Waste Management Fee Calculation and Retribution Module for City/Regency Areas

3RproMar
(Reduce, Reuse, Recycle to Protect the Marine Environment and Coral Reefs)

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List of Abbreviations

APBD	:	Regional Revenue and Expenditure Budget
APBN	:	State budget
APC	:	Air Pollution Control
APD K3	:	Personal Protective Equipment for Health and Safety at Work
BA	:	Bottom Ash
BBM	:	Fuel oil
Bi	:	Total Investment Cost
BLUD	:	Regional Public Service Agency
BPJS	:	Social Security Administrator
BPS	:	Central Bureau of Statistics
CSR	:	Corporate Social Responsibility
DAK	:	Special Allocation Fund
DAU	:	General Allocation Fund
DBH	:	Profit Sharing Fund
DLH	:	Department of Environment
DPA	:	Budget Implementation Document
FA	:	Fly Ash
GCF	:	Green Climate Fund
GEF	:	Global Environment Facility
H_{iu}	:	Fleet Unit Price
I	:	Inflation (Per Year)
Jakstrada	:	Regional Strategy Policy
KK	:	Head of family
KSM	:	Community Self-Help Group
LSM	:	Non-governmental organization
MFA	:	Material Flow Analysis
OPD	:	Regional Device Organization
PAD	:	Locally-generated revenue
PDAM	:	Local water company
PERDA	:	Local regulation
PPP	:	Public-Private Partnership
RDF	:	Refuse Derived Fuel
RKA	:	Work Budget Plan
RPJPN	:	National Long Term Development Plan
Sampah B3	:	Hazardous and Toxic Waste
Sb	:	Bank Indonesia Interest Rate

SDM	:	Human Resources
SIPSN	:	National Waste Management Information System
landfill	:	Landfill
TPS	:	Waste Transfer Station
3R-WPS	:	3R Waste Processing Site
IWPS	:	Integrated Waste Processing Site
UPTD	:	Regional Technical Implementation Unit
U_t	:	Fleet Technical Age
ZISWAF	:	Zakat, Infaq, Shadaqah, and Waqf

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Introduction

1.Introduction

1.1. Background

Waste management is one of the main challenges faced by the government in realizing sustainable development. Along with the increasing population and economic activities, the amount of waste generated by the community has also increased. The National Long-Term Development Plan (RPJPN) 2025-2045 documents project that waste generation in 2045 will reach 82.2 million tons, which has the potential to cause overcapacity of landfills[1]. This condition is increasingly worrying because the waste management infrastructure and services currently available are inadequate, both in terms of quantity and quality. If this challenge is not immediately addressed, the impact will be widespread, not only polluting the environment, but also impacting social and economic aspects.

As stipulated in the 2025-2045 RPJPN, the government is committed to carrying out integrated waste management reforms from upstream to downstream to address waste problems. However, the implementation of this reform requires strong support, one of which is from the financing aspect. Currently, the average budget allocation for waste management in the regions is only around 0.5% of the Regional Revenue and Expenditure Budget (APBD), far below the ideal figure which should be around 3-4% of the APBD[2]. This minimal budget encourages the government to identify alternative sources of financing to ensure optimal waste management services for the community. One possible solution is the collection of waste management levies by local governments. This initiative already has a legal basis through the Regulation of the Ministry of Home Affairs Number 7 of 2021 concerning Procedures for Calculating Retribution Rates in the Implementation of Waste Management[3].

However, the implementation of regulations related to waste retribution still faces a number of challenges in the field. For example, the calculation of waste management retribution is often not based on actual operational costs, but only refers to historical values that are no longer relevant. Another challenge is the determination of retribution rates that do not match actual conditions due to limited accurate data. As a result, there is a funding deficit that hinders the optimization of waste management services. This module is designed to assist local governments in determining waste management retribution rates based on local data. Thus, this module is expected to support local governments in achieving national targets related to sustainable waste management, while also resolving specific challenges faced in their respective regions.

1.2. Goals and Objectives

The purpose of this training module is to provide direction and guidance regarding the calculation of waste handling costs and waste management levies in each city, based on Ministry of Home Affairs Regulation No. 7 of 2021 concerning Procedures for Calculating

[1] RPJPN 2025—2045. [Link]
[2] of Environment and Forestry. (2023). Waste Management Funds Only 0.5 Percent of Total APBD, KLHK Invites Producers to Manage Waste Independently. [Link]
[3] Ministry of Home Affairs. (2021). Regulation of the Ministry of Home Affairs Number 7 of 2021 concerning Procedures for Calculating Retribution Rates in the Implementation of Waste Management. [Link]

Retribution Rates in the Implementation of Waste Management. The targets of the following training modules are:

a. **Improving Participant Understanding**
   Helping participants understand the procedures for calculating waste management costs and waste management retribution rates in accordance with Ministry of Home Affairs Regulation No. 7 of 2021.
b. **Improving the Technical Capacity of Participants**
   Provides participants with technical skills to accurately calculate waste management costs, covering all cost components such as collection, transportation, processing and final disposal.
c. **Encouraging the Implementation of Effective and Fair Retributions**
   Assisting city governments in setting effective, fair and cost recovery-based retribution rates to support the sustainability of the waste management system.

02

Definition and Function of Retribution Calculator

2. Definition and Function of Retribution Calculator

Waste management costs include calculation values that cover all stages of the household waste management process and other similar waste. These stages include waste collection from the source, transportation of waste to processing facilities or Final Disposal Sites (landfill), to the provision and operation of infrastructure used in waste management. These waste management costs not only cover technical aspects, but also consider the need for human resources, infrastructure maintenance costs, and procurement of tools and technology used to improve the efficiency and effectiveness of waste management. Meanwhile, regional waste management levies are defined as official levies used for the sustainability of waste management infrastructure and are determined by the regional government. This levy is intended as compensation for waste management services provided or given to the community, both for individuals and business entities. This levy is one of the important sources of funding to ensure the sustainability of waste management by the regional government, including improving the quality of services and developing waste management infrastructure[4].

In order to support the improvement of service quality and development of waste processing infrastructure, calculations are carried out using a retribution calculator. The retribution calculator in waste management is a tool used to calculate the retribution rates that must be paid by service users. The legislation of the Ministry of Home Affairs Regulation No. 7 of 2021 is a reference in determining the waste retribution rates and parameters in the calculator calculation. The waste retribution rate is calculated by considering several factors; waste volume, type of service, and frequency of waste transportation. The retribution amount calculator can be calculated by filling in data according to the conditions of each region. The calculator filling data consists of[5]:

a. General data on waste service areas.
b. Ideal waste handling cost data.
c. Data on waste handling costs that are covered by non-retribution.

The retribution calculator is divided into two main components[6], namely:

1) **The handling calculator is a calculation used to calculate the ideal cost requirements needed for waste management**, from collection, transportation, to final management. This calculator focuses on estimating the total costs that must be borne to ensure that the waste handling system can run optimally. The Retribution Calculator cannot be used if the ideal handling cost calculator has not been calculated first.

[4] Aksara (National Low Carbon Action Planning-Monitoring Application). [Link]
[5] Ministry of Home Affairs. (2021). Regulation of the Ministry of Home Affairs Number 7 of 2021 concerning Procedures for Calculating Retribution Rates in the Implementation of Waste Management. [Link]
[6] Waste Management Fee Calculation and Retribution Module for City/Regency Areas. [Link]

2) **Calculator is a calculation component designed to calculate the amount of retribution** that must be paid by the community based on the category of waste source and economic class.

Tariff is as a financial management instrument that supports the provision of public services, in this case waste management services. This function includes collecting funds from the community as a form of contribution for the use of services provided, so that local governments can ensure the sustainability of waste management operations. In addition, the retribution tariff also functions to create equality, where the amount of the tariff is adjusted to the type of service used, the volume of waste produced, and the category of service users. Another function of the retribution tariff is as a control tool, which encourages the community to be more responsible in waste management.

The waste retribution calculation calculator can also function as an evaluation and strategic planning tool for local governments. Data generated from the use of this calculator can be analyzed to monitor the effectiveness of the implementation of retribution rates, identify patterns of service use, and design policies that are more adaptive to the needs of the community in the fields of waste and finance. Thus, this retribution not only functions as a fundraising tool, but also as a mechanism to encourage shared responsibility in maintaining environmental cleanliness and sustainability.

03

Data Collection and Identification of Existing Conditions

3. Data Collection and Identification of Existing Conditions

Before calculating the handling costs and waste management fees, it is necessary to know the existing conditions of urban waste by collecting data based on 5 aspects of waste, namely the regulatory and policy aspects that apply at the national and regional levels, institutional aspects especially related to the role of regulators and operators in managing urban waste, financial aspects to determine the funding conditions for existing waste management, technical operational aspects in the field, and aspects of stakeholder and community participation in managing urban waste. The following is an explanation related to the identification of existing conditions and data collection as the initial part of calculating waste management fees:

3.1. Regulatory and Policy Aspects

Data collection related to regulatory and policy aspects is carried out comprehensively to ensure that the preparation of the retribution calculator module is in line with the applicable legal and policy framework, both at the national and regional levels. The legal framework used as a reference is primarily the Ministry of Home Affairs Regulation No. 7 of 2021 concerning Procedures for Calculating Retribution Tariffs for Waste Management Implementation, which aims to provide technical guidance in determining fair and sustainable retribution tariffs.

3.1.1. Legal Foundation

Regulation of the Ministry of Home Affairs Regulation Number 7 of 2021 is the national legal basis for calculating waste management retribution rates. This regulation provides guidance for local governments in setting retribution rates for these services.

Ministry of Home Affairs Regulation No. 7 of 2021 is the main reference in compiling a reliable retribution calculator to ensure integration between local needs and national principles. Here are some important components of the retribution:

A. Object of Retribution

Services subject to retribution fee include waste collection from the source to the Waste Transfer Station (WTS), waste transportation from the source or WTS to waste processing sites such as 3R-WPS and IWPS, or directly to the final waste disposal or processing site such as landfill. Meanwhile, services not subject to levies include cleaning services on public roads, parks, places of worship, social places, and other public facilities.

B. Subject and Obligation of Retribution

Subject of Retribution: Individuals or bodies who utilize or receive waste services from the local government.

Obliged to Pay Retribution: Individuals or bodies who are required to pay retribution in accordance with the provisions of laws and regulations, including retribution collectors or withholding agents.

C. Principles for Determining Retribution Rates

- Based on the cost of providing services which includes operating costs, maintenance and capital costs
- Taking into account the community's ability to pay

- Prioritize aspects of social justice so that the cost burden is in accordance with the benefits of services received by the community
- Ensuring the effectiveness of waste management through realistic tariffs

D. Calculation of Retribution Rates

The amount of retribution can be calculated using a calculator by entering data according to the specific conditions of each region. The data required includes general data on waste service areas, ideal waste handling cost data, and non-retribution covered waste handling cost data.

E. Tariff Determination by Local Government

- The district/city regional government has the authority to determine the retribution rates in accordance with the applicable laws and regulations regarding regional taxes and retributions.
- Tariff determination considers the local context, including the capabilities of the local community.

F. Utilization of Retribution Revenue Results

- Priority Use: Revenue from fees is used to fund activities that directly support waste management, such as daily operations, facility maintenance, or investment in new waste management infrastructure.
- Budget Management: The results of the retribution revenue are budgeted in the Regional Revenue and Expenditure Budget (APBD) as part of the waste service retribution.

3.1.2. Regional Policy

There are several policies in force to support waste management in the regions, such as the Regulation of the Ministry of Home Affairs Number 79 of 2018 concerning Regional Public Service Agencies (BLUD), which provides guidelines for the establishment of BLUD as operators for managing waste services, as well as Regional Regulations Regarding Retributions, for example, Manado City Regional Regulation Number 1 of 2024 concerning Regional Taxes and Regional Retributions, which is an example of the implementation of waste retribution policies.

A. Regulation of the Ministry of Home Affairs Number 79 of 2018 concerning Regional Public Service Agencies (BLUD)

Waste management is part of public services that require an efficient and sustainable approach. Based on Ministry of Home Affairs Regulation No. 79 of 2018 concerning Regional Public Service Agencies (BLUD), local governments can form BLUDs to carry out certain service management functions, including waste management. BLUDs allow local governments to manage these services more flexibly, both in terms of finance and operations. The formation of BLUDs must be outlined in a Regional Regulation (Perda), which regulates their duties, functions, and operational mechanisms. In the context of waste, BLUDs can be designated as the main operator that handles waste management from upstream to downstream.

As an agency with special authority, BLUD can play a role in managing waste service fees as regulated in the Regional Regulation. In the case of Manado City, for example,

the levy rate is regulated through Regional Regulation Number 1 of 2024. This rate covers various categories of users, from households to business entities, which are calculated based on waste volume, management complexity, and additional service needs. BLUD is tasked with ensuring that levy collection is carried out transparently and on target, so that each category of users receives services in accordance with the tariff contribution they pay.

Revenue from these levies is an important resource for BLUD in improving the quality of waste services. With the flexibility of BLUD in financial management, revenue can be allocated to build infrastructure such as waste collection fleets, waste processing facilities, and educational programs for the community regarding waste management. BLUD can also adopt technological innovations in waste management, which support the principles of sustainability and operational efficiency.

With its strategic role, BLUD not only functions as a technical implementer of waste management, but also as the main driver in efforts to create an integrated and sustainable waste management system. Through synergy with local governments, BLUD is able to integrate national policies and local needs in waste management. Thus, the establishment of BLUD is a strategic solution in improving the quality of public services, while strengthening local government efforts in maintaining environmental sustainability.

B. Example of Regional Regulation that regulates Waste Management Retribution: Regional Regulation Number 1 of 2024 concerning Regional Taxes and Regional Retributions of Manado City

The regional government is required to draft a Regional Regulation (Perda) that regulates waste service levies. The Perda must refer to the provisions in Ministry of Home Affairs Regulation No. 7 of 2021 to ensure national policy consistency. The Perda also regulates the details of the implementation of levies, starting from rates, payment mechanisms, to supervision. The following is an example of a list of retribution rates listed in the Regional Regulation that regulates levies in Manado City, namely Perda Number 1 of 2024 concerning Regional Taxes and Regional Retributions for Manado City[7].

Table 3.1 Regional Regulation No. 1 of 2024 Concerning Regional Taxes and Regional Retributions of Manado City

No	Service Details	Rate (Rp)	Unit
1	Residential home	10,000 - 50,000	Per month
2	Boarding House/Dormitory	100,000 - 300,000	Per month
3	Hotel Accommodation	100,000 - 1,800,000	Per month
4	Restaurant	600,000	Per month
5	Restaurant	300,000	Per month
6	Food Kiosk	300,000	Per month
7	Non-Permanent Restaurants and/or Other Food Vendors (Street Vendors) every day	10,000	Per month
8	Hospital/Health Services	50,000 - 400,000	Per month

[7] Regional Regulation No. 1 of 2024 concerning Regional Taxes and Regional Retributions of Manado City [Link]

No	Service Details	Rate (Rp)	Unit
9	Warehouse	100,000 - 500,000	Per month
10	Cinema	200,000	Per month
11	Private Company Office	30,000 - 60,000	Per month
12	Shop	40,000 - 70,000	Per month
13	Self-service	500,000 - 800,000	Per month
14	Salon	30,000 - 50,000	Per month
15	Karaoke Pub and Disco	300,000	Per month
16	Workshop/Repair and Service Place	50,000 - 150,000	Per month
17	Company yard, carpentry, drying, processing of trading materials	70,000	Per month
18	Factory/Industry	50,000 - 1,000,000	Per month
19	Roadside stall	10,000 - 25,000	Per month
20	Each Use of a fixed space/kiosk in the market	50,000	Per month
21	Utilization of Final Waste Disposal Sites (landfill) is subject to landfill levies for every M3 of waste or less.	25,000	Per month
22	Special Transportation of Garbage Fleet for each Garbage Truck	150,000	Per month

Based on Regional Regulation Number 1 of 2024 concerning Regional Taxes and Regional Retributions of Manado City, for example, the determination of waste service retribution rates is carried out by considering several main factors, including:

1. **Service User Categories**
   Each user category has different characteristics and needs, which affect the amount of waste generated and the level of complexity of its management:
   - Residential homes are charged a lower rate (Rp. 10,000 – Rp. 50,000 per month) because the volume of waste produced tends to be small and is a basic need for the community.
   - Boarding houses/dormitories and hotel accommodations have higher rates (Rp100,000 – Rp1,800,000 per month) because the larger scale of activities produces more waste.

2. **Volume and Frequency of Waste**
   The levy rate reflects the volume of waste produced and the frequency of collection required:
   - Non-permanent restaurants or street food vendors are charged a rate of IDR 10,000 per day because the amount of waste produced is small but routine every day.
   - Factories/Industries are charged varying rates between IDR 50,000 – IDR 1,000,000 per month based on the scale of industrial activities and the amount of waste produced.

3. **Types and Characteristics of Waste**
   The type of waste determines the level of complexity of its management:

- Restaurants, Eateries, and Food Stalls produce large amounts of organic waste that requires more intensive handling, so they are charged a fixed rate of between IDR 300,000 – IDR 600,000 per month.
- Repair and Service Places (Rp. 50,000 – Rp. 150,000 per month) produce inorganic waste or hazardous materials that require special management.

4. **Service Complexity**
   Certain services require additional management beyond routine transportation:
   - Utilization of the Final Disposal Site (landfill) is subject to a rate of IDR 25,000 per m^3 as a contribution to operational costs at the landfill, such as waste processing and facility maintenance.
   - Special Waste Transportation (Garbage Trucks) is charged a rate of IDR 150,000 per transportation for additional transportation services (tipping fee), especially for large business entities that produce large amounts of waste.

5. **Location and Scale of Operations**
   Rates are also influenced by the location and scale of the user's operations:
   - Supermarkets are charged Rp500,000 – Rp800,000 per month, higher than small shops, because the high volume of visitors produces more waste.
   - Private Company Offices are charged a rate of IDR 30,000 – IDR 60,000 per month, adjusted according to the number of employees and operational activities that contribute to the amount of waste produced.

3.2. Institutional Aspects

Waste management cannot be separated from the role of institutions. Comprehensive waste management requires cooperation from various parties as a concrete step in implementing Law No. 18 of 2018 concerning Waste Management. In addition, the existence of institutions is also closely related to increasing public awareness, waste utilization, waste management, ensuring the availability of waste infrastructure and facilitating waste management.

Institutional aspects are multidisciplinary activities that are based on technical and management principles concerning aspects, economic, social, cultural, and physical conditions of a region/city, as well as the community served. Planning and selection of organizational forms need to be adjusted to government regulations that foster them, operational system patterns applied, system work capacity, scope of work and tasks to be handled[8].

Because the amount of waste handling and management continues to increase every year according to the population, in its implementation it is necessary to separate the regulator and operator which aims for the effectiveness of waste services in the region. Based on experience so far, there is a strong push for waste management to involve the private sector or other third parties directly involved in waste management. The local government can be positioned as a regulator, while the private sector or third parties formed by the local government and involved

[8] Damanhuri dan Padmi. 2016. Program Studi Teknik Lingkungan Fakultas Teknik Sipil dan Lingkungan Institut Teknologi Bandung (ITB): Pengelolaan Sampah. [Link]

are positioned as operators. Regulations and legislation also need to support in order to attract private interest to invest in the waste sector.

Waste management by operators can support increased funding for waste management directly from the source. Existing waste infrastructure needs to be adjusted to an appropriate institutional model, considering the workload of local governments, human resource (HR) capacity, budget capabilities, and the potential available in the region.

Then in the institutional aspect, it is necessary to pay attention to several things, including: the increase in the typology of the service class, especially the technical OPD for waste management, the establishment of a waste management operator institution in the region in this case the Technical Implementation Element of the Service (UPTD) or the Regional Public Service Agency (BLUD) based on Ministry of Home Affairs Regulation No. 79 of 2018 concerning Regional Public Service Agencies, the development of cooperation mechanisms between sectors and regions in waste management, and increasing the capacity of regional institutions in implementing cooperation in waste management in the region. Therefore, for regions that have not formed a UPTD, it is very important to immediately carry out the formation process to [9]effectively manage waste in the region. For regions that have formed a UPTD, a study process should be carried out for the implementation of BLUD considering the flexibility of BLUD, especially the consolidation of its financing potential. Determination of roles in waste management in the City/Regency can be grouped as follows:

a) Parties involved in waste management
b) