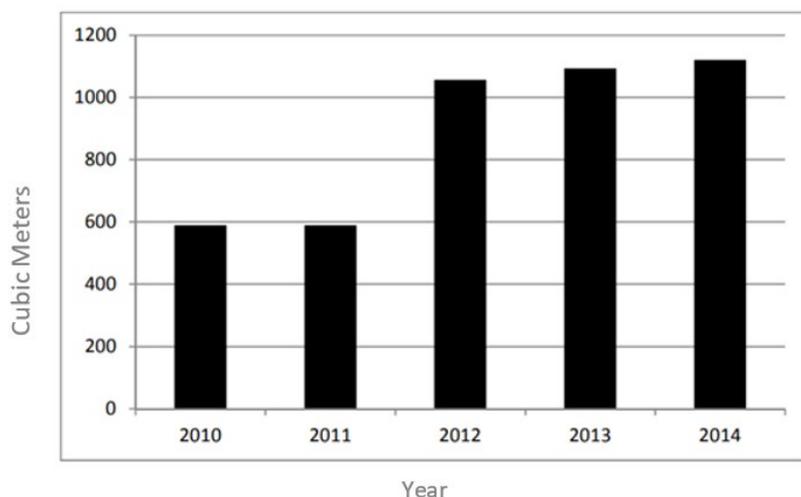


Figure 9. Waste Generation per day (m<sup>3</sup>) in Ambon<sup>64</sup>

Tahun Year	Komposisi Sampah per Hari/ Daily Garbage Composition (%)					
	Organik Sayuran Organics	Logam Metals	Plastik Plastics	Gelas/Kaca Glasses	Kertas Papers	Lainnya Others
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2015	9,57	2,13	27,02	2,13	44,68	14,47
2016	114,00	2,45	4,50	2,45	6,60	1,00
2017	90,40	11,37	12,02	14,80	7,09	6,06
2018	92,80	11,80	10,25	15,00	9,00	7,00
2019	90,70	2,70	9,20	12,90	12,80	8,00

Figure 10. Waste Composition in Kota Ambon<sup>65</sup>

Sumber/Source: Dinas Lingkungan Hidup dan Persampahan Kota Ambon/ Official of Environment and Waste, Ambon Municipality

### 3.2.3 Waste Collection

Kota Ambon has an established collection system. Waste transfer and transportation is handled by the Dinas Kebersihan Kota Ambon (Ambon City Sanitation Department), however, no segregation is done at the household/business level as part of the formal collection system.

As of 2012 (the most current date of available data), it was estimated that 86 percent of waste was collected.<sup>66</sup> Waste is collected in Kota Ambon by approximately 40 hand carts, motor-carts, 15 dump trucks, 7 pick-up trucks, and 9 arm-roll trucks (as of 2017).<sup>67</sup> This list is shown in Table 6. While it is

<sup>64</sup> Maryati et al., "Sustainable Ambon Bay."

<sup>65</sup> Kota Ambon Official Website, "Kota Ambon Dalam Angka 2020."

<sup>66</sup> Damanhuri, "State of the 3Rs."

<sup>67</sup> World Bank, "Project appraisal document."

assumed that this is all city equipment, further research is needed to confirm whether the handcarts are used by city employees or provided to the communities for the use by residents to transport their waste to the TPS.

Table 6. Types of Government SWM Equipment in Kota Ambon (2017)<sup>68</sup>

No.	Type of Facility	Total	Capacity (m <sup>3</sup> ) / (yd <sup>3</sup> )	Notes
1	Dump Truck	17	10 (13)	3 broken
2	Arm Roll Car	8	5 (6.5)	2 broken
3	Container	10	8 (10.5)	-
4	Pick Up Car	8	5 (6.5)	3 broken
5	Speed Boat	3	-	-
6	Garbage Carts	40	2 (2.6)	-
7	Tossa Motorcycle	9	2 (2.6)	-

Residential area waste is collected either by the residents themselves or informal collectors and deposited on the street (in more urban areas), aggregated at a TPS, or aggregated at the Integrated Waste Processing Site (IPST). The TPS is generally 2 x 2 x 2 meters in size with a capacity of 8 m<sup>3</sup> (10 yd<sup>3</sup>). According to a 2017 study, the number of TPS are too few and the frequency of pickup insufficient to effectively handle the waste.<sup>69</sup> There is no formal door-to-door collection of recyclable waste, although the city has developed a plan to have a waste bank in every village of the city. As of 2017, there were six waste banks in Kota Ambon.<sup>70</sup>

For waste, the means of collection for each district and sub-district is not standardized. For example, each housing area in Teluk Ambon and Teluk Ambon Baguala has its own initiative to transport the waste to the TPS.<sup>71</sup> Residents in the same neighborhood use garbage carts to haul the waste from each household to the TPS. Waste collection via garbage carts is only conducted in some of the sub-districts, including Nusaniwe, Benteng, Wainitu, Mangga Dua, Udameti, and Nusaniwe. Residents who live outside of these sub-districts must bring their own waste directly to the TPS/IPST, where some restrictions may be in place. In the District of Nusaniwe, for example, residents are only allowed to leave their garbage at the transfer stations between 10:00 pm and 05:00 am.

From the TPS, waste is transferred to the IPST for sorting, which is located at the same site as the final dumpsite. Table 7 presents additional information regarding quantities of waste banks and workers in Ambon. (Note: that information from the two sources regarding the number of garbage trucks for 2016 are not consistent since it is not clear if garbage trucks includes several types of facilities as listed in Table 6).

<sup>68</sup> Maryati, "Towards Sustainable Ambon Bay."

<sup>69</sup> Maryati et al., "Sustainable Ambon Bay."

<sup>70</sup> World Bank, "Project appraisal document."

<sup>71</sup> Ibid.

In addition to residential collection efforts, it should be noted that the city also collects waste daily from the marine areas of Ambon Bay to maintain its cleanliness. Cleaning officers collect waste in the bay using speedboats, collecting approximately five tons of garbage from the bay daily (Figure 11).<sup>72</sup>



Figure 11. Kota Ambon cleaning officers collecting trash in Ambon Bay<sup>73</sup>

Table 7. Waste Collection Figures in Kota Ambon<sup>74</sup>

Year	Civil Servants	Daily Paid Workers	Garbage Trucks	Waste Banks	Final Dumping Sites
2015	176*	601	31	647	1
2016	176	629	35	164	1
2017	161	791	22	167	1
2018	161	765	25	163	1
2019	160	790	36	163	1

### 3.2.4 Recycling System

As described in Section 3.2.3, waste is not segregated and collected by the formal system in Kota Ambon. Some processing of waste is done at the landfill IPST, but the largest quantities of segregated and aggregated materials are accomplished by the informal sector. Approximately 230 individuals work as IWCs in Kota Ambon.<sup>75</sup> Most of the IWCs reside in the South Leitimur District in Amaori, a sub-village that is located adjacent to the IPST located at the disposal site (toisapu or TPA) (see Section 3.2.6). The second largest number of IWCs live in Nusaniwe District, followed by the Baguala and Sirimau Districts.

There are two types of IWCs: 1) Those collectors who are self-employed and 2) those who depend on a dealer that will lend them money and deduct the loaned money when purchasing items from scavengers.

<sup>72</sup> Rahman Patty, Rahmat. "Setiap Hari."  
<sup>73</sup> Ibid.  
<sup>74</sup> Badan Pusat Statistik, "Ambon in Figures 2020."  
<sup>75</sup> Tahitu, "Scavenger."

Informal waste collectors who depend on a dealer are only allowed to sell their items to that dealer. In some cases, dealers will provide housing to IWCs, usually on land occupied by the dealer.

Items obtained by the IWCs are cleaned so that they may be sold to collectors; junk shops that purchase recyclables such as bottles/glasses, plastics and cans; as well as to one plastic factory in Amaori. Figure 12<sup>76</sup> presents the difference in the buying prices for plastics in Jakarta and Ambon. As of January 2021, five thousand Indonesian Rupiah equals about \$0.355 USD.



Figure 12. PET bottle grades and buying prices (per kg.) in Jakarta and Ambon

### 3.2.5 Processing

As mentioned in 3.2.3, waste is processed at the IPST, which is in the same location as the disposal site (TPA)—see Section 3.2.6. Organic waste is sent for composting and sold to generate revenue for the city. Non-organic waste is further sorted and processed for sale to other recyclers or as feedstock to manufacturing. Some plastics are used for crafts that are sold at the waste banks and provide another source of income for the city.<sup>77</sup> Non-organic waste that can't be processed is sent to the controlled landfill for final disposal. As of 2017, the plastic chopping system handled approximately 3 tons per day.<sup>78</sup>

Figure 13 illustrates the flow of waste in Kota Ambon.

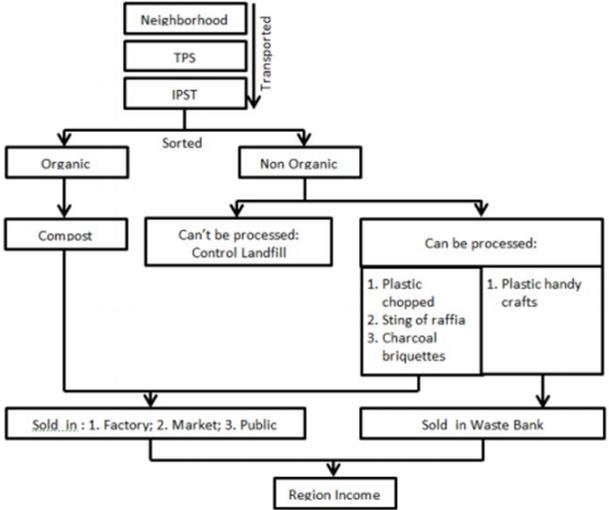


Figure 13. Flow of Waste Processing in Kota Ambon<sup>79</sup>

<sup>76</sup> The Jakarta Post, “The future.”

<sup>77</sup> Ibid.

<sup>78</sup> Ibid.

<sup>79</sup> Maryati et al., “Sustainable Ambon Bay.”

## Composting Facilities

It is believed that composting takes place at the IPST located at the TPA. According to the World Bank, approximately 6 tons are composted each day.<sup>80</sup>

There are also some community composting in Lateri, Baguala according to the SIPSN data.<sup>81</sup>

## Junk Shops

One junkshop was identified in the middle of Kota Ambon, which is located in Talake (Figure 14).<sup>82</sup> Its exact location could not be identified. According to the SIPSN data, there are also some other junkshops in Passo Sub-District, Baguala District, but the locations are in the suburb area of Ambon City.



Figure 14. Junk Shop in Talake, Ambon

### 3.2.6 Waste Disposal

Of the waste generated in Kota Ambon it is estimated that 61.7% is collected, transported and disposed.<sup>83</sup> The local government spends an estimated \$15 USD per ton of waste. According to the World Bank, Kota Ambon received a score of 50/100 based on six scoring parameters identified by the World Bank:<sup>84</sup>

1. Landfill Capacity and/or Land Available to 2025 (5%)
2. Solid Waste Collection Performance (10%)
3. Alternative Funding Sources for Investments (Donor or Private Sector Projects), including recent investment completed (10%)
4. MoEF Adipura Assessment (15%)
5. MoEF and MPWH expert priority ranking (30%)
6. Local Gov't Spending Per Ton of Waste (30%)

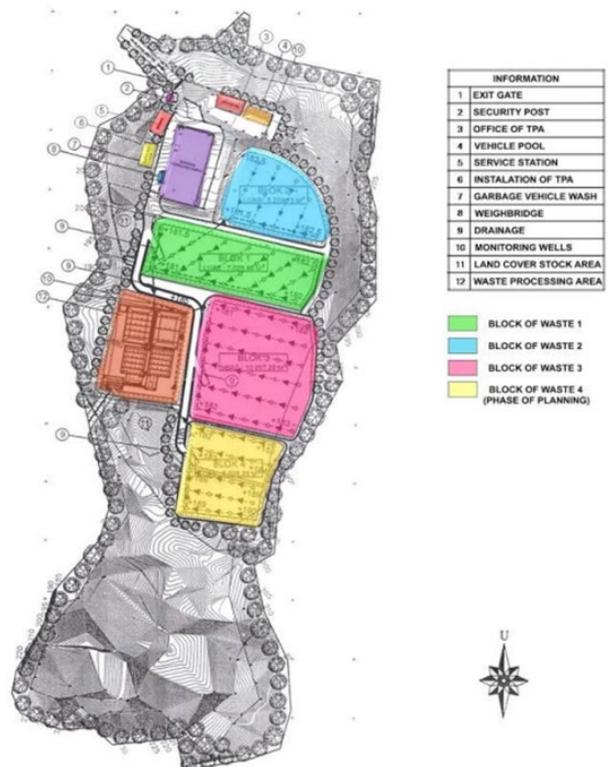


Figure 15. Site Map of TPA/IPST

<sup>80</sup> World Bank, "Project appraisal document."

<sup>81</sup> Ministry of Environment and Forestry, "SIPSN"

<sup>82</sup> Ministry of Environment and Forestry "SIPSN"

<sup>83</sup> World Bank, "Project appraisal document."

<sup>84</sup> Ibid.

Ambon has only one final waste disposal site, also known as TPA Toisapu (Figure 15).<sup>85</sup> The landfill serves most of Kota Ambon, but the District of Leitimur Selatan is not served due to its mountainous geography which makes it difficult to reach. The TPA site also is home to the IPST, where some waste is recycled, as described in Section 3.2.5: Processing.

According to data from the World Bank, approximately 140 tons are transported to the landfill.<sup>86</sup> Twenty percent of all the waste collected at transfer stations is estimated not transported to the landfill.<sup>87</sup>

The TPA’s area covers about nine hectares, of which about five hectares are covered with waste.<sup>88</sup> The area is comprised of four landfill blocks: garbage blocks one and two are currently full, and garbage block three is being filled. CCBO believes that block four is still in the planning phase, but more information is required. The landfill also has a leachate pool to treat water that is generated from the waste.

In 2020, the TPA/IPST were temporarily closed because of a government lapse in payment to the landowners. As of November 2020, the landowners and Kota Ambon government had come to an agreement that both parties must respectfully cooperate with one another for the common interest and in compliance with Law Number 2 of 2012 concerning land acquisition for development of public interests.<sup>89</sup> TPA Toisapu and IPST facilities are now open again with the intention to maintain laws and regulations so that closure of any kind does not happen again.

### 3.2.7 Education and Outreach

The Recycled Island Foundation (RIF) is a non-profit organization based in Rotterdam, Netherlands that has been working in Kota Ambon. The organization seeks to find an active approach to combating worldwide plastic pollution in bodies of water, with a focus on retrieving debris from rivers through litter traps and organized cleanups. The organization is promoting public awareness and education through the sustainable re-use of plastics. Collected plastic is upcycled and turned into a floating park (Figure 16) constructed with hexagon-shaped building blocks made from recycled plastics that have been collected from organized cleanups as well as litter traps in Kota Ambon, the Port of Rotterdam, and the Port of Brussels.<sup>90</sup>



Figure 16. Floating Parks created in Ambon by RIF<sup>91</sup>

<sup>85</sup> Maryati et al., “Sustainable Ambon Bay.”  
<sup>86</sup> World Bank, “Project appraisal document.”  
<sup>87</sup> Maryati et al., “Sustainable Ambon Bay.”  
<sup>88</sup> Ibid.  
<sup>89</sup> East Regency, “Toisapu.”  
<sup>90</sup> Ibid.  
<sup>91</sup> Tech That Matters, “Recycled Island.”



Figure 17. Trash Hero Ambon Clean Up

Another project aimed at reducing unwanted waste is Trash Hero Ambon—an organization that creates sustainable, community-based projects to remove and reduce future waste by inspiring long-term behavior change among residents. According to their Facebook page, the organization has organized dozens of cleanups and has approximately 1,700 members, 100 of which are children. Thus far, the organization has collected approximately 12 tons of garbage<sup>92</sup> in settings such as those pictured in Figure 17.<sup>93</sup>

Another similar NGO to Trash Hero Ambon is Green Moluccas, which has held many beach cleanup events in Ambon City and established a Waste Bank, MSW management campaign, and green school program.<sup>94</sup> Another NGO, Bring Bank, in Maluku also established waste bank/s and conducted a door-to-door MSW segregation at source education campaign.<sup>95</sup>

### 3.2.8 *Solid Waste Planning*

The City of Ambon has complied with the national law and developed a Jakstrada. This solid waste plan document was approved as the Regulation of the Mayor of Ambon Number 43 of 2018, and follows the national guidelines and appears to simply replicate the prepared national template.

---

<sup>92</sup> Trash Hero Ambon, “About.”

<sup>93</sup> Trash Hero Ambon, “Cleanup 40.”

