

Semarang, Indonesia

City Waste Management Profile



Published by:

Resilient Cities Network (R-Cities)

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URL links:

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R-Cities is responsible for the content of this publication.

June 2024

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1. Introduction to Urban Ocean

Urban Ocean is a capacity-building and accelerator program for cities that champions circular economy principles, builds awareness of ocean plastic pollution, and assesses waste management systems. The program leverages city leaders to bring new ideas, partners, and resources together and solve interrelated resilience challenges related to waste management; plastic leakage; and protecting water bodies and the ocean. The program demonstrates how actions to improve waste management and recycling can provide resilient and sustainable solutions that reduce ocean plastic pollution while addressing key city priorities, such as improving public health, supporting economic development, and reducing greenhouse gas emissions. Furthermore, Urban Ocean provides cities with the opportunity to demonstrate thematic leadership and share knowledge and experience across the Resilient Cities Network (R-Cities) community and beyond. The program is jointly led by R-Cities, Ocean Conservancy (OC), and The Circulate Initiative (TCI).

FIGURE 1
Urban Ocean cities map



Overview of the Urban Ocean Challenge

Cities are home to over half of the global population and account for nearly three-quarters of global greenhouse gas (GHG) emissions (IPCC, 2021). No climate nor social target will be met without a deep transformation of urban centers towards a more inclusive, sustainable, and resilient path. Approaching urban waste management systems through a resilience lens reveals complex, interrelated ramifications for social, economic, and environmental indicators. In 2018, the International Labor Organization estimated that the waste management sector alone has the potential to create 45 million jobs globally by 2030 while reducing GHG emissions by 15 to 20%. Additionally, circular economies offer a USD 4.5 trillion economic opportunity by reducing waste, stimulating innovation, and creating employment by 2030 (WRI, 2021). Currently, plastic usage is growing and continues to be a threat to public and environmental health in the ocean and in cities. A huge opportunity exists for city governments to implement policies and projects that promote a more resilient and circular waste sector in their cities. Now is the time to set out on the path towards a more resilient urban–ocean relationship that highlights the importance of preventing marine plastic debris.

Program objective

The Urban Ocean program aims to collaborate with urban leaders to gather new ideas, partners, and resources to address interconnected challenges related to resilience in waste management, reduce plastic leakage and protect water bodies and the ocean. Urban Ocean provides a platform for ocean advocates and urban leaders to join forces in developing comprehensive solutions that meet the needs and priorities of governments, cities, communities, and other stakeholders to create real and lasting impacts.

Cohorts 1 and 2

Urban Ocean works closely with cities to demonstrate tangible solutions and highlight progress in addressing waste management challenges. The first cohort of Urban Ocean cities included Pune (India), Can Tho (Vietnam), Panama City (Panama), Semarang (Indonesia) and Melaka (Malaysia). The work further expanded to four additional cities in Cohort 2 – Chennai, Surat and Mumbai (all India) and Santiago (Chile) – to expand the geographic scope of the program, expand the waste management, circular economy and resilience ecosystem, increase collaboration with local governments and establish effective waste management systems that generate environmental, social and economic co-benefits to cities.

Methodology

This report summarizes the information collected to develop a resilience-oriented analysis of the urban waste management system in Semarang. The profile was created in collaboration with the city of Semarang, Bintari Foundation, R-Cities, Ocean Conservancy and The Circulate Initiative. The analysis involved desk research, a collaborative workshop with city stakeholders, and interviews. The following table presents the key stakeholders who were consulted as part of the program.

TABLE 1
Interviewed stakeholders



Government

Development Planning agency of Indonesia (BAPPEDA)
Environmental Agency of Semarang (DLH)
Department of Housing, Semarang (DISPERKIM)



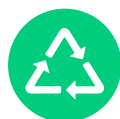
Academia

Diponegoro University (UNDIP)
UNIKA University
Semarang State Polytechnic (POLINES)



NGOs

Bintari Foundation
PRAISE
ASOBSI
ADUPI



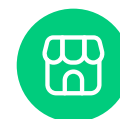
Informal recycling aggregators

Informal waste collectors



Community organizations

Paguyuban Bank Sampah (Waste Bank Association)
TPS3R



Private sector

PT. Marimas
PT. Indofoods
PT. Coca-Cola

2. About the City Waste Management Profile

As part of Urban Ocean, cities create a City Waste Management Profile, in which a city's waste management systems are presented, including technical and sustainability aspects, and formal and informal actors in the system. The City Waste Management Profile ("the Profile") examines major disturbances and stresses prevalent in the city that impact the city's waste management system. It brings together preexisting data and information collected in the initial phases of the program to allow the city to assess the risks and vulnerabilities of the system, as well as support project design.

The Profile seeks to provide insight for the city to better plan and identify appropriate solutions to increase the resilience of their waste management system, reduce plastic leakage into the environment, and improve the city's ability to respond to, adapt to, or otherwise address current and future shocks and stresses. It summarizes the baseline assessment conducted in all cities in the Urban Ocean program and highlights the most relevant data and information to address urban resilience, ocean conservation, and plastic pollution.

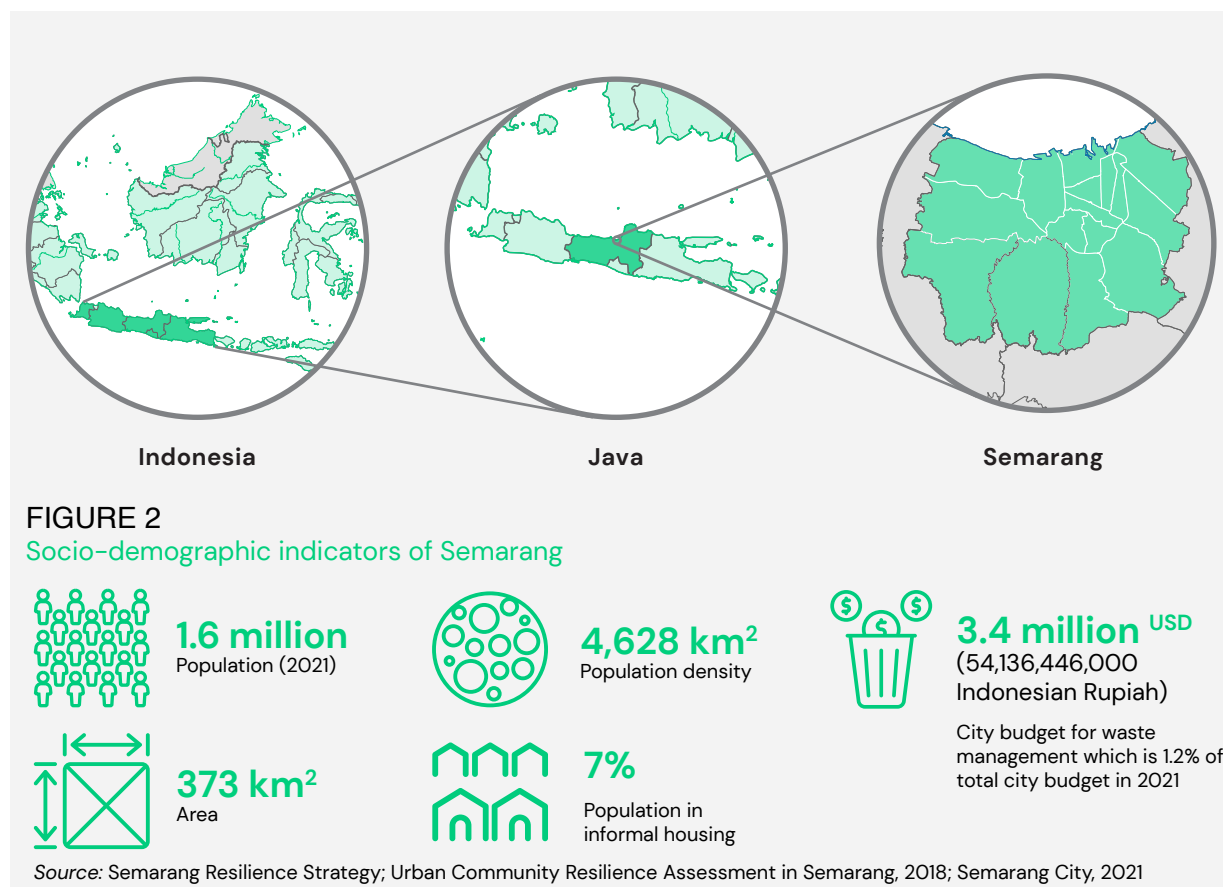
The Profile encourages a more holistic approach to existing challenges and supports cities in the development of individual solutions suited to their specific history, economy, demographics and culture while being aligned with the city's unique institutional, environmental, and financial resources. An added benefit of being part of Urban Ocean is how cities can learn from each other by comparing common elements in their respective Profile.



3. Overview of Semarang and its Resilience Journey

Semarang is the capital of Central Java Province and the fifth largest coastal city in Indonesia. The city has international hubs located at Tanjung Mas Port and Ahmad Yani Airport, which also function as the main economic gate in Central Java.

Semarang has a varied topography. Although known as a coastal city, hilly areas can also be found in Semarang. It comprises two primary topographies: lowland areas and hilly upland, with four main watersheds containing rivers and streams. The lowland in the north region along the coast is known as Semarang bawah (lower). The old city's center and the center of government and trade are in this area. Meanwhile, the hilly south region is known as Semarang atas (upper). Waduk Jatibarang (reservoir) is located here. The city development is increasingly moving to the upper region which threatens the upstream area that functions as a conservation area.

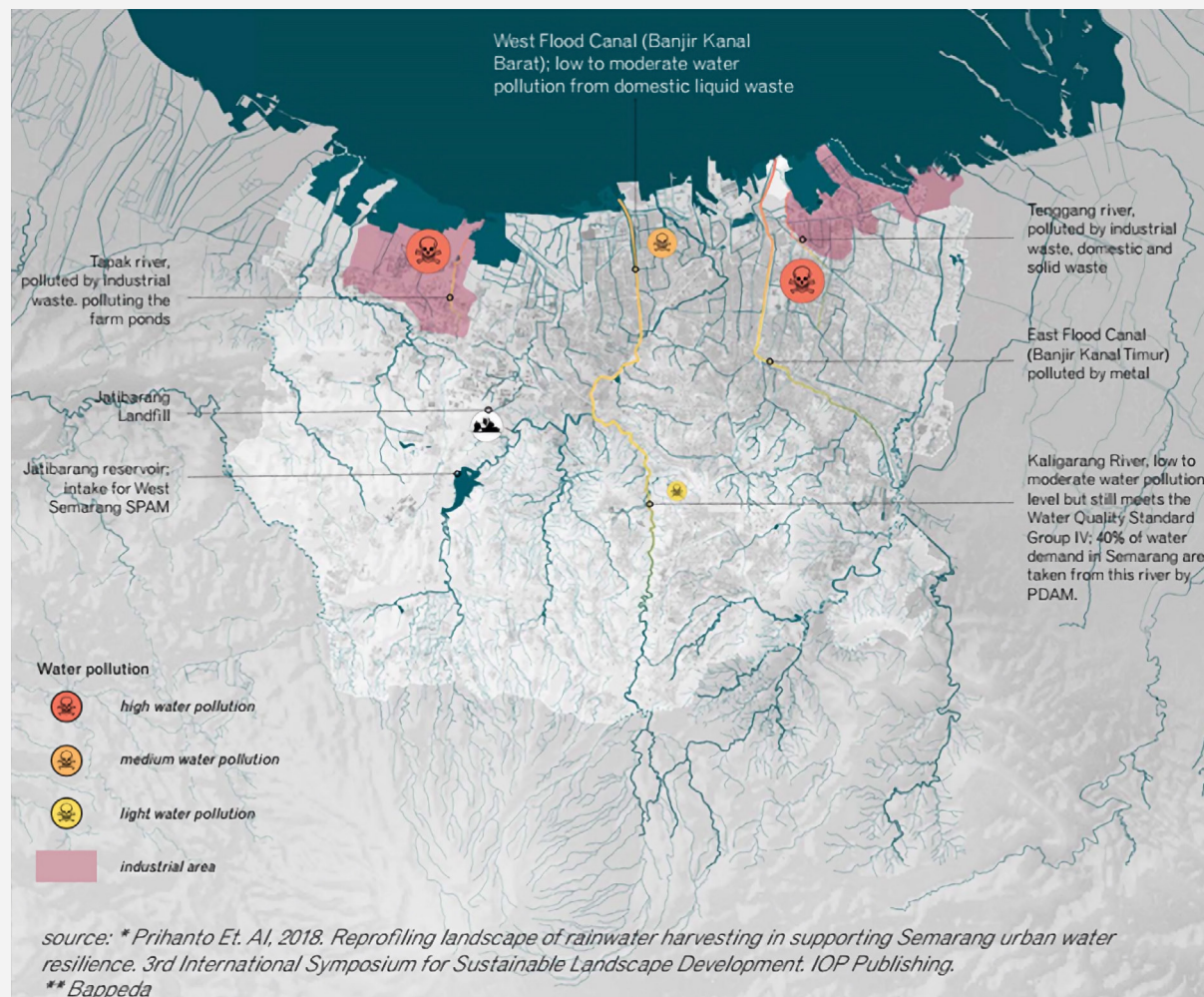


City's connection with the waterbodies

The city of Semarang is in a low-lying area, pressured by the rising sea level and a large amount of run-off from the mountainous region. Therefore, the landscape is crisscrossed by a fine network of streams accumulating into rivers that carry the water to the sea, including four main watersheds containing rivers and streams. The biggest water channel is the Semarang Canal, constructed during the Dutch colonial occupation. The two biggest canals are the Banjir Kanal Timur (East Flood Canal) and Banjir Kanal Barat (West Flood Canal). In addition, there are nine major catchment areas within the municipal boundary, which discharge approximately 1,000 mm of rainfall per year into the Java Sea.

The river/surface water is one of the main water sources in Semarang but is threatened by river pollution due to domestic and non-domestic waste. This is due to increasing population density, industrialization and urbanization, and inadequate infrastructure in recent decades. Given the city's vulnerability to low lying areas, new development is increasingly moving to the upper region.

FIGURE 3



Key shocks and stresses impacting the city's waste management systems

Semarang deals with various physical challenges due to its geography as a coastal city, such as tidal flooding, erosion, land subsidence and rising sea levels, which threaten the lowlands. Simultaneously, development in hilly upper Semarang has led to a decrease of tree coverage in the upstream area, which severely increases vulnerability to landslides, water shortages and floods.

In the sixth century, the coastline of Semarang was in the Bergota area, about 4 km from the current coastline. The continuous sedimentation from the upper area of Semarang expanded the coastline further, thus extending the inland area, which grew into a coastal city. Unfortunately, the current trend of sea level increase presents future flooding risk to this area. Along with these, waste littering in the water bodies might also add to instances of flooding.

Increasing urbanization and development in the city has also led to stressed sanitation and waste management systems, vehicular congestion and high unemployment. These interrelated challenges increase the severity of shocks impacting health and livelihoods, especially for marginal and poor communities.

The city has already implemented some innovative programs to tackle these issues such as increasing rainwater harvesting, planting Vetiver grass to prevent landslides, rehabilitation of mangroves to protect

coastlines and investments in early warning systems for floods and vector-borne diseases.

Building resilience through waste management

The strategy was a result of almost two years of consistent, dedicated and collaborative efforts by local government leaders, city departments, non-government organisations, experts from institutes and universities in the city, local enterprises, and, crucially, local communities. Using a resilience lens, the strategy clearly identified pressing challenges in the city and immediate and long-term actions that the city must take to meet these challenges.

The Urban Ocean program aims to further develop these actions identified in the strategy, based on rigorous research and stakeholder engagement, define opportunity areas in the city and conceptualize pilot ideas ready to implement. The program was jointly led by Urban Ocean partners Resilient Cities Network, Ocean Conservancy, and The Circulate Initiative and implemented by the Semarang City Council and the University of Semarang in the city. For the Urban Ocean Gap Assessment, the Circularity Assessment Protocol, a baseline assessment of waste and circularity within the city conducted as part of the Urban Ocean program, was deployed. The local team also collaborated with other relevant partners for implementation of specific projects ideas.

