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Clean Oceans through Clean Communities

WASTE GENERATION & MANAGEMENT ASSESSMENT

IN CHENGALPATTU, TAMIL NADU, INDIA

A report by Clean Oceans through Clean Communities (CLOCC)

Avfall Norge

ISWA
International Solid Waste Association

HAND IN HAND INDIA

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Abbreviations

CLOCC	Clean Oceans through Clean Communities
BOV	Battery Operated Vehicles
CMA	Commissionerate of Municipal Administration
GIZ	Gesellschaft für Internationale Zusammenarbeit
HCV	Heavy Commercial Vehicles
HH	Household
ICT	Information and Communication Technology
IEC	Information Education and Communication
ISWM	Integrated Sustainable Waste Management
LCV	Light Commercial Vehicles
WWC	Waste Wise Cities
WaCT	Waste Wise Cities Tool
WACS	Waste Amounts and Composition Survey
WFD	Waste Flow Diagram
WMP	Waste Management Plan
MAWS	Municipal Administration and Water Supply Department
MCC	Micro Composting Centre
MoEFCC	Ministry of Environment, Forest and Climate Change
MRF	Material Recovery Facility
MSW	Municipal Solid waste
MT	Metric Tonnes
OCC	Onsite Composting Centre
RDMA	Regional Director of Municipal Administration
RRC	Resource Recovery Centre
RF	Recovery Facility
SDG	Sustainable Development Goal
SUP	Single Use Plastics
TPD	Tonnes Per Day
TNPCB	Tamil Nadu Pollution Control Board
ULB	Urban Local Body

Executive Summary

The Clean Oceans through Clean Communities (CLOCC) Programme is a community and network-driven programme owned by Avfall Norge and funded by Norad (the Norwegian Agency for Development Cooperation). CLOCC's vision is to achieve healthy societies and a clean environment - through sustainable communities, green jobs, and business opportunities in local circular economies. CLOCC uses a participatory planning process through hybrid training (in person with some online components), conducting stakeholder meetings, baseline assessments, and Waste Master Plan development with a focus on governance and stakeholder involvement. CLOCC uses a 7-step ISWM approach for waste management planning and stakeholder engagement process. In this approach, the stakeholders - users and local institutions - choose the system that meets their needs and preferences. Chengalpattu district was selected for CLOCC implementation, where the 7-step methodology will be implemented. Chengalpattu district is situated on the northeast coast of Tamilnadu with a total geographical area of 2802.64 sq. km and a population of over two million people.

This report presents the step of the CLOCC approach involving the data collection and assessment using UN Habitat's Waste Wise Cities tool. The Baseline Assessment in Chengalpattu District was implemented in April 2023, and around 53 participants were involved in the WaCT survey. The assessment carried out eight days of Household waste sampling for 99 households in the district of various income groups to establish the benchmarks on waste generation and composition. Further, it surveyed the disposal sites and all the waste recovery facilities in the district, including the municipal facilities and the private sector players. This assessment establishes a waste data baseline that provides up-to-date waste management data, waste flows, and leakage to the environment and will be used for future waste management planning.

The total MSW generated in Chengalpattu has been computed to be around 1,694 t/d, with households generating most of the waste at 1186 t/d and non-household commercial generation at 508 t/d. The total waste generation for the Chengalpattu district comes to 0.62 kg/Capita, which is higher than the benchmarks shared in SBM 2.0 guidelines. The composition shows that 62.12% is organic waste, comprising Kitchen, Garden and Coconut waste, which is the major waste stream in the Chengalpattu district. Close to 14% is plastic in the waste stream, followed by 7% paper, 2% Glass, 2% metal and 13 % other waste. Though the waste collected by municipal channels is 60% of the total MSW generated, the recovery rate by controlled municipal recovery facilities across the district is only 22%. Most waste collected by municipal channels is being disposed in uncontrolled disposal facilities (Aapur disposal site), which needs urgent attention to scientifically manage the waste and increase its capacity.

Organic and Dry Waste collected through MSW collection managed in 103 Municipal facilities is 148 TPD. The organic waste is composted or used in Biogas (ex. in Mamallapuram Town Panchayat), whereas recyclable waste is sent forward for recycling outside of Chengalpattu district. It was found that there was no prominent recycling facility in the district, and most of the waste collected by traders was sent to Chennai or other regions of India like Gujarat and Delhi for recycling. The non-recyclable waste, mainly one with high calorific value (Reduced Derived Fuel), is sent to cement plants for co-processing.

The waste recovered by the waste value chain comprising waste traders, scrap shops and informal waste picking was found to be 123 TPD; and it was found in the survey that 45% of the waste value chain is informal, and a huge chunk of organic waste in the rural district is managed by feeding to animals, which is 96 TPD or 75 grams per capita in the rural area. The dumpsite in the district at Aapur receives 640 TPD of waste on

average; 54% is an organic waste fraction, and 20% of incoming waste is flexible plastics.

Around 25 families have been residing beside the Dumpsite. The interviews with the informal sector workers gave some interesting insights about their work at Dumpsite. The workers here have been working in this profession for 3 to 4 years and some for the past 15 years. They collect around 40 -45 kg of waste and earn INR 5000- Rs 6000 per week. Further, the dumpsite had limited control as no waste cover was added regularly and no leachate control system was in place.

Another key insight is that 40% of the waste across the district, amounting to around 687 t/d, is not even reaching any of the recovery or disposal facilities. This 687 t/d of unmanaged waste is equivalent to 130 kg/ day/ sq. km of district area. The waste from Tambaram Municipal Corporation is the major official source of waste at the dumpsite, and the dumpsite does not officially manage the final disposal in other municipalities, and it is accounted as unmanaged waste.

It is found that 17% of generated plastic waste is uncollected, 60% is disposed of by dumping, and major leakage is happening from the uncollected and disposed waste. Plastic leakage to the water system is 7688 tons annually, which comes to 2.8 kg/ person/ year, equivalent to 94 PET bottles/ person/ year. The waste flows for Chengalpattu Urban, Chengalpattu Rural, Chengalpattu Municipality, and Tambaram Municipality are also detailed. The issue of unmanaged waste is very significant in the Rural Chengalpattu area; it comes to 512 TPD. In Chengalpattu Municipality, the unmanaged waste was 27 TPD, which is mainly littered and burned. This brings the waste collection in Chengalpattu municipality to 34%; despite door-to-door collection serving more than 90% of households, the 34% gives a realistic inference on the percentage of waste still not collected by municipal services.

The waste flows suggest that collecting unmanaged waste is one of the most important aspects of improving waste management in the district. Though there is a policy in place for door-door collection, despite services for the collection available (Coverage), much waste is not collected and is littered. The other priority area is the dumpsite, where 1/3rd of the waste generated in the district is transferred. It is found that solid policy intervention is needed on disposal and compliance for all municipalities in the district. Even waste recovery must be enhanced through infrastructure development, as waste recovery is 22% for urban areas, whereas the problem is much more significant in rural areas, where it is just 20%, of which 13% is because of animal feeding. A key to enhancing recycling is separation at source, which requires compliance and legal enforcement in the district by enforcing fines and having more regular checks.

As the next steps from this baseline study, a stakeholder workshop shall be conducted, and the other steps of the CLOCC project will be implemented as the final aim to develop a comprehensive waste management master plan for the Chengalpattu district.

1 Introduction

1.1. Importance of data in waste management

Waste management data plays a crucial role in effectively addressing the global challenge of waste management. As the world's population grows and consumption patterns change, waste generation has increased significantly. It is essential to collect, analyze, and utilize data related to waste management to make informed decisions, implement sustainable practices, and mitigate the environmental, social, and economic impacts of waste. Waste management data provides valuable insights into waste composition, volume, and sources. By analyzing this data, policymakers and urban planners can develop effective waste management strategies, set appropriate targets, and allocate resources efficiently. Data-driven planning ensures that waste management systems are designed to meet a given region's specific needs and challenges. It also plays a vital role in monitoring waste-related regulations and ensuring compliance. By tracking waste generation, collection, treatment, and disposal data, authorities can identify non-compliance, unauthorized activities, or illegal dumping. Data-driven monitoring systems enable timely intervention, enforcement of regulations, and the imposition of penalties for non-compliant practices. Furthermore, it enables the evaluation of the effectiveness and efficiency of waste management systems.

1.2. Marine litter issue

The United Nations Environment Programme describes marine litter as any persistent, manufactured or processed solid material discarded, disposed of, or abandoned in the marine and coastal environment. Marine litter consists of items made or used by people and either deliberately or accidentally discarded into the sea, rivers, or on beaches; brought to the sea with rivers, sewage, stormwater or winds; or accidentally lost, including material lost at sea in bad weather.

Marine litter originates from many sources and causes various environmental, economic, safety, health, and cultural impacts. For example, economic consequences include the loss of income from tourism. The very slow rate of degradation of most marine litter items, mainly plastics, together with the continuously growing quantity of litter and debris disposed of, is leading to a gradual increase in marine litter found at sea and on the shores.
The inadequate implementation and enforcement of existing international, regional, and national regulations and standards that could improve the situation, combined with a lack of awareness among main stakeholders and the general public, are major reasons why the marine litter problem remains and continues to increase worldwide. Furthermore, marine litter is part of the broader problem of waste management, which is becoming a major public health and environmental concern in many countries.

Studies have shown that if waste management does not improve profoundly in the coming years, the amount of plastic waste entering the ocean from land is predicted to increase by an order of magnitude by 2025. Many countries, therefore, focus on improving waste management infrastructure at critical locations, including solid waste collection and management. However, improving waste management infrastructure requires substantial investments (and time), especially in low- and middle-income countries. For example, solid waste management strategies can involve recycling, reuse, or upcycling (recycling to improve the value of a material), extended producer responsibility schemes and redesigning products (to make them less hazardous, for instance).

1.3. Background - About CLOCC

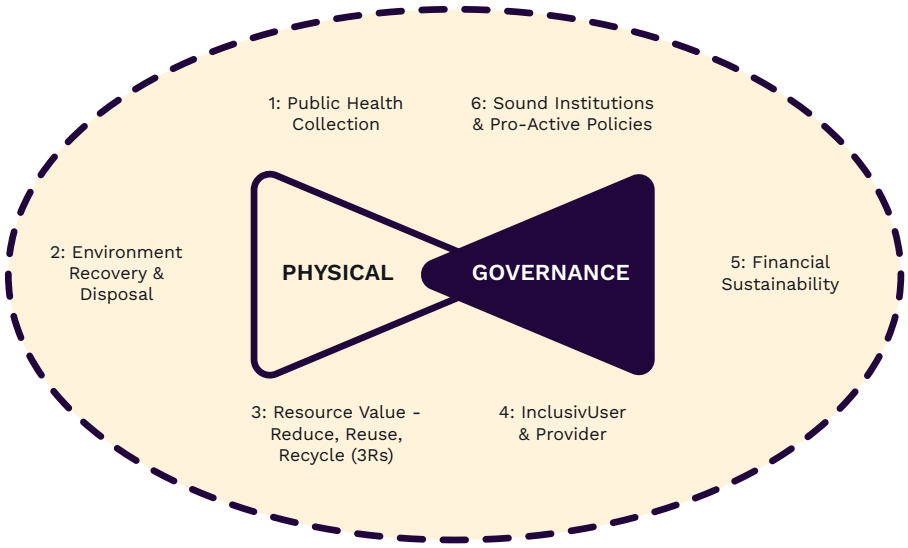
The Clean Oceans through Clean Communities (CLOCC) Programme is a community and network-driven programme owned by Avfall Norge and funded by Norad (the Norwegian Agency for Development Cooperation). CLOCC's vision is to achieve healthy societies and a clean environment - through sustainable communities, green jobs, and business opportunities in local circular economies. Recognizing that the mismanagement of waste on land is one of the largest contributors of plastics to the sea, the CLOCC Programme believes that short-term solutions should focus on improving waste management in low-income settings while long-term solutions should aim at large system changes like moving towards a circular economy, behavioural change, and better design and manufacturing practices.

In India, the waste management ecosystem has been bolstered by National and State waste management policies, and there has been considerable focus on strengthening the Municipal waste management system through Swachh Bharat Mission and Smart City programmes. Nonetheless, an integrated planning and implementation approach in the waste ecosystem is needed to consider the formal municipal waste value chain and the informal/ private waste value chain. Also, the focus on waste leakages to riverine and marine environments from both informal and formal waste value chains has to be ascertained and tackled in all the coastal districts of India. The CLOCC approach would be most suitable to tackle these challenges in India, and based on the successful start of the project in Indonesia, the CLOCC Programme was launched in Chengalpattu District, Tamil Nādu, India, in December 2022. Chengalpattu District is a coastal district in Tamil Nadu close to the capital district of Chennai. Due to growing demography and multiple municipal and private waste management levels, it has diverse waste management challenges. Based on initial discussions and guidance with State and district-level officials, It was decided to pilot the CLOCC approach in Chengalpattu district to strengthen the district's waste value chain and tackle the waste leakages to riverine and marine ecosystems.

1.3.1. CLOCC Methodology

The CLOCC Approach – the CLOCC Programme follows the Integrated Sustainable Waste Management approach, which addresses common challenges and emphasizes three important dimensions: stakeholders, waste system elements and sustainability.

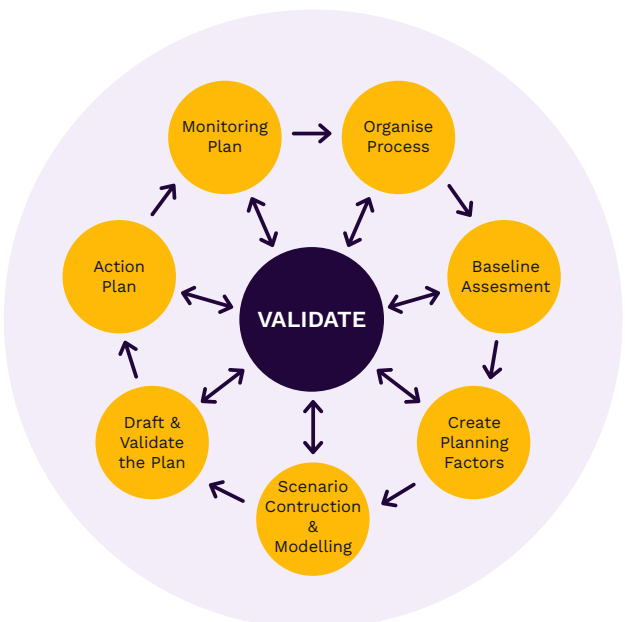
Figure 1: The 'two triangles' of ISWM Framework. Original Source: Wilson et al., 2013. This version redrawn for Whiteman et al., 2021 by Ecuson Studio.



The ISWM framework examines the physical components (collection, disposal, and recycling) and the governance aspects (inclusivity of users and service providers, financial sustainability, coherent, sound institutions underpinned by proactive policies). ISWM has undergone several development cycles and evolved to be represented by a simplified 'two triangles' figure, emphasising the need to focus on the 'hard' physical components, each related to a primary driver and the 'soft' governance aspects.

Within this framework, CLOCC uses a participatory planning process through hybrid training (in person with some online components), stakeholder meetings, baseline assessments, and Waste Master Plan development focusing on governance and stakeholder involvement. CLOCC uses a 7-step ISWM approach for waste management planning and stakeholder engagement process. In this approach, the stakeholders - users and local institutions - choose the system that meets their needs and preferences.

Figure 2: CLOCC 7 Steps Planning Approach



1.3.2. The Objective of the Report

The Step 2 CLOCC approach involves the data collection and assessment using UN Habitat's Waste Wise Cities Tool. The Baseline Assessment in Chengalpattu District was implemented in April 2023.

This assessment establishes a waste data baseline, and this report aims to represent the results that provide up-to-date waste management data, waste flows and waste leakage to the environment, which will be used for future waste management planning. A key target is to develop strong and sustainable local waste management plans. The program utilises a strategic approach, ISWM (Integrated Sustainable Waste Management) and draws on the knowledge of our network of highly skilled waste management practitioners and trainers. The program delivers training and network possibilities, supports the development of local waste management plans and provides access to finance for infrastructure and debottlenecking in material recovery ecosystems.

1.4. Introduction to Waste Assessment and WaCT

As part of the Waste Wise Cities (WWC) programme, a global call for action to support the world's cities to enhance waste and natural resources management. UN-Habitat has developed the Waste Wise Cities Tool (WaCT) to support cities and countries in establishing better waste and resource management strategies, creating business and livelihood opportunities, and contributing towards - an improved economy.

UN-Habitat finalized the Waste Wise Cities Tool – Step-by-Step Guide to Assess City MSWM Performance through SDG Indicator 11.6.1 Monitoring (WaCT) in 2020 through the African Clean Cities Platform and Waste Wise Cities initiative. WaCT guides cities and local governments through the steps to assess the environmental performance of municipal solid waste management (MSWM) systems, food waste generation and resource recovery systems in cities. Doing so provides critical information for cities and countries to establish better waste and resource management strategies.

WaCT assesses the parameters for Sustainable Development Goal indicator 11.6.1 - the proportion of municipal solid waste collected and managed in controlled facilities out of total municipal solid waste generated by the city. It comprises seven steps and provides the necessary data to support city managers' evidence-based decision-making. SDG 11.6.1 has three data points to be collected, including total municipal solid waste generated by the city, total municipal solid waste collected, and total municipal solid waste managed in controlled facilities. The monitoring methodology also aims to standardise simple waste amount and composition survey, which provides primary data input into calculating the indicator.

The primary data collected is also relevant to the different waste-related SDG indicators, including SDG 1.4.1 on access to basic services, SDG 12.3 on food waste, 12.4.2 on hazardous waste, 12.5.1 on recycling rate and 14.1.1 on marine litter. The tool provides a household survey guide for estimating

total MSW generation, a questionnaire to investigate the MSW recovery chain and criteria to check the environmental control level of waste management facilities in the city. In the last step, linkages with other SDG indicators are elaborated, and a Waste Flow Diagram (WFD) assessment is introduced. The WFD is a separate but complementary methodology to the WaCT. It uses rapid and observation-based assessment for mapping waste flows and quantifying plastic leakage from MSW management systems.

The steps a city needs to implement can be determined depending on the data available. UN-Habitat recommends that cities go through all the steps if the city has large amounts of uncollected waste or illegal dumping and has never done a waste amounts and composition survey (WACS) from households to estimate waste generation per capita or if such a survey was conducted more than five years ago. In this context, it is important to understand that the waste received at recovery and disposal facilities sometimes does not represent the total MSW generated, especially in cities with large amounts of uncollected waste.

The cities confident about their total MSW generation data's accuracy should go through Steps 4 and 5 to identify their waste management facilities' environmental and operational control levels.

1.5. Demographics of Chengalpattu District

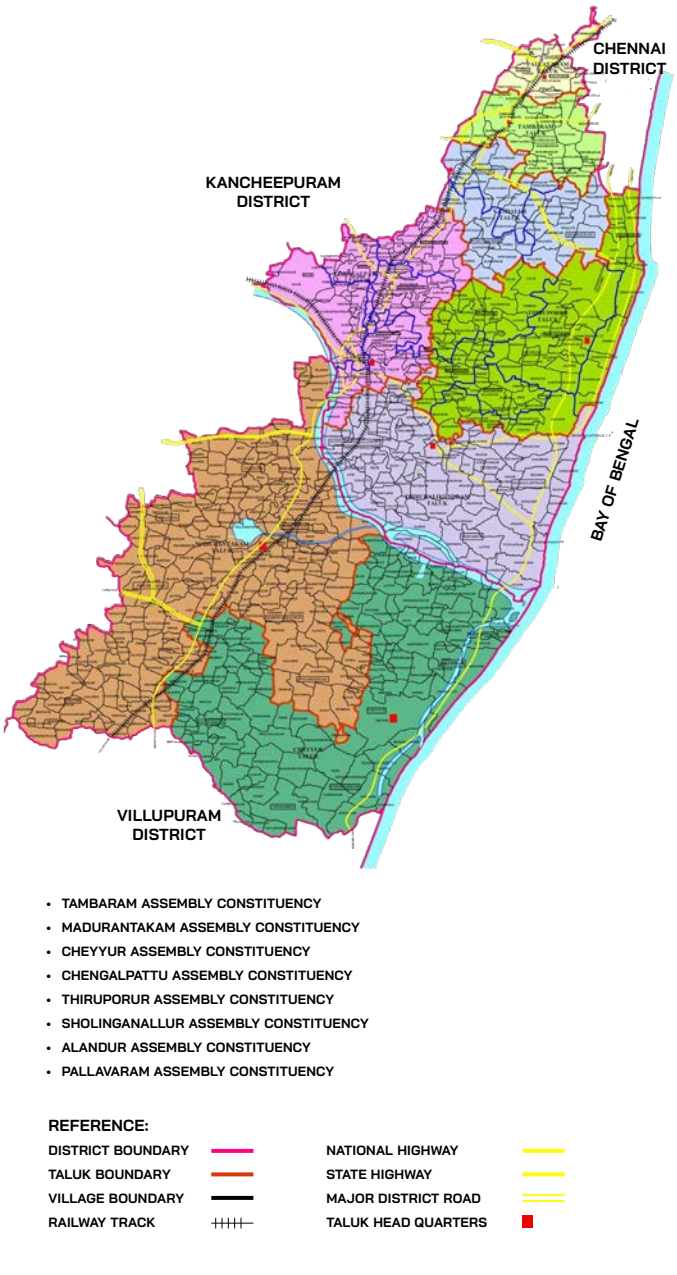
Chengalpattu district came into existence on 29.11.2019, when it was carved out of the erstwhile Kancheepuram district. Chengalpattu is a district located in the southern Indian state of Tamil Nadu. Chengalpattu district is situated on the northeast coast of Tamilnadu with a total geographical area of 2802.64 sq. km and a population of over two million people in the district, West by the Kancheepuram district and Thiruvanamalai districts and on the south by the Vilupuram District. With a coastal length of 57 Km, the district is bounded to the east by the Bay of Bengal. As per Census 2011, Density per Sq. Km is 928, and the literacy rate is 89.89 % male and 79.02 % female.

The district is primarily an agricultural region, with crops such as rice, sugarcane, and coconut grown in the area. Agriculture is the main occupation of the majority of people in this district. Even though the district is very close to Chennai, agriculture is the inevitable occupation of the people living there. Rice is the major crop grown throughout the district. Madurantakam, cheyyur and Thirukkazhukkundramtaluks are major producers of rice in this district. Sugarcane is also grown in some parts of the district. Tamil Nadu Government has a cooperative sugar mill in Padalam village of Madurantakam taluk.

There are also many industries in the district, like Siruseri SIPCOT IT Park, one of the largest IT parks in Asia in Thirupporurtaluk. Madras Export Processing Zone has many IT and BPO-based companies in Tambaram. Maraimalai Nagar is Detroit of Chengalpattu district, having various automobile manufacturing units such as Hyundai, Rane TRW, etc. Mahindra World City has many companies in the IT SEZ, Auto Ancillary SEZ, Apparel and Fashion Special Economic Zone(SEZ) and Domestic Tariff Area (DTA). Madras Automic power station is present in Kalpakkam. MargSwarnabhoomi SEZ present in Kodur. Chengalpattu also has a rich cultural heritage, with several temples and historical sites in the district. The Mahabalipuram UNESCO World Heritage Site, renowned for its ancient rock-cut temples and sculptures, is in the district.

Palar is one of the major rivers in Tamil Nadu, traversing through Chengalpattu district for a length of 54 Km. The river Palar enters the district at Palur village and confluxes with the Bay of Bengal between Vayalur and Kadalur village. Moreover, the district is bounded by the river Adayar north and the Ongurriver south. Besides the rivers above, Neenjal Maduvu, Pukkaduraiodai, and Kiliyar are other minor rivers flowing through the Chengalpattu district.

Figure 3: Chengalpattu District Map



1.5.1. Municipalities

Chengalpattu District has one Municipal corporation, four Municipalities and six town Panchayats, which form its major urban centres of the district.