<sup>94</sup> Green Moluccas “Event and Program”

<sup>95</sup> Indorelawan “Bring Bank”

### 3.3 Kota Semarang

Kota Semarang is the capital and the largest city of the Central Java province. It has an area of 144 square miles<sup>96</sup> and, in 2015, had an estimated population of 1.68 million.<sup>97</sup> With such a large number of residents, it is one of the top five largest population districts/cities in Central Java.<sup>98</sup> The city is located on the north coast of Java, 540 km east of Jakarta, in the Central Java province (Figure 18). The city has been named as the cleanest tourist destination in Southeast Asia by the Association of South East Asian Nations' (ASEAN) Clean Tourist City Standard (ACTCS) for 2020–2022.

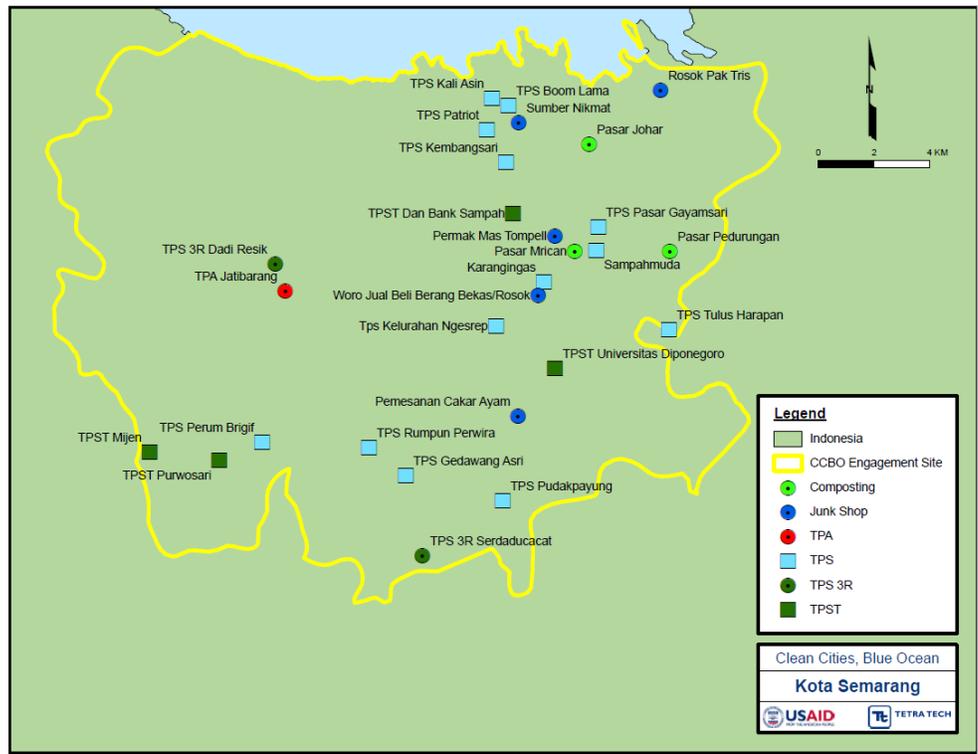


Figure 18. Map of Kota Semarang and Waste Management Operations

#### 3.3.1 Governance

Jurisdictionally, Kota Semarang is a municipality (second level of government) consisting of 16 districts (kecamatan):<sup>99</sup>

- Banyumanik
- Candisari
- Gajahmungkur
- Gayamsari
- Genuk
- Gunungpati
- Mijen
- Ngaliyan
- Pedurungan
- Semarang Barat
- Semarang Selatan
- Semarang Tengah
- Semarang Timur
- Semarang Utara
- Tembalang
- Tugu

<sup>96</sup> City Population, “Kota Semarang.”

<sup>97</sup> World Bank, “Project appraisal document.”

<sup>98</sup> Hadiwidodo, Samadikun, and Arinasandi, “Waste Bank’s Condition.”

<sup>99</sup> Maryono and Hasmantika, “Smart Urban Waste.”

These 16 districts are then divided into 177 urban villages (kelurahan). Since 2013, the largest sub-district area in Kota Semarang is Mijen sub-district.<sup>100</sup> The city administration is headed by a mayor, with a legislative assembly.

The local Environment Agency is responsible for the municipal SWM in Kota Semarang. The divisions and subdivisions of the agency are established under Mayor Regulation No. 72/2016. Figure 19 presents the organizational structure of Dinas Lingkungan Hidup (DLH) or Environment Agency of Semarang. The average budget allocated by the Local Government for waste services in Semarang reached only 1.7 percent of their total budget. A separate source calculated that the average local SWM budget in Kota Semarang was 2.0% of the total budget.<sup>101</sup>

There are three divisions and one unit within the Environment Agency of Semarang, including the:

- **Division of Environmental Governance** - responsible for policymaking regarding environmental governance, assessment of environmental impacts, and prevention of hazardous and toxic substance pollution.
- **Division of Solid Waste Management** - the main division that manages waste generated by public and industries. There are three specific sections in this division, including the partnership development section, facility and infrastructure section, and operation of waste management section.
- **Division of Pollution Control and Environmental Conservation** - responsible for pollution and wastewater management, biodiversity conservation, and environmental restoration.
- **Division of Environmental Monitoring and Development** - has three sections, including the section of complaint and settlement of environmental conflict, the section of environmental monitoring, and the section of developing awareness of environmental conservation for public communities.
- **Regional Technical Implementation Unit (UPTD)** - There are seven UPTD in DLH Kota Semarang, including UPTD of environmental laboratory, final treatment site, wastewater management, and cleanliness area I – VIII.

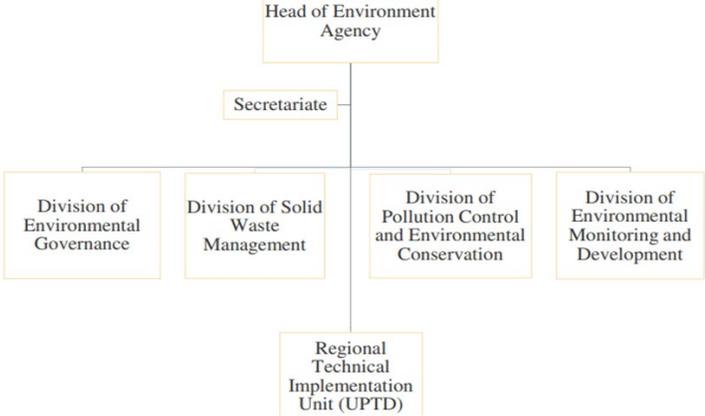


Figure 19. Organizational Structure of the DLH in Kota Semarang

Semarang City has some regulations that control MSW management activities, which are:

- 1) Semarang City Local Regulation No. 6 of 2012 about MSW Management

<sup>100</sup> Wikipedia, "Semarang."  
<sup>101</sup> World Bank, "Project appraisal document."

- 2) Semarang City Mayor Regulation No. 79 of 2018 about Municipality Policy and Strategy for MSW Management (Jakstrada);
- 3) Semarang City Mayor Regulation No. 34 of 2019 about Amendment of Perwali No. 79 of 2018 about Municipality Policy and Strategy for MSW Management (Jakstrada);
- 4) Semarang City Mayor Regulation No. 27 of 2019 about Plastic Utilization Control; and
- 5) Regional Regulation Number 2 Year 2012 about General Service Retribution in Semarang City.

One of the earliest statutes in Semarang is Regulation Number 6 of 1993, which identifies the city's solid waste collection, disposal fees, and waste disposal.<sup>102</sup> The regulation also states that the government and community are responsible for waste collection services and considers open dumping and waste burning an offense. A significant aspect of this regulation is that establishes that residents are charged for waste services according to their property values.

Future regulations provide more detail. According to the Semarang City Local Regulation No. 6/2012 (referred to as PerDa), the local government is responsible for supporting waste reduction by:<sup>103</sup>

- 1) Establishing waste reduction targets;
- 2) Facilitating the implementation of environmentally friendly waste treatment technologies;
- 3) Facilitating product labeling;
- 4) Supporting reuse and recycling activities; and
- 5) Promoting the marketing of recycled materials.

The Local Regulation also defines the responsibilities for waste management as follows:

- 1) The community RT/RW is responsible for managing waste from households to the TPS/TPST;
- 2) The local government is responsible for managing waste from the TPS/TPST to TPA;
- 3) Facility managers are responsible for managing their own waste with support from the local government; and
- 4) The local government is responsible for managing waste from public facilities.

The regulation also defines the treatment process as the process of converting the characteristics/ composition and quantity of waste at the TPS/TPST/landfill by applying environmentally friendly treatment technologies. The final processing of waste is defined as the disposal of the residues of processed waste back into the environment properly. To manage the waste, the local government may:

- Develop a community group to handle the waste at each RT/RW, village, sub-district, commercial area, industrial area, public facility, and other facilities;
- Collaborate with other city governments to manage the waste by providing or constructing waste facilities and infrastructures, transportation vehicles, landfill management, and environmentally friendly waste treatment technology; and may
- Develop a partnership with the private sectors to manage the waste.

Semarang City regulates the MSW service fee under the Semarang City Regional Regulation/Peraturan Daerah (PerDa) Number 2 Year 2012 about General Service Retribution in Semarang City. This regulation states that the fees vary according to the activity, which include the following tipping fees for entities to transport their MSW to the landfill:

---

<sup>102</sup> Supriyadi, "Solid Waste Management Solutions for Semarang, Indonesia."

<sup>103</sup> Dewi, Vidyaningrum, and Munksgaard, "Screening."

- 1) Households - 7,500 IDR per m<sup>3</sup> plus a road cleaning fee that varies between 2000-10,00 IDR per month (depending on the class of road and its width).
- 2) Businesses -
  - a) Small enterprises (small office, small restaurant, small shop, salon, gym arena, clinic, apothecary, non-star small hotel and other similar businesses) - 7,500 IDR per m<sup>3</sup> plus road cleaning fee that varies between 10,000 – 50,000 IDR per month (depending on the class of road and its width).
  - b) Big enterprises (starred hotel, supermarket, mall, factory, warehouse, hospital, restaurant, office building, and other businesses) - 40,000 IDR per m<sup>3</sup> plus 250,000 IDR per month for road cleaning service fee.
- 3) Markets - 7,500 IDR per m<sup>3</sup> plus market aisle cleaning fee that varies based on the type of space that the seller rents (300-500 IDR depending on its size).
- 4) Street Vendors - 7,500 IDR per m<sup>3</sup> plus road cleaning fee that varies based on the road class and width (varies between 500-2,000 IDR per month).

Through the Environmental Agency, the Kota Semarang government has also established regulations regarding the management of solid and domestic waste as listed in Article 32 of the Semarang City Regional Regulation Number 13 of 2006.<sup>104</sup> The article prohibits burning of waste in open spaces and explains that each person who produces domestic waste is responsible for sorting the waste and processing organic waste independently into compost. These regulations, however, have not been implemented well and are not typically followed.

The Semarang Municipality Policy and Strategy for MSW Management that has been stated in Perwali No. 79 of 2018 about Municipality Policy and Strategy for MSW Management (Jakstrada) and Perwali No. 34 of 2019 which is an Amendment of the Jakstrada. This plan is required by national law. It outlines a local strategy policy related to household waste management. A copy of this plan is available [here](#). The Semarang City Jakstrada, or the Municipality MSW Management Policy and Strategy, has two main components; the MSW reduction and MSW handling improvement. The local government agencies involved in the implementation of Jakstrada Kota Semarang are:

- 1) Environmental Agency (*Dinas Lingkungan Hidup*) - main agency that will implement Jakstrada
- 2) Public Works Agency (*Dinas Pekerjaan Umum*) - supporting agency for building MSW management infrastructures
- 3) Spatial Planning Agency (*Dinas Penataan Ruang*) - supporting agency for land acquisition and permit for MSW management infrastructures
- 4) Cooperative and Small Medium Enterprise Agency (*Dinas Koperasi dan Usaha Mikro*) - supporting agency for developing the capacity of MSW communities and regulating incentive and disincentive.
- 5) Industry Agency (*Dinas Perindustrian*) - supporting agency for regulating the producer of MSW generating products and recycling industry and also to implement law enforcement for Extended Producer Responsibility (EPR)
- 6) Trading Agency (*Dinas Perdagangan*) - supporting agency for regulating the MSW service fee and also helping the industry agency to regulate the producers
- 7) Municipal Police (*Satuan Polisi Pamong Praja*) - supporting agency to monitor and implement law enforcement for littering

---

<sup>104</sup> Maryono and Hasmantika, “Smart Urban Waste.”

- 8) Transportation Agency (*Dinas Perhubungan*) - supporting agency to monitor and implement law enforcement for MSW transportation
- 9) Police Department (*Polisi Daerah*) - supporting agency to monitor and implement law enforcement for MSW treatment process
- 10) Education Agency (*Dinas Pendidikan*) - supporting agency for research and development of MSW treatment technology and also for educating the schools about MSW management
- 11) Regional Income Agency (*Badan Pendapatan Daerah*) - supporting agency for regulating MSW incentive and disincentive for business owners and also for developing the investment scheme for Public Private Partnership
- 12) Housing and Settlement Agency (*Dinas Perumahan dan Kawasan Permukiman*) - supporting agency for regulating MSW incentive and disincentive for home owners
- 13) Communication, Informatic, Statistic, and Coding Agency (*Dinas Komunikasi, Informatika, Statistik dan Persandian*) - supporting agency for disseminating the MSW management information to the people of Semarang City and also to develop the MSW information system of Semarang City

The most recent regulation is the Semarang City Plastic Utilization Control (Perwali Semarang No. 27 of 2019) which controls the usage of single use plastic bags, straws, and Styrofoam. It prohibits these single use plastics at hotels, restaurants, and in modern markets, and it subjects violators to a written warning on their first offense. With a second offense, the municipality will come to their business place to warn them personally; and on the third infraction, the municipality will freeze their business permit temporarily until single use plastic use is no longer being used in their business place.

There is also a regulation that stated that Semarang City is chosen as one of the cities from 12 cities that instructed to have MSW to energy generation. It is stated in the Presidential Regulation/ Peraturan Presiden (PerPres) Number 35 Year 2018 about MSW Processing Installation into Electric Energy Based on Environmentally Friendly Technology Construction Acceleration. Based on the regulation, the Municipality Government can build the infrastructure using the Regional Budget, National Budget, or Public Private Partnership (PPP). As for the operating agency, it can be a Regional Owned Enterprise or Private Enterprise. But if the Regional Owned Enterprise is not capable and there is no Private Enterprise interested then the National Owned Enterprise will take charge. After it is operated, the MSW to energy plant can charge for MSW tipping fee of 500,000 IDR max. It can also charge for selling the electricity to the National Electricity Company (PLN) for 13.35 cent USD/kWh if the electricity plant is under 20 MW. If it is more than 20 MW it can charge 14.54 cent USD – (0.076 x MSW to energy plant capacity in MW) per kWh.

### 3.3.2 Waste Generation and Composition

Approximately 1,270 tons per day of waste are generated in Kota Semarang.<sup>105</sup> According to the World Bank, this number is expected to increase to approximately 1,375 tons per day in 2025.<sup>106</sup> According to the World Bank, approximately 74 percent of waste is organic and 26 percent is non-organic. Households are the largest source of solid waste in Kota Semarang—approximately 70 percent of the total, or

---

<sup>105</sup> Dewi, Vidyaningrum, and Munksgaard, "Screening."

<sup>106</sup> World Bank, "Project appraisal document."

approximately 900 tons/day. Figure 20 presents the waste generation sources in Kota Semarang.<sup>107</sup> Corresponding tonnages and percentages of waste sources are provided in Table 8. According to Kota Semarang’s SSK, there were a total of 432,888 households in Kota Semarang in 2020.<sup>108</sup>

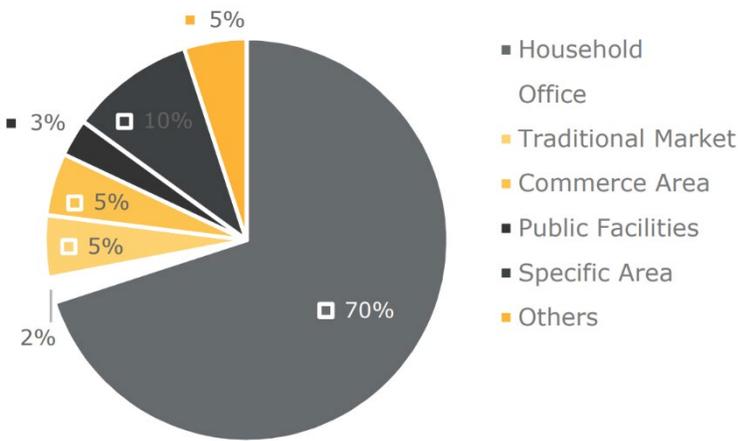


Figure 20. Breakdown of Types of Waste Generated in Kota Semarang

Table 8. Waste Sources and Generation 2017-2018<sup>109</sup>

Waste Sources in City	Percentage	Tons/Day
Households	70	889.0
Offices	2	25.4
Traditional Markets	5	63.5
Commercials	5	63.5
Public Facilities	3	38.1
Specific Region (Industries, Warehouses, etc.)	10	127.0
Others	5	63.5
<b>Total</b>	<b>100</b>	<b>1,270.0</b>

Of the seven waste sources listed above, there is considerable organic content from the household, traditional market, commercial, and region (industry) sectors. The organic fraction of household waste consists of 60 percent green waste and 40 percent food waste. The three other fractions are referred to as other organic waste, as shown on Table 9.<sup>110</sup>

Table 9. Organic Waste Source and Quantities<sup>111</sup>

Organic Waste	Waste	Organic Waste Amount	Organic Waste Amount
---------------	-------	----------------------	----------------------

<sup>107</sup> Dewi, Vidyningrum, and Munksgaard, “Screening.”  
<sup>108</sup> Government of Semarang, “Strategi Sanitasi Kota 2016-2020.”  
<sup>109</sup> Ibid.  
<sup>110</sup> Ibid.  
<sup>111</sup> Ibid.