FIGURE 4
Key shocks and stresses in the city

SHOCKS



Landslides in upper Semarang and hilly areas



Flash floods



Land subsidence due to excessive groundwater extraction



Disease outbreaks

STRESSES



Water scarcity



River pollution



Tidal flooding



Poor sanitation and waste management



Coastal erosion



Power outages



High unemployment



Traffic congestion

The Urban Ocean program was implemented in Semarang as below:

2016–17

Resilience strategy

Semarang identified solid waste management as a key challenge

2020

Launch of Urban Ocean (Launch of program and Preparation forum)

Semarang joined the Urban Ocean program to address the interrelated resilience challenges related to waste

2020–21

Gap Assessment (Circularity Assessment Protocol –CAP, City Waste Management Profile, Opportunity Assessment Tool – OAT)

The city undertook assessment of risks and vulnerabilities within the waste management systems that lead to plastic leaking into the municipal environment and beyond, identification of opportunities by rethinking waste management through circular economy and resilience principles

2021–22

Design Proposal

Project Statements and Accelerator summit

The city developed specific actions to advance solutions to address plastic waste challenges

Semarang city generates 1,250 tons of waste per day. Approaching urban waste management systems through a resilience perspective reveals the complex, interrelated ramifications for social, economic, and environmental indicators. To maximize resilience co-benefits and to positively impact the wider social, economic and environmental context, waste management needs to be tackled in an integrated manner. An integrative approach will include the objectives of reducing waste, managing the exiting waste efficiently to reduce waste leakage in water bodies, promoting sustainable innovations as well as impacting livelihoods. Actions towards improved waste management and recycling can provide resilient and sustainable solutions that reduce waste pollution and address key stresses in the city, such as improving public health, supporting unemployment and economic development, and reducing environmental degradation.

The Semarang Urban Ocean initiative is changing the relationship between the city and the waste it produces. Through the program, the City Council is exploring solutions of adaptive waste management models and inclusive waste governance, with environmental, social and economic co-benefits.



4. Legal, Policy and Governance

Governance structure

The following authorities at various level are involved and impact the waste management systems in Semarang. Their roles and responsibilities are as below:

LEVEL OF GOVERNANCE	STAKEHOLDER	ROLES AND RESPONSIBILITIES
National level	Ministry of Environment and Forestry (MOEF)	Responsible for developing national policies and regulations related to environmental protection, including waste management standards and guidelines.
Provincial level	Provincial Environment Agency of Central Java	The role primarily revolves around overseeing and coordinating environmental matters at the provincial level, which includes waste management in Central Java cities including Semarang. In addition, the agency serves as a coordinating body between the provincial government and Semarang City, facilitating communication and cooperation on waste management issues and projects. It also deals with permits and licenses for waste management activities within the province, including those conducted in Semarang. This ensures waste management operations comply with environmental standards.
City level	Semarang City Government	Led by the mayor, it is responsible for formulating strategies and overseeing waste management efforts in the city.
	Planning and Development Board	Responsible for policy formulation related to waste management and infrastructure. Additionally, this board acts as a coordinating board to manage tasks for agencies and departments in Semarang.
	Environmental Agency of Semarang	Responsible for implementing and managing day-to-day waste management, including coordinating and overseeing the collection, transport, and disposal of waste, as well as ensuring compliance with waste management regulations. In addition, the agency is also responsible for the construction, operation, and management of the Jatibarang landfill in the city.
	Public Works Department	While their primary focus is infrastructure projects, the Public Works Department may play a role in the construction and maintenance of waste management facilities, such as transfer stations within the city.

Apart from the government body, key stakeholders in the Semarang waste management ecosystem include local communities, non-governmental organizations, and universities and research institutions.

- **Community participation** is actively encouraged through waste reduction campaigns and waste banks, which incentivize recycling and segregating waste at source. NGOs provide valuable support through advocacy, education, and awareness programs, further mobilizing the city's residents towards responsible waste practices.
- **The private sector** also plays a crucial role. Waste collection and recycling companies operate under contracts with the city government, ensuring the systematic removal and processing of waste. These partnerships have fostered innovation, with companies investing in technologies for waste treatment and disposal.
- **Universities and research institutions.** These organizations in Semarang (e.g. Universitas Diponegoro and Universitas Negeri Semarang) are actively collaborating with the city government on research and development projects related to waste management, helping to identify innovative solutions and sustainable practices.

State and local regulations and guidelines

The following regulations guide the city for waste management.

Semarang regulation

Semarang Mayor Regulation Number 34 Year 2019 stating regional policies and strategies on household

waste management and households like waste.

Retribution

Retribution is a collection fee for services provided by the authorities. There is a regional regulation, Perda No. 2 of 2012, which regulates tariffs that the city can levy to users as well as all matters related to user fees for waste management. Retribution planning aims to optimize the collection of solid waste user fees to finance waste management. The person/group in charge of waste management can collect waste management user fees from the community and business actors to pay for waste management services that refer to the minimum service standards and technical requirements. These minimum service standards and technical requirements are regulated, but not enforced or monitored.

Semarang Wegah Nyampah and Plastic Bag Ban

The city government has the “*Semarang Wegah Nyampah*” (“No waste Semarang”) program for 2025 to realize the vision of a plastic-free city in 2025. The program is part of the Mayor Regulation No. 27 of 2019 concerning the ban of plastic waste for retailers and restaurants.¹

Existing projects for waste management

Strengthening waste collection and recycling through the Clean Cities, Blue Ocean program by USAID

In October 2022, the U.S. Agency for International Development's (USAID) Clean Cities, Blue Ocean, the agency's flagship program to address ocean plastic pollution under the Save our Seas Initiative,

partnered with Circulate Capital and Prevented Ocean Plastic (POP) South East Asia to expand recycling infrastructure through new aggregation and collection centers that optimize the volume and value of plastic waste in Indonesia.

The partnership initially focused on the city of Semarang to expand collection and recycling infrastructure and build local government capacity for solid waste management planning. USAID is working with local partner Bintari to revitalize six community-based recycling centers and five waste banks to make them functional through improved operations and equipment and to create an integrated system for solid waste management.

Within two months of receiving support from USAID's Clean Cities, Blue Ocean, POP Indonesia has doubled its processing volume, and within eight months it is expected to increase its volumes six-fold.

Waste to Energy Plant

With support of the national government, the Semarang City Government is planning the construction of a Waste-to-Energy Plant (WtE) with a capacity of around 1,000 tons per day (TPD). This WtE will be in the Jatibarang municipal landfill (TPA) Area. However, some challenges persist, such as waste sorting/storage and subsidy structure. It is important to note that WtE plants have negative consequences because of associated GHG emissions and no reuse and recovery of plastics for recycling. Urban Ocean partners recognize the need for implementable and circular solutions in Semarang that hold plastics producers accountable for the full lifecycle of their products, cease the leakage of plastics into the environment, and incentivize reuse.

¹ <https://distaru.semarangkota.go.id/v2/berita/view/60>

5. Waste Management in the City

Overview of Semarang's waste management system

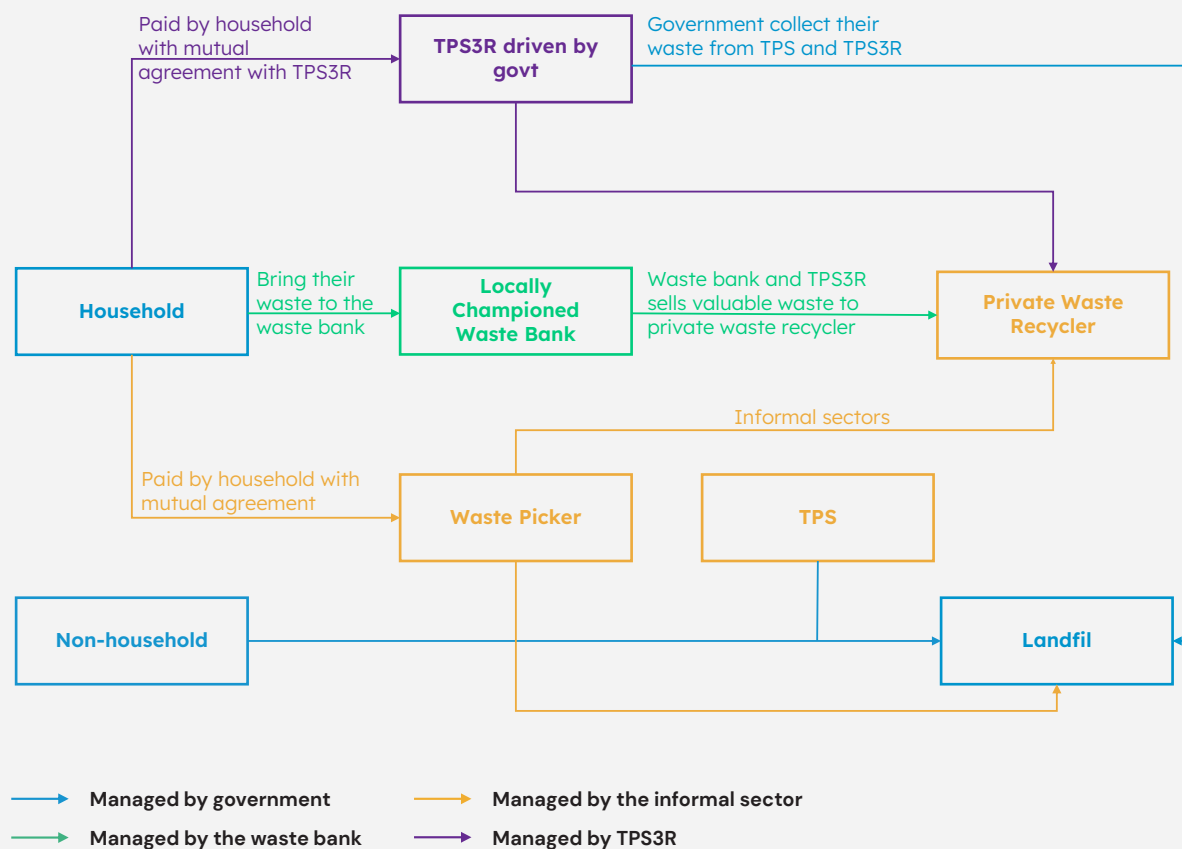
Semarang city generates 1,250 tons of waste per day and is unable to provide waste management services for the entire city's population. A study conducted in preparation of the installation of a WtE plant in 2019² estimated that around 5% of waste in Semarang goes uncollected. The Semarang waste management masterplan states only 87 percent coverage, while the Circularity Assessment Protocol³ found 61 percent coverage. The city government lacks the financial capacity to cover waste collection transportation. The waste is disposed of in Jatibarang municipal landfill. However, the landfill is already at capacity.

Waste generation and characterization

Waste generation

Semarang city's 1,250 tons of waste per day is equivalent to 456,873 tons per year. As per the CAP

FIGURE 5
The city's existing waste management value chain



2 Outline Business Case, Technical Assistance for Semarang Waste to Energy, 2019, Cardno

3 Circularity Informatics Lab, April 2021. Circularity Assessment: Semarang, Indonesia. University of Georgia, Athens, GA, USA. - <https://assets.website-files>.

report, household waste accounted for 67% of Semarang's daily waste generation rates, markets and commercial areas generated 20%, industrial areas generated 7%, and the remaining 6% was generated from public facilities, streets, and sewers. Waste segregation is typically not performed in Semarang at the household level. As a result, it is observed that those who do not have access to collection services often turn to burning or dumping their waste in the surrounding environment.⁴

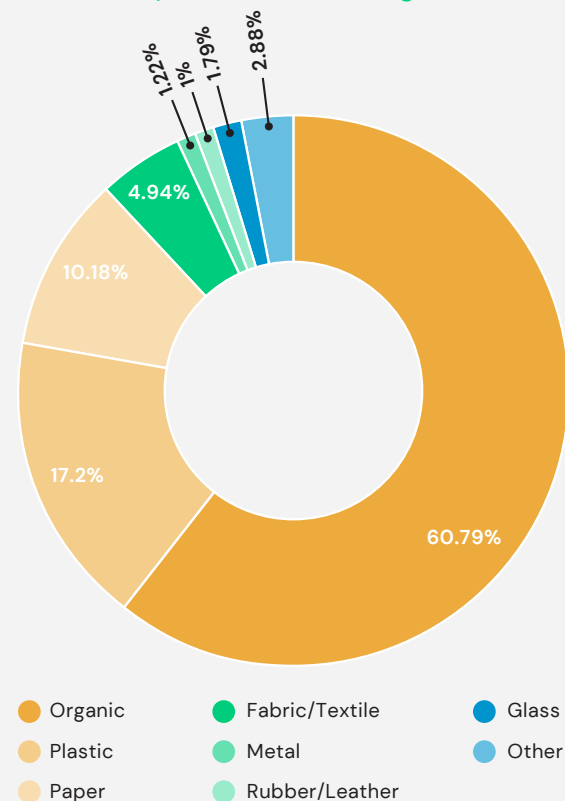
The city has set itself the target of reducing its waste generation by 30% by 2025. However, a study conducted in 2018 showed the waste generation itself is projected to increase around 70%, and the plastic waste generation is projected to nearly double within that time frame. The city government has delivered some interventions in the community and the private sector. However, Semarang faces the critical issue of waste segregation at the source, which impacts the city's ability to reuse and/or recycle the waste generated, largely caused by lack of public awareness.

Waste characterization

The proportion of organic waste in the city is high. As per the CAP report, waste composition in Semarang consisted of 78% organic waste (e.g., organic materials and paper) and 22% inorganic waste, whereas data from the Semarang Environmental Agency suggests 61% organic waste. Plastics also account for a relatively high

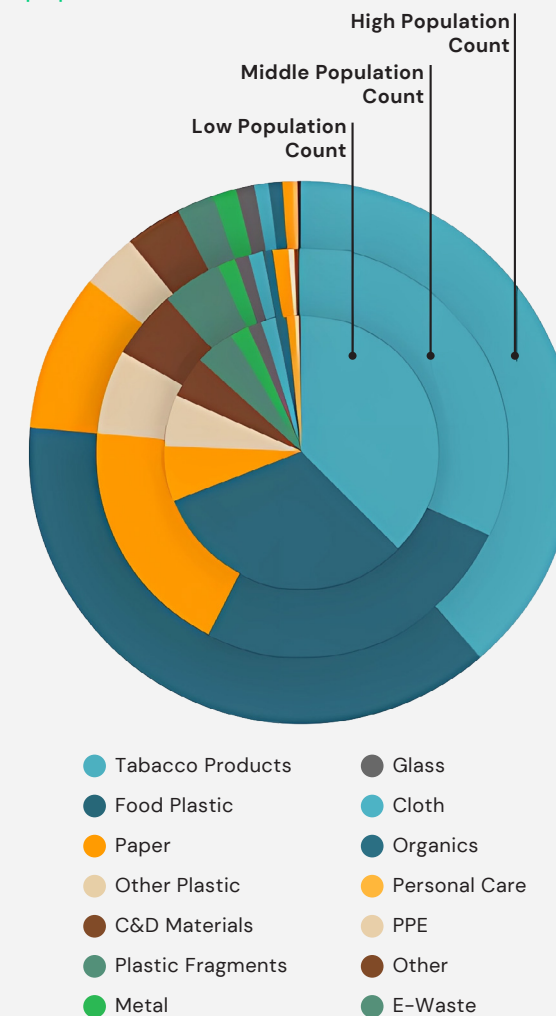
⁴ Andarani et al., 2018 - https://www.researchgate.net/publication/329834060_Preliminary_Study_on_Plastic_Waste_Handling_in_Semarang_City_-_Indonesia_Estimated_Generation_and_Existing_Management

FIGURE 6
Waste composition in Semarang



Source: Environmental Agency, 2021

FIGURE 7
Categorizes of litter across all transects by population count



Source: Circularity Assessment Protocol, Semarang

proportion, i.e. 17% of the entire solid waste stream in the city.

The Circularity Assessment Protocol, as part of the Urban Ocean program, saw a survey conducted over 27 transect areas and provided a more detailed breakdown of waste types in Semarang. The largest percentage by category of litter items was tobacco products, followed by food plastic. It is applied for every population count sampled in CAP. Organics, paper, and plastic fragments comprised between 4% and 8%; construction and demolition (C&D) materials, glass, and metal formed 2% or less of the total litter count. Although the values are relatively close, the density of litter per square meter was slightly higher in the upper population count areas and lowest among the lower population count areas.

Semarang City has restrictions in place on single-use plastic bags. Still, these only apply to a limited number of stores, and many of the small- to mid-scale stalls, cafes and mini markets are still using cheap plastics for packing purposes (wrappers or bags).

Waste collection and transportation

System

While numbers vary across data sources, municipal waste management services do not cover the entire city. The Semarang Waste Management Master Plan states 87% coverage while the CAP report states 61% coverage. Waste separation is typically not performed

in Semarang at the household level. The Semarang Environmental Agency manages waste transportation from the transfer station (TPS) or reuse-reduce-recycle transfer station (TPS3R) to the landfill, while citizens have to individually manage waste transportation from households to the TPS or TPS3R themselves. Waste collection depends on the economic status of the households in Semarang:

- Low- to middle-income households do not pay for waste collection; they manage waste disposal individually. (For example, by burning the waste, dumping it in fields, taking it directly to the landfill, or disposal in a nearby river/water body). However, some neighborhoods have active local champions and initiatives, such as a waste bank or TPS3R driven by the government (and managed by the community) resulting in a well-organized waste collection in such neighborhoods.
- Middle- to high-income households make payments to waste pickers/third party vendors to collect and transport their waste to waste banks/TPS3Rs or directly to the landfill.

TPS3R and waste banks often offer waste collection services to households located close to their site. However, not all households are willing to pay collection fees to the waste banks/TPS3Rs. There are two types of informal waste pickers in Semarang: those hired to collect waste from households and transport it to the landfill by community groups in neighborhoods (RT i.e. Rukun Tetangga at community level for smaller areas

and RW i.e. Rukun warga at neighborhood level in larger areas) where there is no TPS3R nor waste bank; and those who pick up and/or buy waste from households to sell it to a private waste recycler.

Treatment and disposal

The Office of Environmental Management handles waste transportation in Semarang. There is a formal collection by garbage collectors, while local neighborhood associations oversee TPS and TPA. There are four Technical Implementation Units (UPTs) representing the administrative boundaries for waste management in Semarang. The area coverage and waste generation of these UPTs are as follows:

Most of the waste in Semarang goes to Jatibarang. It is estimated that the city would require an average of 950,000 m³ of landfill space per year to maintain the current level of waste generation. However, the city cannot meet this as the landfill is at capacity.

Recycling of waste

One of the most popular strategies promoted by the Indonesian government nationwide, including the City of Semarang, are the community waste banks and TPS3R. A waste bank operates at the community level on various scales using similar principles as banking. However, instead of depositing money, people deposit waste that can be recycled. The waste collected is sold to private recyclers, and waste bank members get monetary value in return. Similarly, a TPS3R is

TABLE 2
Payment structure

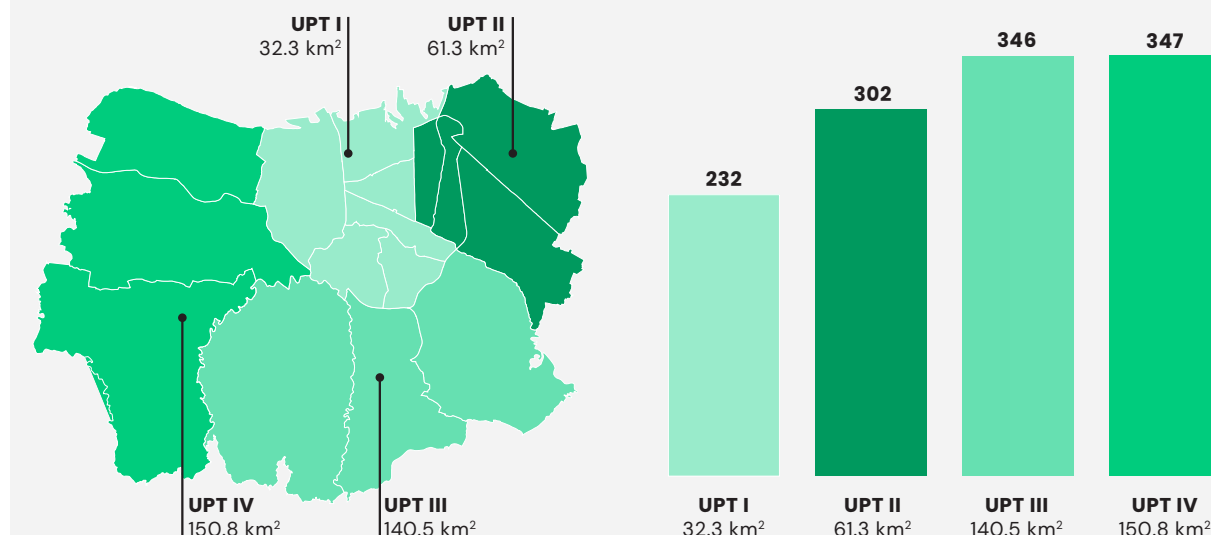
TRANSPORTATION	PAYMENT MADE BY	MECHANISM
From household to TPS	By household/ community	Usually organized at community (RT/Rukun Tetangga) level or neighborhood level (RW/Rukun warga); each RT or RW will hire a minitruck/pedicab driver to collect their household waste and deliver it to a TPS 1 RT= c.20–40 households 1 RW = c.150–400 households
From TPS to final landfill	By the city government, the DLH (Environmental Agency)	DLH operates trucks to final landfill; waste stays in the temporary landfill for a day Retribution fee included in the PDAM/water bill; for households without a water connection, payment collected via RT/RW head

conceptualized as a reduce, reuse, recycle center at the community level. TPS3Rs have an important role in recycling with contribution from the community in waste segregation and collection.

As such, waste banks and TPS3R encourage waste reduction, recycling, and tackle pollution, while generating community level social and economic benefits. A study by USAID and Bintari foundation concluded that construction of TPS3R and waste banks are two main programs for the local government to achieve the target of reducing 30% of waste by 2025. However, there are obstacles in implementation with some communities being skeptical of waste sorting efforts, which is a critical first step in the process. The study also inferred inadequate infrastructure and support for managing the waste banks and TPS3R such as warehouses, shredding machines and transportation fleets. In Semarang, there are 212 units of waste banks all managed by communities with an average number of 110 customers per unit. However, another study by Bintari Foundation found that the amount of waste that waste banks can reduce per year in Semarang reaches only 826 tons. Compared to the 1250 ton of daily waste generated, this remains far from the city's 30% waste reduction target.

While waste banks and TPS3R are a good practice to promote reduce, reuse and recycling in the city, successful implementation comes with various challenges. The amount of waste reduction is low, and without financial incentives from government

FIGURE 8



it is difficult to remain operationally sustainable. The closing down of waste banks is not uncommon. Despite these challenges, the waste banks movement is understood to have contributed to change in people's behavior towards waste. Bintari Foundation identified several difficulties in the operation of waste banks such as lack of participation, low volume of materials that can be recycled, and waste collection infrastructure that is not meeting the needs for wider recycling practice.

FIGURE 9
Waste Banks



FIGURE 10
TPS3R



6. Key Findings and Opportunities

Key challenges

Potential opportunities



Urbanization and governance

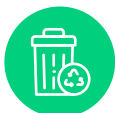
- Built-up areas of Semarang and the surrounding areas have grown rapidly in a sprawling pattern, not supported by adequate transport services and infrastructure. The city has witnessed urban sprawl in recent years with many communities now inhabiting the high-density suburban areas far from the coast.

- There is a need for the city to focus on citizen behavior change and investment in waste collection and transportation systems for improved operations covering the entire city.
- The city should explore ways to address the resilience issues of pollution in water bodies, improvement in public health and livelihoods opportunities through stronger enforcement and incentives to support existing regulations.



Resilience

- Increasing urbanization and development in the city has impacted stresses like sanitation and waste management and high unemployment. These interrelated challenges increase the severity of further shocks impacting livelihoods, especially in marginal and poor communities.
- Semarang deals with various physical challenges due to its geography as a coastal city, such as tidal flooding, erosion, land subsidence and rising sea levels.



Existing waste management systems

- Waste segregation at source is a concern due to lack of public awareness which eventually leads to low recycling rates in the city.
- Though the city has restrictions on single-use plastic packaging, enforcement is a concern with only limited enterprises implementing the ban.
- The city has set a target of reducing its waste generation by 30% by 2025. However, even hitting the target, the city's waste generation rate in 2025 is still expected to be greater than 1,000 tons per day.

- Awareness on waste segregation and community participation and engagement can be strengthened, which is crucial to improve the city's waste management and enhance the value of resources recovered.
- There are existing community waste management models such as waste banks and TPS3Rs in selected neighborhoods based on the social context of the area. Integration and scaling up of these models can potentially improve Semarang's waste management system.

7. Glossary of Terms

ADUPI: Asosiasi Daur Ulang Plastik Indonesia (Indonesian Waste Recycler Association)

ASOBSI: Asosiasi Bank Sampah Indonesia (Indonesian Waste Bank Association)

BAPPEDA: Development Planning Agency of Indonesia

CAP: Circularity Assessment Protocol. Assessment protocol developed by the University of Georgia to identify and analyze waste streams, particularly plastics

DISPERKIM: Department of Housing, Semarang

DLH: Environmental Agency of Semarang

GHG: Greenhouse Gases

IPCC: Intergovernmental Panel for Climate Change

MOEF: Ministry of Environment and Forestry

NGOs: Non-Governmental Organizations

OAT: Opportunity Assessment Tool

OC: Ocean Conservancy

PDAM: Perusahaan Daerah Air Minum – Local Water Company

POLINES: Semarang State Polytechnic

PRAISE: Packaging and Recycling Association for Indonesia Sustainable Environment

R-Cities: Resilient Cities Network

RTs: Rukun Tetangga Neighborhood Association

RWs: Rukun warga Community Organisation

TCI: The Circulate Initiative

TPD: Tons Per Day

TPS: Temporary waste collection points

TPS3R: Tempat Pengolahan Sampah – Reduce, Reuse, Recycle (Solid Waste Processing Centre – 3R)

UNDIP: Diponegoro University

USD: United States Dollar

WRI: World Resources Institute

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