Figure 4: Chengalpattu Local Bodies

- *Tambaram City Municipal Corporation*
- *Chengalpattu Municipal Office*
- *Nandivaram Guduvancheri Municipal Office*
- *Madurantakam Municipality Office*
- *Maraimalai Nagar Municipality Office*
- *Acharapakkam Town Panchayat*
- *Edakazhinadu Town Panchayat*
- *Karungukuzhi Town Panchayat*
- *Mamallapuram Town Panchayat*
- *Thirukazhukundram Town Panchayat*
- *Thiruporur Town Panchayat*

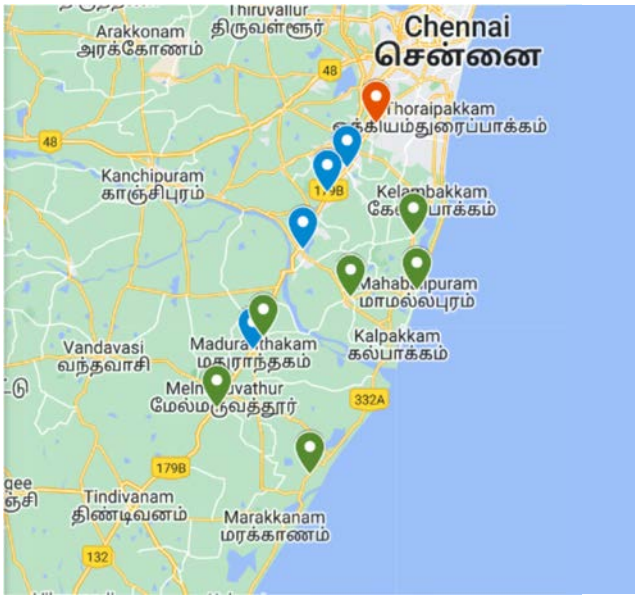


Table 1: Chengalpattu Municipalities

Municipality Name	Chengalpattu	Maramalainagar	Madhurantagam	Guduvancheri
Area (sq. km)	6.09	58.08	21.67	8.58
Population	70056	110593	32872	96408
Households	17514	27646	8076	24102
No of Wards	33	21	24	30

a. Chengalpattu Municipality

Chengalpattu started as a Panchayat and became a town with the inclusion of Periyanatham, Chinnanatham, Gundoor, Hanumanthaputheri and Melamaiyur villages functioning in 1886. As per G.O.01.02.1972 Order no 169/01.04.1972 Second Grade Municipality and after 12 years, another G.O. Order No599/17.04.84 First Grade Municipality.

Chengalpattu, previously known as Chingleput, is a city and the headquarters of the Chengalpattu district of Tamil Nadu, India. It is the district headquarters and is 56 kilometres (35 mi) away from the state capital, Chennai, on the National Highway 45. Chengalpattu has a population of about 70,056 and has 33 wards.

b. Maramalai Nagar Municipality

Maraimalai Nagar is the Headquarters town of Maraimalai Nagar taluk in Chengalpattu District. Maraimalai Nagar is in the south direction at 81 km from Chennai. It is situated at 12'41'30" latitude and 74'58'00" longitude and 28m elevated from M.S.L. This Town was formed and named Maraimalai Nagar to remember Maraimalai Adigalar. It has a population of about 1,10,593 and has 21 wards.

c. Madhurantangam Municipality

Madurantakam Municipality comprises Madurantakam, Kadaperi, and Mambakkam villages and is constituted second-grade Municipality 1991. Madurantakam is the Headquarters town of Madurantakam taluk in Chengalpattu district. Madurantakam town is located in the south direction at a distance of 81 km in Chennai. It is situated at 12'41'30" latitude, 74'58'00" longitude and 28m elevated from M.S.L. Its current population is about 32,872, and it has 24 wards.

d. Guduvancheri Municipality

The Nandhivaram-Guduvancheri Municipality was upgraded from a special Grade Town panchayat on 01.11.2021 as per G.O.(Ms) No.94, Municipal Administration & Water Supply (Election) Department, dated 01.11.2021. It was constituted as Grade II Municipality as per G.O.(Ms) No.122 Municipal Administration & Water Supply (Election) Department, dated 08.12.2021. Guduvancheri's population is 96,408, and it has 30 wards.

1.5.2. Town Panchayats

Chengalpattu District has six Town Panchayats, namely Acharapakkam, Edakazhinadu, Karunkuzhi, Mamallapuram, Thirukazhukundram and Thiruporur with a total population of 109248. A town panchayat or nagar panchayat is a form of an urban political unit comparable to a municipality in India. It is a settlement transitioning from rural to urban and is classified as a Nagar panchayat if it has more than 12,000 and less than 40,000 inhabitants. Town Panchayats are under the Municipal Administration and Water Supply Department's administrative control at Govt. level. Each Nagar panchayat has a committee consisting of a chairperson or president with ward members. Membership consists of a minimum of ten elected ward members and three nominated members. The Chairperson or President is the head of Nagar Panchayat.

1.5.3. Municipal Corporation

Chengalpattu District has one Corporation, Tambaram City Municipal Corporation (TCMC), which is constituted by annexing five municipalities and 5 Town Panchayat vide G.O.No:66 (MA & WS dept/ Election) Date: 11.09.21. The five municipalities, namely Anakaputhur, Pallavaram, Pammal, Sembakkam and Tambaram, and five town panchayats namely Chitlapakkam, Madambakkam, Perungaluthur, Peerkangaranai and Tiruneermalai, were merged to form the Tambaram City Municipal Corporation. The executive authority in Tambaram City Municipal Corporation is vested in the Corporation Commissioner, and the Legislative body is presided over by the mayor, who is indirectly elected by the councillors.

Tambaram Town is situated 24 km south of the Capital City of Chennai. The closest airport to Tambaram is Chennai International Airport (MAA). The distance from Chennai International Airport to Tambaram is 5.3 miles / 8.6 kilometres. The famous Grand Southern Trunk Road and Railway route from Chennai Egmore to Kanyakumari divides the town east and West. The Municipal Town, Tambaram, is described as the Gateway of the Beautiful Metropolitan City of Chennai.

Table 2: Tambaram Municipal Corporation

Corporation	Tambaram
Area (sq. km)	87.64
Population	1001132
Households	252830
Number of Zones	5
No of Wards	70

Tambaram City Municipal Corporation is one of the three municipal corporations in the Chennai Metropolitan Area, the other two being the Greater Chennai Corporation and Avadi City Municipal Corporation. The executive authority in Tambaram City Municipal Corporation is vested in Corporation Commissioner. The legislative branch of Tambaram City Municipal Corporation consists of a council of elected councillors from each ward. The Legislative body is presided over by the Mayor, indirectly elected by the councillors.

1.5.4. Gram Panchayats

Gram panchayat (transl. 'Village council') is a basic governing institution in Indian villages. It is a political institution, acting as a cabinet of the village—the Gram sabha work as the general body of the Gram panchayat. The members of the Gram panchayat are elected directly by the people. The President of Gram Panchayat is called Pradhan or Sarpanch.

The Department of Rural Development and Panchayat Raj is responsible for implementing various rural development and welfare schemes. It facilitates Panchayat Raj Institutions to discharge their duties. It functions effectively to provide all the basic amenities in the rural areas at the habitation level, promote sanitation, reduce poverty, conserve natural resources, minimize the urban-rural divide and ensure improvement in the quality of life of the rural people. Chengalpattu District has 636 Villages, 8 Panchayat Unions (Blocks) and 359 Village Panchayats.

2 Waste Management Status Quo in Chengalpattu District

There is a specific need to strengthen the waste management situation in Chengalpattu district as it faces infrastructural and technical challenges with the increasing population. Each municipal administration district has consolidated waste resources and management data, and the State and National government supports them for infrastructure and outreach. Nonetheless, there is a need to consolidate the data across the various municipalities in the district and ascertain the informal/private waste value chain, which lacks insight for district administration.

One of the major problems in waste management in Chengalpattu district is the lack of proper waste segregation. Most households do not segregate their waste, making it difficult for the collectors to separate the recyclable and non-recyclable waste. However, most urban municipal units have waste collection vehicles and offer door-to-door collection services, whereas the waste collection service is inadequate in rural areas. The district has adopted a decentralised waste management system, where collected waste is brought for composting and waste recovery. However, their capacity is insufficient, and as a result, a significant amount of recyclable waste ends up in landfills, leading to environmental degradation.

The district administration has taken measures to address waste management, such as setting up waste collection centres and promoting composting and recycling. However, these efforts need further strengthening to tackle the growing waste problem.

2.1. Waste Management in Urban Areas

At present, the four Municipalities and the Tambaram Corporation have treatment facilities such as MCC (Micro Composting Centre), OCC (Onsite Composting Centre), RRC (Resource Recovery Centre), and Biogas plants. The Municipality is either responsible for managing the waste in facilities or may even give it to private contractors to manage the facility on a contract basis. The sanitary Inspectors or the Sanitary Engineers are held responsible for managing the recovery facilities. Details of facilities present in Chengalpattu District are listed in Annexure 1.

- **Chengalpattu Municipality:**
  Source segregation is not much practised in this Municipality. All the facilities present in the city receive mixed waste from all wards. The Chengalpattu Municipality has eight recovery facilities, of which four are active. The MCC and OCC facilities handle organic waste of around 7.8 TPD, whereas the Thukkumarakuttai MRF handles dry waste of 1.6 TPD. Windrow composting is practised, and the compost produced is sold to the farmers at Rs 10/kg. The dry waste sorted at the MRF is sold to PCB or sent to the cement plant. There are around 6 School Micro composting units with 0.05 TPD capacity. The Municipality also has a Pyrolysis unit that is not working due to some issues.

- **Maduranthagam Municipality:**
  The total waste generation reported was about 6.7 MT (wet- 3.3 MT, dry- 2 MT). All the waste is collected and brought to the site where MCC, RCC and Dumpsite are all present at the same place. This is only one active facility at present. 3 School micro composting units are present with a capacity of 0.01 TPD. 70 – 80 % source segregation is achieved in this Municipality. The capacity of MCC is 5 Tons, and RRC capacity is 4 Tons. Windrow Composting is practised. There were bailing machines present. Dry waste is sent to ultra-tech Dalmia cement, and traders pick up the rest. They have rejected waste burnt in the pit and biomining under process by IIT Chennai. SHG groups are created to spread awareness about zero waste and handling. Construction of new MCC (cost around 35 Lakhs) and RRC (24 Lakhs) is under process. The Municipality has plans to set up an incineration unit and sanitary waste treatment plant.

- **Maraimalainagar Municipality:**
  80% Door-to-door collection is achieved, and 70% HH practice source segregation in the municipality. Currently, four active MCCs handle the total waste of around 10.4 TPD, and 2 RRCs handle the dry waste of around 8 TPD. The non-saleable waste and plastic waste are sent to Ultratech Cement.

- **Nandivaram Guduvancheri Municipality:**
  The mixed waste is collected by primary collection vehicles and transported directly to Appur Dumpsite as there is no treatment facility. In the existing collection centre, close to 4 TPD Dry waste is recovered and sold to recyclers. MCC of 5 MT capacity and RRC of 5MT capacity are under construction.

- **Tambaram Corporation:**
  Tambaram population is about 10 Lakh, 5 Zones, 70 wards, around 3 Lakh Households, and over 2000 employees working in waste management. The city sanitation plan has been developed for Tambaram. There are no bins present. 60% of segregation is achieved through around 680 Home composting units. The treatment plan for garden waste is under process. Currently, 26 active MCCs are handling 62.02 TPD of organic waste, 47 OCCs are handling 27.178 TPD organic waste and 4 RRCs with a total capacity of 20 dry waste. The dry waste is either sent to the cement plant or sold to the local vendor.

Figure 5: Waste Management Centres in Chengalpattu

Micro composting Centre (Thukumurakottai) - Chengalpattu Municipality

Ramapalyam MCC - Compost - Chengalpattu Municipality

Resource Recovery Centre – Madhuranthagam Municipality

2.2. Waste Management in Rural Areas

The Panchayat officials are responsible for managing the waste. Currently, the rural areas of Chengalpattu have a waste collection system but no scientific treatment facilities. The waste is collected through tricycles or BOVs and dumped at dumpsites. Some gram panchayats have small composting sheds where organic waste is handled. It was found that the organic and waste management sheds, though established, are not functional in some rural areas.

The organic food waste in some villages is fed to animals, and the informal workers mostly collect the dry waste. A few private waste management companies, such as Hand in Hand India, are picking up waste disposed of in open dumping grounds around rural areas and transferring it for processing or final disposal at Appur dumpsite, the only landfill in the district.

2.3. Waste Collection and Transportation

All the Municipalities have a primary collection system, which is necessary to ensure that waste stored at the source is collected regularly and not disposed of on the streets, drains, water bodies, etc. They have a door-to-door Collection system through tricycles/push carts and battery-operated vehicles using segregated bins and containers on streets collected through autos, tipper lorries, dumper placers and compactors. The sanitation workers do a door-to-door collection of waste. All the waste collected through Primary Collection System from the households, shops and establishments is taken to the processing or disposal site, either directly necessitating a large fleet of vehicles and human resources or through cost-effective systems which are designed to ensure that all the waste collected from the sources of waste generation is temporarily stored at a common place called “Waste Storage Depots” and then transported in bulk to the processing or disposal sites.

Table 3: Number of Vehicles engaged in Sanitary Services by District

Sr. No.	Name of Municipality	No. of Vehicles engaged in Sanitary Services
1.	Chengalpattu	9
2.	Maduranthagam	9
3.	Maraimalainagar	28
4.	Nadivaram Guduvanchery	2
5.	All Town Panchayat	100
6.	All Panchayat Union (2020-21)	371

Source: Assistant Director of Panchayat, Chengalpattu & Municipal Administration, Chengalpattu @ Tambaram & All Town Panchayats[1]

Table 4: Number and Types of Vehicles Engaged in Waste Collection

Sr. No.	Name of Municipality/ Corporation	No. and types of Vehicles engaged in Waste Collection
1.	Chengalpattu	5 Tricycles, 15 BOV, 5 LCV, 2 HCV, 1 Compactor
2.	Maduranthagam	10 Pushcarts, 5 LCV, 3 BOV, 2 HCV, 1 Compactor
3.	Maraimalainagar	13 LCV, 8 BOV, 4 HCV, 1 Compactor, 1 JCB, 16 Hired LCV, 1 Dumper Placer
4.	Nadivaram Guduvanchery	12 LCV, 3 BOV, 1 HCV, 18 Hired LCV
5.	Tambaram Corporation	185 LCV, 65 BOV, 28 Compactor, 64 Hired LCV

Source: Municipality/Corporation

[1] Chengalpattu District Handbook 2020-21

Figure 6: Waste Collection in Chengalpattu

2.4. Legal and Institutional Framework

Acts and Rules: The principal policies and regulations are established at the National and State level. The Ministry of Environment, Forest and Climate Change (MoEFCC) develops and administers national waste management policies. At the State level, TNPCB(Tamil Nadu Pollution Control Board) is a regulatory body which enforces the Acts at State. The National and State Laws are listed in Annexure 2.

The Municipal Administration and Water Supply Department (MAWS) is the focal state-level department for urban development and is responsible for urban sector activities in Tamil Nadu, except urban planning and housing. The Commissionerate of Municipal Administration (CMA) has been established under MAWS to support cities (other than Chennai) to plan and implement urban infrastructure projects and advance the urban reform agenda under the Constitution (Seventy-fourth Amendment) Act, 1992 in key areas of planning, development, revenue generation, financial management, and service delivery.

CMA's engineering wing is responsible for planning, designing, coordinating and supervising all the urban infrastructure investments in ULBs (except Chennai), with their responsibility varying with the ULB size. CMA undertakes a review and technical appraisal for large municipal corporations and assists with designing, procuring and implementing small ULBs. The engineering staff includes three executive or higher-level engineers and eight junior engineers — the District Collectorate at Chengalpattu functions under the District Collector and the District Magistrate. The district collectorate is the pivotal point of the district administration. General administration of the district, law and order and welfare administration are headquartered at the district collectorate.

Figure 7: Chengalpattu District Administration

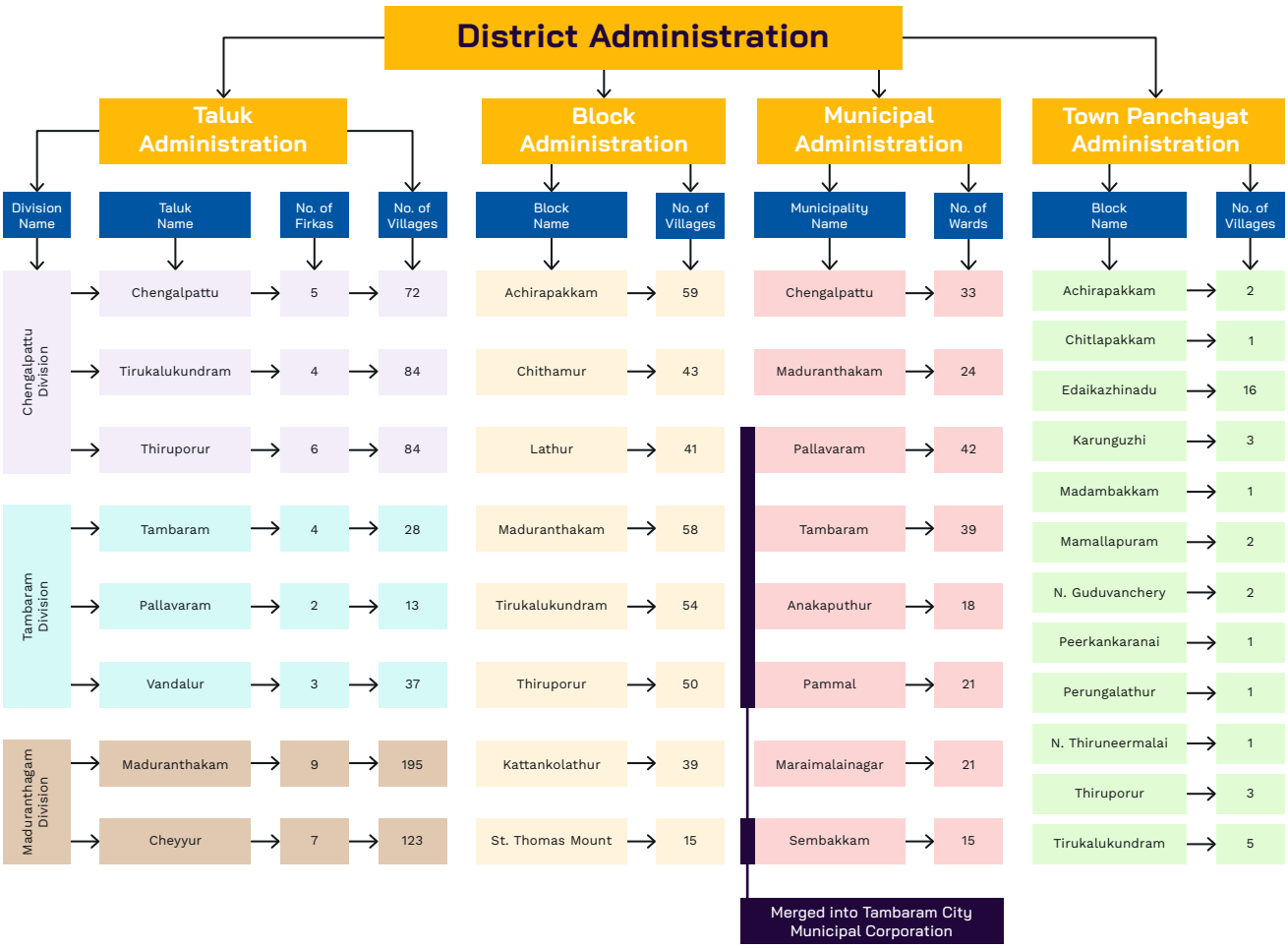
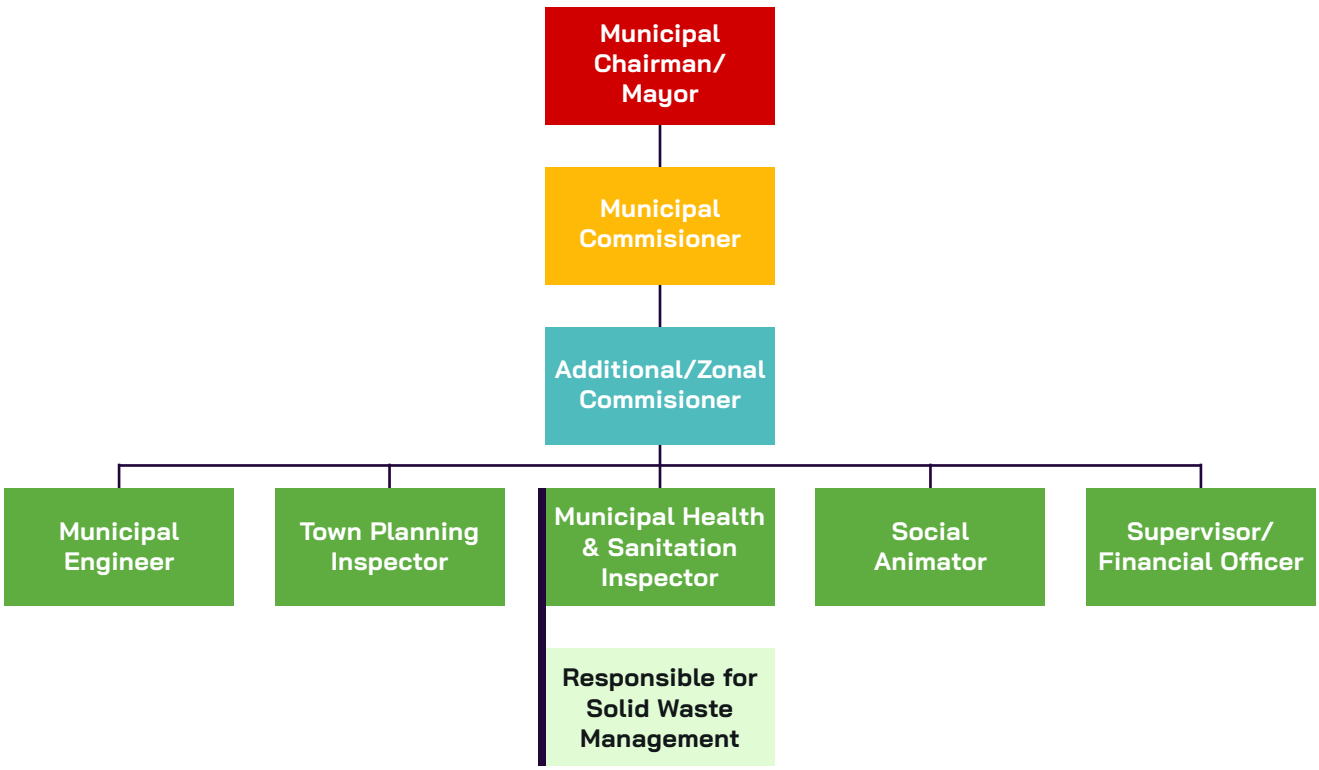


Figure 8: Common Institutional Framework for Municipality in Chengalpattu District



Data Collection using WaCT Methodology

3

The waste data baseline for Chengalpattu District is generated primarily using the Waste Wise Cities Tool (WaCT)[2]. WaCT is a diagnostic tool developed by UN-Habitat and supported by ISWA, enabling cities to standardise how they monitor and report progress against Sustainable Development Goal Indicator 11.6.1. "Proportion of municipal solid waste collected and managed in controlled facilities out of total municipal waste generated, by cities".

Through developing WaCT, UN-Habitat aims to guide evidence-based waste planning using fact-based data, resulting in efficient solid waste collection systems, improved local resource recovery and controlled waste disposal. This impact will improve residents' quality of life and enhance environmental sustainability.

3.1. WaCT tool and its seven steps

The WaCT consists of seven steps to guide cities in collecting data on municipal solid waste (MSW) generated, collected, and managed in controlled facilities. For WaCT, MSW includes waste from households, businesses, offices, and institutions, e.g. schools, municipal services, e.g. parks maintenance, street cleaning and bulky waste. It does not include construction and demolition waste.

Figure 9: Waste Wise City Tool's Seven Steps

Step 1 in WaCT included engaging the data collection (survey) team by Hand in Hand India and identifying stakeholders, including formal and informal participants in the existing waste management system, e.g. waste collections, private companies, value chain enterprises and local authorities.

- The existing waste management data from local municipal authorities were specifically important and captured through engagement with each municipal body within the district.
- Robust additional data sources were also identified, such as population statistics.

Steps 2 and 3 included a composition analysis for domestic (household) waste generation.

Step 4 assessed the wastes received at recovery/recycling facilities.

Steps 5 and 6 assessed wastes at disposal facilities, including further waste composition analysis.

Step 7 combined and analysed the data to calculate waste flows and leakages.

[2] https://unhabitat.org/waste-wise-cities

3.2. Selection of the Study Area

The Chengalpattu district boundary was considered the study area. Assessment on recovery and disposal was carried out for the whole district, whereas for waste generation and composition, sampling was carried out as recommended by WaCT to produce benchmarks which can be extrapolated for the whole district.

In Chengalpattu District total of 99 Households were selected for Household Survey. WaCT suggests selecting a minimum of 90 Households to produce statistically significant waste generation and composition benchmarks. The sample size determines the statistical significance of the results obtained. The statistical confidence level and margin of error reflect this.

For example, in a city with a population size of 10,000 – 10,000,000, at least 370 to 384 households need to be sampled to achieve the normally recommended values of a confidence level of 95% with a margin of error of 5%.

However, in many situations, it may be unfeasible and costly to collect waste samples from 384 households for seven days for a city, therefore as the WaCT guideline suggests, sampling 90 households for cities, which is still in the same confidence level, but with a margin of error of 10%. Three survey areas were selected: Chengalpattu Municipality, Siruthavoor Gram Panchayat and Arungundram Village, in which High-, Low- and Middle-Income houses were selected for sampling.

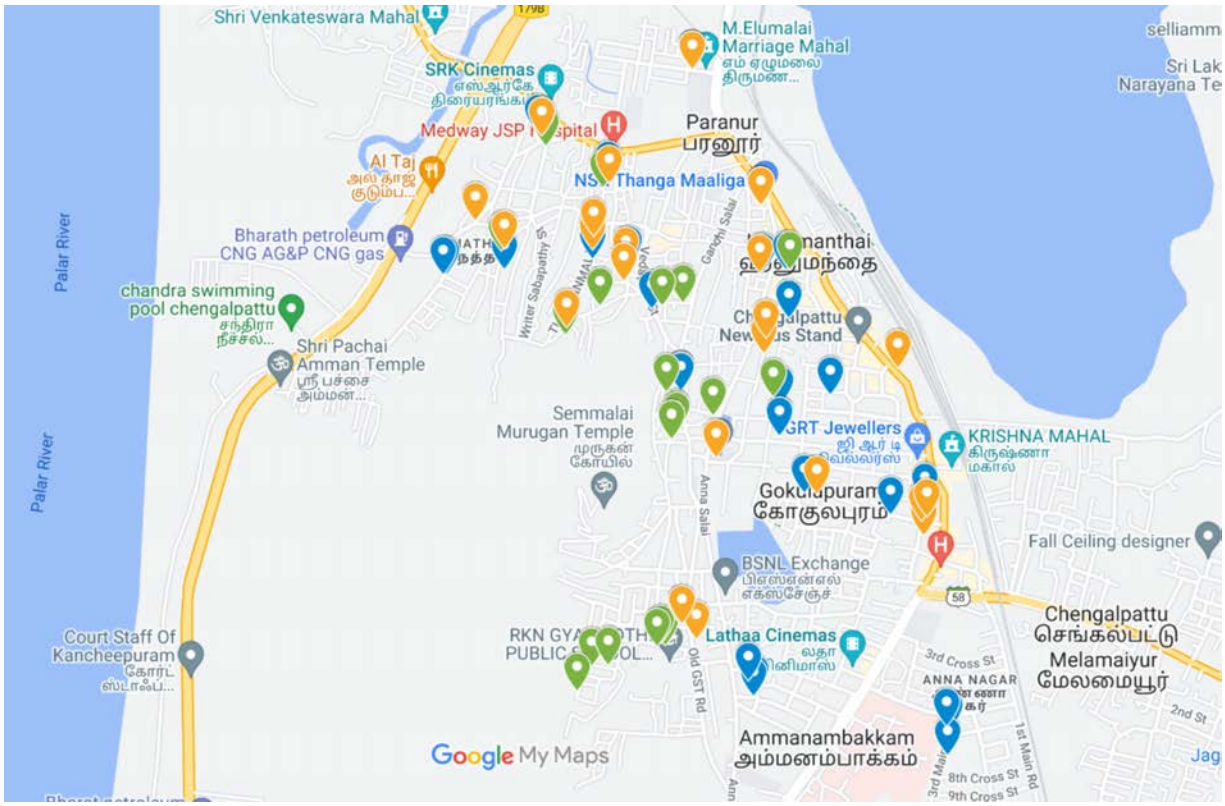
Table 5: Housing Type for Survey Sampling

Income Level	Housing Type Example
High	The luxury condominium single-detached house with a garden and sophisticated alarm systems.
Middle	Apartments, a single-detached house without a garden.
Low-Income/ Informal Settlements	Slums, apartments with single rooms (apartments mud house).

Sampling:

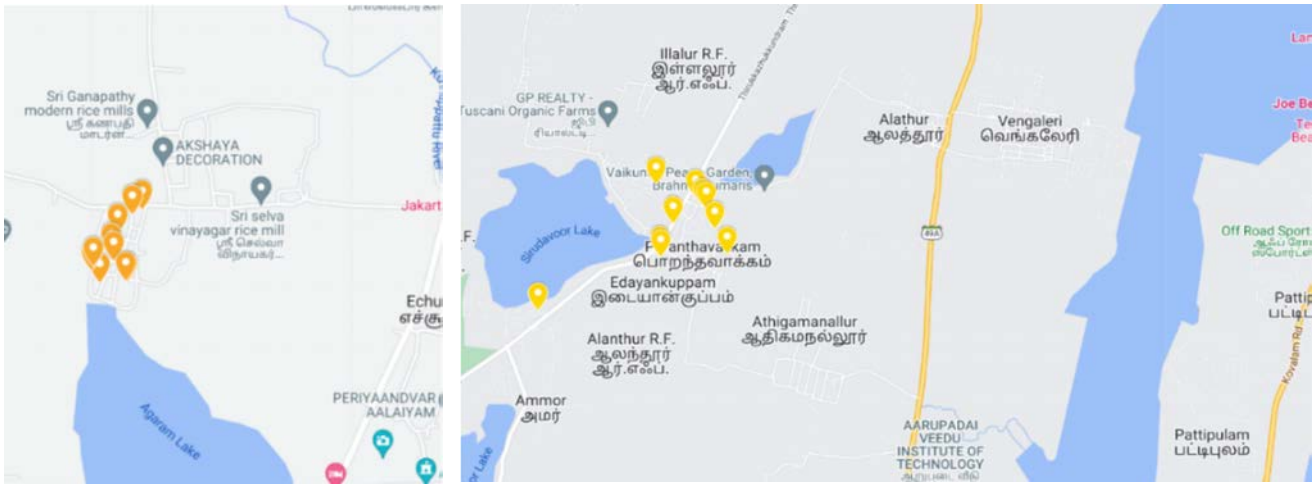
High-Income Group: 33 Households – Chengalpattu Municipality | Middle Income Group: 23 Households – Chengalpattu Municipality
Low Income Group: Urban - 23 Households – Chengalpattu Municipality | Rural - 10 Households Each in Arungundram Village & Sirvathoor Village

Figure 10: Urban Area Sampled in Chengalpattu Municipality



*High-Income Households (Blue), Middle-Income households (green), and Low-Income Households (Orange)

Figure 11: Rural Area Sampling



Arungundrum Village (Orange), Sirvathoor Village (Yellow)

Table 6: Details of the Survey Areas

Survey Area	Population	Area (sq. Km)	Number of Wards
Chengalpattu Municipality	70056	6.09	33
Siruthavoor Gram Panchayat	2696	8.1	9
Arungundram Village	420	2.1	1

Based on the description in Table 5 above, the team conducted a survey, and households were considered High-, Middle- and low-income households in Chengalpattu Municipality. Whereas Siruthavoor Gram panchayat Households were considered low-income and Arungudram Village Households as Low income (Note: All villages are considered low-Income Groups). The list of selected 99 Household samples can be found in Annexure 3.

Table 7: Survey Sample Size

Survey Area	High Income	Middle Income	Low Income
Chengalpattu Municipality	33	23	23
Siruthavoor Gram Panchayat			10
Arungundram Village			10
Total	99 Sample Households		

3.3. Population estimates for Chengalpattu District

The population data for the Chengalpattu district were collected from literature and municipal office records. The municipality's data records were from 2023, whereas population records for villages and town panchayats were from 2011. Using the annual growth factor of India's population, the growth rate was estimated for population rise from 2011-2023, which came to be 13.5%.

Table 8: Chengalpattu Population Estimates

Sr. No.	Particulars	Total No.	Total Population Reported	Total Population 2023
1.	Chengalpattu	1	10,11,321	10,11,321
2.	Maduranthagam	4	3,02,452	3,02,452
3.	Maraimalainagar	6	1,09,248	1,24,091
4.	Nadivaram Guduvanchery	359	11,27,209	12,80,360
Total			25,50,230	27,18,224

3.4. Forming the Work Team

Around 53 participants were involved in the WaCT survey. The list of participants can be found in Annexure 4. Teams were formed to carry out different activities such as Household waste collection, sampling, and visiting the recovery facilities and the dumpsites. The team comprised the following:

A. Coordinators for supporting team coordination and data compilation.
B. Field survey team for sample collection, conducting interviews.
C. Helpers for sorting and characterisation study.

Figure 12: WaCT Survey Team

3.5. Training for WaCT Implementation

Two online trainings followed by one offline training were conducted for the work team to familiarise them with the study. The online training focused on WaCT overview and pre-study data collection, which included selecting households for sampling and collecting existing information on waste.

Figure 13: Online Training for WaCT Survey

The WaCT survey was carried out for 11 Days from 3rd April to 13th April 2023. The exercise kicked off with a review training with the field team on 3rd April around 2 PM at Akshaya Hotel Chengalpattu Municipality for around 50 Participants (Hand in Hand India SWM Team, Volunteers and waste workers). The WaCT expert presented how the WaCT Tool implementation will be carried out step by step for the next 10 Days.

The team was given an overview of how to carry out the Household survey and label the Household bags for the Team. They carried out a demo exercise on how to check the waste's weight and sort it into 12 categories. The Team was also instructed to collect data on the District level, recycling chain, Informal sector, Apex traders, intermediate traders, number of dumpsites present and landfill.

The training was graced by the presence and support of Ms. Sasikala from the RDMA and Sanitary Inspector Mr. Paul Davis. Ms. Sasikala spoke a few words on the present waste management status in the district and encouraged the participants to carry out the exercise enthusiastically.

Figure 14: WaCT Training

3.6. Planning the Survey

The survey had a set of activities pertaining to the seven steps of WaCT. The first activity to plan was collection and sampling activities for the generation and composition of waste. Sampling was carried out for 8 (eight) days. Firstly 99 households were selected as per income group, and all HH members were informed about segregating and handing the waste to the team daily for the survey period. The necessary equipment was procured as per requirements. Two bags were given to households for putting wet and dry waste separately.

The location was selected for the sampling exercise, and the bags were coded daily as per the allocated household number and survey day. The filled bags of the previous day were collected and brought to the location where they were weighed and characterised into 12 categories of waste, and additional reading was taken for Single-use plastic (SUP) and coconut shells in the waste stream. The data sheets attached in Annexure 5 were printed for data-keeping.

Figure 15: Liner Bags Used for Wet & Dry Waste Collection

Figure 16: Location for Sampling exercise-Chengalpattu Municipality RRP/Shed

Figure 17: Sample Survey Timeline

Date	Day	Survey Team	One day delay for Volunteers in Rural Area	Households
3rd April	Day -1	3-4 hours training and discussion - What and How to do	Training	
4th April	Day 0	Distributes empty bags and gives instructions on segregation to HH	At Chengalpattu	Provide the number of people in household
5th April	Day 1	• Day used for Step 3 Interview • Collects the filled bags of previous day, Reject it! • Give new bag for next day	At Chengalpattu	Fills all the Waste of Day 1
6th April	Day 2	• Give new bag for next day • Collects the filled bags of previous day, weigh them at sorting site! • Do the waste sorting study • Plan interviews of Recyclres and do it • Survey at Dumpsite	Day 1	Provide bag for previous day Fill the new given bag with waste of that day
7th April	Day 3		Day 2	
8th April	Day 4		Day 3	
9th April	Day 5		Day 4	
10th April	Day 6		Day 5	
11th April	Day 7		Day 6	
12th April	Day 8	• Collects the filled bags of previous day, weigh them at sorting site! • Do the waste sorting study • Thank the Households for Participation	Day 7	
13th April	Day 9	Buffer Day!	Day 8	

3.7. Household Waste Sampling

At the beginning of the survey, information was also collected on the number of family members at the respondent's homes. For data on the generation and composition of domestic source waste, calculations are carried out per category of household income level (high, medium, and low). Respondents were asked for consent and willingness to store waste in the trash bags provided during the sampling activity. Also, the participating households were instructed that for the next eight days of survey, they must hand all the waste to the team in given bags and not practice any storage or household-level recycling. Table-8 below explains the step-by-step activities carried out for Household waste Sampling.

Table 9: Step by Step Procedure followed for Household Waste Sampling

1. Labelling of Bags: Both the wet and dry waste bags were labelled as per the Household Income (HI, MI, LI) and the Day of distribution (ex: Day 0, Day 1, Day 2) for eight days.	 
2. Distribution of Bags: The bags were distributed to the selected Households.	 
3. Collection of the Distributed Bags: The bags distributed the previous day were collected the next day from all the Households.	
4. Sorting of Waste: The waste was sorted into 12 categories using buckets. Buckets were labelled into 14 sorting categories, as in Table 10 below.	 
5. Composition Study of Waste: The waste of each category was weighed with a digital scale and recorded in datasheets.	 

Table 10: Waste Categories for Waste Composition Measurement

Sr. No.	Categories	Example of Waste
1.	Kitchen Waste/ Canteen Waste	Bread, Coffee Grinds, Cooked or Uncooked Food Items, Food Leftovers, Fruit and Vegetables, Meat and fFsh, Pet Foods, Tea Bags, Peels, Skins, etc.
2.	Garden/ Park Waste	Flowers; Fruit and Vegetable Garden Waste; Grass Cuttings; Hedge Trimmings; Leaves; Pruning; Tree Cranches; Weeds, etc.
3.	Paper & Cardboard	Brochures, Magazines, Newspapers; Cereal Packets, Noodle Boxes; Fast Food Paper Bags/ Wrapping; Cards, Books, Wallpapers; Paper Bags, Tissue Boxes, Wrapping Paper, Tissue Paper, Writing Paper, Printouts, Envelopes, Eolders, Files, Letters, Directories, Tickets, etc.
4.	Plastics (Film)	Biscuit Wrappers; Cling Film; Frozen Food Bags; Packaging Plastic Film; Cello Tape; Garden Sheets; Non-Packaging Film; Plastic Bags; Waste Liner Bags; etc.
5.	Plastics (Film)	All Plastic Bottles/ Jars; Appliance Packaging; Egg Boxes; Food Packaging Trays; Plastic Lids; Ready Meal Trays; Bank/ Credit Cards; Buttons; CDs; Music Cassettes; Cosmetic/ Glue/ Paint Applicators; Lighters; Pens; etc.
6.	Metals	Packaging for Carbonated Drinks; Shoe Polish Cans; Tinned Food; Aerosols (Deodorant, Perfume, Hairspray); Aluminium Foil Sheets; Other Food/ Non-Food/ Pet Food Containers; Bike Parts; Building Materials; Car Parts; Cutlery; Keys; Metal Shelves; Nails; Paper Clips; Plumbing; Pots and Pans; Radiators; Ring Pulls; Safety Pins; Screws; Tools; Locks; etc.
7.	Glass	Alcoholic and Non-Alcoholic Drinks Bottles/ Jars; Food Jars; Medicine Bottles; Cookware; Flat Glass (e.g. Table Top, Window, Mirrors, Reinforced, Windscreens); Mixed Broken Glass; etc.

Sr. No.	Categories	Example of Waste
8.	Textiles & Shoes	Clothes Balls of Wool; Blankets; Carpets; Cloths; Cords; Curtains; Household Soft Furnishings and Upholstery; Mats; Pillow Cases; Rags; Ropes; Rugs; Sheets; Threads; Towels; Shoes (incl. Flip-Flops); etc.
9.	Wood (Processed)	Bottle Corks, Cork Packaging; Pallets; Solid Timber and Timber Fragments; Particle Board (e.g. Chipboard, Plywood, MDF), Wood Fencing; Wooden Furniture; Wood Work Tops; etc.
10.	Special Wastes	All Waste Electric and Electronic Equipment such as Clocks, Toaster, Electric Tools, Hair Dryer, Telephones, Laptops, PCs, Printers, Screens, Smoke Detector, etc; Batteries/ Accumulators (e.g. Lead Acid, Nickel Cadmium, Lithium Ion); Other Hazardous Waste such as Asbestos; Fire Extinguishers; Chemicals; Glues and Solvents; Medicines; Paint Products; Used Face Masks and Gloves, etc.
11.	Composite Products	Composite Packaging such as Aluminium-Foil coated Card and Drinking Containers (“Tetrapack”); Products made out of Different Materials, e.g. Scissors, Knifes, Razors, Umbrellas, etc.
12.	Other	Inert (Boulders; Bricks; Gravel; Pebbles; Sand; Soil; Stones; Ceramics, Clay Plant Pots; Crockery; Stone/ Ceramic Floor and Wall Tiles; Vases); Nappies/ Diapers; Rubber; Light Bulbs (All Kinds); etc.
13.	Single Use Plastic (SUP)	The single use plastic items banned as per Tamil Nadu's SUP ban notification, mainly consisting of plastic cutlery and plastic bags less than 50 microns were separated.
14.	Coconut Waste	Coconut Shells

3.8. Recovery Facility Mapping

For Recovery Facility (RF) Mapping of WaCT Step 4, a combination of field visits and detailed questionnaires were used to obtain primary waste data such as type of waste processed, source of waste and waste processing capacity from the facilities identified in the survey areas. Based on these data, RF activities can be divided into several categories referring to the criteria from the Waste Wise Cities Tools, including:

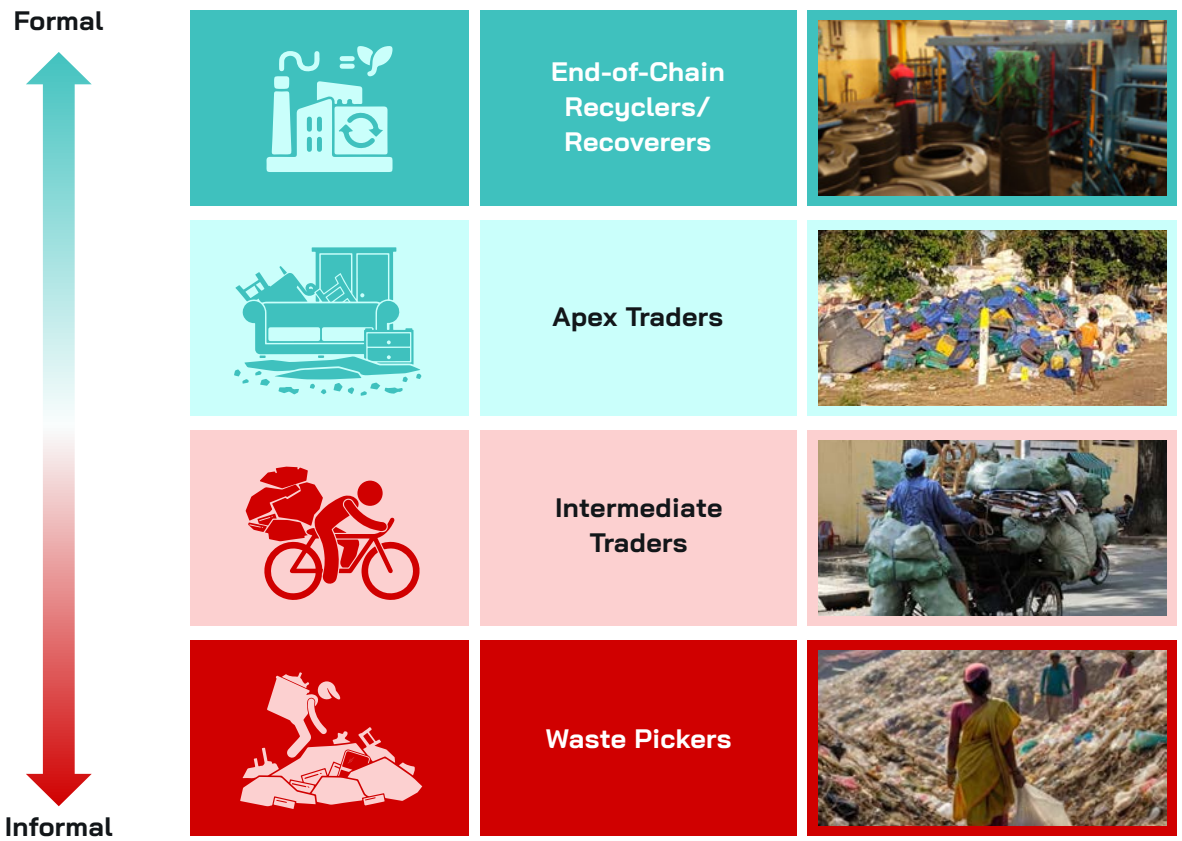
a. **End of chain recycler -** RF activity is categorized as End of chain recycler in the recycling industry. End of Chain recycler receives materials from apex traders or formal and informal MSW collection systems. It processes them into materials and products with economic value through recycling, incineration with energy recovery, or other recovery processes.

b. **Apex trader -** RF activities of Apex traders are collectors with various sizes/capacities for processing waste and supplying it further to End of chain recyclers or traders outside the survey area's boundary.

c. **Intermediate trader –** RF facilities who collect waste directly from households and commercial areas or scrap dealers and supply it to Apex traders.

d. **Material Recovery Facility (MRF) -** RF activities in the MRF category include Waste Banks, 3R Waste Management sites, and others majorly operated by municipalities.

Figure 18: Type of Recovery Facilities



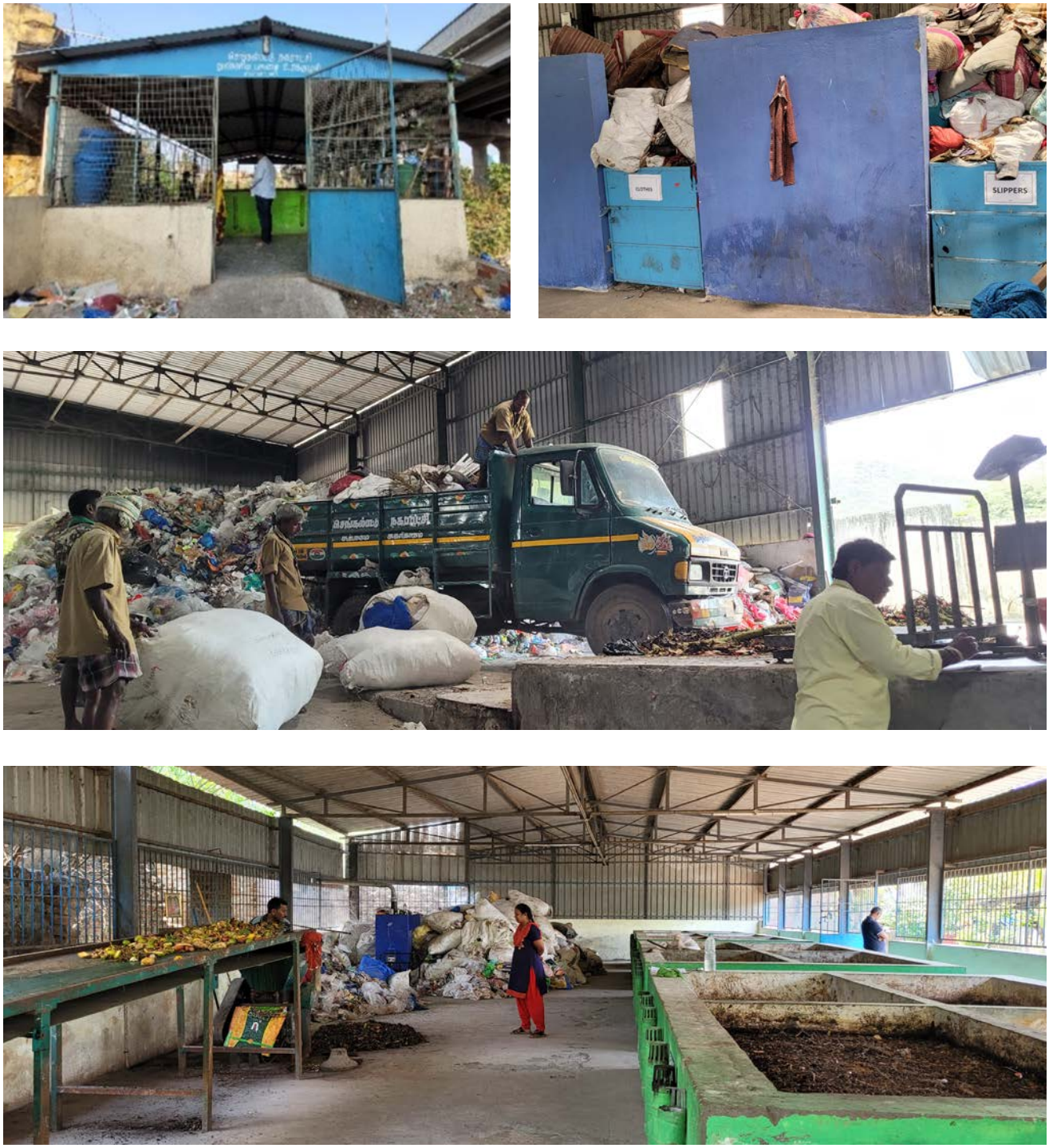


Figure 19: Chengalpattu Waste Recovery Facilities

3.9. Disposal Facility Mapping

For Disposal facilities sampling of WaCT Step 5 and 6, interviews were undertaken with operators and informal waste pickers at the dumpsite to assess the recyclables removed from the waste. A waste composition analysis was undertaken by sampling waste for one day from 9 different trucks (3 from each income group).

Figure 20: Chengalpattu Waste Disposal Facilities

For Plastic leakage estimation, observations were made across the district as per the guidance of the WFD tool of GIZ[3].

[3] Waste Flow Diagram Tool user manual - GIZ https://www.giz.de/expertise/html/62153.html

3.10. Assumptions

Estimating the population of different income groups:

- Information on ward-level tax demand was taken from all the municipalities, and based on that, a per capita tax demand benchmark was established.
- For benchmark, less than 350 INR/Capita ward population was considered low income, 350-750 INR/Capita were considered Middle-Income wards and greater than 750 INR/Capita were considered High income.
- The field team cross-checked the wards falling into these categories -checked by the field team based on the income group description in Table 5 above.
- Since Households in the wards are mixed in income groups, the field survey team looked at which household types, as described in Table 5 above, were the majority in the ward.
- Other than this, all the town panchayats were considered to fall in the middle-income category, and all the villages were assumed to be in the low-income group.
- Based on municipality guidance, the benchmark for urban areas in all municipalities and corporations was considered consistent and focused on one municipality - Chengalpattu is assumed to be representative of the district.

Non-Household Waste:

- As per WaCT's recommendation, non-household waste was assumed to be 30% of the total waste generated.
- This was also found consistent based on discussions with municipality officials.

Waste Fed to Animals:

- The survey found that most households in Rural areas feed their leftover kitchen waste to Animals.
- Here it was assumed that 90% of kitchen waste from rural households is fed to animals.

No of Working Days for the Recovery Facility:

- The waste traders were interviewed to get information on the waste they handled.
- Their reporting has been based on per day, week, and month units.
- To normalise it, we assume six working days a week and 26 working days a month to factor the reporting numbers into tonnes per day values.

4 Findings of WaCT Application in Chengalpattu

4.1. Waste Flows in Chengalpattu District

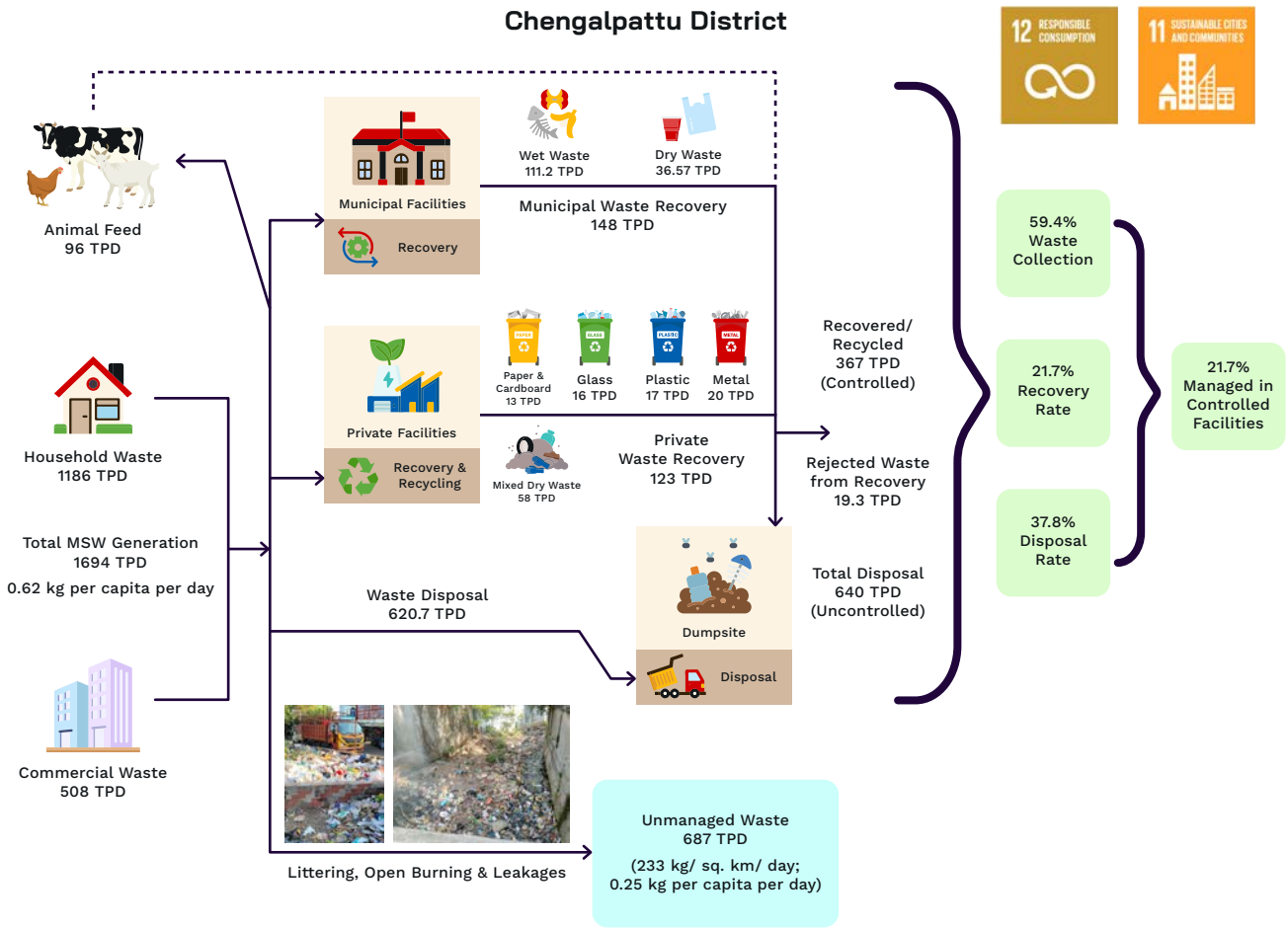


Figure 21: Chengalpattu District Waste Flow

The above waste flow illustrates the approximate waste management characteristics of the Chengalpattu district based on the WaCT tool implementation and analysis. The total MSW generated in Chengalpattu has been computed to be around 1,694 t/d, with households generating the majority of the waste at 1186 t/d and non-household commercial generation at 508 t/d. Though the waste collected by municipal channels is 59% of the total MSW generated, the recovery rate by controlled municipal and private recovery facilities across the district is only 22%.

The majority of waste collected by municipal channels is being disposed in uncontrolled disposal facilities (Aapur disposal site), which needs urgent attention to manage the waste scientifically and also to increase its capacity. Another key insight is that 40% of the waste across the district, amounting to around 687 t/d, is not even reaching any of the recovery or disposal facilities. This 687 t/d of unmanaged waste is equivalent to 233 kg/day/sq.km of district area, and is the major source of leakage to water bodies and littering in the district.

4.2. Waste Generation

4.2.1. Household Waste Generation

The household (HH) waste generation per capita for the income group is shown in table 11. The total waste generation for the Chengalpattu district comes to 0.62 kg/Capita, which is higher than the benchmarks shared in SBM 2.0 guidelines, which is

- ULB Population < 1 Lakh – 0.3 kg/ Capita
- ULB Population 1 to 10 Lakh – 0.45 kg/Capita
- ULB Population > 10 Lakh – 0.55 kg/Capita

The report's findings also reflect on waste generation in Urban and Rural contexts. It was found that Rural household waste generation is close to 408 grams per capita, which is lower compared to waste generation in urban areas, as shown in the table below.

Table 11: Household Waste Generation as per Income Group - Chengalpattu District

Income Level	HH Waste kg/Capita	Total HH Waste (Tonnes)
High	0.483	236.20
Middle	0.432	249.78
Low-Income	0.414	683.48
Low Income Urban	0.428	158.47
Low Income Rural	0.408	521.99

*The per capita benchmarks for Households are estimated by taking the weighted mean against the population

These benchmarks are produced by taking the weighted mean of household waste generation across seven days. Samples were collected for eight days, but the sample from day-1 was rejected as WaCT suggests. This is to give a day demo to households to avoid mistakes. Secondly, it tends to happen that households reject additional stored waste, which can add up to wrong estimates.

The Figure 23 below looks in detail at waste generation patterns. Wet waste, consisting of kitchens, gardens, and Coconuts in all income group households, is more than the generated dry waste. However, it is interesting that wet waste generation for Low-income HH is marginally higher than wet waste generated in middle-income households.

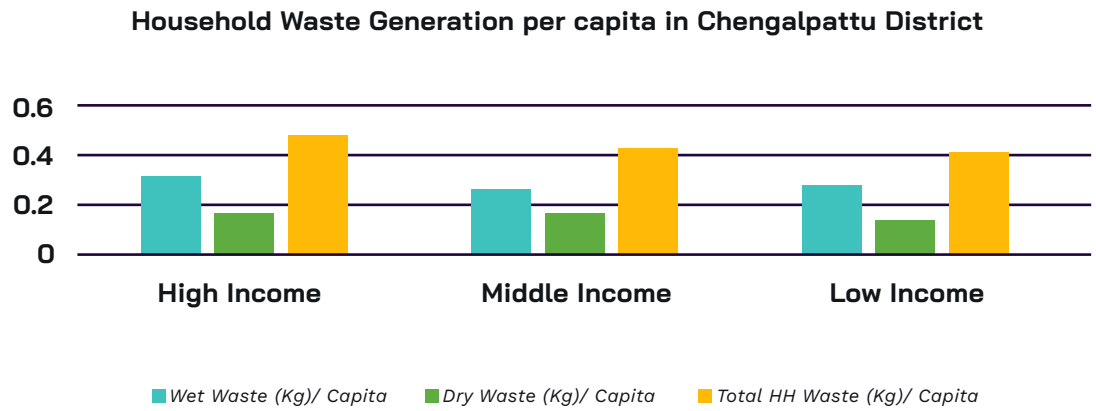


Figure 22: Household Waste Generation per capita - Chengalpattu District

Furthermore, compared to global benchmarks, waste from low-income households is on the higher side compared to waste generated by middle and higher-income households. There is little difference in MSW generated across income groups, but the higher income households have a higher MSW generation capacity, as observed globally.

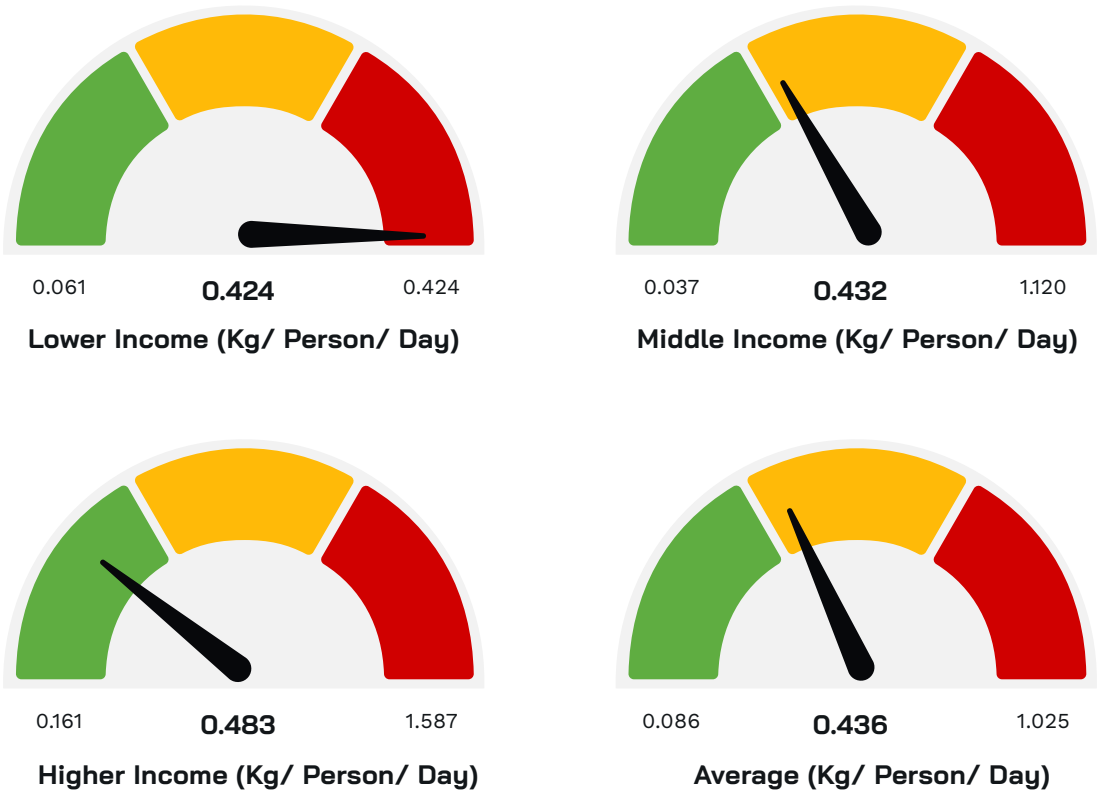


Figure 23: Household Waste Generation - Chengalpattu District against Global Benchmarks

4.2.2. Commercial/ Non-Household Waste Generation

Non-household waste considers waste from Hotels, Restaurants, Schools, Offices, Supermarkets / Malls, Markets, Hospitals and Public spaces. Commercial waste was considered 30% of total waste generation as a suggested proxy by WaCT. The commercial waste for the Chengalpattu district comes to 508 TPD.

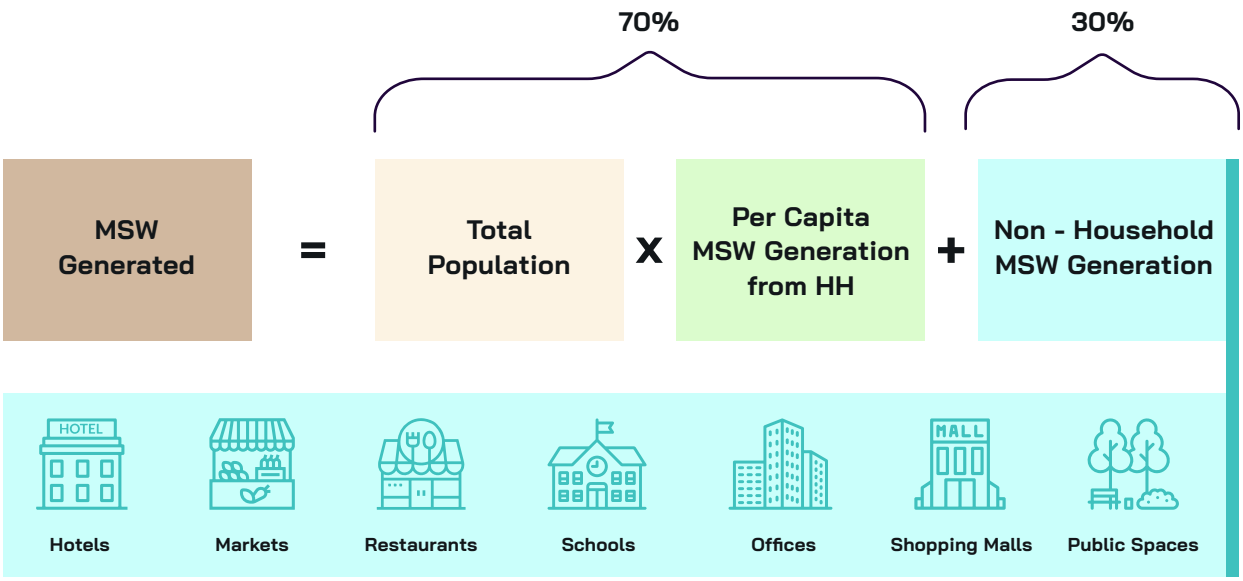


Figure 24: Calculating Non-household Waste Composition

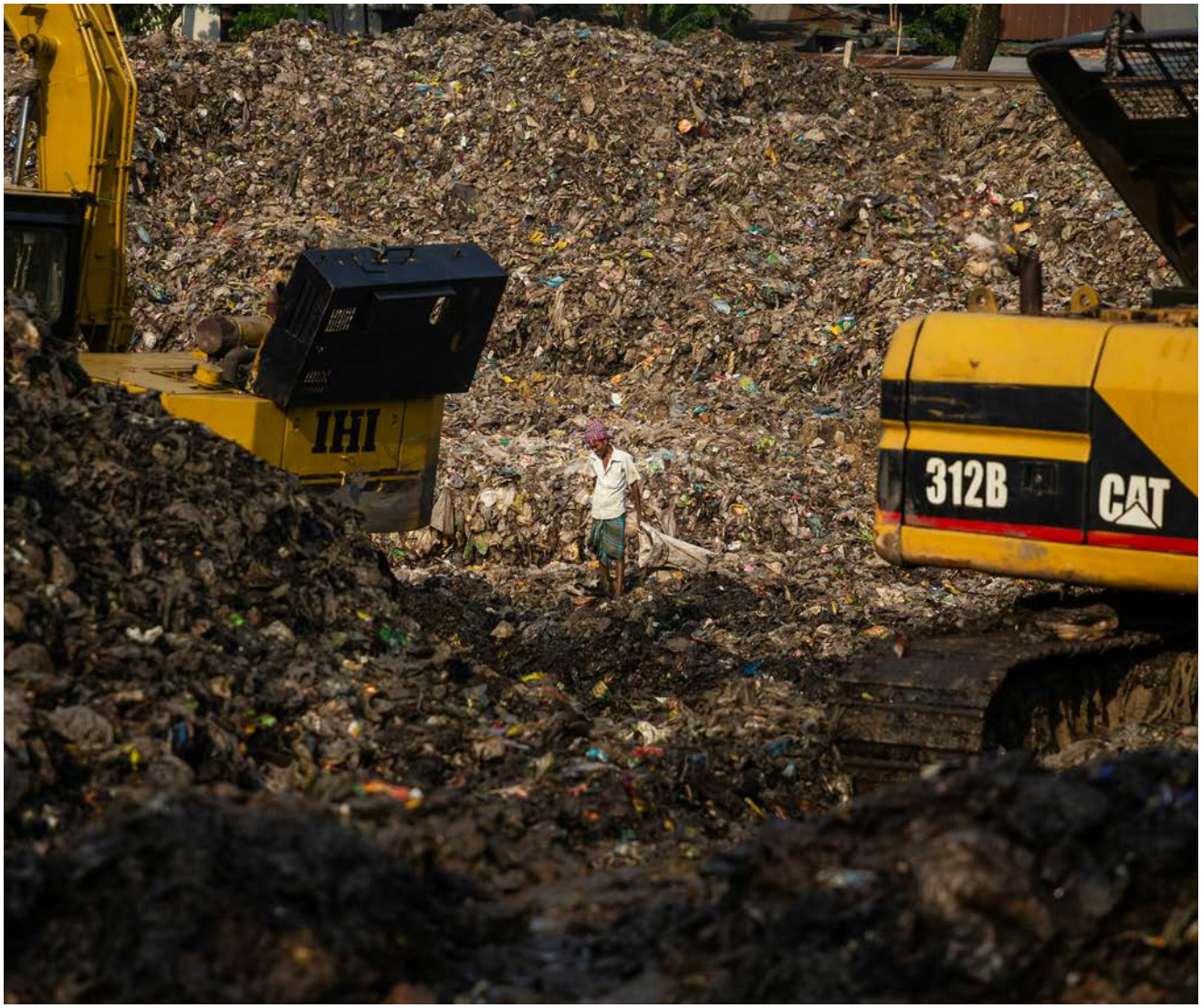
Table 12: Total Waste Generation for Municipal Units in Chengalpattu District

Area	Chengalpattu Municipality	Gurvanchery Municipality	Madhuranthagam Municipality	MM Nagar Municipality	Tambram Municipal Corp.
Population	62579	96408	32872	110593	1011321
HH Waste Generation	27	40	14	51	454
Commercial Waste Generation	12	17	6	22	194
Total Waste Generation (TPD)	39	57	20	72	648

4.2.3. Comparing Reported & Observed Waste Generation Data

Currently, Municipalities use waste generation as 300 grams/capita. Further, commercial waste is not even accounted for by them, which is an important element of MSW, but given local regulations and KPIs, often, the commercial waste accounted for is limited to market areas only. The Household waste generation in this study is to be 428 grams/capita for Urban Chengalpattu. There is a significant difference between the reported and observed values. However, as shown in Figure 23, the new benchmark is comparable with global benchmarks and is validated by the WaCT application in the district.

Using the 300 grams/capita benchmark, if we look at urban waste data, the waste data collectively for all urban areas in the district for recovery and disposal will add to much more than what is generated. Hence, it can be said confidently that waste generation is more than 300 grams/capita. Also, the study (Step 2) can be replicated at the Municipality level, and the data can be validated. If such a study is carried out regularly, the data set can be more diverse and give accurate results accommodating monthly variations. However, based on the WaCT methodology, as discussed, it is a rapid assessment, and the result seems acceptable to build up the understanding of the waste management situation.



4.3. Waste Composition

4.3.1. Waste Composition of Household Waste

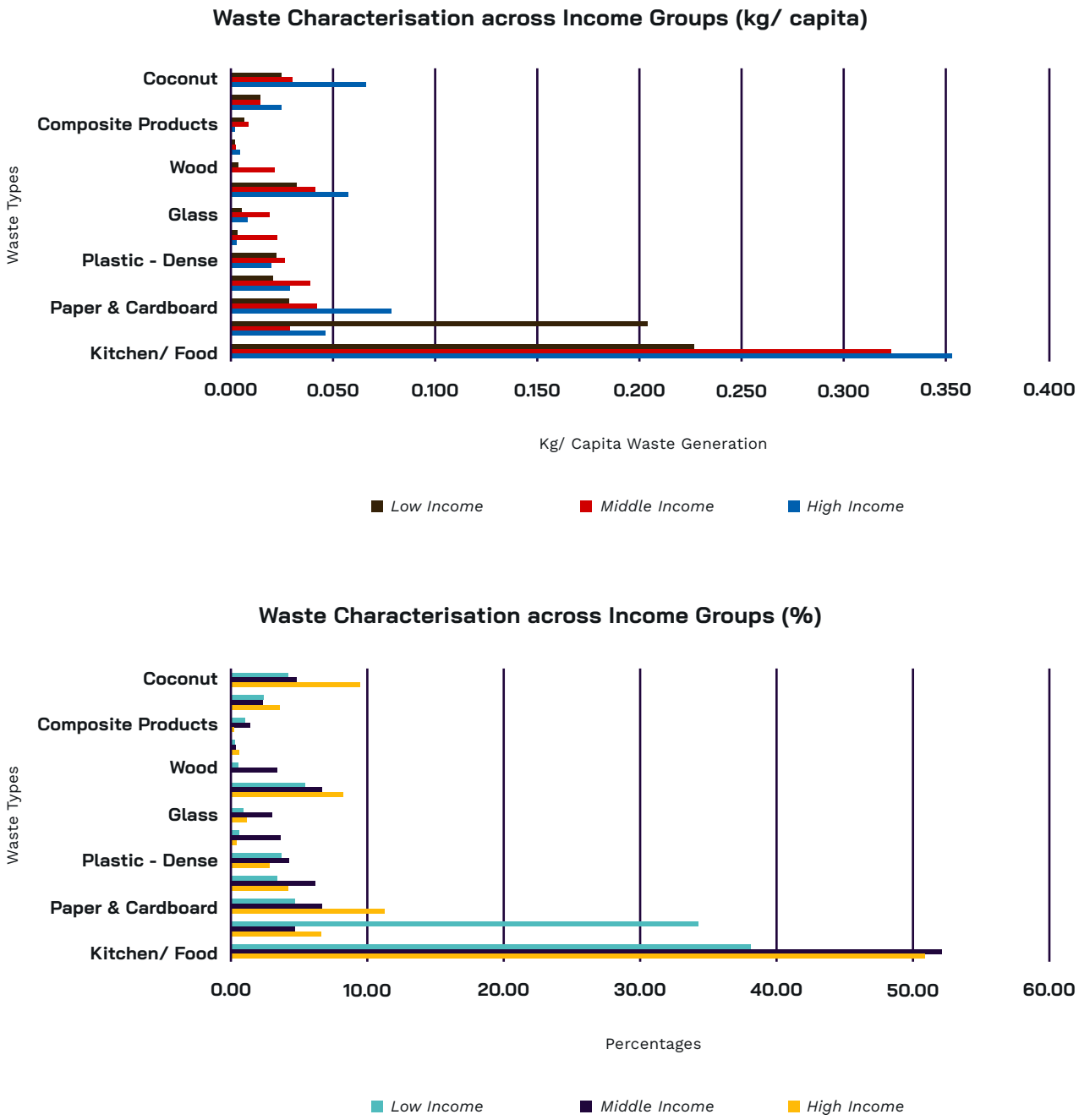


Figure 25: Household Waste Composition across Income Groups - Chengalpattu District

On analysing the household waste composition in the district, it is apparent that organic waste accounts for a higher proportion of waste generated across all income groups. This includes Kitchen/food, Garden/Park and Coconut waste. Among dry waste, Paper, Cardboard, Textiles, and shoes are the major components, with a marginally higher quantum among high-income groups. Another major dry waste component is Plastic-dense and film, which is high among all income groups.