Source	Type/Source	Tons Per Day	Per Year Tons Per Year
<b>Households</b>	Green Waste	250	91,245
	Food Waste	408	148,874
<b>Other Organic Waste</b>	Traditional Market	44	16,224
	Commercials	32	11,589
	Region (Industries)	44	16,224

### 3.3.3 Waste Collection

As is the case in other cities in Indonesia, waste management in Kota Semarang consists of several phases, including collection, temporary collection point/transfer, treatment, transportation, and final disposal. Waste collection at the source is organized by the RT/RW and collected by waste collectors (outsourced based) using hand/push carts and motor carts. The collected waste is gathered at the temporary waste collection point to be eventually transported to the final disposal/landfill. A small portion of the collected waste is further treated at a waste treatment facility using the 3R concept (TPS 3R) for composting and pre-processing recyclables to sell to dealers. Some collectors provide door-to-door collection systems that transport the waste directly to the landfill. Solid waste management practices in the city are summarized in Figure 21.<sup>112</sup> According to Kota Semarang’s SSK, 85% of collected trash was transported to a TPA as of 2015.<sup>113</sup>

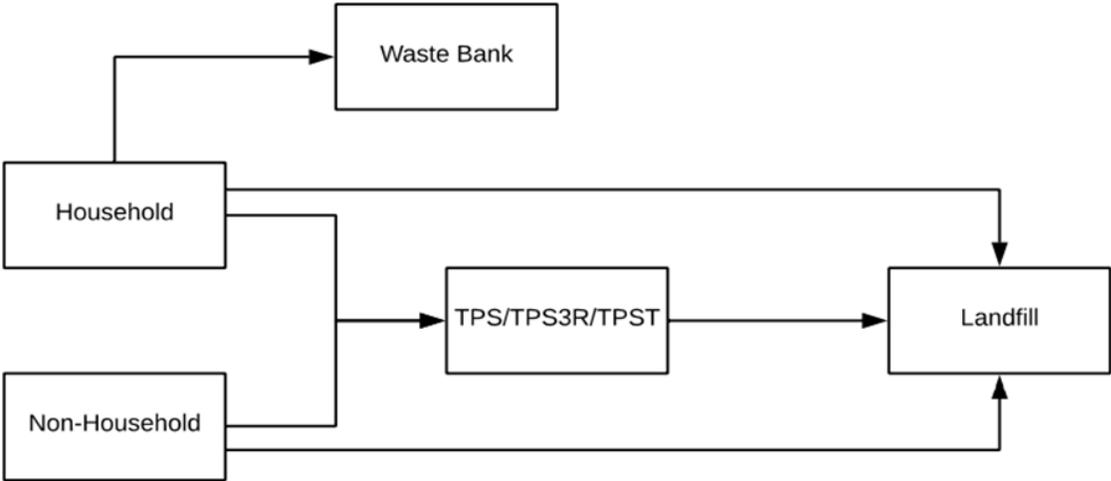


Figure 21. Existing Waste Management System in Kota Semarang

A total of 13 TPS were identified in Semarang City, including:

- TPA Karangingas
- TPS Boom Lama
- TPS Gedawang Asri

<sup>112</sup> Dewi, Vidyaningrum, and Munksgaard, “Screening.”

<sup>113</sup> Government of Semarang, “Strategi Sanitasi Kota 2016-2020.”

- TPS Kali Asin
- TPS Karangingas
- TPS Kelurahan Ngesrep
- TPS Kembangari
- TPS Pasar Gayamsari
- TPS Patriot
- TPS Perum Brigif
- TPS Pudukpayung
- TPS Rumpun Perwira
- TPS Tulus Harapan
- TPS Sampahmuda

At some TPS locations, garbage tends to pile up because containers are picked up late or not returned.<sup>114</sup> The TPS Karangingas sign reads, “Semarang City Government, Sanitation and Gardening Services. Prohibited: 1) throwing garbage anywhere and 2) burning trash,” although enforcement of this is challenging.

To collect and transport the waste from the sources, the Environmental and Forestry Agency of Semarang uses various equipment and facilities, such as push and motor carts. Table 10 provides a list of SWM equipment and facilities as of 2015, based on the Semarang City Sanitation Strategy (2016-2020).<sup>115</sup>

Table 10. Waste Management Equipment in Semarang<sup>116</sup>

Facility/Equipment	Unit	Quantity	Capacity (m <sup>3</sup> ) / (yd <sup>3</sup> )	Transport Frequency (trip/day)
<b>Collection</b>				
Push Cart	Unit	38	1 (1.3)	2
Bicycle/Motor Cart	Unit	59	1 (1.3)	2
Pick-Up Truck	Unit	15	1.5 (2)	2
<b>Collection/Transfer Point</b>				
Container	Unit	406	6 (8)	-
Transfer Station	Unit	246	2x6 (2.6x8)	-
<b>Transport</b>				
Dump Truck	Unit	33	6 (8)	2
Arm Roll Truck	Unit	137	6 (8)	4
Compactor Truck	Unit	4	6 (8)	1
<b>Treatment Facility</b>				
TPS 3R	Unit	20	30 (39)	-
<b>Heavy Equipment at Final Disposal Site</b>				
Bulldozer	Unit	2	-	-

<sup>114</sup> Google Maps, “Sampah near JL Karangingas.”

<sup>115</sup> Dewi, Vidyaningrum, and Munksgaard, “Screening.”

<sup>116</sup> Ibid.

Wheel/Truck Loader	Unit	2	-	-
Excavator/Backhoe	Unit	2	-	-
Truck	Unit	4	-	-

The service level of Semarang SWM has increased significantly in the last few years. Based on a Solid Waste Management Master Plan prepared by COWI, an international consulting group, in 2012/2013, the service level in Semarang was only 33 percent, with zero percent level of service in Mijen and Gunungpati sub-districts.<sup>117</sup> This resulted in large amounts of illegal disposal/dumping practiced in the city, including open burning, dumping into the rivers, and burying in backyards. In 2017-2018, the level of service increased to 72 percent.<sup>118</sup>

The cost of services in Semarang City, as reported in 2010, was \$0.75/ton for collection, \$0.06/ton for transfers, \$2.41/ton for transportation, and \$0.59/ton for landfill—for a total of \$3.81/ton.<sup>119</sup>

Figure 22 presents the flow of waste in Semarang city (and the associated tonnages per day), starting from collection, transfer, transport, to final disposal.<sup>120</sup> Unidentified waste on the diagram below is defined as the waste that is collected from the source but does not reach the landfill and is instead burned, dumped, or leaked to the environment.

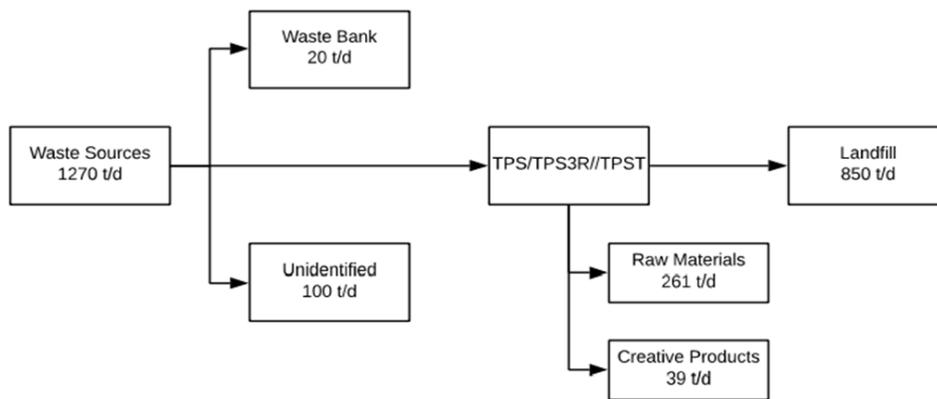


Figure 22. Waste Tonnages in Kota Semarang

Around 350 IWCs work and reside in the surrounding areas of the Jatibarang Landfill. They collect, pretreat, and transfer recyclables to the recycling factory. Some IWCs also raise and graze cattle at the dump site (Figure 23).<sup>121</sup> The total livestock population is approximately 1,300.<sup>122</sup>

Also supporting collection are community-based waste banks that are promoted by the Semarang government to reduce waste generation at the source. A waste bank operates as a place to collect valuable waste for recycling. Waste bank activities include gathering the reusable and the recyclable waste that can be sold or used for handcrafting or, in for more valuable recyclables sold directly to the waste dealers.

<sup>117</sup> Hadiwidodo, Smadikun, and Arinasandi, “Waste Bank’s Condition.”

<sup>118</sup> Dewi, Vidyningrum, and Munksgaard, “Screening.”

<sup>119</sup> Rahim, Nakayama, and Shimaoka, “Municipal Solid Waste.”

<sup>120</sup> Dewi, Vidyningrum, and Munksgaard, “Screening.”

<sup>121</sup> Ibid.

<sup>122</sup> Lokahita et al., “Excavated waste.”

Some waste banks also produce compost from organic waste. The waste bank also creates revenue by selling the pre-processed (sorted, washed, and packed) recyclables to the waste dealer. About 20 tons of household waste are collected through waste banks daily.<sup>123</sup>



Figure 23. Local Informal Waste Collectors and Cattle in TPA Jatibarang

Based on 2018 data from the Semarang City Environmental Agency, there are 44 active waste banks in Semarang City spread across its sub-districts (see Figure 24),<sup>124</sup> although CCBO has received information that in 2020 this number may be as high as 65.

They are managed independently by the community and managers at waste banks are local residents who work voluntarily. Not all waste banks in Semarang City have their own buildings and most of the waste bank buildings are adjoined to a resident’s house—usually those of village officials, RW/RT, or the manager of waste bank.

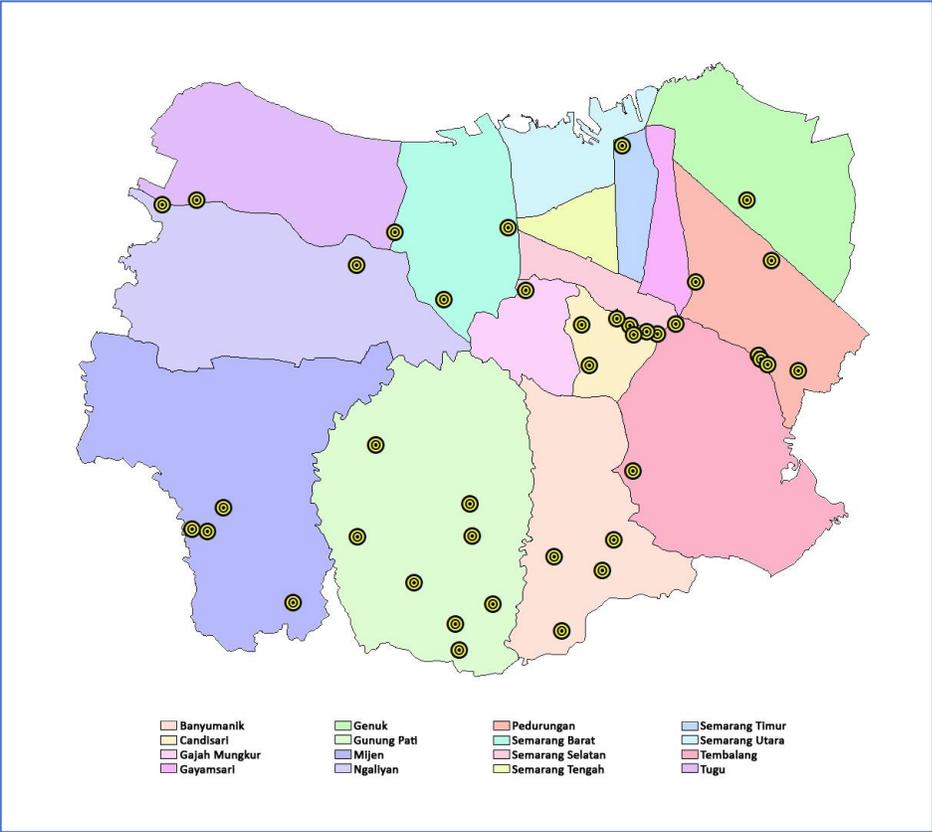


Figure 24. Map of Waste Bank Distribution in Kota Semarang

<sup>123</sup> Dewi, Vidyningrum, and Munksgaard, “Screening.”  
<sup>124</sup> Hadiwidodo, Samadikun, and Arinasandi, “Waste Bank’s Condition.”

### 3.3.4 Recycling System

As shown in Figure 25, of the quantities of potentially recyclable materials in the waste stream, plastic has the highest potential; about 54 percent of the total non-degradable recyclable material.<sup>125</sup> Informal waste collectors typically seek plastic types such as PET, PE, and PP since they have value and can be sold—as opposed to LDPE plastic bags, which have a relatively low selling price, exacerbating environmental leakage.

Segregation of recyclable waste is carried out by households in Kota Semarang,<sup>126</sup> but only in an informal way (not organized by the local government). Informal waste collectors collect any valuable recyclables from homes, or scavenge from the TPS, or at the TPA. Once collected, it is sold to the other collectors/junk shops for sorting. The sorted recyclables are sold to a plastic waste mill to be used that make them into flakes of plastic ore that is then used in primary manufacturing. Some collectors also send their plastic waste stocks directly to the advanced processing plant (primary manufacturing) without plastic milling. Of the plastic waste produced by households, about 24 percent (53.5 tons) were collected for the recycling process through IWC’s collecting activities.<sup>127</sup>

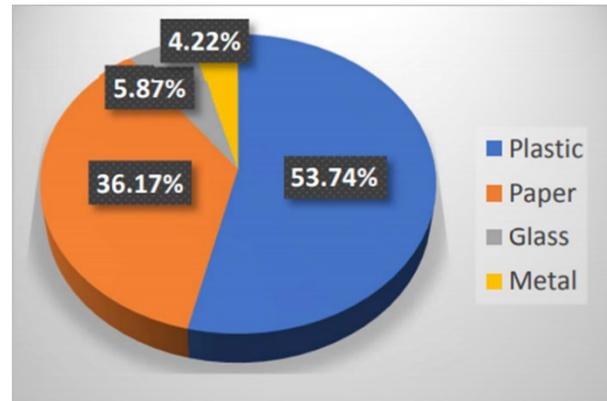


Figure 25. Breakdown (by %) of the types of recyclables in the waste stream

According to Kota Semarang’s SSK, the city is looking to develop a reward system for community participation in 3R waste management.<sup>128</sup>

### 3.3.5 Processing

#### **Recycling Centers**

In Semarang, there are small scale waste processing facilities (TPS 3Rs) which normally process the small portion of collected recyclables before they are sold to waste dealers as secondary raw materials or recycled into creative products, as well as process organic waste into compost.

There are five TPS 3R actively operating in Semarang City with various capacities between 0.5 to 1.5 TPD.<sup>129</sup> Two of the five TPS 3R in Semarang City were found via satellite photography; TPS 3R Dadi Resik and TPS Sedaducacat (see Figure 18). Three other TPS 3R facilities (TPS 3R Bergaskidul, KSM Sokaku Asri TPS 3R, and Calon TPS 3R Pianggang 3) are located along the outskirts of Semarang City, which could

<sup>125</sup> Andarani, “Preliminary Study on Plastic Waste Handling in Semarang City.”

<sup>126</sup> Dewi, Vidyaningrum, and Munksgaard, “Screening.”

<sup>127</sup> Andarani et al., “Plastic Waste Handling.”

<sup>128</sup> Strategi Sanitasi Kota Makassar 2012 – 2017.

<sup>129</sup> Dewi, Vidyaningrum, and Munksgaard, “Screening.”

potentially be the additional three out of the five TPS 3R identified. Figure 26<sup>130</sup> is a picture of TPS 3R Dadi Resik, a typical TPS 3R in Semarang.



Figure 26. TPS 3R Dadi Resik

### **Material Recovery Facilities**

Integrated solid waste treatment facility (TPST) Mijen is managed and owned by the developer of “Bukit Semarang Baru,” an urban development in Semarang. The facility is treating household generated waste. A total of eight people work at TPST Mijen and earn a salary of IDR 65,000 (\$4.63) per day/worker. The incoming waste input to TPST Mijen reaches 6 m<sup>3</sup> (8 yd<sup>3</sup>)/day (three pick-ups with the capacity of 2 m<sup>3</sup> [2.6 yd<sup>3</sup>]/pick-up) in mixed condition. Then, the incoming mixed household waste is manually sorted into organic and inorganic waste. The size of organic waste is then reduced to 20-50 mm with a chopper and then continues to the fermentation (semi aerobic) phase for one month. The pile of compost is turned manually every three days.

The composition of non-organic waste from the TPST mainly consists of PET bottles, HDPE bottles, cardboard, paper, and other plastics. The PET bottles are compacted and sold to a waste dealer once or twice a week. The price of pressed PET bottles is around 2,500 IDR/kg (\$0.18/kg) and HDPE bottle is 4,000 IDR/kg (\$0.28/kg); however, the price is usually unstable. Figure 27 shows recyclables and windrow composting at TPST Mijen.<sup>131</sup>

According to 2018 data from Indonesia’s National Solid Waste Management Information System (Sistem Informasi Pengelolaan Sampah - SIPSAN), there are five TPSTs in Kota Semarang with various capacities ranging from 0.75-1.5 TPD. In the development of this assessment, it was assumed that the waste composition and condition are similar to TPST Mijen. Therefore, the potential feedstock coming from all TPSTs in Kota Semarang is estimated to reach 4.30 TPD (1,570 TPY) of mixed waste and 0.77 TPD (283 TPY) of organic waste. Four of the five TPSTs were located online, including TPST Universitas Diponegoro, TPST Dan Bank Sampah, TPST Purwosari, and TPST Mijen.<sup>132</sup>

---

<sup>130</sup> Google Maps, “TPS 3R Dadi Resik.”

<sup>131</sup> Dewi, Vidyaningrum, and Munksgaard, “Screening.”

<sup>132</sup> Google Maps, “TPST Purwosari.”



Figure 27. Recyclables and Windrow Composting at TPST Mijen



Figure 28. TPST Purwosari

### **Composting**

Since management of non-household waste is the responsibility of the individual business, some traditional markets have been processing their waste independently, primarily through composting the organic waste generated at the market. Approximately 150 m<sup>3</sup> (196 yd<sup>3</sup>) of waste are processed for composting as shown in Table II.

Table II. Waste Treatment in Semarang City<sup>133</sup>

Market Name	Method	Volume (m <sup>3</sup> /month)/(yd <sup>3</sup> /month)	Executing Agency
Pasar Johar	Composting	37.5 (49)	UPTD Johar
Pasar Gayamsari	Composting	37.5 (49)	UPTD Gayamsari
Pasar Pedurungan	Composting	37.5 (49)	UPTD Pedurungan
Pasar Mrican	Composting	37.5 (49)	UPTD Mrican

<sup>133</sup> Dewi, Vidyaningrum, and Munksgaard, "Screening."

Jatibarang landfill is equipped with an organic waste treatment facility (composting) operated by PT. Narpati Agung Karya Persada Lestari.<sup>134</sup> The Environmental Agency of Semarang and PT. Narpati partnered beginning in 2010. The total amount of waste treated in this composting facility reached 250 tons/day.

The composting plant operates six days per week for seven hours per day. The soil amendment produced is then purchased by petrochemical industry for the price of 1,180 IDR/kg (\$0.08/kg) as well as refuse derived fuel (RDF) for the price of 200 IDR/kg (\$0.01/kg). The RDF was purchased by the cement industry in another city in Central Java and has a calorific value of 25,104 KJoule/Kg. (10,900 BTUs/lb.) However, due to the high cost of transporting the RDF, it was discontinued. As of mid-2018, PT Narpati is not operating due to a management issue, both external (related to retribution fee) and internal (organizational issue). According to the information from DLH, there is a plan (still in the discussion phase) for the city government to take over the composting plant through a business enterprise owned by regional government/authorities known as BUMD (PT. Bumi Pandanaran Sejahtera).

### **Junk Shops**

There are five junk shop facilities identified in Semarang where a variety of items are sorted and resold (see Figure 18 for junkshop locations). Many vehicles such as cars, trucks and motorcycles are sold or abandoned at these facilities, and parts are resold based on the quality of the items. Figure 29 shows an example of a junk shop in Kota Semarang.<sup>135</sup>



Figure 29. Pemensanan Cakar Ayam (Junk Shop)

According to Kota Semarang's SSK, there are a number of communities in urban villages across Kota Semarang that sort waste; organic waste for compost and inorganic waste for handicraft.<sup>136</sup> Each location processes between 3 m<sup>3</sup> and 60 m<sup>3</sup> each month.

### **Recycling Factories**

There are no factories in Semarang City that use recycled plastic. The closest plastic recycling factory from Semarang City is located in Karangjati, Semarang Regency, but there is only one factory.<sup>137</sup> Therefore, the recyclable material that are collected in Semarang City are often transported to Surabaya to be recycled. Semarang City does, however, have a few factories that use virgin plastic as a feedstock. According to the Ministry of Industry data, there are about 38 plastic factories in Semarang City.<sup>138</sup> Since Semarang City has started to implement its plastic control regulation, it has been considering whether the plastic factories could shift from using new plastic to recycled plastic because the basic machinery are almost the same.

---

<sup>134</sup> Andarani et al., "Plastic Waste Handling."

<sup>135</sup> Google Maps, "Pemensanan Cakar Ayam."

<sup>136</sup> Government of Semarang, "Strategi Sanitasi Kota 2016-2020."

<sup>137</sup> Ministry of Industry (2019a)

<sup>138</sup> Ministry of Industry (2019b)

### 3.3.6 Waste Disposal

The disposal rate in Semarang City was estimated to be 86.98 percent,<sup>139</sup> and TPA Jatibarang is the only existing landfill in Semarang City and serves all administrative areas. The Jatibarang Final Solid Waste Dumping Site (TPA Jatibarang) is located on the west side of Semarang City (see Figure 18). Based on USAID-provided information, it is estimated that the local government spends \$10/per ton on collected waste.<sup>140</sup> According to the World Bank, Kota Semarang received a score of 43/100 based on the criteria described in Section 3.2.6.<sup>141</sup>



Figure 30. Aerial View of the Jatibarang Landfill

The waste coming into this facility was approximately 800 tons of per day, according to a 2018 study. The capacity of the dumping site is about 4.15 million m<sup>3</sup> (5.43 million yd<sup>3</sup>) of solid waste. The total area of Jatibarang landfill is 0.4 km<sup>2</sup> (approximately 100 acres) and about 0.09 km<sup>2</sup> (22 acres) of the total area has been used. The landfill is divided into three zones—an inactive zone that is currently under closure and rehabilitation for the landfill gas recovery project; an active zone where tipping takes place; and an inactive zone to stockpile soil.

The facility is equipped with leachate treatment (a combination of anaerobic and aerobic treatments), where the leachate collection channels distribute the collected leachate to a treatment plant. The plant contains a pump house with a small generator set and pumps. Other facilities at TPA Jatibarang include an office, a weighing bridge, and equipment such as bulldozers, wheel/truck loaders, excavators, and dump trucks.

The landfill system is operated as a controlled landfill, but it has several features of a sanitary landfill. For example, there is a landfill gas recovery facility installed. The landfill gas (methane gas) is used to replace liquefied petroleum gas for the local residents. The landfill gas recovery facility produces 120 m<sup>3</sup> (4200 scfm)/day of methane. According to the Environment Agency of Semarang, in 2016, 125 households were using the TPAs landfill gas instead of liquid petroleum.

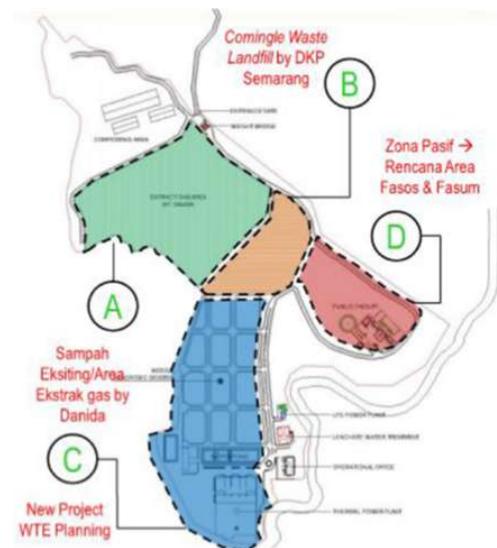


Figure 31. Site Map of Jatibarang Landfill DANIDA project

<sup>139</sup> World Bank, "Project appraisal document."

<sup>140</sup> Ibid.

<sup>141</sup> Ibid.

The Danish International Development Agency (DANIDA) and the national ministries have also initiated a landfill gas recovery project at TPA Jatibarang.<sup>142</sup> The project's objective is to close the current inactive area, collect the methane gas produced and produce electricity out of it. It will also close two zones of waste dumping (zone A and B), construct a new disposal site with a sanitary landfill system, collect and treat the methane gas, and utilize the methane gas as fuel for the power plant. The generated electricity will be sold to *Perusahaan Listrik Negara*/National Electricity Company.

The landfill gas recovery project began in 2017 and is scheduled to be completed with the closure and cover of zone D in 2026.

As of the drafting of this document, CCBO could not obtain an update on the status of this project. Figure 31 shows a site plan of the landfill and Figure 30 an aerial view of the TPA Jatibarang landfill zone.<sup>143</sup>

### 3.3.7 *Waste Reduction Initiative*

The Semarang government recognizes the importance of waste reduction in its policies and planning. One initiative it has launched is a prepaid plastic bag program which aims to minimize the amount of waste by discouraging the use of single use plastic bags by making the user pay to use one. As a result, every purchase using a plastic bag will be subject to a tariff of IDR 200 (\$0.1).<sup>144</sup> This program is one of the activities to implement the plastic control regulation that has been enacted. According to the Semarang City Environmental Agency data, in 2020 there has been a decrease of around 97% of single use plastic bag usage in those official shops and clinic compared to the usage in 2019.<sup>145</sup>

### 3.3.8 *Education and Outreach*

The BINTARI Foundation (The Indonesian Association for Sustainable Development) is working closely with Semarang's Environmental Agency, Indofood, and other companies that package products in plastic. The objective is to strengthen the community's management of solid waste and plastic recycling by helping the packaging industry test models for promoting recycling practices that reduce plastic waste among consumers. The project is identifying approaches that promote the collection and recycling of lower-value, single-use plastics. BINTARI is also supporting community waste banks in Semarang City by linking them to private sector recyclers and coordinating garbage collection with the city's SWM operation.<sup>146</sup>

One education program in Semarang has been developed through a USAID Municipal Waste Recycling Program (MWRP) grant. This project launched a public-private partnership between 54 waste banks, serving more than 6,500 households, local authorities, and companies, including the major food manufacturing company PT Indofood. The partnership with PT Indofood is particularly important since it

---

<sup>142</sup> Dewi, Vidyaningrum, and Munksgaard, "Screening."

<sup>143</sup> Maryati, "Towards Sustainable Ambon Bay."

<sup>144</sup> Dinus Lingkungan Hidup Kota Semarang, "5 Program."

<sup>145</sup> Semarang City Environmental Agency "Data Monitoring"

<sup>146</sup> Urban Links, "MWRP Indonesia."

focuses on increasing the recycling of single-use, low-value plastics such as noodle wrappers that are not typically recycled.<sup>147</sup>

An additional education program has been initiated by the Semarang City Environmental Agency known as the “Kelurahan Ramah Lingkungan” (Environmentally Friendly Village) program.<sup>148</sup> One of the activities is a “Lomba Kelurahan Ramah Lingkungan” (Environmentally Friendly Village Competition), which has been implemented since 2011 among 16 villages with representatives of each district. The competition focuses on waste management including sorting waste, organic and inorganic waste recycling.

### 3.3.9 Solid Waste Planning

The City of Semarang complied with the national law and developed a Jakstrada. This solid waste plan document was approved as the Regulation of the Mayor of Semarang Number 34 of 2019. This plan follows the national guidelines and appears to simply replicate the prepared national template.

## 3.4 Kota Makassar

Kota Makassar is the capital of the Indonesian province of South Sulawesi—located on the southwest coast of the island and east of the Kota Makassar Strait. It is one of the largest cities in Eastern Indonesia with a total area of 77.0 square miles. As of 2020, the population was estimated to be around 1.6 million, with a total population density of 20,000/square mile. According to the City Sanitation Strategy for 2012-2017 for Kota Makassar, the city’s population was increasing at approximately 1.6% each year.<sup>149</sup>

The economy heavily depends on the service sectors and industrial activities such as restaurants, hotel services, transportation, communication, trading, and finance.<sup>150</sup> Kota Makassar lies directly between the western and eastern part of Indonesia, making it a central trading hub. The Port of Kota Makassar is one of the highest in passenger traffic among Indonesian ports and the largest cargo traffic in Sulawesi. It is also the gateway to Eastern Indonesian tourist attractions.<sup>151</sup>

The city’s solid waste system is developing, and a network of infrastructure is in place. Figure 32 maps out the various facilities in Kota Makassar that form its 3R/SWM system.

### 3.4.1 Governance

The city is divided into 15 administrative districts (Kemantan) and 153 urban villages. They are governed by the executive head of the city which consists of an elected mayor who serves a five-year term. The mayor is then assisted by an elected deputy official and legislative assembly. The 15 administrative districts are:

- Biringkanaya
- Bontoala

---

<sup>147</sup> Ibid.

<sup>148</sup> Maryono and Hasmantika, “Smart Urban Waste.”

<sup>149</sup> Strategi Sanitasi Kota Makassar 2012 - 2017

<sup>150</sup> Wikipedia, “Makassar.”

<sup>151</sup> Wonderful Indonesia, “Makassar.”

- Kota Makassar
- Mamajang
- Manggala
- Mariso
- Panukkukang
- Rappocini
- Sangkarang Islands
- Tallo
- Tamalanrea
- Tamalate
- Ujung Pandan
- Ujung Tanah
- Wajo

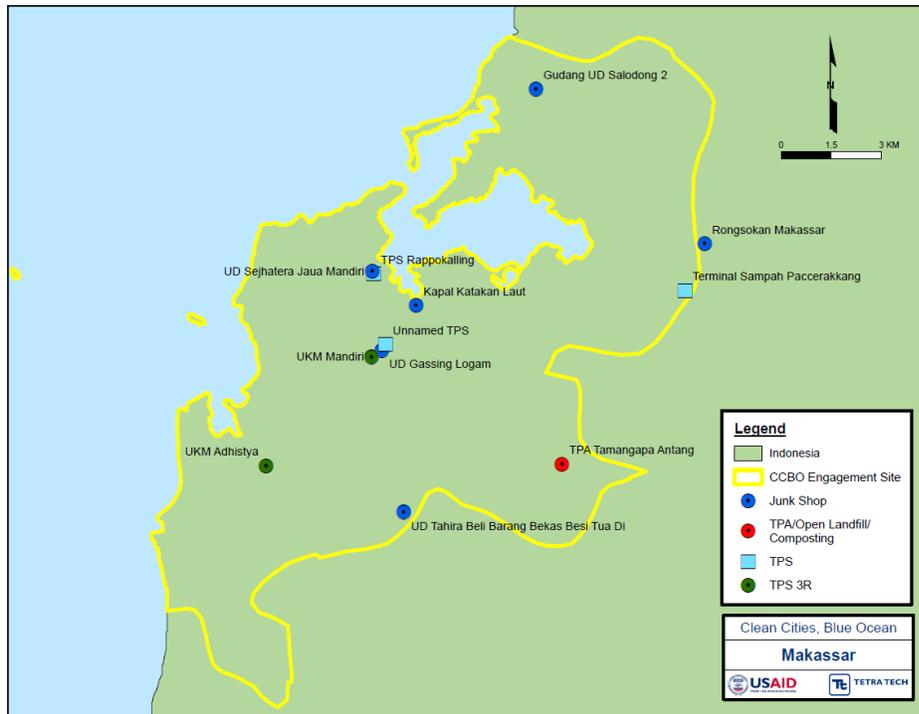


Figure 32. Map of Kota Makassar and Waste Management Facilities

According to UN Habitat’s Climate Change Assessment, the five-year term that elected officials serve is part of a budget plan called Rencana Pembangunan Jangka Menengah Daerah (RPJMD), or the regional medium-term development plan. This plan allows the city to allocate funds to different departments and keep track of them on an annual basis. Each district is then divided by local levels of governments that provide services for residents and act as the first contact that citizens have with government officials. It was estimated that 3.3% of the annual budget was allocated towards solid waste management in Kota Makassar.<sup>152</sup>

Regulation Number 36 of 2018 is the regional policy regarding the management of household waste and similar types of waste in Kota Makassar known as Jakstrada.<sup>153</sup> The regulation requires the reduction of household waste through the promotion of the 3R’s and proper handling of waste from point of disposal to final processing. Waste management strategies are further discussed in section 2.1. The CCBO team

<sup>152</sup> World Bank, “Project appraisal document.”

<sup>153</sup> Mayor of Makassar, “Regulation Number 36 of 2018.”

was unable to obtain an English version of this regulation, but a copy of the original Jakstrada can be found [here](#).

Like Semarang and Ambon, Makassar also has regulation for Municipal Solid Waste Management, Single Use Plastic Bag Control, and MSW management service retribution, in the following regulations:

- 1) Makassar City Mayor Regulation Number 4 Year 2011;
- 2) Makassar City Mayor Regulation Number 11 Year 2011; and
- 3) Makassar City Mayor Regulation Number 70 Year 2019.

### 3.4.2 Waste Generation and Composition

According to an article from the World Bank, Kota Makassar produces about 1,000 to 1,200 tons of waste per day (4,495 m<sup>3</sup> [5,879 yd<sup>3</sup>]/day)<sup>154</sup>. This is expected to increase to nearly 1,400 tons per day by 2025.<sup>155</sup> Figure 33 demonstrates that in 2009, approximately 60 percent of the solid waste in Kota Makassar was generated by households, and of that, the majority was from those who lived in standard housing.<sup>156</sup>

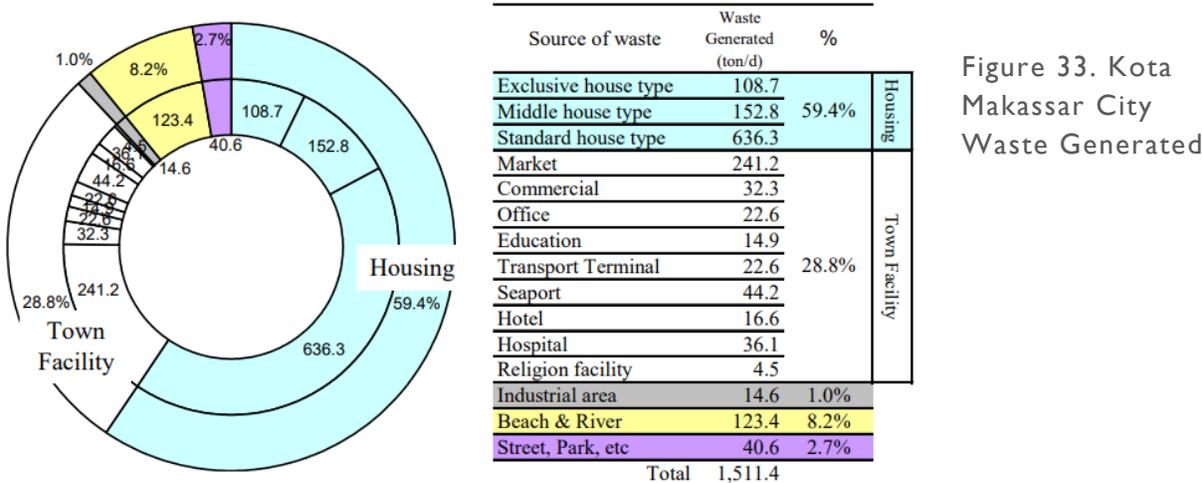


Figure 33. Kota Makassar City Waste Generated

Composition data like this can also be viewed in a table format (Table 12).<sup>157</sup> This table shows more recent data than Figure 33—however, data still shows that household waste is the largest percentage.

Table 12. Waste Generators and Transported Waste in Kota Makassar City<sup>158</sup>

Waste Sources	Daily Waste Generation (m <sup>3</sup> /day) / (yd <sup>3</sup> /day)	Percentage (%)	Transported Waste (m <sup>3</sup> /day) / (yd <sup>3</sup> /day)
Residential/Household	2136 (2793)	51.0	1807 (2364)
Commercial Areas	1466 (1917)	35.0	1210 (1583)

<sup>154</sup> World Bank, “City.”  
<sup>155</sup> World Bank, “Project appraisal document.”  
<sup>156</sup> Rahim, Nakayama, and Shimaoka, “Municipal Solid Waste.”  
<sup>157</sup> Permana et al., “Practices.”  
<sup>158</sup> Ibid.

Industrial Areas	84 (110)	2.0	60 (78)
Open Spaces/Water Body	314 (411)	7.5	265 (347)
Tourist Coastal Areas	42 (55)	1.0	40 (52)
Street	117 (153)	2.8	110 (144)
Others	29 (38)	0.7	22 (29)
<b>Total</b>	<b>4188 (5,477)</b>	<b>100.0</b>	<b>3514 (4597)</b>

Another way to characterize Kota Makassar’s waste stream is by the type and quantity of different materials that it can be found to contain. Table 13 shows that organic waste is the predominant waste generated in the city. According to a 2015 article from Habitat International, much of the organic waste is left unmanaged despite its large part in the waste composition. Kota Makassar lacks up-to-date composting or other appropriate technologies that could reduce this amount.

Table 13. Solid Waste Composition in Kota Makassar City<sup>159</sup>

<b>Waste Type</b>	<b>Quantity of Waste Generated (m<sup>3</sup>/day) / (yd<sup>3</sup>/day)</b>	<b>Percentage (%)</b>
Organic Waste	2998 (3921)	71.5
Paper	429 (561)	10.0
Plastic	401 (524)	9.6
Metal, Tin, Iron, Aluminum	164 (215)	4.0
Rubber	123 (161)	3.0
Glass	39 (51)	0.1
Lumber	32 (42)	0.1
Others (i.e. Hazardous Wastes)	2 (2.6)	0.1
<b>Total</b>	<b>4188 (5478)</b>	<b>100.0</b>

### 3.4.3 Waste Collection

Kota Makassar’s collection service rate is high; estimated to be about 95 percent.<sup>160</sup> The city also uses the TPS/TPA system, as seen in other Indonesian cities. According to the World Bank, responsibilities for certain waste services are as follows:

- Collection and transport of household waste to TPS is the responsibility of the RT/RW;
- Transport of waste from the TPS to the TPA is the responsibility of the local government;
- Collection and transport of non-household waste from businesses to the TPS/TPA is the responsibility of the estate management (residential, commercial, or industrial); and
- Collection and transport of waste from public and social facilities is the responsibility of the local government.

<sup>159</sup> Ibid.

<sup>160</sup> World Bank, “Project appraisal document.”

Kota Makassar has ten **Regional Technical Implementation Units (UPTDs)** who manage municipal solid waste facilities and oversee sorting activities in the community.<sup>161</sup>

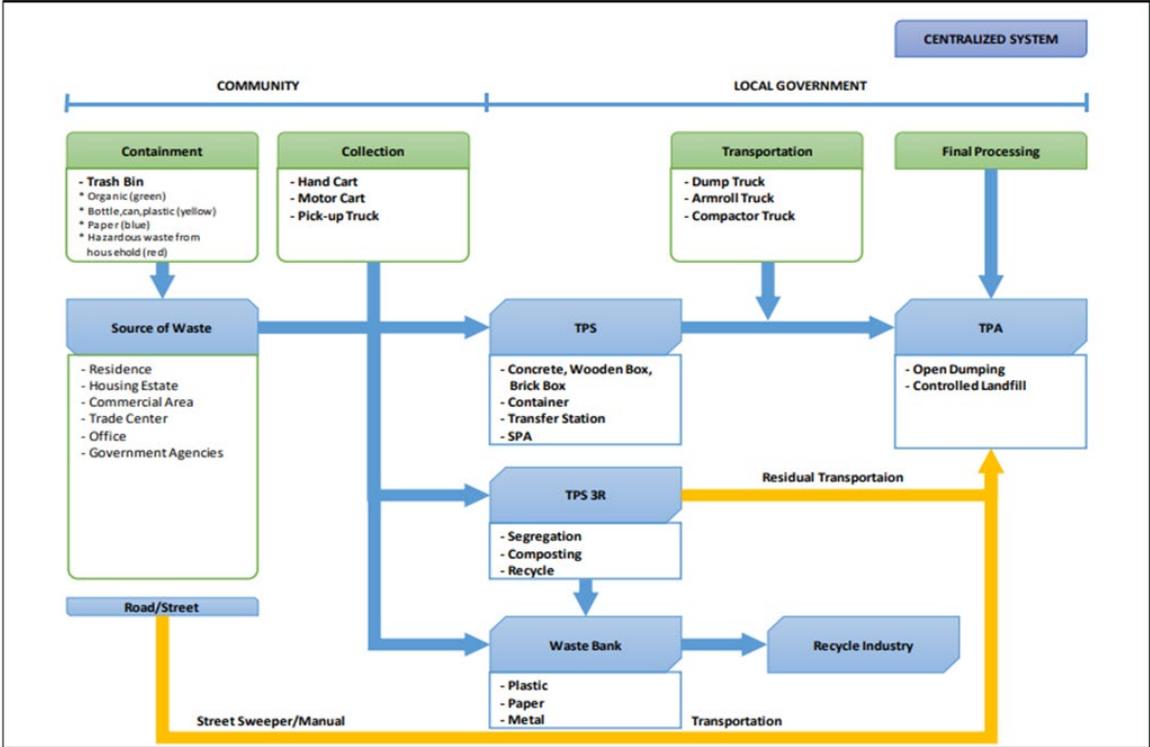


Figure 34. Flow chart of Makassar’s existing solid waste management system<sup>162</sup>

According to a study from the Japan International Cooperation Agency (JICA), PD Kebersihan (Regional cleansing enterprise) collects solid waste from households, hotels, and restaurants in four districts (Ujung Pandang, Wajo, Biringkanaya and Tamalanrea); the Department of Environment and Beautification collects waste in other areas in Kota Makassar and disposes it in TPA Tamangapa.

In ISMA research, limited information was found on the number facilities currently operating in the city. All locations were mapped using Google Earth, and not all TPS/TPA may have been identified. Figure 32 shows current TPS and TPA locations.

Table 14, below, shows the equipment recorded for transporting waste around the city.<sup>163</sup> Residents primarily use handcarts, trucks, and motor vehicles, while local government services use more of the heavy machinery (arm roll trucks and compactors).

<sup>161</sup> Completeneews, “Pj. Wali Kota Kota Makassar.”  
<sup>162</sup> World Bank, “City.”  
<sup>163</sup> JICA, “Mamminasata.”

Table 14. Equipment for Transportation of Waste in Kota Makassar<sup>164</sup>

Equipment	Volume (m <sup>3</sup> ) / (yd <sup>3</sup> )	Quantity
Handcart (1m <sup>3</sup> )	1 (1.3)	299
Tipper Truck (6m <sup>3</sup> )	6 (8)	64
Arm Roll Truck (6m <sup>3</sup> )	6 (8)	48
Arm Roll Truck (10m <sup>3</sup> )	10 (13)	2
Compactor (6m <sup>3</sup> )	6 (8)	4
Motor Becak	-	6
Other Vehicles	-	12

**Waste Bank Facilities**

Waste banks in Kota Makassar allow citizens to collect trash and cash out their waste at these facilities. Using data management services from BankSampah.id and Google Earth, ISWMA research located five waste bank locations in the city where residents may exchange their garbage. It is believed, however, that there are hundreds more. According to The Jakarta Post, waste banks have become the favored solution to waste problems in Kota Makassar because they have been effective in keeping the city clean and providing residents with an additional income.

The first waste bank in Kota Makassar, Yayasan Peduli Negeri, was built in 2011 and since then there have been 230 built. The facilities currently accommodate over 6,000 suppliers across the city. On average, each bank receives anywhere from 10 to 20 kg per day (22 to 44 lbs./day) and, collectively, the banks have decreased the city’s inorganic waste which makes up about 40 percent of the total waste composition.<sup>165</sup> These facilities, however, have limitations mainly because of the lack of collection from the UPTD. As seen in Figure 35, Bank Sampah Pusat Kota Kota Makassar has collected materials piling up behind the gate. Most waste banks can only collect and transport about 60 kg (132 lbs.) per day, therefore much of the waste is left to accumulate.<sup>166</sup>



UPTD Bank Sampah Pusat Kota Kota Makassar (Central Waste Bank), shown left,<sup>167</sup> was established by the local government to purchase recyclable waste at set prices in the local waste banks.<sup>168</sup> The city administration sends trucks to collect waste and brings it to the central trash bank where it can be sorted, processed and sold.

Figure 35. Bank Sampah Pusat Kota Kota Makassar

<sup>164</sup> Ibid.  
<sup>165</sup> Hiramurni, “Cash in on Trash.”  
<sup>166</sup> Ibid.  
<sup>167</sup> Google Maps, “Bank Sampah Pusat Kota Makassar.”  
<sup>168</sup> Law-In-Action, “3000 Trash Banks.”

### 3.4.4 Recycling System

Households in Kota Makassar are not required to separate recyclable waste for formal collection. Although the local governments encourage the 3R method (reduce, reuse, and recycle), recycling is only practiced on a small scale. The recycling system in Kota Makassar first starts at the household level, where the homeowners sort their recyclable waste. Only a small number of households in Makassar implement this way. The households that have sorted the waste then will bring their sorted recyclable to the waste bank or junk shop to sell it. The waste banks and junk shops then will sell the recyclables to a bigger aggregator. The aggregator then will finally sell it to the recycling factories. Each waste type has a different recycling factory.

The flow of domestic waste of RW communities in Kota Makassar can be seen in Figure 36.<sup>169</sup> Only 0.7 percent of households practice sustainable SWM. As a result, TPA Tamangapa, which is the only landfill site operation in Kota Makassar, is over-capacity in waste.

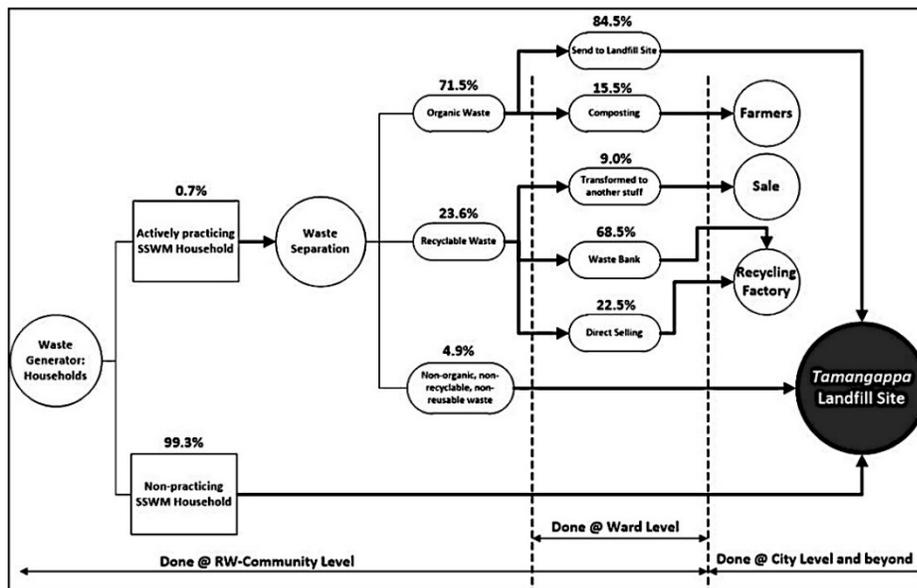


Figure 36. Flow of Waste through Kota Makassar's 3R/SWM System

### 3.4.5 Processing

#### Recycling Centers

Recyclable waste is often sorted by IWCs at the waste banks, TPS, or even in TPA Tamangapa. According to Kyushu University, around 300-400 IWCs sort through the waste delivered to Tamangapa Landfill where they collect and sell waste with economic value directly to recycling factories or to traders and waste banks who sort and sell materials to the recycling factories.

<sup>169</sup> Towolioe et al., "Rukun Warga-based 3Rs."

### **3R TPS Facilities**

According to Kompasiana, Usaha Kecil Menengah (UKM) are small, medium, and micro enterprises that are also known as TPS 3R. Two UKMs were identified by satellite photos in Kota Makassar: UKM Mandiri and UKM Adhistya (Figure 32). The CCBO team understands, however, that there are seven TPS 3R that have been built in Makassar City. These seven TPS3R are located in the District of Mamajang, Tamalanrea, Mariso, Biringkanaya, and Manggala. Of these TPS3R, however, only one is currently operating properly, which is TPS Darul Aman in Biringkanaya District. <sup>170</sup>

### **Composting Facilities**

Composting of organics is becoming more common. Some housing, and collection departments that transfer waste from TPSs in Kota Makassar practice small scale composting; TPA Tamangapa has composted on a larger scale (approximately 40 TPD),<sup>171</sup> although ISWMA research seemed to indicate that composting at this site is currently inactive.

### **Junk Shops**

Junk shops are small businesses that sort through waste for materials to resell. Six junk shop locations were identified in Kota Makassar found through aerial photography and are indicated in the Figure 32 map. According to the SIPSN data, in total there are 18 junk shops in Makassar City. ISWMA research has also found that Facebook Marketplace contains posts from facilities that list items for sale such as Rongkosokan Kota Makassar.



Figure 37 shows UD Sejahtera Jaya Mandiri, an example of a typical junkshop.<sup>172</sup> Some recycling activities are situated in residential neighborhoods.

Figure 37. Entrance to UD Sejahtera Jaya Mandiri

Figure 38<sup>173</sup> shows another junk shop facility, UD Gassing Logam, located within the city. Its sign lists a variety of metals available for resale. Google reviews for these junk shops indicate that many residents visit to obtain electronics and spare parts for their motor vehicles.

---

<sup>170</sup> WWF, “Plastic Smart Cities Scoping”

<sup>171</sup> World Bank, “Project appraisal document.”

<sup>172</sup> Google Maps, “UD Sejahtera Jaya Mandiri”

<sup>173</sup> Google Maps, “UD. Gassing Logam.”

## **Waste Recycling Factories**

There is one waste recycling factory in Makassar, which is PT Aneka Daur Ulang. But according to WWF, some plastic producer factories also willing to join the Plastic Smart Cities program. Therefore, in the future, it may be possible that additional factories might change their feedstock to recycled plastic waste rather than producing plastic packaging from virgin stock. Some of the plastic producer factories that are interested in joining the WWF Plastic Smart Cities program are PT. Indo Brush Utama, PT. Prima Abadi Persada, and CV. Hamparan Plastindo Gowa.<sup>174</sup>



Figure 38. UD. Gassing Logam

### 3.4.6 Waste Disposal

TPA Tamangapa is the final destination for waste disposal in Kota Makassar (Figure 39)<sup>175</sup>—located in Manggala Sub-District over about 16.86 hectares (41.7 acres) of land. UPTD’s government office resides at the entrance of this landfill, and a 2017 study from the World Bank states that the site currently contains a



Figure 39. UPTD TPA Tamangapa Raya

sorting area, workshops, and office. It also has a composting unit and landfill methane collection and flaring system, but both are inactive. The site is characterized as a controlled landfill, which is an “upgrade” from open dumping systems.<sup>176</sup>

Figure 40 shows an aerial view of the landfill. According to the Environmental & Social Safeguards study from the World

Bank, Cell C1 is the only region that is equipped with lining and a leachate collections system that is inactive. A site visit performed in 2017 estimated that the landfill had at least five years remaining landfill lifetime.

An article from Terkini.id discussed that, as of 2020, Mayor Danny Pomanto has made great efforts towards organizing operations in the landfill. He formed a special team of both government employees and community service workers to ensure that machine operators were undisturbed while “Tangasaki” a

<sup>174</sup> WWF, “Plastic Smart Cities Scoping”

<sup>175</sup> Google Maps, “UPTD TPA Tamangapa Raya.”

<sup>176</sup> Zuraida, “Let's Get to Know.”

garbage truck service, transported waste in and out of the landfill. However, after Mayor Pomanto left office, the landfill slowly began to disorganize once again.<sup>177</sup>



Figure 40. Aerial view and map of TPA Tamangapa Raya<sup>178</sup>

The disposal rate in Makassar is estimated to be approximately 90.7%.<sup>179</sup> The local government spends approximately \$17 per ton. According to the World Bank, Kota Makassar received a score of 67/100 based on the criteria described in Section 3.2.6.<sup>180</sup>

### 3.4.7 Education and Outreach

The Government of Kota Makassar has attempted to educate the community on good 3R/SWM practices through training via print/online media in each district, but the information has been found to not have significant reach into the community. Its limited success may be attributed to its top-down “educational” nature, developed without formative research, which have not had success in many places in the world. Other challenges are likely to include that RT and RW often lack financial incentives to organize SWM practices.<sup>181</sup>

Private organizations have assisted the local governments in certain sub-divisions to implement waste services in accordance with environmentally friendly and sustainable regulations. For instance, MallSampah

<sup>177</sup> Kamsah, “Kondisi TPA.”  
<sup>178</sup> World Bank. “City Technical Report.”  
<sup>179</sup> World Bank, “Project appraisal document.”  
<sup>180</sup> Ibid.  
<sup>181</sup> Tahitu, “Scavenger.”

is a digital platform who has been able to recycle an average of 30 tons of waste per month through a downloadable application. This app allows households, stalls, restaurants, hotels, and other industries to schedule their waste for pick-up and purchased at a market price. MallSampah will then separate it by organic and inorganic waste for recycling. The platform has had major success with 20,000 users in Kota Makassar for the first year and has received grant awards for its encouragement of community collaboration and better solid waste and recycling practices.<sup>182</sup>

Waste4Change is also another prominent organization that promotes responsible, collaborative, and technology-based waste management solutions in Indonesia. Zero Waste to Landfill is one of their waste management services options that implements treatment of all waste, 3R methods, and comprehensive reports on the waste flow before entering the landfill. One of their clients, Kafe Selatan (in Jakarta), has implemented this solution and found great success in segregating organic and inorganic waste while also educating employees in the importance of sorting waste.<sup>183</sup>

In 2018, the World Wildlife Fund (WWF) in Indonesia set forth the No Plastic in Nature initiative.<sup>184</sup> Through institutional funding and charity, their goal is to stop the leakage of plastic by 2030 in hotspots around the coasts of southeast Asia (Indonesia, Thailand, Philippines, China and Hong Kong). As of 2020, the organization was in the process of conducting scoping and assessing plastic waste issues, hotspots, and current plastic waste management systems in Jakarta and Kota Makassar. They encouraged all applicants from NGOs, CSOs, universities, and consulting firms to aid in the development plan of waste management in cities. The proposal was submitted in July 2020 and a draft “Plastic Waste Management Action Plan” will be made on the basis of Kota Makassar authority and other stakeholders. According to Yayasan Konservasi Laut (YKL), the preliminary draft will be consulted through participatory workshops that include local government organizations, agencies and services in Kota Makassar.<sup>185</sup> The scope of assessment will then focus on surveying around TPA Tamangapa Landfill, Tallo River, Jeneberang River, Pampang River and several canals throughout the city. Afterwards, the waste management assessment will be integrated by evaluating social/economic feasibility and stakeholder analysis using the Multi Criteria Ranking Analysis and strategic recommendations for both short-term and long-term plans will be formulated.

### 3.4.8 *Solid Waste Planning*

The City of Makassar complied with the national law and developed a Jakstrada. This solid waste plan document was approved as the Regulation of the Mayor of Makassar Number 36 of 2018. This plan follows the national guidelines and appears to simply replicate the prepared national template.

As of 2019, Kota Makassar had begun to prepare documents in accordance with the Improvement of Solid Waste Management to Support Regional and Metropolitan Cities Program (ISWMP), another program overseen by Waste4Change to improve national waste management under the supervision of the Indonesian Ministry of Public Works and Housing.<sup>186</sup>

---

<sup>182</sup> Mappong and Muryono, “MallSampah.”

<sup>183</sup> Zuraida. “Let's Get to Know.”

<sup>184</sup> WWF, “Global Environmental Conservation.”

<sup>185</sup> Yayasan Konservasi Laut, “Plastic Smart Cities.”

<sup>186</sup> Bahraini. “Program Improvement.”

## 4. Gender

Indonesian women participate in SWM and 3Rs in a variety of ways. Many of the waste pickers in the vast Jakarta dumps are women. Interestingly, outside Jakarta women reportedly do not serve as informal waste collectors at all because such work is considered polluting and demeaning for women.<sup>187</sup> As everywhere else, waste pickers are stigmatized. Local governments, especially in outer islands, may hire waste pickers to collect trash, but these are men. Waste pickers are generally stigmatized, and perhaps women more than men due to the belief that waste picking is particularly degrading for women. In recognition of waste pickers' crucial role in SWM in Indonesia and to counteract stigma, a Presidential Decree was once issued "exhorting citizens to respect [waste pickers] because of the useful function they perform."<sup>188</sup>

Women work in and, not uncommonly, head waste banks, Indonesia's interesting experiment that has been endorsed by the government and enshrined in national as well as local regulations.<sup>189</sup> The largest waste bank in Makassar, for example is chaired by the Rukun Warga leader as are the other Makassar waste banks. However in the largest of these waste banks, "about 90% of the Waste Bank Officers [*sic*] are housewives who work voluntarily; they are unpaid workers."<sup>190</sup> Volunteer work is not uncommonly, in Indonesia and the rest of the world, a way to exploit women's skills and time. Would waste banks be as economically viable if women were compensated for their labor? There is a natural experiment, since not all waste banks are owned or mostly operated by women. A Bali waste bank, for example, is owned by a group of environmentalists who teach 3Rs, provide reusable bags for waste segregation, as well as owning a waste bank. There are also school-based waste banks.<sup>191</sup>

Country-wide, only about 2% of the population patronizes waste banks, while in Makassar it is about one percent.<sup>192</sup> Some scholars, e.g., Towolio, et al, believe that waste banks, although currently processing but a small fraction of plastic waste, have the potential to be a large force in preventing waste plastic from entering the ocean. The ultimate success or failure of the waste bank experiment rests largely with women, as well as with recycling markets and transportation. Women are also waste generators: the other part of the waste bank equation. Women are often the household member who takes the waste to the waste bank and earns the recompense, whether money, credits/points, consumer goods, or children's school tuition or schoolbook payments. The key research question is why do some women (families) separate their household waste and trade recyclables at the waste bank, while other women (families) do not? While both men and women bring household recyclables to waste banks, women are by far the largest patron group.

Biology plays a part in assigning roles in SWM, but culture also plays a large part in conceptualizing physical strength of men and women. In Indonesia, women are believed to be incapable of heavy lifting, even when they work as informal waste collectors. Women collect the lighter, often less valuable, items.<sup>193</sup> Outside of metropolitan Jakarta, women are viewed as being physically unsuited to waste collection. Reportedly, collecting waste is also perceived by both men and women as degrading and polluting to women. "In

---

<sup>187</sup> Ocean Conservancy, *Role of Gender*; Mockler, "Community-based."

<sup>188</sup> Mockler, "Community-based."

<sup>189</sup> Ocean Conservancy, *Role of Gender*.

<sup>190</sup> Towolio et al., "Rukun Warga-based 3Rs."

<sup>191</sup> Vital Ocean, *Leave No Trace*.

<sup>192</sup> Towolio et al., "Rukun Warga-based 3Rs."

<sup>193</sup> Ocean Conservancy, *Role of Gender*.

Indonesia, the recycling collectors surveyed were primarily men and on-ground sources indicate that women typically did not engage in collection activities as it is considered laborious and demeaning. Even in extreme poverty situations, women would choose begging over waste collection. This, however, is not the case at the landfills such as Bantar Gabang in Greater Jakarta where women and children work alongside the male street recycling pickers.”<sup>194</sup>

Both junk shops and upcycling businesses may be run out of the home, which provides flexibility in hours as well as the ability to care for home and children. Indonesian women are represented among junk shop owners, often in partnership with the husband, or as a member of a family owning and operating a junk shop. In addition, women dominate the upcycling industry in: “... organizations that upcycle/ downcycle recyclables into other household products, arts and crafts. These include the weaving of different plastics in bags, pouches, toys and crafts, the creation of products from recycled paper, making jewelry from metal recyclables etc.”<sup>195</sup> However, this is currently a very small industry. It may be that women in these enterprises do not want to move up the value chain into positions that would provide less ability to fulfill their family obligations. Women do work in paid positions outside the home in the SWM sector in Indonesia. As in most of the world, women are valued for the repetitive tasks requiring fine motor skills to sort waste. As such, they may be preferred by aggregators to sort waste.<sup>196</sup>

In summary, women may segregate waste at the household level and a relative few bring their cleaned, plastic, metal and sometimes cardboard to waste banks to redeem for credits, cash, or other valued items. Alternatively, they may not segregate household waste; possibly their school children do this if they participate in a school-based waste bank. Women virtually never work in the formal sector as waste collectors and work as informal waste collectors only in the Jakarta dumps. Many, perhaps most, waste banks are run and staffed mostly by women, but the authors were unable to find a complete census of waste banks according to the gender of staff and ownership. Women work as junkshop owners and employees, especially as part of their families, as small-scale upcyclers, and may be employed by larger aggregators to do repetitive sorting task.

---

<sup>194</sup> Ibid.

<sup>195</sup> Ibid.

<sup>196</sup> Ibid.

## 5. Additional Information/Data Required

To develop a more detailed ISWMA, additional information and data will be required - as outlined throughout this report. Additional data will enable the ISWMA to establish a high confidence in the critical information being presented such as existing waste generation, collection, recycling, and final disposal data. The following lists some of the information that will be needed depending on the priorities identified by this ISWMA:

- Solid Waste Management Plan – There are no indications that local governments (Engagement Sites) have any type of waste management plan. Need to verify that indeed that is the case.
- Solid Waste Generation – Need to identify breakdown of tons of waste generated by each sector including residential, commercial, and industrial.
- Per Capita Generation – Verification of publicized calculations is needed.
- Identification and verification of collection methods for all sectors at each engagement site.
- Collection – Identify collection method and associated volumes (recovered materials and residual).
- Existing Waste Management Processes/Infrastructure – Identification/verification of active:
  - Informal waste collectors,
  - Organized Collectors,
  - Junk shops (Primary and secondary),
  - Junk Buyers, and
  - Organics Processing.
- Permitted/Certified Operations/Facilities – Identify permitting/certification process for the various types of operations/facilities. Available mechanisms to shut down operations/facilities.
- Recovered/Recycled Material Quantities – Tons received, recovered, and residual as applicable. Types of materials recycled. The identification of processors, brokers, or end-users.
- Programs or initiatives involving reuse or reduction of materials.
- Solid Waste Disposal – Total tons disposed on a daily and annual basis and associated tipping fee at:
  - TPS,
  - TPS 3R,
  - TPST/IPST, and
  - TPA.
- Existing Active and Inactive TPAs – Estimated waste in-place calculations to assess proper closure of facilities.
- Informal Waste Collectors – Need to identify the number of informal waste collectors associated with junk shops, TPS, TPST/IPST, TPS 3R, and TPAs.
- Outreach and Education – Need to identify all existing/current publicly funded education and outreach efforts and NGOs with focus on SWM.

- Regulatory Enforcement and Penalties – Need to identify enforcement actions and penalties if any at any of the engagement sites.
- An understanding of funding and financial systems as well as fee structures and how fees are collected.
- Field Observations – It is obvious that solid waste at CCBO engagement sites is not properly managed, field observations should be focused on set-out, aggregation, collection, and processing (resource recovery).

## 6. Recommendations and Next Steps

The 3R/SWM systems in all three engagement sites are developing. Planning is the key to maintaining any momentum. There are multiple ministries associated with waste management in Indonesia under Waste Management Act No. 18/2008; however, enforcement of regulations within the local governments is largely absent. This is due to a lack of sufficient funding and high recurrent expenditures associated with collection and landfill maintenance. Unfortunately, this ISWMA was not able to find evidence of written solid waste planning documents with the exception of Kota Semarang where there was a reference to a Solid Waste Management Plan prepared by COWI (an international consulting group); however, a copy of the document could not be found. There was, however, evidence of planning in the form of assistance by many foreign NGOs. This is particularly apparent in Kota Semarang and Kota Makassar.

Improving universal collection and management of waste will be the foundation of reducing plastics from leakage and ocean pollution in the future. The promising news is that, in all three engagement sites, there appears to be some form of formal collection for waste. The three engagement sites utilize the TPS/TPA (transfer/recycle/disposal) system as seen in other Indonesian cities. Responsibilities for certain stages of waste service provision are as follows:

- Collection and transport of household waste to Temporary Disposal Sites (TPS) is the responsibility of the RT/RW (neighborhood associations/community groups).
- Transport of waste from the TPS to the landfill (TPA) is the responsibility of the local government
- Collection and transport of estate waste from source to the TPS/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 the local government.

Unfortunately, the level of service is not consistent even in the larger engagement sites (i.e., Kota Semarang and Kota Makassar) resulting in large amounts of illegal disposal/dumping practiced in the cities, including open burning, dumping into the rivers, and burying in backyards.

While not entirely informal, waste banks, or Bank Sampahs, are a more informal alternative method for managing waste that can be recycled in Indonesia. A reported 5000 waste banks exist across the country and allow community members a location to deposit their recyclable waste where people get to “bank”

the value of the waste they deliver. The deposited materials are then sold to scrap dealers for recycling. The Indonesian government has reportedly endorsed the waste bank concept as “currently the best way of dealing with waste across the country”. All three engagement sites utilize waste banks.

WWF Indonesia has set forth the No Plastic in Nature initiative. As of 2020 the organization is in the process of conducting scoping and assessing plastic waste issues, plastic waste hotspots, and current plastic waste management systems in Jakarta and Kota Makassar. They encouraged all applicants from NGOs, CSOs, universities, and consulting firms to aid in the development plan of waste management in cities. The proposal was submitted in July 2020 and a draft “Plastic Waste Management Action Plan” will be made on the basis of Kota Makassar authority and other stakeholders. CCBO should coordinate with WWF in this effort as similar goals are desired.

CCBO has learned a lot through its online research and will build upon this knowledge as this program progresses. There are, however, some immediate steps that the team believes should be taken and recommends the following be considered in this initial phase of the CCBO program in Indonesia.

#### Recommendations:

- Continue to research and better understand the existing 3R/SWM systems in the engagement sites.
- Work within the communities to develop a network of government officials, civic society, citizens, workers, NGOs, private sector, and other entities that have been involved in the current systems and can help improve them.
- Work with these stakeholders to increase their capacity to develop sound 3R/SWM systems.
- Learn more about the funding for the 3R/SWM systems and work with stakeholders to consider additional or alternative revenue generation and financing options to support improvements to their systems.
- Seek ways in which to expand and develop the markets for plastics (those that are currently valuable and those that are not) and bio-degradable materials.
- Support communities to develop and improve the services needed to create efficient collection, aggregation, and transport of materials as part of a sound 3R/SWM system.
- Support the communities in updating and revising their master plans to improve their 3R/SWM systems.
- Engage stakeholders and the private sector to seek mutually beneficial means of building the infrastructure needed in improved 3R/SWM systems (MRFs, Compost Facilities, Anaerobic Digestors, WTE, Sanitary Landfills or other appropriate technologies.)

- Learn more about existing social behavior of Indonesians within the 3R/SWM systems, what they are able to and desire to do to increase 3R practices (such as material separation at the source), and seek appropriate ways to create awareness (if this is what is needed).
- Evaluate the potential use of the residual waste materials (not economically recyclable) to produce Refuse Derived Fuels (RDF) for cement kilns and other waste to energy (WTE) systems.
- Determine how environmentally secure the TPAs (landfills) are in each engagement site and make recommendations for improvements as applicable for each TPA.
- Consider conducting operations research, if possible in collaboration with other donors, to learn the effectiveness of waste banks, the circumstances under which waste banks are maximally effective, those conditions that inhibit optimal functioning of waste banks and, for each engagement area, who utilizes waste banks and why, similarly identify populations that do not patronize the waste banks and their reasons.
- Conduct a gender analysis of women and youth regarding SWM and 3Rs in the engagement sites and work with women's organizations and government to include women and youth's interests and perspectives as part of the 3R/SWM planning process.
- Review existing laws, policies and regulations pertaining to 3R/SWM systems and support additions or revisions that would support the 3R/SWM planning and implementation process.

## 7. Bibliography

- Aqil, Ibnu. "Ineffective recycling compounds Indonesia's marine waste problem." *The Jakarta Post*, May 10, 2020. <https://www.thejakartapost.com/news/2020/05/10/ineffective-recycling-compounds-indonesias-marine-waste-problem.html>.
- Asian Development Bank. "Indonesia, 2020–2024 —Emerging Stronger." September 2020. <https://www.adb.org/sites/default/files/institutional-document/640096/cps-ino-2020-2024.pdf>
- Badan Pusat Statistik Kota Ambon (Statistics - BPS Ambon Regional Office). "Ambon Municipality in Figures 2020." April 27, 2020. <https://ambonkota.bps.go.id/publication/2020/04/27/0072157fa7d7bf288ceb130a/kota-ambon-dalam-angka-2020.html>.
- Bahraini Amanda. "Program Improvement of Solid Waste Management to Support Regional Metropolitan Cities" *Waste4Change*, May 8 2019. <https://waste4change.com/blog/program-improvement-of-solid-waste-management-to-support-regional-and-metropolitan-cities/>.
- "Bank Sampah Pusat Kota Makassar," Google Maps, accessed December 2020. <https://www.google.com/maps/@-5.1627435,119.4531493,3a,75y,77.54h,80.28t/data=!3m6!1e1!3m4!1so4xszAyOYdjVdHg6DiUNNQ!2e0!7i16384!8i8192>.
- BeritaBeta. "Setiap Desa dan Kelurahan di Ambon Akan Dibangun Bank Sampah." September 25, 2019.
- City Population. "KOTA SEMARANG City in Indonesia Population 2005-2015." *Citypopulation.de*, January 27, 2019. <http://www.citypopulation.de/php/indonesia-admin.php?adm2id=3374>.
- Colombijn, Freek. "Secrecy at the End of the Recycling Chain: The Recycling of plastic Waste in Surabaya Indonesia," *WorldWide Waste Journal*, 2020. <https://www.worldwidewastejournal.com/articles/10.5334/wwwj.43/>.
- Completenews. "Pj. Wali Kota Kota Makassar: UPTD Yang Membawahi Bank Sampah, Agar Melayani Dengan Baik." June 1, 2020. <https://completenews.id/pj-wali-kota-makassar-uptd-yang-membawahi-bank-sampah-agar-melayani-dengan-baik/>.
- Damanhuri, Enri, "State of the 3Rs in Asia and the Pacific – The Republic of Indonesia," *United Nations Center for Regional Development*, November 2017. [https://www.unrcd.or.jp/content/documents/5689\[Nov%202017\]%20Indonesia.pdf](https://www.unrcd.or.jp/content/documents/5689[Nov%202017]%20Indonesia.pdf).
- Deputy for Human Resources, Science, Technology, and Maritime Culture. "Indonesia's National Action Plan for Marine Plastic Debris 2017-2025." 2017. <https://maritim.go.id/portfolio/indonesias-plan-action-marine-plastic-debris-2017-2025/>.
- Dewi, Ova Candra, Widita Vidyaningrum, and Reno Munksgaard. "Screening and Selection of Technologies and Pre-feasibility Study of Best Option for Resource and Energy Recovery from Organic Household Waste in Indonesia." Ramboll, December 2018. <https://indonesien.um.dk/~media/indonesien/tc/sba/selection%20of%20technologies%20from%20organic%20household%20waste.pdf?la=en>.

- Diela, Tabita. "Indonesian president tells cities to build waste-to-energy plants." *Reuters*. July 16, 2019. <https://www.reuters.com/article/us-indonesia-environment-energy/indonesian-president-tells-cities-to-build-waste-to-energy-plants-idUSKCN1UBICG>.
- Dinus Lingkungan Hidup Kota Semarang (Department of the Environment of Semarang City). "5 Program Pemerintah Kota Semarang Untuk Menangulangi Sampah [5 Semarang City Government Programs to Tackle Waste]." November 19, 2020. <https://dlh.semarangkota.go.id/5-program-pemerintah-kota-semarang-untuk-menangulangi-sampah/&prev=search&pto=aue>.
- East Regency. "Toisapu Far-far IPST Land: The Heir Mistakes to Fund Appraisal" *Kabartimur News*, 2020. <https://www.kabartimurnews.com/2020/11/09/lahan-ipst-toisapu-far-far-keliru-ahli-warisan-biaya-appraisal/>.
- Global Business Guide Indonesia. "Indonesia's Plastic & Packaging Industry: Still Dependent on Raw Material Imports." 2016. [http://www.gbgingonesia.com/en/manufacturing/article/2016/indonesia\\_s\\_plastic\\_andamp\\_packaging\\_industry\\_still\\_dependent\\_on\\_raw\\_material\\_imports\\_11500.php](http://www.gbgingonesia.com/en/manufacturing/article/2016/indonesia_s_plastic_andamp_packaging_industry_still_dependent_on_raw_material_imports_11500.php).
- Hadiwidodo, Mochtar, Budi Samadikun, and Desy Arinasandi. "Study of Waste Bank's Condition in Semarang City." *E3S Web of Conferences*, 2019. [https://www.researchgate.net/publication/336849132\\_Study\\_of\\_Waste\\_Bank%27s\\_Condition\\_in\\_Semarang\\_City](https://www.researchgate.net/publication/336849132_Study_of_Waste_Bank%27s_Condition_in_Semarang_City).
- Hajramurni, Andi. "Kota Makassar Residents Cash in on Trash." *The Jakarta Post*, 2016. [www.thejakartapost.com/news/2016/03/05/Kota-Makassar-residents-cash-trash.html](http://www.thejakartapost.com/news/2016/03/05/Kota-Makassar-residents-cash-trash.html).
- Hoorweg, Daniel and Perinaz Bhada-Tata. "What a waste: A global review of solid waste management." *Urban Development Series Knowledge Papers: World Bank*, 2012. <https://openknowledge.worldbank.org/handle/10986/17388>.
- IDN Financials. "Inaplas projects petrochemical industry to grow by 5.2% in 2020." January 24, 2020. <https://www.idnfinancials.com/news/31512/inaplas-projects-petrochemical-industry-grow>.
- JICA. "Study on Implementation of Integrated Spatial Plan for The Mamminasata Metropolitan Area." [https://openjicareport.jica.go.jp/pdf/11834108\\_05.pdf](https://openjicareport.jica.go.jp/pdf/11834108_05.pdf).
- Kamsah. "Kondisi TPA Tamangapa Di Zaman Danny Pomanto, Berikut Faktanya." November 4, 2020. [terkini.id/news/kondisi-tpa-tamangapa-di-zaman-danny-pomanto-berikut-faktanya/](http://terkini.id/news/kondisi-tpa-tamangapa-di-zaman-danny-pomanto-berikut-faktanya/).
- Kaza, Silpa, Lisa C. Yao, Perinaz Bhada-Tata, and Frank Van Woerden. "What a waste 2.0: A global snapshot of solid waste management to 2050." *Urban Development Series: World Bank*, 2018. <https://openknowledge.worldbank.org/handle/10986/30317>.
- Law-In-Action. "3000 Trash Banks: Indonesia." October 31, 2018. <https://law-in-action.com/2016/06/06/cash-for-trash/>.
- Lestari, Prieskarinda and Yulinah Trihadiningrum. "The impact of improper solid waste management to plastic pollution in Indonesian coast and marine environment." *Marine Pollution Bulletin* 149, 2019. <https://doi.org/10.1016/j.marpolbul.2019.110505>.

- Lokahita, Baskoro, A. Abadi, I. Hutabarat, L. Sembiring, R. Andrianingsih, Ganjar Samudro, Haryono Huboyo, Muhammad Aziz, and Fumitake Takahashi. "Excavated waste characteristic from Semarang City landfill sites. Part 1: physical characteristic." *IOP Conference Series: Earth and Environmental Science*, 2019. <https://iopscience.iop.org/article/10.1088/1755-1315/245/1/012046/pdf>.
- MacAulay, Brad. "Indonesia Suspends Scrap Imports Amid New Policy." *Argus Media*, 2019. <https://www.argusmedia.com/en/news/2020587-indonesia-suspends-scrap-imports-amid-new-policy>.
- Mappong, Suriani and Sri Muryono. "MallSampah Mendaur Ulang 30 Ton Sampah per Bulan - ANTARA News Ambon, Maluku [MallSampah recycles 30 tons of waste per month]." *Antara News Ambon*, 2020. [ambon.antaranews.com/internasional/berita/1770833/mallsampah-mendaur-ulang-30-ton-sampah-per-bulan?utm\\_source=antaranews](https://ambon.antaranews.com/internasional/berita/1770833/mallsampah-mendaur-ulang-30-ton-sampah-per-bulan?utm_source=antaranews).
- Maruf, Maruf. "Indonesia Response and Recent Development of Law and Policy in Addressing Marine Plastic Litter." *JILS (Journal of Indonesian Legal Studies* 4, no. 2 (November 3, 2019): 167-188. <https://doi.org/10.15294/jils.v4i2.34757>.
- Maryati, Sri, Miharja, Marjan, Iscahyono, A, Arsallia, Sheryta, and Syfa Humaira. "Towards Sustainable Ambon Bay: Evaluation of Solid Waste Management in Ambon City." *IOP Conference Series: Earth and Environmental Science*, 2017. [https://www.researchgate.net/publication/319170581\\_Towards\\_Sustainable\\_Ambon\\_Bay\\_Evaluation\\_of\\_Solid\\_Waste\\_Management\\_in\\_Ambon\\_City](https://www.researchgate.net/publication/319170581_Towards_Sustainable_Ambon_Bay_Evaluation_of_Solid_Waste_Management_in_Ambon_City).
- Maryono, M. and I. H. Hasmantika. "Preliminary Study of Smart Urban Waste Recycling in Semarang, Central Java, Indonesia." *IOP Conference Series: Earth and Environmental Science*, 2019. <https://iopscience.iop.org/article/10.1088/1755-1315/248/1/012048/pdf>.
- Ministry of Environment. "Panduan Praktis Pemilahan Sampah." *Japan International Cooperation Agency (JICA)*. 2008. <https://www.batukarinfo.com/system/files/KNLH-P3S.pdf>.
- Ministry of Environment and Forestry. "DLHK Aceh Selenggarakan Bimtek Penyusunan Kebijakan dan Strategis Daerah (Jakstrada) Dalam Pengelolaan Sampah." August 2018. <https://dlhk.acehprov.go.id/2018/08/dlhk-aceh-selenggarakan-bimtek-penyusunan-kebijakan-dan-strategis-daerah-jakstrada-dalam-pengelolaan-sampah/#:~:text=Dengan%20telah%20dikeluarkannya%20Peraturan%20Presiden,pengelolaan%20smpah%20nasional%20yang%20melibatkan>
- Ministry of Environment and Forestry. "SIPSN (Sistem Informasi Pengelolaan Sampah Nasional)." <http://sipsn.menlhk.go.id/sipsn/>
- Ministry of Industry. 2019a. "Direktori Perusahaan Industri Daur Ulang di Jawa Tengah". Retrieved from: <https://kemenperin.go.id/direktori-perusahaan?what=daur+ulang&prov=33>
- Ministry of Industry. 2019b. "Direktori Perusahaan Industri Plastik di Jawa Tengah". Retrieved from: <https://kemenperin.go.id/direktori-perusahaan?what=plastik&prov=33&hal=1>

- Mockler, Margaret. "Community-based Solid Waste Management in Indonesia. A Background Paper." *World Bank, Indonesia*. May 20, 1998.
- Ni'mah, Nuzuli Ziadatun and Lena Keller-Bischoff. "Java's waste banks." *Inside Indonesia*, 2020. <https://www.insideindonesia.org/java-s-waste-banks>.
- Nugroho Adi, Ganug. "Surakarta inches closer to turning trash into power." *The Jakarta Post*. February 9, 2017. <https://www.thejakartapost.com/news/2017/02/09/surakarta-inches-closer-to-turning-trash-into-power.html#:~:text=The%20Surakarta%20administration%20has%20begun,megawatts%20of%20electricity%20per%20hour>.
- Ocean Conservancy. *The Role of Gender in Waste Management: Gender Perspectives on Waste in India, Indonesia, the Philippines and Vietnam*. June 2019.
- "Pemensanan Cakar Ayam," Google Maps, accessed December 2018. [https://www.google.com/maps/@-7.0635144,110.4232046,3a,90y,196.83h,86.48t/data=!3m7!1e1!3m5!1stfj5CSj\\_fwZqHCtVyHrKRw!2e0!6s%2F%2Fgeo0.ggpht.com%2Fcbk%3Fpanoid%3Dtfj5CSj\\_fwZqHCtVyHrKRw%26output%3Dthumbnail%26cb\\_client%3Dmaps\\_sv.tactile.gps%26thumb%3D2%26w%3D203%26h%3D100%26yaw%3D334.5399%26pitch%3D0%26thumbfov%3D100!7i16384!8i8192](https://www.google.com/maps/@-7.0635144,110.4232046,3a,90y,196.83h,86.48t/data=!3m7!1e1!3m5!1stfj5CSj_fwZqHCtVyHrKRw!2e0!6s%2F%2Fgeo0.ggpht.com%2Fcbk%3Fpanoid%3Dtfj5CSj_fwZqHCtVyHrKRw%26output%3Dthumbnail%26cb_client%3Dmaps_sv.tactile.gps%26thumb%3D2%26w%3D203%26h%3D100%26yaw%3D334.5399%26pitch%3D0%26thumbfov%3D100!7i16384!8i8192).
- Pemerintah Kota Semarang, "Permutakhiran Strategi Sanitasi Kota (SSK)" 2015. [https://sippa.ciptakarya.pu.go.id/sippa\\_online/ws\\_file/dokumen\\_usulan/ssk/SSK\\_033ca8a6c9b87624903701189d1e3423892fb596.pdf](https://sippa.ciptakarya.pu.go.id/sippa_online/ws_file/dokumen_usulan/ssk/SSK_033ca8a6c9b87624903701189d1e3423892fb596.pdf)
- Permana, Ariva Sugandi, Towolioe, Sherly, Aziz, Norsiah Abd, and Chin Siong Ho. "Sustainable solid waste management practices and perceived cleanliness in a low-income city." *Habitat International* (2015): 197-205. [https://www.researchgate.net/publication/277818084\\_Sustainable\\_solid\\_waste\\_management\\_practices\\_and\\_perceived\\_cleanliness\\_in\\_a\\_low\\_income\\_city](https://www.researchgate.net/publication/277818084_Sustainable_solid_waste_management_practices_and_perceived_cleanliness_in_a_low_income_city).
- Peroepatan Pembangunan Sanitasi Perukiman, "Strategi Sanitasi Kabupaten/Kota (SSK)." <https://amdal.menlhk.go.id/klh/admin/assets/uploads/penyusun/filelppj-99720200130121623.pdf>
- Rahawarin, Fauzia. "Controlling Water Pollution in Batumerah Village Ambon City." January 2020. [http://repository.iainambon.ac.id/152/1/IJSRP\\_Controlling%20water%20pollution%20in%20batu%20merah%20village%20ambon%20city.pdf](http://repository.iainambon.ac.id/152/1/IJSRP_Controlling%20water%20pollution%20in%20batu%20merah%20village%20ambon%20city.pdf).
- Rahim, Irwin Ridwan. "Municipal Solid Waste Management in Kota Makassar City, Indonesia." *JSCE Kyushu University*, 2011. <http://library.jsce.or.jp/jsce/open/00074/2011/55-07-0046.pdf>.
- Rahman Patty, Rahmat. "Setiap Hari, 5 Ton Sampah Diangkut Petugas Kebersihan dari Teluk Ambon [Every day, 5 tons of garbage are transported by cleaning officers from Ambon Bay]." *Kompas.com*, June 4, 2020. <https://regional.kompas.com/read/2020/06/04/08441021/setiap-hari-5-ton-sampah-diangkut-petugas-kebersihan-dari-teluk-ambon?page=all>.
- Rakhmani, Inez. "Indonesia's approach to Waste-to-Energy." *AsianPower*. November 14, 2018. <https://asian-power.com/environment/commentary/indonesias-approach-waste-energy>.

- Ratnawati, Rosa Vivien "The 3Rs and Clean Land – The Role of the Circular Economy in Preventing Land Pollution (Indonesian Perspective)." [https://www.uncrd.or.jp/content/documents/6473PS-3-Panel-Slide-Indonesia-Ministry of Environment & Forestry.pdf](https://www.uncrd.or.jp/content/documents/6473PS-3-Panel-Slide-Indonesia-Ministry%20of%20Environment%20&%20Forestry.pdf)
- "Sampah near JL Karangingas," Google Maps, accessed December 2020. [https://www.google.com/maps/@-6.9764473,110.4503578,3a,79.1y,219.65h,84.68t/data=!3m6!1e1!3m4!1s06EKP\\_iuk6IHWI ZNX6hLg!2e0!7i16384!8i8192](https://www.google.com/maps/@-6.9764473,110.4503578,3a,79.1y,219.65h,84.68t/data=!3m6!1e1!3m4!1s06EKP_iuk6IHWI ZNX6hLg!2e0!7i16384!8i8192).
- Sasaki, Shunsuke, Tetsuya Araki, Armansyah H. Tambunan, and Heru Prasadja. "Household income, living and working conditions of dumpsite waste pickers in Bantar Gebang: Toward integrated waste management in Indonesia." *Resources, Conservation and Recycling* 89 (August 2014): 11-21. <https://doi.org/10.1016/j.resconrec.2014.05.006>.
- Sembinging, Emenda and Vilas Nitivattananon. "Sustainable solid waste management toward an inclusive society: Integration of the informal sector." *Resources, Conservation and Recycling* 54 (September 2010): 802-809. <http://dx.doi.org/10.1016/j.resconrec.2014.05.006>.
- Soba, Heri. "Meski Dilarang, Impor Sampah Plastik 2018 Naik 141% [Although Prohibited, 2018 Plastic Waste Imports Up 141%]." *Beritasatu.com*, March 26, 2019. <https://www.beritasatu.com/nasional/545065/meski-dilarang-impor-sampah-plastik-2018-naik-141>.
- Suroyo, Gayatri. "Indonesia's parliament delays approval for levy on plastic bags." *Reuters*, July 3, 2019. <https://www.reuters.com/article/us-indonesia-plastic/indonesias-parliament-delays-approval-for-levy-on-plastic-bags-idUSKCN1TY0LT>.
- Supriyadi, Slamet & Kriwoken, Lorne & Birley, Imogen. "Solid waste management solutions for Semarang, Indonesia." 2000. [https://www.researchgate.net/publication/227900239\\_Solid\\_waste\\_management\\_solutions\\_for\\_Semarang\\_Indonesia](https://www.researchgate.net/publication/227900239_Solid_waste_management_solutions_for_Semarang_Indonesia)
- Tahitu, Amelia. "Scavenger in the Frame of Poverty in Ambon City." 2019.
- Tech That Matters, "Recycled Island Foundation." Accessed 2020. <https://www.techthatmatters.com/this-floating-park-and-thriving-ecosystem-is-made-up-of-recycled-plastic/>.
- The Jakarta Post. "Indonesia to auction three waste-to-energy projects this year." June 27, 2019. <https://www.thejakartapost.com/news/2019/06/27/indonesia-to-auction-three-waste-to-energy-projects-this-year.html>.
- The Jakarta Post. "The future of plastic waste: Is there any hope?" June 4, 2020. <https://interactives.thejakartapost.com/2020/06/04/the-future-of-plastic-waste/>.
- Towolioe, Sherly, Ariva Sugandi Permana, Norsiah A. Aziz, Chin Siong Ho, and Dario G. Pampanga. "The Rukun Warga-Based 3Rs and Waste Bank as Sustainable Solid Waste Management Strategy." *PLANNING MALAYSIA: Journal of the Malaysian Institute of Planners* 4(2016): 181 -196.
- "TPS 3R Dadi Resik." Google Maps, accessed December 2020. [https://www.google.com/maps/place/Tps+3R+Dadi+Resik/@-7.0142993,110.4845022,3a,75y,90t/data=!3m8!1e2!3m6!1sAFI QipO6I lv0zxyOoBNu\\_tXcybwWH CtZtU54Kklc0tf!2e10!3e12!6shhttps:%2F%2Fh5.googleusercontent.com%2Fp%2FAFI QipO6I lv0zxyOoBNu\\_tXcybwWH CtZtU54Kklc0tf%3Dw217-h100-k-](https://www.google.com/maps/place/Tps+3R+Dadi+Resik/@-7.0142993,110.4845022,3a,75y,90t/data=!3m8!1e2!3m6!1sAFI QipO6I lv0zxyOoBNu_tXcybwWH CtZtU54Kklc0tf!2e10!3e12!6shhttps:%2F%2Fh5.googleusercontent.com%2Fp%2FAFI QipO6I lv0zxyOoBNu_tXcybwWH CtZtU54Kklc0tf%3Dw217-h100-k-)

no!7i4000!8i!840!4m5!3m4!1s0x2e708d2ee06ad4ff:0xb3bab8c040cc53be!8m2!3d-7.0143954!4d!10.4845798.

“TPST Purwosari,” Google Maps, accessed December 2020.

[https://www.google.com/maps/place/TPST+Purwosari/@-7.0781259,110.3285969,3a,75y,90t/data=!3m8!1e2!3m6!1sAFIQipP2NWD\\_fopsv6S4TEJCUG9g82CSpTOMNK9kXtAZ!2e10!3e12!6shhttps:%2F%2Fh5.googleusercontent.com%2Fp%2FAFIQipP2NWD\\_fopsv6S4TEJCUG9g82CSpTOMNK9kXtAZ%3Dw203-h114-k-no!7i4!28!8i2322!4m5!3m4!1s0x2e70636151392e77:0xe03e38a016c86c9a!8m2!3d-7.0781541!4d!10.3285141](https://www.google.com/maps/place/TPST+Purwosari/@-7.0781259,110.3285969,3a,75y,90t/data=!3m8!1e2!3m6!1sAFIQipP2NWD_fopsv6S4TEJCUG9g82CSpTOMNK9kXtAZ!2e10!3e12!6shhttps:%2F%2Fh5.googleusercontent.com%2Fp%2FAFIQipP2NWD_fopsv6S4TEJCUG9g82CSpTOMNK9kXtAZ%3Dw203-h114-k-no!7i4!28!8i2322!4m5!3m4!1s0x2e70636151392e77:0xe03e38a016c86c9a!8m2!3d-7.0781541!4d!10.3285141).

Trash Hero Ambon. "About." Facebook, accessed November 11, 2020.

<https://www.facebook.com/trashheroambon>.

Trash Hero Ambon, “Cleanup 40 (15-03-2020) 12 volunteers, 2 kids, 22,5 kg Sampah,” Facebook album, May 7, 2020.

<https://www.facebook.com/media/set/?vanity=trashheroambon&set=a.1578007422373859>.

“UD. Gassing Logam” Google Maps, accessed December 2020. [https://www.google.com/maps/@-](https://www.google.com/maps/@-5.1454825,119.4419093,3a,75y,156.79h,80.65t/data=!3m6!1e1!3m4!1soTLjQ6Oeus_Bp3X6CXvYzg!2e0!7i133!2!8i6656)

[-5.1454825,119.4419093,3a,75y,156.79h,80.65t/data=!3m6!1e1!3m4!1soTLjQ6Oeus\\_Bp3X6CXvYzg!2e0!7i133!2!8i6656](https://www.google.com/maps/@-5.1454825,119.4419093,3a,75y,156.79h,80.65t/data=!3m6!1e1!3m4!1soTLjQ6Oeus_Bp3X6CXvYzg!2e0!7i133!2!8i6656).

“UD Sejahtera Jaya Mandiri,” Google Maps, accessed December 2020. [https://www.google.com/maps/@-](https://www.google.com/maps/@-5.1247306,119.4397065,3a,44.9y,301.8h,80.22t/data=!3m6!1e1!3m4!1s1tbf0Ru-SCF4tuMaVbhUGg!2e0!7i133!2!8i6656)

[-5.1247306,119.4397065,3a,44.9y,301.8h,80.22t/data=!3m6!1e1!3m4!1s1tbf0Ru-SCF4tuMaVbhUGg!2e0!7i133!2!8i6656](https://www.google.com/maps/@-5.1247306,119.4397065,3a,44.9y,301.8h,80.22t/data=!3m6!1e1!3m4!1s1tbf0Ru-SCF4tuMaVbhUGg!2e0!7i133!2!8i6656).

UNEP. “Summary report: Waste management in ASEAN countries.” *United Nations*, 2017.

<https://environment.asean.org/wp-content/uploads/2020/03/Summary-Report-Waste-Management-in-ASEAN-Countries-UNEP.pdf>.

Unilever Indonesia Foundation. "Environment Programme." 2020. Accessed November 16, 2020.

<https://www.unilever.co.id/en/about/unilever-indonesia-foundation/environment-programme.html>.

“UPTD TPA Tamangapa Raya” Google Maps, accessed December 2020. [https://www.google.com/maps/@-](https://www.google.com/maps/@-5.1760053,119.4886804,3a,75y,118.6h,73.46t/data=!3m6!1e1!3m4!1sHYj-n7651TYCWvLYLqVU5A!2e0!7i16384!8i8192)

[-5.1760053,119.4886804,3a,75y,118.6h,73.46t/data=!3m6!1e1!3m4!1sHYj-n7651TYCWvLYLqVU5A!2e0!7i16384!8i8192](https://www.google.com/maps/@-5.1760053,119.4886804,3a,75y,118.6h,73.46t/data=!3m6!1e1!3m4!1sHYj-n7651TYCWvLYLqVU5A!2e0!7i16384!8i8192).

Urban Links. “MWRP Indonesia: Using Public-Private Partnerships to Improve Semarang City Waste Management and Recycling.” 2019. <https://urban-links.org/resource/mwrp-indonesia-using-public-private-partnerships-to-improve-semarang-city-waste-management-and-recycling/>.

Urban Links. “Tackling Ocean Plastic Pollution in Indonesia.” Urban Links, 2020. <https://urban-links.org/insight/tackling-ocean-plastic-pollution-in-indonesia/>.

USAID. “USAID Adaptasi Perubahan Iklim Dan Ketangguhan (APIK) Project Final Report.” June 30, 2020.

<https://www.climatelinks.org/resources/usa-id-adaptasi-perubahan-iklim-dan-ketangguhan-apik-project-final-report>.

- Vital Ocean. *Leave No Trace: Vital Lessons from the Frontline*. 2019. <https://www.vitalocean.org/book-download>.
- Wikipedia. "Makassar." Accessed November 7, 2020. <https://en.wikipedia.org/wiki/Makassar>.
- Wikipedia. "Semarang." Accessed November 3, 2020. <https://en.wikipedia.org/wiki/Semarang>.
- Wikipedia. "Subdivisions of Indonesia." Accessed December 13, 2020. [https://en.wikipedia.org/wiki/Subdivisions\\_of\\_Indonesia](https://en.wikipedia.org/wiki/Subdivisions_of_Indonesia).
- Wonderful Indonesia. "Makassar." Accessed February 2021. <https://www.indonesia.travel/gb/en/destinations/sulawesi/makassar>.
- World Bank. "City Technical Capacity Support for Solid Waste Management Investment Preparation for Indonesia." 2017. <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/194401508742537177/environmental-and-social-safeguards-for-Kota-Makassar>.
- World Bank. "East Asia's changing urban landscape: Measuring a decade of spatial growth." Urban Development, 2015. <https://openknowledge.worldbank.org/handle/10986/21159>.
- World Bank. "Indonesia Marine Debris Hotspot – Synthesis Report" April 2018. <http://documents1.worldbank.org/curated/en/983771527663689822/pdf/126686-29-5-2018-14-18-6-SynthesisReportFullReportAPRILFINAL.pdf>.
- World Bank. "Project appraisal document on a proposed loan in the amount of \$100 million to the Republic of Indonesia for a improvement of solid waste management to support regional and metropolitan cities." November 7, 2019. <http://documents1.worldbank.org/curated/en/608321575860426737/pdf/Indonesia-Improvement-of-Solid-Waste-Management-to-Support-Regional-and-Metropolitan-Cities-Project.pdf>.
- World Bank Group. "Solid Waste Management in Indonesia: Opportunities and Challenges for Recycling and Waste Reduction." Presentation, Jakarta, Indonesia, October 25, 2018. [https://ec.europa.eu/environment/international\\_issues/cem\\_presentations/EU%20SWM%20Oct2018.pdf](https://ec.europa.eu/environment/international_issues/cem_presentations/EU%20SWM%20Oct2018.pdf).
- World Economic Forum. "Radically Reducing Plastic Pollution in Indonesia: A Multistakeholder Action Plan | National Plastic Action Partnership." 2020. [https://globalplasticaction.org/wp-content/uploads/NPAP-Indonesia-Multistakeholder-Action-Plan\\_April-2020.pdf](https://globalplasticaction.org/wp-content/uploads/NPAP-Indonesia-Multistakeholder-Action-Plan_April-2020.pdf).
- WWF. "Global Environmental Conservation Organization - WWF Indonesia." March 2020. <https://wwf.id/publikasi/call-proposal-for-plastic-smart-cities-scopingassessment-in-ciliwung-jakartamakassar-city>.
- Yayasan Konservasi Laut (YKL) Indonesia, "Assessment of Plastic Waste Management 'Plastic Smart Cities' Scoping in Kota Makassar City." 2020.
- Zuraida, Nurgusti. "Let's Get to Know the Functions of Indonesia's Waste Management Facilities: TPS, TPS 3R, TPST, and TPA!" *Waste4Change*, April 20, 2020. <https://waste4change.com/blog/lets-get-to-know-the-functions-of-indonesias-waste-management-facilities-tps-tps-3r-tpst-and-tpa>.

## 8. Glossary of Terms

**Composting Facility** – A facility where organic matter is broken down into simpler organic or inorganic matter in a process called composting. Composting is the process of the controlled aerobic decomposition (with oxygen) of organic material such as leaves, twigs, grass clippings, and food scraps. This process recycles various organic materials otherwise regarded as waste products and produces a soil conditioner. Compost is rich in nutrients. These facilities keep organic material out of the waste system where they can be beneficially reused.

**Dump or Open Dump** – A facility where waste is disposed by both the public sector and private individuals in an uncontrolled manner. Such sites generally lack even minimal environmental controls and can have a significant negative impact on the local community.

**Junk Shops** – Informal solid waste management operations typically operated by individuals out of residences or small street facing lots with canopies.

**Landfill** – A landfill typically means that a site has undergone some type of siting process to ensure that its environmental impacts to the community are minimized. Generally, a disposal site falling into this category involves the excavation of land to create a “cell” and the waste is covered with soil on a regular basis to minimize odors and vectors. However, it may or may not include modern environmental controls such as methane and leachate collection systems, proper drainage for stormwater run-off and other controls. Minimal equipment is on site to compact the waste to preserve the capacity of the site.

**Sanitary Landfill** – A sanitary landfill is typically an engineered facility built to accommodate known or projected waste streams over a long-term horizon. A site of this variety typically goes through a rigorous siting and environmental impact process, before being designed and constructed by engineering and solid waste professionals. A sanitary landfill has environmental systems in place to control methane and other air emissions, leachate, stormwater run-off and daily cover material and includes monitoring systems to maintain metrics for operating and reporting requirements. Such facilities are operated with modern equipment, including compaction of the waste to optimize the available “airspace” based on a “fill plan” or “fill sequence that places an economic value on the airspace.

**Transfer Station/Material Recovery Facility (U.S.)** – For the purposes of this document a transfer station is a facility where waste is aggregated by both the public sector and private individuals (self-haul) in a controlled manner. Materials separation occurs utilizing manual labor and automated equipment if possible. Recyclables are baled and sent to market. Residual waste is then transferred into larger vehicles and taken to a landfill for final disposal. This may include multiple streams including commercial and residential waste, recyclables, organics, and construction and demolitions debris.