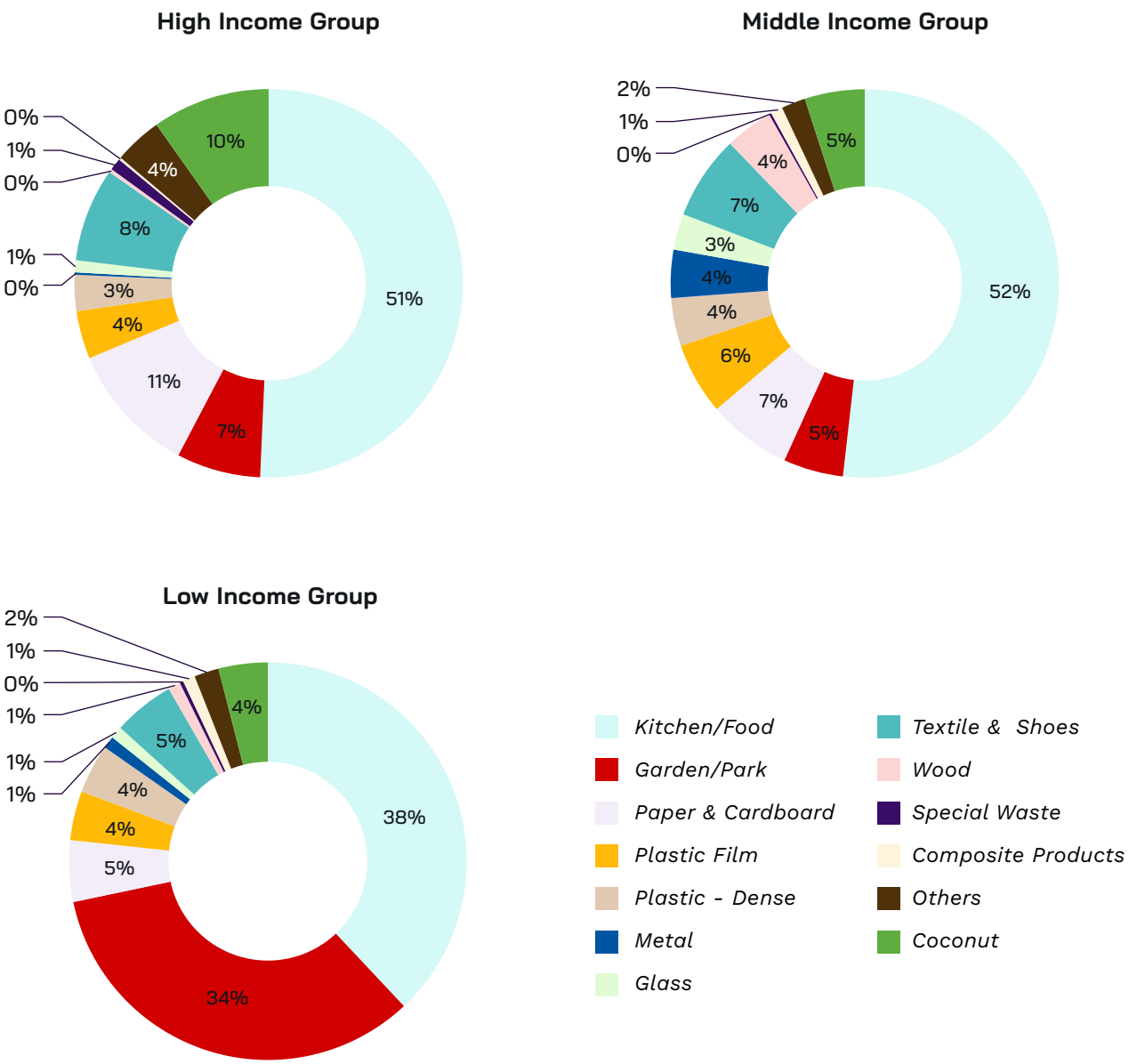


Figure 26: Household waste composition for High-, Middle- and Low-income Households - Chengalpattu District

Considering the individual income groups, high- and middle-income households have similar waste generation patterns wherein around half the waste generated is from kitchen/food waste and a significant share of Garden/Park and Coconut waste.

Regarding dry waste, middle-income households have a slightly higher proportion of Plastic waste (dense and film) than high-income households. High-income households have a slightly higher proportion of Paper, Cardboard, Textiles and Shoe waste than middle-income households. Low-income households in the district have a higher proportion of Garden/Park waste, and Kitchen/Food waste accounts for more than 70% of total waste generated. There is also a lower proportion of Paper, Cardboard, Textile, and Shoe waste but a similar proportion of plastic waste compared to middle- and high-income groups.

4.3.2. Waste Composition in Urban and Rural Contexts

The waste composition analysis also highlights a significant difference in waste generation between urban and rural households, specifically between urban low-income and rural households. Urban low-income households have a higher share of Kitchen/food waste and a lower share of Garden/Park waste than the Urban average due to the lack of garden spaces in low-income housing in Urban areas.

Alternatively, rural low-income households have a significantly higher proportion of Garden/Park waste, more than half of the total waste generated due to the possibility of home gardening practices in rural areas. No wood waste is generated in rural areas as it is mostly consumed within the household.

Urban low-income households and Urban areas have a higher proportion of paper, cardboard, textile, and shoes waste due to consumption patterns in urban areas. With regards to plastic, Plastic-film waste has a slightly higher proportion in urban areas, whereas Plastic-dense has almost similar proportions.

Table 13: Overall Waste Composition for Chengalpattu District

Waste Types	Percentages		
	Urban – all (948 TPD)	Urban –LI (226 TPD)	Rural –LI (746 TPD)
Kitchen/ Food	47.18 %	58.66 %	21.54 %
Garden/ Park	15.25 %	9.80 %	54.50 %
Paper & Cardboard	7.61 %	7.15 %	2.79 %
Plastic - Film	4.62 %	4.36 %	2.69 %
Plastic - Dense	3.63 %	3.58 %	3.88 %
Metals	1.54 %	0.43 %	0.67 %
Glass	1.70 %	0.53 %	1.22 %
Textile & Shoes	6.80 %	8.73 %	2.73 %
Wood	1.36 %	1.29 %	0.00 %
Special Waste	0.42 %	0.41 %	0.17 %
Composite Products	0.90 %	0.65 %	1.39 %
Others	2.78 %	1.02 %	3.57 %
Coconut	6.20 %	3.41 %	4.85 %

The composition of HH MSW was obtained with a characterization study of HH waste. However, that cannot be generalized for the whole city as waste composition will vary for commercial spaces. The overall composition of the city is calculated as shown in the table below based on suggestions in "Table 5 of the GIZ guideline for WFD".

The composition shows that 62.12% is organic waste, comprising Kitchen, Garden and Coconut waste, which is the major waste stream in the Chengalpattu district. Close to 15% is plastic in the waste stream, followed by 7% paper, 2% Glass, 2% metal and 13.5 % other waste.

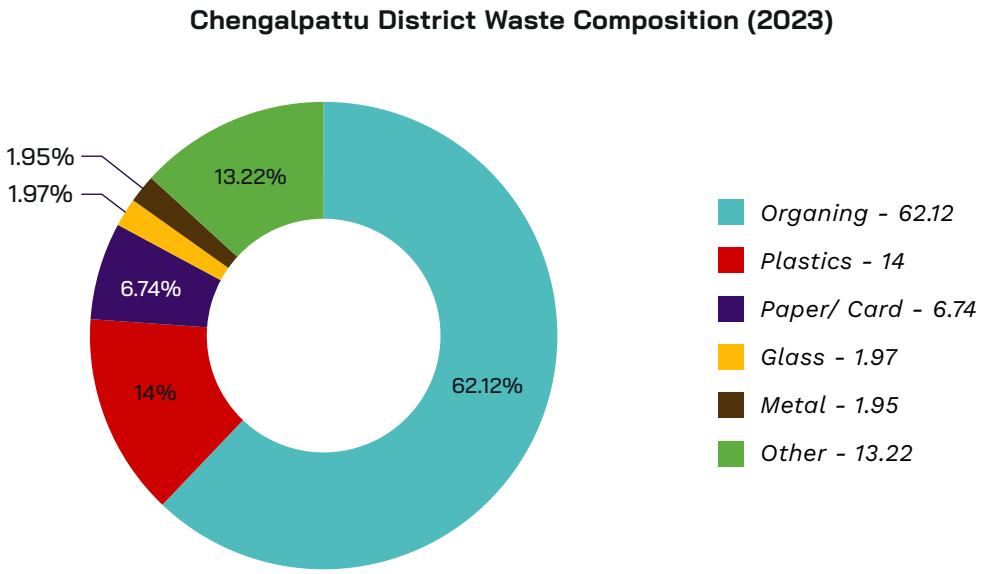


Figure 27: Total Waste Composition - Chengalpattu District

Here, the composition of MSW recovered is taken from the total obtained from the survey of recovery facilities; note that rejects (5%) are subtracted from recovered waste as it ends in the district's disposal system and recorded in the disposal facility. Accounts for the overall waste composition of the city can be referred to in Table 14 below.

Table 14: Calculation for MSW Composition

	Paper/ Cardboard	Plastics	Glass	Metal	Other	Organic	Total
MSW Recovered (TPD)	13.69	16.88	16.73	21.21	0.00	207.31	275.82
MSW Recovered as mixed dry waste (TPD)	21.57	26.96	4.28	3.21	38.48	0.00	94.49
MSW Disposed (TPD)	37.50	141.89	4.16	2.62	111.74	341.76	640.00
MSW Uncollected (TPD)	41.56	51.94	8.24	6.18	74.13	504.95	687.00
Extracted from disposal site (TPD)	0.00	0.07	0.00	0.07	0.00	0.00	0.20
Total MSW (TPD)	**114.33**	**237.60**	**33.41**	**33.16**	**224.28**	**1054.02**	**1694.00**
MSW Composition	6.74 %	14.00 %	1.97 %	1.95 %	13.22 %	62.12 %	100 %

4.4. Recovery of Waste

Organic and Dry Waste collected through MSW collection managed in 103 Municipal facilities is 148 TPD. The organic waste is composted or used in Biogas, whereas recyclable waste is sent forward for recycling outside of Chengalpattu district. It was found that there was no prominent recycling facility in the district, and most of the waste collected by traders was sent to Chennai or other regions of India like Gujarat and Delhi for recycling. The non-recyclable waste with high calorific value (Reduced Derived Fuel) is sent to cement plants for co-processing. The waste recovered by the waste value chain comprising traders was 123 TPD. This is after removing 5% of rejects from the total waste collected by waste traders daily.

4.4.1. Private Sector Recycling Industry

There were no recycling facilities in Chengalpattu, but 48 Apex traders and 24 Intermediate traders are recovering recycling materials. The details on the recovery facility can be found in Annexure 6. The image below shows the geographical spread of the Apex/ Intermediate traders and end-of-chain recycling facilities. Table 15 shows that private sector traders recover closely equal to 123 TPD of waste.

The waste is collected through urban and rural areas by the informal sector and small traders, which then are supplied further to big traders, named Apex here, who then supply to recyclers across India. Only data from 48 Apex traders was taken by considering double counting factors, as intermediate and small traders all supplied waste to them only.

Table 15: Private Sector Apex Traders Recovery Potential - Chengalpattu District

Recoverable Material	Qty (t/d)
Plastic PET	8.57
Plastic HDPE	3.60
Plastic PP	1.90
Plastic PVC	0.07
Plastic LDPE & Films	1.90
Plastic EPS/ Styrofoam	0.00
Mixed dry waste	57.92
Paper or Cardboard	13.01
Glass	15.89
Metal	20.15
Other waste	0.00
Total	**123**

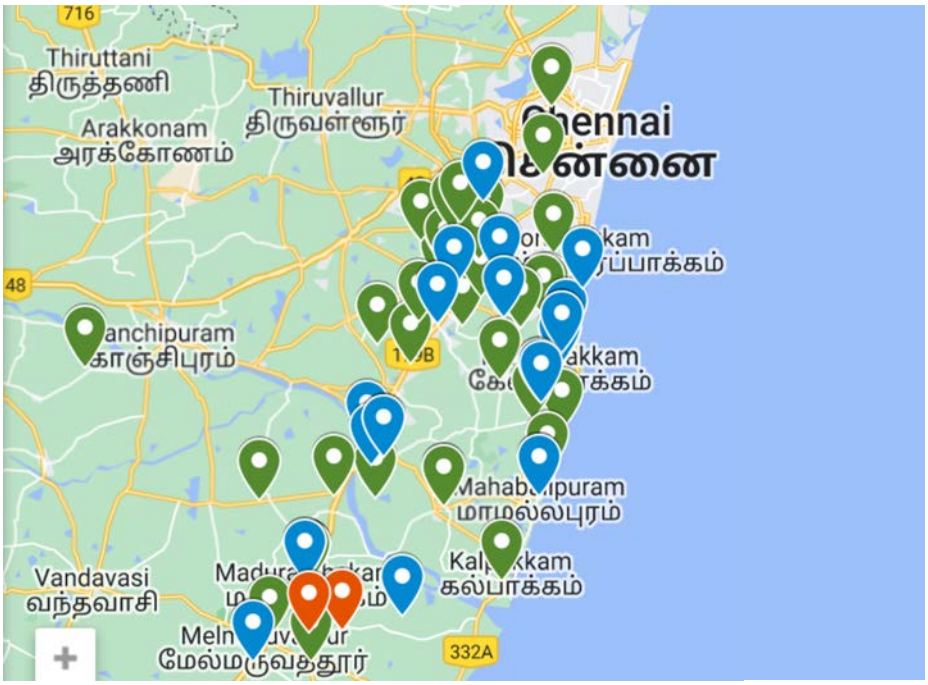
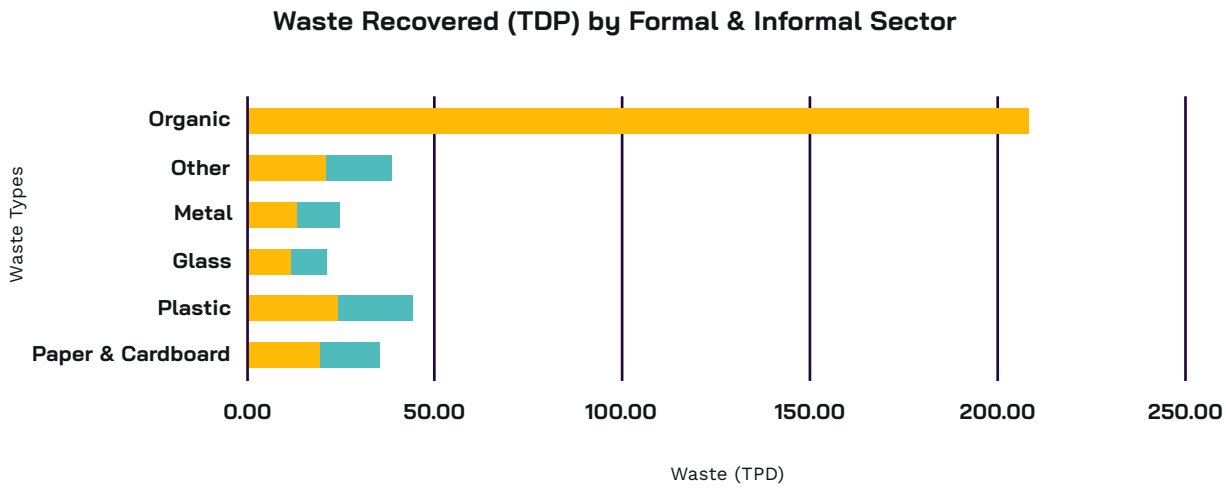


Figure 28: Private Sector Recycling Facilities in Chengalpattu District

Figure 29: Interviews with the Private Sector

4.4.2. Informal Players in Waste Recovery

Based on the reporting by the Traders, the informality was calculated as the weighted mean of the total waste collected by informal channels by these traders, and it came to be 45%. Formal players completely managed the waste from municipal facilities. This means that of the waste managed by the private sector, 45% of waste is collected by the informal sector. In the fieldwork, it was observed that scrap shops play an important role in material collection, and all these shops had a network of suppliers for both collection and forward linkage of the waste. The below image shows the split of total waste recovered between formal and informal players. Formal routes completely manage the organic waste, whereas formal and informal players manage other waste streams.



	Paper/ Cardboard	Plastics	Glass	Metal	Other	Organic
Formal System	19.39	24.15	11.56	13.47	21.20	207.31
Inormal System	15.87	19.76	9.45	11.02	17.34	0.00

Figure 30: Waste Recovered by the Formal & Informal Sector - Chengalpattu District

4.4.3. Waste Fed to Animals

Kitchen waste generation in Rural areas is 21.54% of total Household waste generation, which is 522 TPD. Based on our assumption that 90% of HH in the rural areas feed their kitchen waste to animals, some 5% are assumed to be rejected. The amount of waste fed to animals was estimated to be 96 TPD in Chengalpattu district. This can be an overestimation of recovery, but it seems a reasonable assumption for the assessment regarding 75 grams/capita of the rural population. It can also be argued that feeding kitchen waste to animals is waste disposal, not waste recovery. However, in the assessment, feeding kitchen waste to animals is modelled as a process similar to composting. Further, considering disposal or recovery will not change the other data points.

4.5. Waste Disposal

Aapur was the only official dumpsite found in the Chengalpattu district. During a field visit, the team identified many hotspots where waste was dumped, but since it was not official, it was considered part of the unmanaged waste, especially at the municipality level.

The Aapur dumpsite has been in operation for 4 to 5 years. The dumpsite officially receives waste from Medavakkam, Athanur, Madambakkam, Pammal, Tambaram, Nanmangalam, and Chitralapakkam, who are billed for disposal. It receives waste around 14 -15 Trucks daily, unofficially from other district areas. It is operational for six days weekly, from Monday to Saturday. It is observed that usually, on Mondays, the dumpsite receives more waste than the other days. As per discussions with the Dumpsite contractor, the Dumpsite has controlled disposal, and its capacity is almost full. The informal settlements beside the Dumpsite have not received any PPE kits. During Monsoon season, it is tough to maintain the Dumpsite as there is an increase in leachate.

Figure 31: Aapur Dumpsite

4.5.1. Waste Received at Dumpsite

The waste received at the dumpsite was taken from the official records; the Dumpsite operates six days a week. Incoming trucks come with weighbridge slips, which the management team records at the dump site. Other than that, some small vehicles from nearby villages and private vehicles also dispose of waste there, which was reported to be 30 TPD.

Table 16: Waste Disposal at Chengalpattu District Dumpsite

Date	Day	No. of Trucks	Load (Tonnes)
3rd April, 2023	Day 1 - Monday	84	834
4th April, 2023	Day 2 - Tuesday	91	892
5th April, 2023	Day 3 - Wednesday	72	714
6th April, 2023	Day 4 - Thursday	86	848
7th April, 2023	Day 5 - Friday	45	444
8th April, 2023	Day 6 - Saturday	58	568
Average Truck Quantity (No./ Day)		**73**	**717**
Trucks Unofficial		Approx 30 TPD	30
Weekly Waste Received at Dumpsite			**4480**
Average Daily Waste Received at Dumpsite			**640**

4.5.2. Waste Composition at Dumpsite

The composition was carried out for nine samples at the dumpsite, three from each income group. The incoming trucks were questioned to check the income group they represented. The total composition of waste at the dumpsite is shown in the figure below, which shows that other than the organic waste stream, 20% of waste coming to the dumpsite is plastic films, and 10% is textile waste.

Some inferences can be drawn from Table 17 below, which compares the waste composition from income groups. It shows kitchen waste is increasing with increasing income. It also shows that despite higher garden waste generation in a low-income area, the middle-income area has higher disposal of garden waste; this can be because of collection services in a low-income area, or as discussed earlier, there are no major differences in income groups in districts. There are chances that the middle-income group waste at the dumpsite also represents low-income areas. It can also be seen that all recyclable plastics are recovered and are not reaching a dumpsite in big quantum. It is also noteworthy that plastic films here were lower in middle-income group samples.

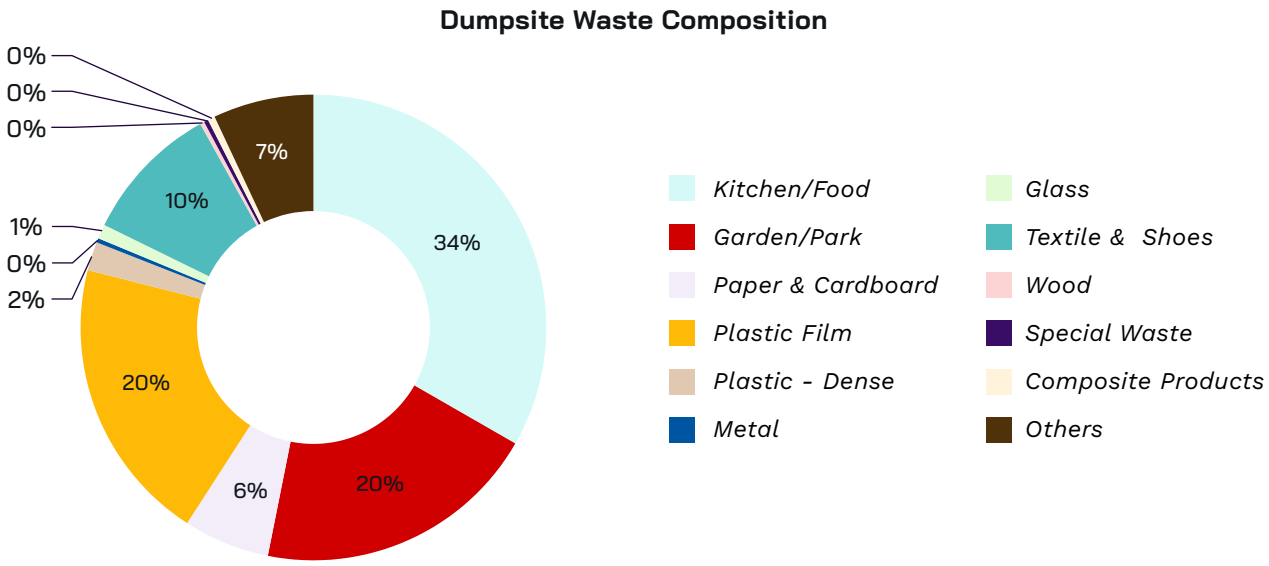


Figure 32: Waste Composition at Chengalpattu District Dumpsite

Table 13: Overall Waste Composition for Chengalpattu District

Waste Types	Percentages		
	High Income	Middle Income	Low Income
Kitchen/ Food	32.23	29.24	21.68
Garden/ Park	14.89	26.51	19.64
Paper & Cardboard	6.61	7.75	4.98
Plastic - Film	20.95	12.95	21.87
Plastic - Dense	1.67	1.89	2.47
Metals	0.25	0.25	0.54
Glass	0.98	0.43	0.58
Textile & Shoes	11.71	9.80	9.28
Wood	0.05	0.26	0.00
Special Waste	0.09	0.05	0.39
Composite Products	0.75	0.44	0.48
Others	4.14	4.43	8.01
Coconut	5.67	5.99	10.10

4.5.3. Informal Sector at Dumpsite

Around 20- 25 families have been residing beside the Dumpsite. The interviews conducted with the informal sector workers gave some interesting insights about the Dumpsite. The workers here have been working in this profession for 3 to 4 years and some for the past 15 years. They collect around 40 -45 kg of waste and earn Rs 5000- Rs 6000 per week, of which they spend around Rs 2000 for their needs.

Types of material collected are ornaments, metals, coconut shells, glass, pet bottles, tyre wastes, electrical wastes, HDPE, Leather, etc. The waste they collect is sold to nearby waste traders, and cash is received immediately as they cannot afford to travel long distances to sell it.

Due to this reason, they sell their waste at a lesser rate than the actual market rate. One of the workers said,

> ***"If we go for work outside, we may get weekly wages where job security and payment are uncertain. However, here at Dumpsite, we are entrepreneurs. We sell waste and get cash in return at the end of the day".***

There is no water facility or electricity at the Dumpsite. The workers have to travel long distances to get water and food. The workers are not provided with gloves or any PPE kits. Some mentioned that they use the used gloves from the waste sometimes.

Figure 33: Informal Sector workers at Appur Dumpsite

4.6. Level of Control for Facilities

MSW Managed in Controlled Facilities refers to MSW collected and transported to recovery and disposal facilities operated under basic, improved or full control according to the Ladder of waste management facilities' control level (Figure below). The Ladder can be used as a checklist for assessing the level of control of a particular recovery or disposal facility. The control level emphasis is on operational control rather than engineering/design.

A facility constructed to a high standard but not operated in compliance with Level 3 -Basic (or above) standards is not regarded as a controlled facility. The Aapur dumpsite was scored to have a limited level of control. Of the Apex traders that were surveyed, it was found that 147 had a basic level of control, and 2 of them had limited control.

Control Level	Other Recovery Facilities
Full Control	• Built to and operating in compliance with current national laws and standards • Pollution control compliant to environmental standards • Protection of workers' health and safety • The nutrient value of biologically treated materials utilized for separate organic waste (e.g. in agriculture/horticulture) • Materials are extracted, processed according to market specifications, and sold to recycling markets • Weighing and recording of incoming loads conducted • All outgoing loads registered by weight and type of destination
Improved Control	• Engineered facilities with effective process control • Pollution control compliant to environmental standards • Protection of workers' health and safety • Evidence of materials extracted being delivered into recycling or recovery markets • Weighing and recording of incoming and outgoing loads conducted
Basic Control	• Registered facilities with marked boundaries • Some environmental pollution control • Provisions made for workers' health and safety • Weighing and recording of incoming and outgoing loads conducted
Limited Control	• Unregistered facilities with distinguishable boundaries • No environmental pollution control • No provisions made for workers' health and safety • Weighing and recording conducted
No Control	• Unregistered locations with no distinguishable boundaries • No provisions made for workers' health and safety • No environmental pollution control

Figure 34: Ladder of Control for Recovery Facilities

Control Level	Landfill Site
Full Control	• Waste daily covered • Waste compacted • Site fenced and full 24-hour control of access • Properly sited, designed and functional sanitary landfill • Leachate containment and treatment (naturally consolidated clay on the site or constructed liner) • Landfill gas collection and flaring and/or utilization • Site staffed • Post closure plan • Weighing and recording conducted • Protection of workers' health and safety
Improved Control	• Waste periodically covered • Waste compacted • Site fenced and control of access • Leachate containment and treatment • Landfill gas collection (depending on landfill technology) • Site staffed • Weighing and recording conducted • Protection of workers' health and safety
Basic Control	• Some use of cover • Waste compacted • Sufficient equipment for compaction • Site fenced and control of access • No fire/smoke existence • Site staffed • Weighing and recording conducted • The slope of the landfill is stable, landslides not possible • Protection of workers' health and safety"
Limited Control	• No cover • Some compaction • Some equipment for compaction • Some level of access control/fencing • No leachate control • Some fire/ smoke existence • Site staffed • Weighing and recording conducted • The slope of the landfill is unstable with high possibility of a landslide
No Control	• No cover • No compaction • No/limited equipment • No fencing • No leachate control • Fire/smoke existence • No staff • The slope of the landfill is unstable with high possibility of a landslide

Figure 35: Ladder of Control for Dumpsite/Landfill

4.7. Plastic Leakage

The WFD tool gives the following analysis for Chengalpattu district. The WFD aims to provide a rapid assessment methodology for mapping the flows of macro waste in a municipal solid waste management system at the city or municipality level, including quantifying the sources and fate of any plastic pollution. This aim can be summarized into six objectives:

1. To provide a rapid assessment of a city or municipal solid waste management system and visualize the waste flows, including informing the SDG 11.6.1 sub-indicators.
2. To use observational-based assessments to quantify the sources of plastic leakage into the municipal solid waste management system's environment and determine the eventual fate of this uncontrolled waste.
3. To identify the high-priority sources of plastic pollution to make informed interventions.
4. To allow benchmarking and comparison between cities.
5. To run scenarios to gain approximate insights into how proposed interventions may impact the solid waste management system and plastic pollution.
6. To quantify the effectiveness of applied interventions.

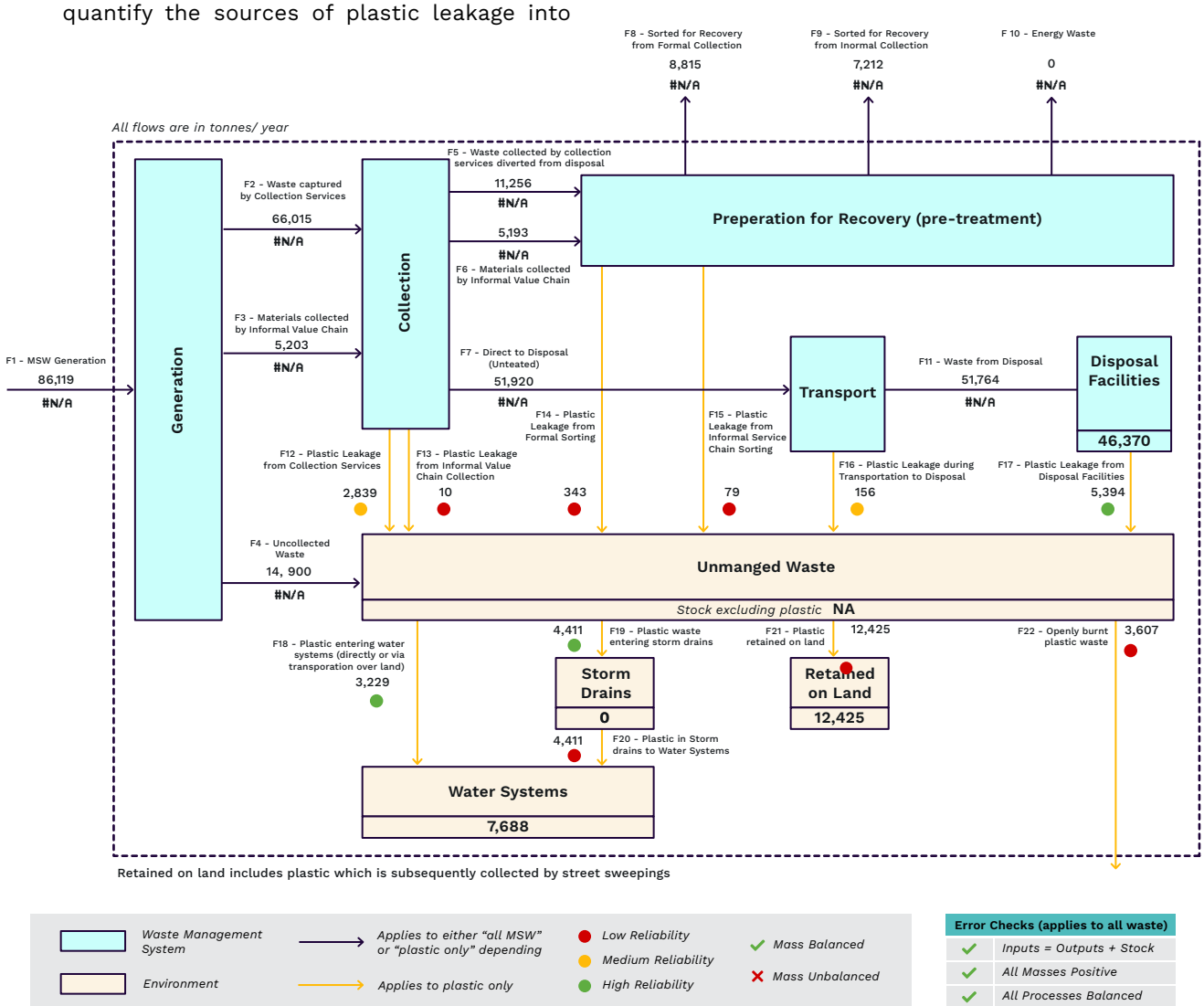


Figure 36: Plastic Leakage Analysis- Chengalpattu District

Table 18 below shows the plastic flow in the city with potential leakages and fate. It is found that 17% of generated plastic waste is uncollected, 60% is disposed of by dumping, and major leakage is happening from the uncollected and disposed waste. Plastic leakage to the water system is 7688 tons annually, which comes to 2.8 kg/ person/ year, equivalent to 94 PET bottles/ person/ year

Table 18: Flow of Plastic in the City with Potential Leakages and Fate

Flow Name	Mass (TPA)	% of Generation
Generation	86,119	100%
Collected by Service Providers	66,015	77%
Informal Value-Chain Collection	5,203	6%
Disposal	14,900	17%
Sorting by Formal Sector	51,764	60%
Sorting by the Informal Sector	7,212	8%
Unmanaged Plastic Waste	23,721	28%
Landfill/ Dumpsite	51,764	60%
Energy from waste	0	0%
Sorted for recovery	16,027	19%
Retained on land	12,425	14%
Water	7,688	9%
Burnt	3,607	4%
Drains	0	0%

Table 19: Unmanaged Plastic Waste Results Summary

Flow	Baseline Data	Unit
Unmanaged plastic waste	23,721	Tonnes/year
Unmanaged plastic waste	28%	% of plastic waste generation
Contribution from uncollected waste	*62.81%*	*% of mismanaged plastic waste*
Contribution from collection service	*11.97%*	*% of mismanaged plastic waste*
Contribution from informal value-chain collection	*0.04%*	*% of mismanaged plastic waste*
Contribution from formal sorting	*1.45%*	*% of mismanaged plastic waste*
Contribution from informal sorting	*0.33%*	*% of mismanaged plastic waste*
Contribution from transportation	*0.66%*	*% of mismanaged plastic waste*
Contribution from disposal facilities	*22.74%*	*% of mismanaged plastic waste*
Plastic waste retained on land	12,425	Tonnes/year
Plastic waste retained on land	52%	% of mismanaged plastic waste
Plastic waste openly burnt	3,607	Tonnes/year
Plastic waste openly burnt	15%	% of mismanaged plastic waste
Plastic waste cleaned from drains	0	Tonnes/year
Plastic waste cleaned from drains	0%	% of mismanaged plastic waste
Plastic waste to water systems	7,688	Tonnes/year
Plastic waste to water systems	32%	% of mismanaged plastic waste
Plastic waste to water systems	9%	% of plastic waste generation
Contribution directly entering water systems	*43%*	*% of plastic in water systems*
Contribution entering via storm drains	*57%*	*% of plastic in water systems*
Plastic to water systems per person	2.8	kg per person/year
Plastic to water systems per person (Equivalent)	94	No. PET bottles per person/year
Plastic to water systems (Equivalent)	90	No. of Olympic swimming pools/year
Plastic to water systems (Equivalent)	11,306	No. of waste trucks/year

The below Sankey diagram gives an overview of plastic leakages in the city. Burning is also one of the major issues, as 3607 Tons of plastic waste is getting burned in the whole district every year.

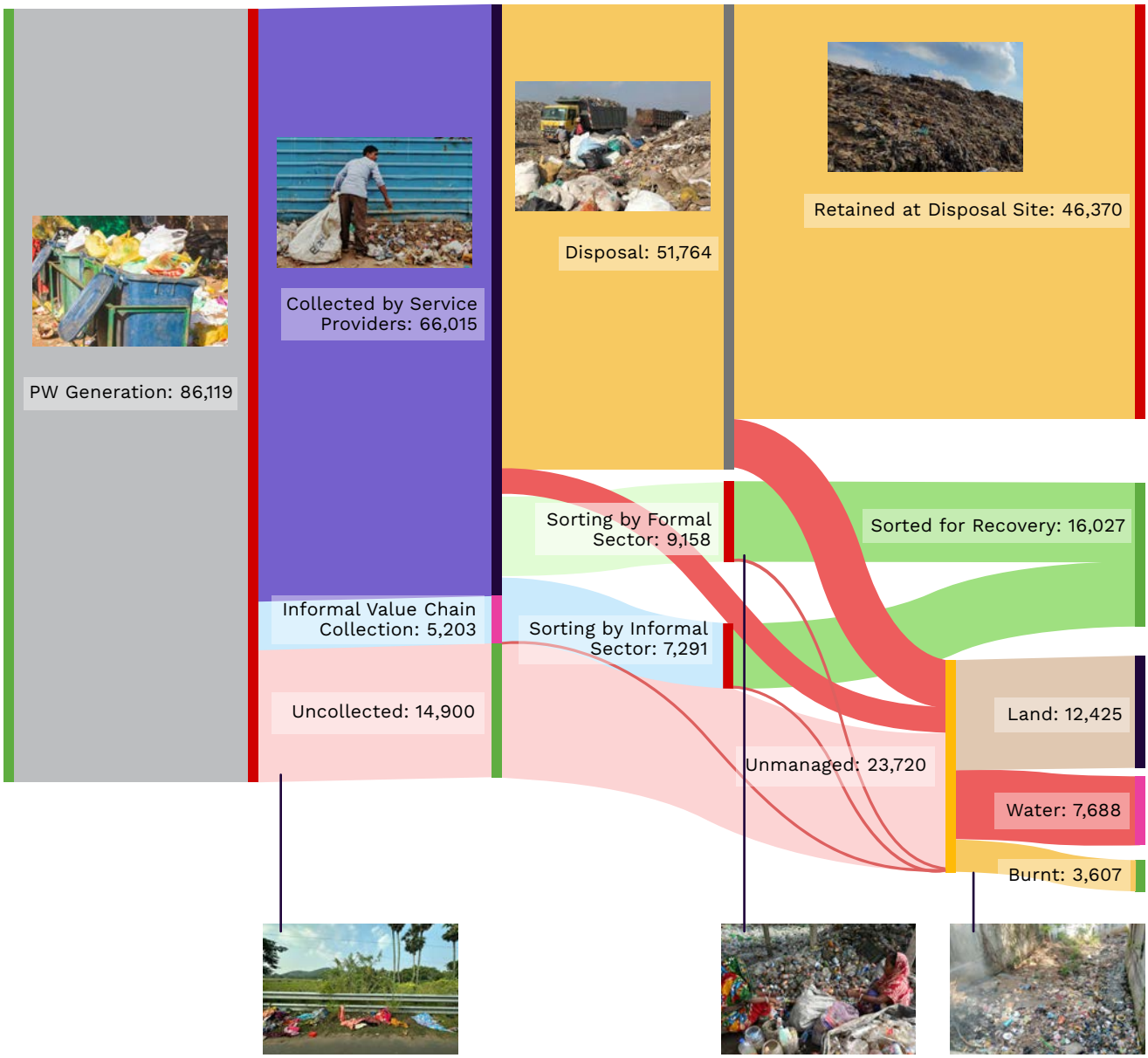


Figure 37: Plastic Leakage Analysis - Chengalpattu District

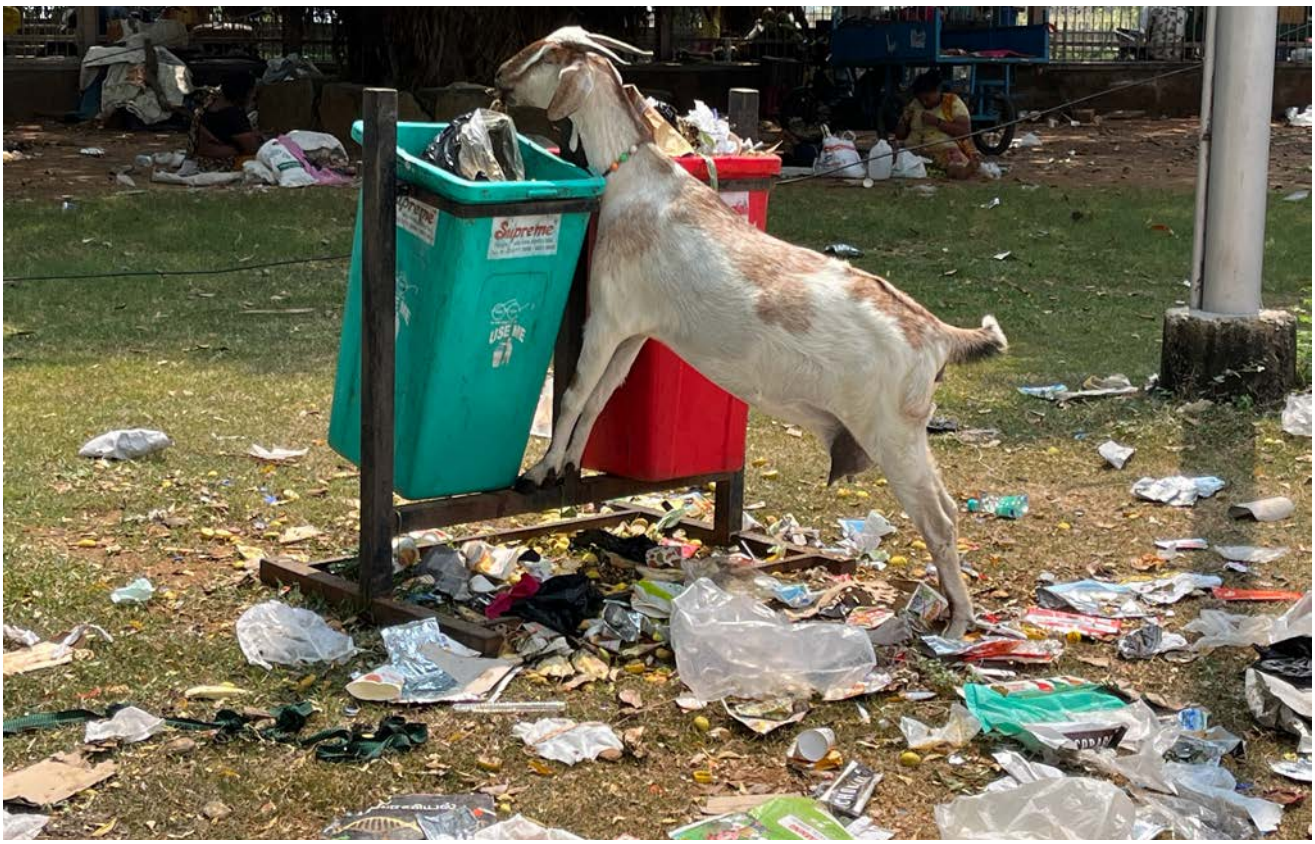
4.8. Single Use Plastics

Single-use plastic is a form of disposable plastic used in products like water bottles, straws, cups etc., which can only be used once and then must be discarded. In August 2021, the Indian federal government amended the Plastic Waste Management Rules, 2016, prohibiting identified single-use plastic items in India, which have low utility and high littering potential. As a landmark initiative, the Government of Tamil Nadu vide G. O. (Ms) No. 84 Environment and Forests (EC. 2) Department dated 25.06.2018 has issued orders banning all types of "use and throwaway plastic" items irrespective of thickness with effect from 01.01.2019.

The characterisation study of Household sampling also collected data on SUP items, and it was found that approx. 1.2% was SUP in the waste stream.

Table 20: Percentage of SUP in Waste

	High Income	Middle Income	Low Income
% of total Municipal waste	1.06	1.17	1.57
% of total plastic waste	15.05	11.14	21.85



5

Waste Flows Analysis

Other than the overall waste flow for the district, as shown in Figure 22, the below sections show the waste flows for different entities in the district. The waste flows for Chengalpattu Urban, Chengalpattu Rural, Chengalpattu Municipality and Tambaram Municipal Corporation are discussed. Looking at these flows, an idea could be perceived on waste recovery, disposal patterns and the issue of unmanaged waste in the district.

Chengalpattu District - Urban

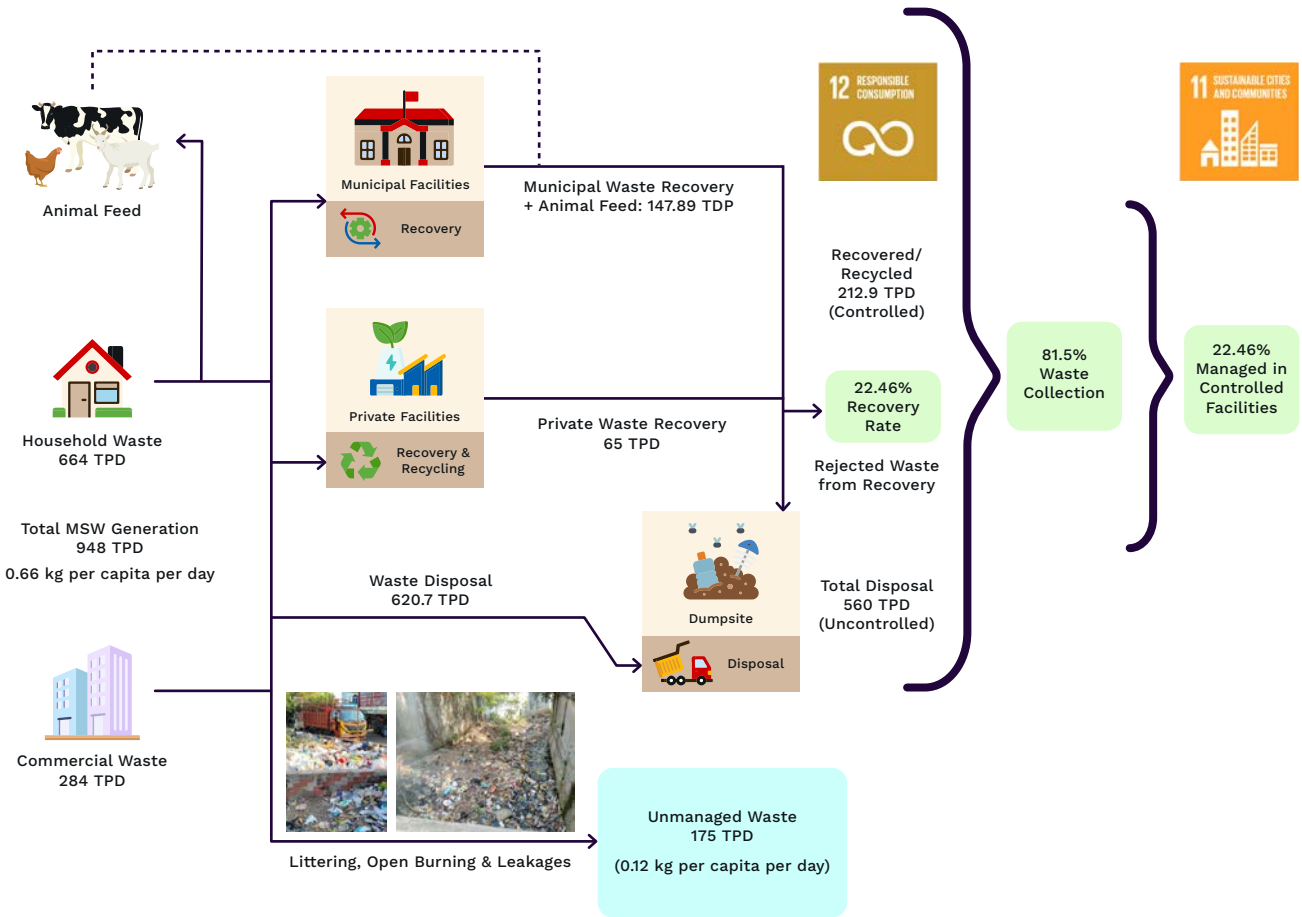


Figure 38: Waste Flow for Urban Chengalpattu

The unmanaged waste comes to 175 TPD in urban Chengalpattu, and waste collection is close to 82%, with a recovery rate of only 22.4%. The majority of the urban waste, around 560 TPD, is sent to the dump site.

Chengalpattu District – Rural

The issue of unmanaged waste is very significant in the Rural Chengalpattu area; it comes to 512 TPD. Even the collection rate was found to be very low in rural Chengalpattu at 31%, highlighting it as one of the essential intervention areas to improve waste management in the district. The lack of recovery options in the rural areas signifies the low recovery rate at 20%. As specified earlier, most recovery is by feeding organic waste to animals at the household level.

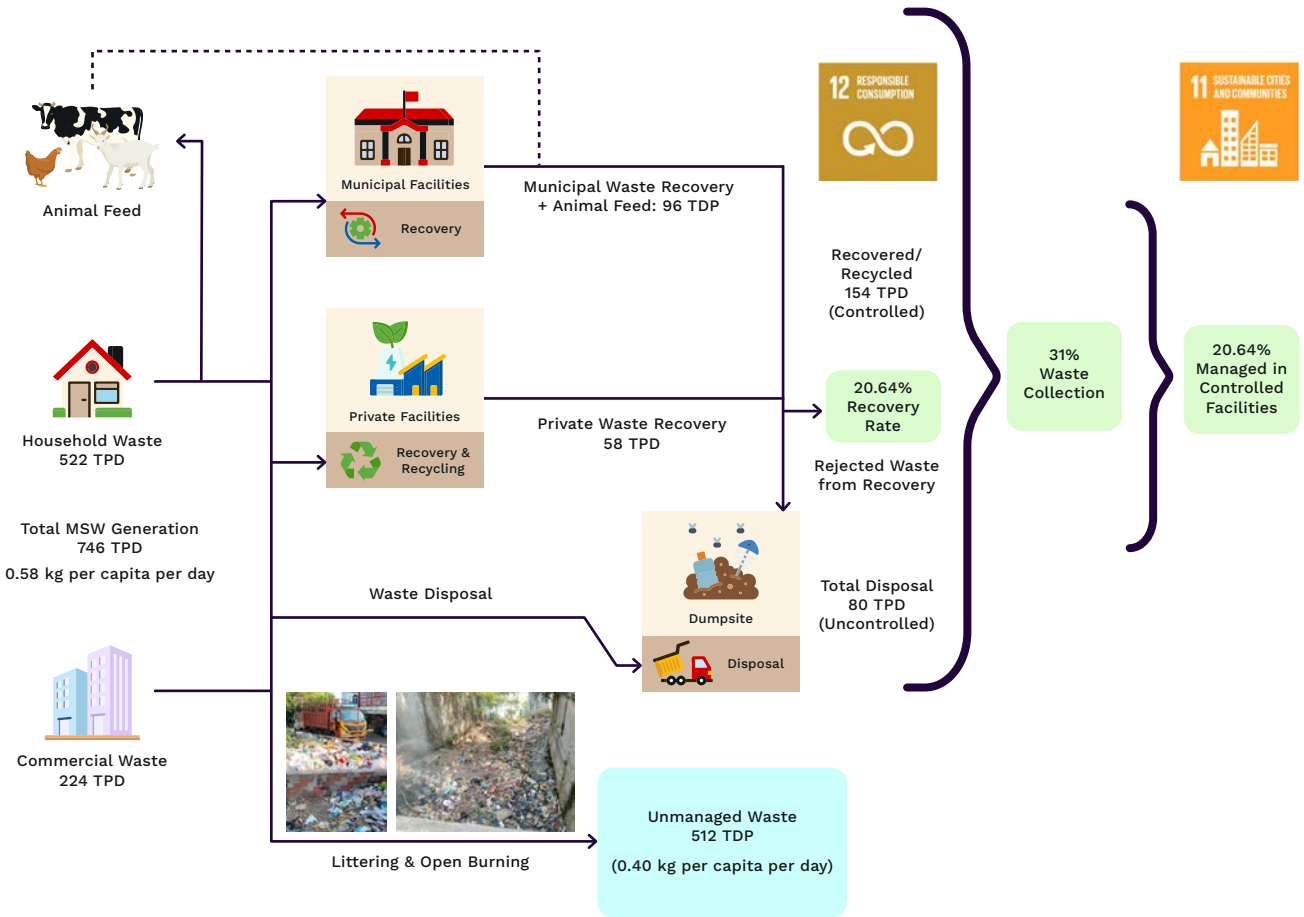


Figure 39: Waste Flow for Rural Chengalpattu

Chengalpattu Municipality

In Chengalpattu Municipality, the unmanaged waste was 27 TPD, which is mostly littered and burned. This brings the waste collection close to 31%; despite door-to-door collection serving more than 90% of households, the 31% gives a realistic inference on the percentage of waste still not collected by municipal services. There is a lack of official disposal options for the municipality, which accounts for the large amount of waste unmanaged.

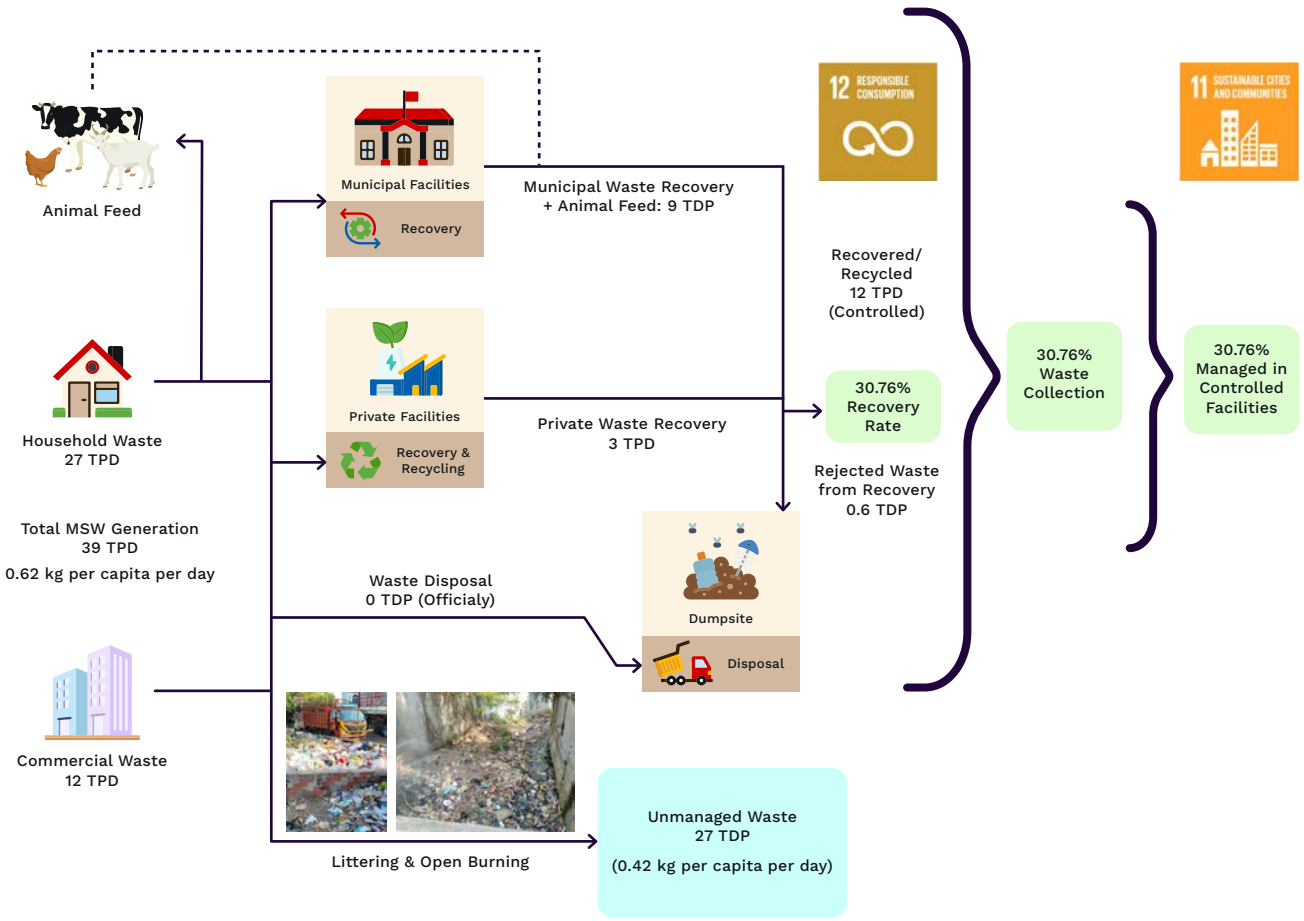


Figure 40: Waste Flow for Chengalpattu Municipality

Tambaram Municipal Corporation

Since Tambram is the district's biggest municipal corporation and closely generates 1/3rd of its waste, its waste flows are also detailed. Though Tambram data shows the concrete efforts for recovery and proper disposal of waste.

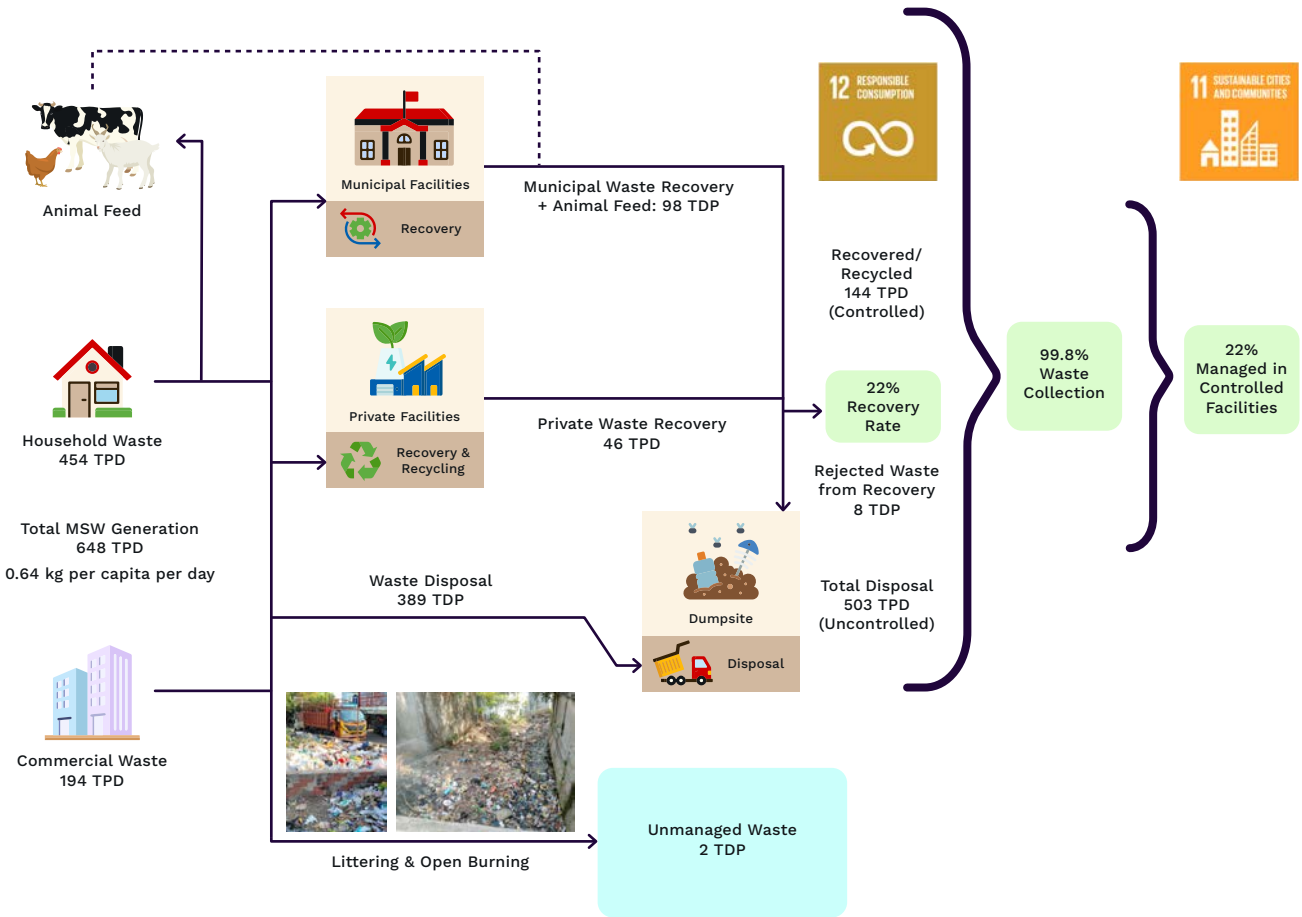


Figure 41: Waste Flow for Tambram Municipal Corporation

6 Stakeholder Discussions

During the fieldwork, the discussion was carried out with a diverse stakeholder group to understand the waste management situation in the Chengalpattu district in a better way. The discussions with the Informal group and recovery facilities are already covered in the above chapters.

Other than that, the Sanitary officers were interviewed in each municipality to understand their area's waste management status quo. Also, the meeting was scheduled with the district collector, Tambram Municipal Corporation Commissioner and RDMA officials. During the discussion, the steps of the CLOCC project were explained, and details on WaCT implementation were discussed.

Meeting With District Collector

Meeting with RDMA Officials

Meeting with Tambaram Commissioner

Discussions with Chengalpattu Municipality Sanitary Inspector

Figure 42: Discussions with Stakeholders

7 Policy and Infrastructure Gap Analysis

The waste flows suggest that collecting unmanaged waste is one of the most important aspects of improving waste management in the district. Though there is a policy for door-door collection, despite services for the collection available (Coverage), a lot of waste is not collected and is littered. The other priority area is the dumpsite, where 1/3rd of the waste generated in the district is transferred. It is found that strong policy intervention is needed on disposal and compliance for all municipalities in the district. Even waste recovery must be enhanced through infrastructure development, as the current interventions are insufficient to examine the quantum of waste generated. Waste recovery is 24% for urban areas, whereas the problem is much bigger in rural areas, where it is just 18%.

A key to enhancing recycling is separation at source, and currently, that needs compliance and legal enforcement in the district by enforcing fines and having more regular checks. The gap analysis is shown in Table 21 below.

Table 21: Policy and Infrastructure Gap Analysis - Chengalpattu District

SWM Stage	Policy/ Legal	Infrastructure/ Intervention	Prioritization (1-high, 3-low)
Waste Separation at the source			2
Waste Collection Coverage			3
Waste Collection			1
Material Recycling			1
Waste Disposal			1
Informal Sector (incl. Integration)			2
Waste Financing, including User Fees			2
Local SWM Plan/Strategy			1

Priority	
High	1
Medium	2
Low	3

Gaps	
Large	
Medium	
Small	

7.1. Waste Segregation

Waste segregation into three categories - biodegradable, non-biodegradable and domestic /commercial hazardous (as required by the SWM Rules) was observed only in Tambaram Corporation. Around 60- 70 % of source segregation is achieved in Tambram. Whereas in Municipalities, the source segregation level is very low. It is observed that only a few households segregate waste into two categories (dry and wet), and the majority of the households hand over mixed waste for collection. The Households/generators are unaware of the importance of adopting the segregation method. There is no system for segregated collection and management of sanitary waste too. It is currently disposed of with non-biodegradable waste.

This could be primarily because of the limited IEC and awareness campaigns reaching the waste generators to inform and educate them regarding the importance of waste segregation at source. Also, it is observed that there is a lack of incentives, penalty measures and enforcement to promote segregation.

7.2. Waste collection

As per the SWM Rules 2016 Door to door collection and segregation of waste must be practised at the household level. It was observed that the district has a good door-to-door collection system at the Corporation level, not the Municipality level. Door-to-door collection system coverage was only observed in a few wards. It should be made from all wards. The vehicles present for primary collection should be covered, have separate bins and transport segregated waste only. There is a lack of ICT and technological interventions to monitor door-to-door services. Overall, the district has intervention for door-to-door coverage. However, the collection rate is still low, which means that vehicles offering collection services are under capacity and leave the waste uncollected on streets or dump it around cities instead of transferring it for proper disposal or recovery. The community bin could be a good way to collect waste, but existing ones are not maintained well, and collection providers do not clear them effectively.

The mismanagement of community waste bins/ dumping points and inefficiencies in door-to-door collection majorly contribute to waste leakage from the system. Also, policies can be strengthened for Bulk waste generators, industries, and Residential societies to manage their waste at their facility.

7.3. Waste Recovery

It was observed that due to the collection of unsegregated waste from households and unscientific disposal of waste at secondary collection points (two bin system not present), the mixed waste which is transported to the processing and disposal site through compactors is unable to be further segregated into a clean fraction which reduces the value of the non-biodegradable dry waste, reducing the potential value of the material for the centralised processing and recycling facilities.

The recovery facilities like MCC and OCC, which Municipalities handle, lack proper management and manpower. Furthermore, some facilities that private contractors handle are not working, indicating a lack of proper monitoring and sustainable contracts by the Municipalities. It was observed that the operational efficiency of MRF is low as most of the waste received at the facility is compacted mixed waste because of poor segregation in the city. Hence, it becomes difficult to segregate the dry waste, resulting in its devaluation due to contamination.

It was observed that the informal sector plays a very significant role in the District. According to our survey, 124 TPD of waste is recovered by the private sector. Kabadiwalas collect high-value recyclable dry waste from households and commercial establishments. On the other hand, waste pickers collect dry waste (mostly high-value recyclable) from the hotspots (created from dumping of uncollected waste), secondary collection /transfer points, transfer stations etc. According to SWM Rules 2016, a system is to be established integrating the informal and formal sectors. Observations during field visits indicate that the Municipalities have prioritised other aspects of the system to date and have not actively engaged in this sector.

7.4. Waste Disposal

Many hotspots were noticed in the Municipalities where the mixed waste is being dumped. This is a reflection of missing policies and compliance on adequate disposal and open burning of waste. Further, the containers kept for the collection of waste were generally uncovered, open and inadequate, exposing waste to waste pickers, animals, rain, and wind, which can result in potentially recyclable materials being mixed and contaminated with wet and other incompatible wastes, as well as all waste materials being scattered across the area and leaking from the collection system (e.g., entering storm drains).

It was observed that the waste not transferred to any recovery facility is directly sent to Appur Dumpsite or burnt in the open; this survey found that 15% of generated plastic waste is openly burnt. On a positive note, the Biomining of legacy waste is being processed in Chengalpattu Municipality and Madhuranthagam Municipality, but the district has yet to establish a Sanitary Landfill. The present Appur Dumpsite cannot be considered a Sanitary Landfill as it does not meet its standards. The site lacks an impermeable baseliner, leachate collection and management system, efficient drainage system (perimeter and internal), machine layering and compaction of waste, gas extraction etc. Hence, there is a need for development and operational financing for sanitary landfills.

7.5. Waste Financing

Waste financing for Indian cities is essential to sustainable waste management and environmental conservation. Adequate funding is necessary to develop and implement effective waste management systems, infrastructure, and initiatives. The government already allocate funds in their annual budgets for waste management. These funds must be used to prioritise waste treatment plants, improve waste collection and disposal systems, and implement recycling and composting programs. Further, encouraging public-private partnerships can help attract private investment and expertise in waste management. This collaboration can lead to the development of innovative waste management solutions, efficient service delivery, and revenue generation through waste-to-energy projects or recycling facilities.

Implementing user fees or tariffs for waste collection services can generate revenue to fund waste management initiatives. The User fee collection must be strengthened in districts. The financing can also explore the benefits of Extended Producer Responsibility (EPR, Municipal Bonds, Grants and Funding from International Organizations) by developing bankable proposals and Corporate Social Responsibility (CSR) Initiatives. Exploring innovative financing mechanisms, such as green bonds, impact investing, or crowdfunding, can help raise funds for waste management projects. These mechanisms can attract individuals, institutions, and organizations interested in supporting sustainable initiatives. Further, avenues to generate revenue from waste recovery and providing technical assistance and capacity-building programs to municipalities to enhance their ability to secure and efficiently manage waste financing. Assistance can include financial management training, project planning, and accessing funding opportunities.

8 Next Steps of CLOCC

The waste data baseline should be used as a tool in the practical implementation of ISWM improvements; it is not an end point, but instead is a sound basis for progressing waste management in the District.

The CLOCC project aims to promote and support integrated sustainable waste management (ISWM) planning and the waste data baseline forms one of the steps in ISWM planning.

The next steps will involve:

- **Stakeholder Meeting:** Further engagement and participation with all the stakeholders of Chengalpattu District to ensure that any waste management solutions fit with the needs of the local communities. This will feed into the WMP (Waste Management Plan) which is a key CLOCC project output. This plan will define the way forward and aspirations of the District for its waste management future.

- **Addressing the gap with Stakeholders:** An integrated approach to overcoming the barriers and challenges for SWM is implemented; without progress on all elements of the ISWM framework including physical and governance requirements, any changes are not likely to be sustainable in the long term. This will include addressing legislative and policy gaps and overcoming institutional barriers such as clearly defining roles and responsibilities for all actors in the waste and resource management sector.

- **Support Program:** Support for circular businesses identified by mentored participants - through a support program for improved waste value chains.

- **Funding WMP:** Funding WMP implementation is essential to delivering improved control over waste in the District. It is recommended that consideration is given at an early stage in planning the budget sources for SWM capital expenditure and operational expenditure; this may include elements of, national budget support, as well as addressing fee structures within the SWM system to support the daily operational costs. International institutional funding support for investments may also be sought for capital investment, but with caution to avoid projects without long-term financial sustainability. Priority should be given to designing affordable and environmentally sustainable solutions which can be operated independently of external support.

Annexure 1: Details of Facilities in Chengalpattu District

Sr. No.	Name of Municipality	Material Type	Amount of Waste Handled (TPD)
Chengalpattu Municipality			
1.	Thukkumarrakuttai ChengalPattu Resource Recovery Centre	Mix Waste	2
2.	Anna Nagar Chengalpattu Onsite Composting Centre	Organic	0.5
3.	Thukkumarrakuttai Chengalpattu Micro Composting site	Organic	3
4.	Ramapalyam Chengalpattu Micro Composting Site	Organic	2
5.	St. Joseph Matricular Higher Secondary School Chengalpattu School Micro Composting	Organic	0.05
6.	SDA School Matric Higher Secondary School Chengalpattu School Micro Composting	Organic	0.05
7.	St. Joseph Hig Sec. Girls School Chengalpattu School Micro Composting	Organic	0.05
8.	Hildas Matric High Sec. school Chengalpattu School Micro Composting	Organic	0.05
9.	Arinjar Anna Girls School Chengalpattu School Micro Composting	Organic	0.05
10.	Little Jockey School Chengalpattu School Micro Composting	Organic	0.05
11.	CMC Chengalpattu Micro Composting site	Organic	2
Gurvanchery Municipality			
1.	OCC Centre Shed	Mix Waste	4
Maduranthagam Municipality			
1.	Thukkumarrakuttai ChengalPattu Resource Recovery Centre	Mix Waste	2
2.	Anna Nagar Chengalpattu Onsite Composting Centre	Organic	0.5
3.	Thukkumarrakuttai Chengalpattu Micro Composting site	Organic	3
4.	Ramapalyam Chengalpattu Micro Composting Site	Organic	2
5.	St. Joseph Matricular Higher Secondary School Chengalpattu School Micro Composting	Organic	0.05
6.	SDA School Matric Higher Secondary School Chengalpattu School Micro Composting	Organic	0.05

Sr. No.	Name of Municipality	Material Type	Amount of Waste Handled (TPD)
Maraimalai Nagar Municipality			
1.	Kudaloor Maraimalai Nagar RRC	Mix Waste	5.5
2.	Peramanur Maraimalai Nagar RRC	Mix Waste	2.5
3.	Gandhi Nagar Maraimalai Nagar MCC	Organic	3.2
4.	Kudaloor Maraimalai Nagar MCC	Organic	2.5
5.	Sithamanur Maraimalai Nagar MCC	Organic	2.2
6.	Peramanur Maraimalai Nagar MCC	Organic	2.5
Tambaram Corporation			
1.	Jain Park MCC Tambram RRC	Mix Waste	5
2.	Shanmugam Muthali Street Tambram RRC	Mix Waste	5
3.	Kannadapalyam West Tambaram Tambram RRC	Mix Waste	5
4.	Arul Nager East Tambram RRC	Mix Waste	5
5.	Vishveshapuram Tambram MCC	Organic	2.12
6.	Vishveshapuram Park Tambram MCC	Organic	1.82
7.	SBI Colony Tambram MCC	Organic	1.825
8.	Jain Park MCC Tambram RRC	Organic	1.729
9.	EB Colny Tambram MCC	Organic	1.85
10.	Adyar River Tambram MCC	Organic	3.123
11.	Highways Nagar Tambram MCC	Organic	2.36
12.	Katchimalai Tambram MCC	Organic	2.58
13.	Ganga Garden Tambram MCC	Organic	3.52
14.	Pumping Station Tambram MCC	Organic	2.45
15.	Thiruvina Nagar Phase 2 Tambram MCC	Organic	1.33
16.	VGP Pon Nagar Tambram MCC	Organic	3.998
17.	VGP Pon Nagar Tambram MCC	Organic	1.895
18.	Manikandan Tambram MCC	Organic	3.615
19.	Thiruvina Nagar Phase 1 Tambram MCC	Organic	4.315
20.	Amman Kovil Tambram MCC	Organic	1.45
21.	Maulana Nagar Tambram MCC	Organic	2.16
22.	Kannadpalayam Tambram MCC	Organic	1.85

Sr. No.	Name of Municipality	Material Type	Amount of Waste Handled (TPD)
23.	Market Tambram MCC	Organic	1.58
24.	Mannurankulam Tambram MCC	Organic	2.3
25.	Kannadpalayam Tambram MCC	Organic	2.27
26.	Gundu Medu Tambram MCC	Organic	3.75
27.	Selaiyur Burial Ground Tambram MCC	Organic	2.1
28.	Anandapuram Road Tambram MCC	Organic	1.85
29.	Arul Nagar Tambram MCC	Organic	2.11
30.	Ambedkar Burial Ground Tambram MCC	Organic	2.12
31.	Sankar Nagar Park Tambram OCC	Organic	0.19
32.	Prasanthi Nagar Park Tambram OCC	Organic	0.032
33.	Vishveshapuram Park Tambram OCC	Organic	0.032
34.	Lakshmi Nagar Tambram OCC	Organic	0.07
35.	Kasthuri Bai Nagar Tambram OCC	Organic	0.204
36.	Kannabiran Koil Street Tambram OCC	Organic	0.705
37.	Chitra Township Tambram OCC	Organic	0.705
38.	Malaimagal Nagar Tambram OCC	Organic	0.178
39.	Subham Nagar 1 Tambram OCC	Organic	0.808
40.	Subham Nagar Park Phase II Tambram OCC	Organic	0.55
41.	Subham Nagar Park Phase III Tambram OCC	Organic	0.414
42.	Balaji Nagar Tambram OCC	Organic	0.513
43.	Kasivisalatchi Puram Tambram OCC	Organic	0.487
44.	Arul Murugan Nagar Tambram OCC	Organic	1.504
45.	Ranagasamy Street Tambram OCC	Organic	0.784
46.	Ags Nagar Tambram OCC	Organic	0.479
47.	Pallava Garden Tambram OCC	Organic	0.507
48.	Pallava Garden Tambram OCC	Organic	0.514
49.	Lakshmi Nagar - I Tambram OCC	Organic	0.487
50.	Lakshmi Nagar - II Tambram OCC	Organic	0.732
51.	Shanthi Nagar Main Road Tambram OCC	Organic	0.404

Sr. No.	Name of Municipality	Material Type	Amount of Waste Handled (TPD)
52.	GST Road Tambram OCC	Organic	1.37
53.	Kurinji Nagar Tambram OCC	Organic	0.477
54.	Bharathi Puram Tambram OCC	Organic	0.747
55.	Gangaiyamman Nagar Tambram OCC	Organic	0.467
56.	SBI Colony Tambram OCC	Organic	0.521
57.	Gayathiri Nagar Tambram OCC	Organic	0.736
58.	Office OCC Tambram OCC	Organic	0.738
59.	Kowshik Avenue Tambram OCC	Organic	0.506
60.	Saraswathi Nagar Tambram OCC	Organic	0.499
61.	Saravana Nagar Tambram OCC	Organic	0.469
62.	Annai Anjugam Tambram OCC	Organic	0.243
63.	TNHB Colony Tambram OCC	Organic	0.254
64.	Burma Colony Tambram OCC	Organic	0.179
65.	Ranganathapuram Tambram OCC	Organic	0.523
66.	Muthurangam Park Tambram OCC	Organic	0.219
67.	Kalyan Nagar Tambram OCC	O	0.32
68.	CTO Colony Tambram OCC	Organic	0.246
69.	Gandhi Park Tambram OCC	Organic	0.204
70.	Thirupoorkumaran Park Tambram OCC	Organic	0.19
71.	Selaiyau Municipal School Tambram OCC	Organic	0.19
72.	Adhi nagar Tambram OCC	Organic	0.204
73.	Arul Nagar Park Tambram OCC	Organic	0.19
74.	Ganesh Nagar Tambram OCC	Organic	0.639
75.	Thirumagal nagar Tambram OCC	Organic	0.362
76.	Bharathi Park Tambram OCC	Organic	0.19
77.	Subarayan Park Tambram OCC	Organic	0.196

Annexure 2: Acts and Rules

National Laws:

- Municipal Solid Wastes (Management & Handling) Rules 2016 (revising & replacing the 2000 version)
- Plastic Waste Management Rules 2016, as amended in 2018 and 2021
- The Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016
- The Bio-Medical Waste Management Rules, 2016
- The Solid Waste Management Rules, 2016
- The E-Waste Management Rules, 2016
- The Construction and Demolition Waste Management Rules, 2016
- The Coastal Regulation Zone Notification, 2019
- Plastic Waste Management Amendment Rules, 2021

State Laws:

- The Tamilnadu Water (Prevention and Control of Pollution) Rules, 1983
- The Tamilnadu Air (Prevention and Control of Pollution) Rules, 1983
- The Environment (Protection) Rules, 1986
- The Fly Ash Utilization Notification,1999
- The Noise Pollution (Regulation and Control) Rules, 2000
- The Batteries (Management and Handling) Rules, 2001
- The Environment Impact Assessment Notification, 2006
- The Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016
- The Bio-Medical Waste Management Rules, 2016
- The Solid Waste Management Rules, 2016
- The Plastic Waste Management Rules, 2016
- Ban on one-time use and throwaway plastics, 2019
- The E-Waste Management Rules, 2016
- The Construction and Demolition Waste Management Rules, 2016
- The Coastal Regulation Zone Notification, 2019

Annexure 3: List of Selected 99 Household Samples

Sr. No.	Area	Ward No.	Name of HH Representative	Address (Nearest Landmark)
High Income Group				
1.	Chengalpattu	19	Ms. Jerinabhegam	Kavarai Street
2.	Chengalpattu	19	Ms. Parimala	Kavarai Street
3.	Chengalpattu	19	Ms. D. Patturani	Kavarai Street
4.	Chengalpattu	17	S. Kothandan	JCK Nagar
5.	Chengalpattu	17	V. Bhuvaneswari	Periyamanikarar Street
6.	Chengalpattu	16	Mrs. Bhavani	Varathanaar Street
7.	Chengalpattu	16	Mrs. Sathyabhama	Alageshan Road
8.	Chengalpattu	16	Mrs. Rajamani	Alageshan Road
9.	Chengalpattu	32	Mani	Alageshan Road
10.	Chengalpattu	32	Antony	Alageshan Road
11.	Chengalpattu	32	Nagarathinammal	Alageshan Road
12.	Chengalpattu	33	Bhuvaneswari	Main Road Anna Nagar
13.	Chengalpattu	33	Aysha Begum	Main Road Anna Nagar
14.	Chengalpattu	33	Shanthi	Cross Street Anna Nagar
15.	Chengalpattu	21	Vinayagam Parvathi	5 /14 Sasthiri Nagar
16.	Chengalpattu	13	Kalaiselvi Kumaravel	Sundhara Moorthy Vinayagar Kovil Street
17.	Chengalpattu	20	Yuvanesh Malathi	Murugesan Muththaiya Street
18.	Chengalpattu	11	Roslin	Vardhappar Street
19.	Chengalpattu	9	Mrs. Priya	Thattanmalai Street
20.	Chengalpattu	14	Uma Maheshwari Manigandan	Periyar Chetti Street
21.	Chengalpattu	3	Logeshwari	Chinnamman Kovil Street
22.	Chengalpattu	5	Prabavathy	Kaathan Street
23.	Chengalpattu	6	Manjula	Meattu Street
24.	Chengalpattu	6	Revathy	Meattu Street
25.	Chengalpattu	1	Jayavalli	Balasubrmaniam Street

Sr. No.	Area	Ward No.	Name of HH Representative	Address (Nearest Landmark)
26.	Chengalpattu	2	Cristianamery	JCK Nagar
27.	Chengalpattu	2	Indhumathy	JCK Nagar
28.	Chengalpattu	7	Geetha	Badmini Apartment
29.	Chengalpattu	7	Reshvana	Badmini Apartment
30.	Chengalpattu	8	Shameem	Thattanmalai Street
31.	Chengalpattu	23	Nandhini	Gaandiyapan Street
32.	Chengalpattu	25	Akila	Veeragudi Velavar Street
33.	Chengalpattu	26	Kabilan	Bharathiyar Street
Middle Income Group				
34.	Chengalpattu	17	Ms. Geethaprabakar	Periyamanikarar Street
35.	Chengalpattu	31	Ramanadhan	Pillayar Kovil Street
36.	Chengalpattu	30	Buwana	Roja Street
37.	Chengalpattu	30	Mani	Malligai Street
38.	Chengalpattu	30	Yuvarani	Roja Street
39.	Chengalpattu	31	Senthamarai Kannan	Pillayar Kovil Street
40.	Chengalpattu	31	Veeraragavan	Pillayar Kovil Street
41.	Chengalpattu	29	Lakshmi	Madhurai Veeran Kovil Street
42.	Chengalpattu	13	Revathi Babu	Sundhara Moorthy Vinayagar Kovil Street
43.	Chengalpattu	12	Kuppu Selvam	Jeevanantham Street
44.	Chengalpattu	12	Mangaiyarkarasi Purushothamman	Jeevanantham Street
45.	Chengalpattu	20	Bakkyalakshmi Mohan	Murugesh Nagar
46.	Chengalpattu	21	Kaleeshwari Sundharamoorthi	Sasthiri Nagar
47.	Chengalpattu	21	Lakshmi Ganesh	Sasthiri Nagar
48.	Chengalpattu	10	Mrs. Jeenath	KK Nagar
49.	Chengalpattu	14	Santhanam Thillai	Periyar Chetty Street
50.	Chengalpattu	3	Jayasri	Chinamman Kovil Street
51.	Chengalpattu	5	Ponmalar	Kanthan Street
52.	Chengalpattu	8	Padmavathy	Thattanmalai Street

Sr. No.	Area	Ward No.	Name of HH Representative	Address (Nearest Landmark)
53.	Chengalpattu	10	Barvin	KKA Street
54.	Chengalpattu	6	Dona	Nathan Mettu Street
55.	Chengalpattu	22	Shankar Dhanalakshmi	Kuppusamy Street
56.	Chengalpattu	1	Aruljothi	Balasubramanian Street
Low Income Group				
57.	Siruthavoor	8	Latha	Main Road
58.	Siruthavoor	1	Selvi	Ambedkar Nagar
59.	Siruthavoor	2	Thilothammai	Goiyathoppu
60.	Siruthavoor	4	Aiswarya	Selliyamman Kovi Street
61.	Siruthavoor	4	Kalaivani	Selliyamman Kovi Street
62.	Siruthavoor	5	Depika	Periyar Street
63.	Siruthavoor	6	Santhosh Kumar	Bajanaikovil Street
64.	Siruthavoor	7	Krishnaprasad	Karumbathan Street
65.	Siruthavoor	7	Elzhumalai	Karumbathan Street
66.	Siruthavoor	9	Krisnamoorthi	Vaelangaadu Street
67.	Chengalpattu	10	Haribabu	KK Street
68.	Chengalpattu	9	Maariyammal	Thukumarar Kuttai Street
69.	Chengalpattu	9	Rani	Thukumarar Kuttai Street
70.	Chengalpattu	7	Jothi	Thukumarar Kuttai Street
71.	Chengalpattu	11	Esther	Vaedhappar Street
72.	Chengalpattu	28	Murugan	Anumanthaputheri Palraj Compound
73.	Chengalpattu	29	Jayanthi	Mathurai Veeran Kovil Street
74.	Chengalpattu	8	Mrs. Pandiyammal	Thattanmalai Street
75.	Chengalpattu	13	Rajeshwari Ethirajan	Sunthara Moorthy Vinayagar Kovil Street
76.	Chengalpattu	11	Ramanathan	Vaedhappar Street
77.	Chengalpattu	20	Neelavathi Krishnamoorthy	Murugeshan Muthliyar Street
78.	Chengalpattu	3	Umarani	Chinamman Kovil Street
79.	Chengalpattu	5	Malliga	Kanthan Street

Annexure 4: List of Participants for WaCT Survey

Sr. No.	Name of the Members	Total Members
1.	RDMA Office Staff Members	6
2.	Chengalpattu Municipality Staff Members	13
Hand in Hand India		**20**
3.	Mr. Bryav	1
4.	Mr. S. Kumar	1
5.	Ms. Aarthy	1
6.	Dr. Porselvam	1
7.	Mr. Selvan	1
8.	Mr. N. Kumar	1
9.	Mr. Arumugam	1
10.	Mr. Jayaram	1
11.	Mrs. Revathy	1
12.	Mrs. Deepa	1
13.	Mr. Thangaduari	1
14.	Mr. Selva Raj	1
15.	Green Workers	8
Volunteers		**10**
16.	Hariprasad M	1
17.	Harish A	1
18.	Priyan S	1
19.	Dineshkumar S	1
20.	Janarthanan R	1
21.	Narayanan B	1
22.	Prabu S	1
23.	Aravind R	1
24.	Kalaivani G	1
25.	Thilagavathi M	1

Sr. No.	Name of the Members	Total Members
ISWA/ Ambire Global		**4**
1.	Aditi Ramola	1
2.	Prateek	1
3.	Kartik Kapoor	1
4..	Neha Nalge	1
Total		**53**

Annexure 5: Data Sheets

Data Sheet used for Household Waste Generation

House hold_Waste Generation_Survey																								
Incharge Name																								
Area																								
Income Group																								
Average weight of liner bags (Grams)																								
			Weight of collected bags in Kg																					
			Day 2			Day 3			Day 4			Day 5			Day 6			Day 7			Day 8			
			Date			Date			Date			Date			Date			Date			Date			
S. No	House Code	No of residents	Wet waste (a)	Dry Waste (b)	Total (c=a+b)	Wet waste (a)	Dry Waste (b)	Total (c=a+b)	Wet waste (a)	Dry Waste (b)	Total (c=a+b)	Wet waste (a)	Dry Waste (b)	Total (c=a+b)	Wet waste (a)	Dry Waste (b)	Total (c=a+b)	Wet waste (a)	Dry Waste (b)	Total (c=a+b)	Wet waste (a)	Dry Waste (b)	Total (c=a+b)	
1																								
2																								
3																								
4																								
5																								
6																								
7																								
8																								
9																								
10																								
Notes:																								

Data Sheet used for Household Waste Characterisation Study

Household Waste Characterisation Study										
Income Group			Date			WaCT Day	| 2 | 3 | 4 | 5 | 6 | 7 | 8 |			
Survey Area			Volunteer name:							
Total no of HH in this study										
Categories	Bucket -1		Bucket -2		Bucket -3		Bucket -4		Bucket -5	
	Weight (Kg) Full Bucket	Weight (Kg) Empty bucket	Weight (Kg) Full Bucket	Weight (Kg) Empty bucket	Weight (Kg) Full Bucket	Weight (Kg) Empty bucket	Weight (Kg) Full Bucket	Weight (Kg) Empty bucket	Weight (Kg) Full Bucket	Weight (Kg) Empty bucket
Kitchen/Food										
Garden/Park										
Paper & cardboard										
Plastic - film										
Plastic- dense										
Metals										
Glass										
Textile & Shoes										
Wood										
Special Waste										
Composite products										
Others										
Notes: Since waste quantity at characterisation can be more than bucket capacity, if needed use other bucket as bucket no 2,3,4,5 to cover all waste. If not used, leave it blank										

Data Sheet used for Household Waste Characterisation Study

Landfill Waste Characterisation Study								
Landfill/Dumpsite name							Waste Quatered	
Income Group				Date			Yes | No	
Study Number	1 | 2 | 3 |			Volunteer name:				
Categories	*Bucket -1*		*Bucket -2*		*Bucket -3*		*Bucket -4*	
	Weight (Kg) Full Bucket	**Weight (Kg) Empty bucket**	Weight (Kg) Full Bucket	Weight (Kg) Empty bucket	Weight (Kg) Full Bucket	Weight (Kg) Empty bucket	Weight (Kg) Full Bucket	Weight (Kg) Empty bucket
Kitchen/Food								
Garden/Park								
Paper & cardboard								
Plastic - film								
Plastic- dense								
Metals								
Glass								
Textile & Shoes								
Wood								
Special Waste								
Composite products								
Others								

Datasheet used for Waste Pickers Interviews at Landfill

Interview of waste pickers at landfill						
Location:		Total number of waste pickers at lanfill site:				
No	Name	Quantity recovered daily (kg)	No of active days	Recovered material type	Destination of recovered material	Comments
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Response Recording Sheet

Annex 6: Recovery survey questionnaire

Facility / Company Name : _____

Location : _____

Contact Person : _____

Telephone / Email : _____

Q1. Which category in the recovery value chain below best describes your operation?

- ☐ **End-of-chain recycler/recoverer** who receives materials from apex traders or directly from both formal and informal MSW collection systems and processes them into materials and products that has value in the economy either through recycling, incineration with energy recovery, or other recovery process.
- ☐ **Apex trader** who receive materials from intermediate traders or directly from both formal and informal recyclable collection systems (including waste pickers), store and prepare these materials for onward trading to end-of-chain recyclers/recoverers .
- ☐ **Intermediate trader** who receive materials from both formal and informal recyclable collection systems (including waste pickers), store and prepare these materials for onward trading to apex traders.

Q2. Which recyclable material(s) do you handle? Please tick all that apply.

☐ PET ☐ HDPE ☐ PP ☐ PVC ☐ LDPE & Films

☐ EPS ☐ Other plastics ☐ Paper or Cardboard ☐ Glass

☐ Metal ☐ Organic waste ☐ Mixed waste

☐ Other (Specify: _____)

Q3. For each of these recoverable/recyclable materials you receive from the MSW stream(s), please provide how much you source from which suppliers and/or cities. (use a separate line for every combination of material, trader and source city):

Table Q3

Recyclable material	Name of supplier (where applicable)	Type of supplier*	Amount you source (kg/d)	Source City	Point of entry into recovery system (Y/N)**

** "Type of supplier" includes 1) MSW collection system, 2) Many small suppliers (e.g. waste pickers), 3) Intermediate traders and 4) Apex traders*

*** "Point of entry into recovery system" is YES (Y) if the material is received from any person, trader or facility that is NOT itself being included in the survey programme. If the person, trader or facility that the materials have come from is already included in the survey programme then the answer to the "Point of Entry" query should be NO (N). If NO is checked here, please ensure that for this material, the actual point of entry to the recovery system has been identified. This column should be filled by surveyor, not answered by recovery facilities.*

Q4. For each of these recoverable/recyclable materials you receive from non-MSW stream (s), please provide how much you source from which companies.

Table Q4		
Recyclable material	**Name of supplying company**	**Amount you receive (kg/d)**

Q5. From the total amount you receive, how much do you estimate has been collected informally*?

☐ 0% - 19% ☐ 20% - 39% ☐ 40% -59%

☐ 60% - 79% ☐ 80% - 100%

**The informal sector refers to individuals or enterprises who are involved in private sector recycling and waste management activities which are not sponsored, financed, recognised, supported, organised or acknowledged by the formal solid waste authorities, or which operate in violation of or in competition with formal authorities (Scheinberg et al., 2010)*

Q6. What share of the total material recovered in your city do you reckon you process?

☐ 0% - 19% ☐ 20% - 39% ☐ 40% -59%

☐ 60% - 79% ☐ 80% - 100%

Q7. Please tell us how much residue/rejects are generated during your recovery process in tonnes per day and where the residue is transported.

Table Q7		
Material description	**Destination**	**Amount you generate (t/d)**

Q8. What is your current spare capacity? _____ **t/d**

Annexure 6: Recovery Facility Survey

Sr. No.	Company Name	Area	Recycled Material Type (TPD)	Total Amount Handles (TPD)	Informal (%)	Source Type
1.	Anandha Vinayaga Waste Mart	Vadanemilli (ECR)	Mix Waste	3	20-39	Many Small Traders
2.	Anandhan Waste Mart	Kannadapalayam, Tambaram	Mix Waste	1	40-59	Many Small Traders
3.	Antony Scrap (I)	Tiruporur (Kalvakkam)	Mix Waste	0.17	80-100	Many Small Traders
4.	Arul Joshi Trader	OMR, Kelambakkam	PET = 1.7 TPD HDPE = 0.3 TPD	2	20-39	Many Small Traders
5.	Ashraf Steel	Thiruneermalai	Mix Waste	2.88	20-39	Many Small Traders
6.	Bhavani Traders	Tiruporur (OMR Road)	Mix Plastic	0.33	80-100	Many Small Traders
7.	BPN Traders	Chithamur	Mix Plastic	1.17	20-39	Many Small Traders
8.	CED Trader	Vembakkam Malaiyadi	PET = 0.01 | PVC = 0.07 Paper = 0.15 | HDPE = 0.02	0.2	80-100	Many Small Traders
9.	DD Kalis Waste Mart	Tirukazhukundram	Mix Plastic	1.54	20-39	Many Small Traders
10.	Ebenesar Plastics	Kayar	Mix Plastic	4		Many Small Traders
11.	Gayathri Traders	Mannivakkam	PET	2.67	20-39	Many Small Traders
12.	Jasmine Traders	Nelvoy	Mix Plastic	4.62	20-39	Many Small Traders
13.	Jeni Traders	Pallikaranai	Mix Waste	0.77	60-79	Many Small Traders

Sr. No.	Company Name	Area	Recycled Material Type (TPD)	Total Amount Handles (TPD)	Informal (%)	Source Type
14.	JJK Plastic Traders	SRM	Mix Waste	2	0-19	Many Small Traders
15.	JP Plastic	Kishkinda Poad, Tambaram	Mix Plastic	2	40-59	Many Small Traders
16.	Just Plastic	Rayappa Nagar	Mix Waste	2	20-39	Many Small Traders
17.	Kathar Waste Mart	Oragadam, Thirukalukundram	Mix Waste	0.54	40-59	Many Small Traders
18.	Krishna Traders	Appur	Mix Waste	0.96	20-39	Many Small Traders
19.	Mathue	Tambaram	Mix Waste	3	0-19	Many Small Traders
20.	MG Plastics	Kaaranai	Mix Plastic	2	0-19	Many Small Traders
21.	MV Trader	Mambakkam	HDPE	1.17	40-59	Many Small Traders
22.	Naveen Kumar Agency	Maraimalai Nagar	Mix Plastic	1.33	40-59	Many Small Traders
23.	PKB Traders	Vandalur	Mix Plastic	2	0-19	Many Small Traders
24.	Punitha Micheal Traders Antoniyar Trader	Thalampur	Metal = 5 Mix Plastic = 0.33	5.33	20-39	Many Small Traders
25.	Rexson Plastics	Kandigai	Mix Waste	0.17	20-39	Many Small Traders
26.	Risvana Waste Shop	Devanari	PET - 0.17 Glass = 3.3 Paper = 0.33	0.77	60-79	Many Small Traders
27.	RS Plastic	Thiruneermalai	Mix Waste	5	20-39	Many Small Traders

Sr. No.	Company Name	Area	Recycled Material Type (TPD)	Total Amount Handles (TPD)	Informal (%)	Source Type
28.	SBS Enterprises	Somangalam, Varatharajapuram	Mix Waste	5	60-79	Many Small Traders
29.	Seliyamman Traders	Kolathur	Mix Waste	1.15	20-39	Many Small Traders
30.	Selvi Traders and Bottles	Kaaranai	Glass	3	0-19	Many Small Traders
31.	Shirajudeen Trader	Kalpakkam, ECR	Glass = 0.83 | PET = 0.25 Paper = 0.83 | Metal = 0.75	2.67	40-59	Many Small Traders
32.	Shiv Shakthi Trader	P.V. Kalathur	PET =2.3 | HDPE - 2.3 Metal = 10 | Paper = 5.38 Glass = 4 | PP = 2 | LDPE = 2	28	80-100	Many Small Traders
33.	SKS Traders	Anna Main Road	Mix Waste	0.12	0-19	Many Small Traders
34.	SL Plastic	Orathur	Mix Waste	2	0-19	Many Small Traders
35.	SMB Traders	Acharapakkam, Maduranthagam	Mix Waste	0.67	20-39	Many Small Traders
36.	SN Traders	Maduranthagam	Glass	5	80-100	Many Small Traders
37.	Sri Ganapathy Traders	Old Perungalathur	Metal	0.46	40-59	Many Small Traders
38.	Sri Mahalakshmi Traders	Mambakkam	Paper	2	0-19	Many Small Traders
39.	Sri Murugan Scrab Enterprises	Mudichur	Mix Waste	1.38	80-100	Many Small Traders
40.	Suresh PET Traders	Kolapakkam, Nedugkundram Salai	PET	1.92	40-59	Many Small Traders
41.	Surya Traders	Maduranthagam	Glass	0.6	80-100	Many Small Traders

Sr. No.	Company Name	Area	Recycled Material Type (TPD)	Total Amount Handles (TPD)	Informal (%)	Source Type
42.	SVS Steels	Palathandalam	Metal	5	60-79	Many Small Traders
43.	Thamiraiparani Traders	Kishkinda Road, Tambaram	Mix Waste	1.54	60-79	Many Small Traders
44.	VPP Traders	Sothupakkam	Mix Waste	3.33	20-39	Many Small Traders
45.	VSE Traders	Maduranthagam	Mix Plastic	2	0-19	Many Small Traders
46.	Waste Mart	Guduvancheri	Mix Waste	2	0-19	Many Small Traders
47.	Waste Mart Papers (Mass Paper)	Thirumudivakkam	Paper	5	20-39	Many Small Traders
48.	Yoshana Plastics	Pukkathurai	Mix Plastic	1.15	40-59	Many Small Traders

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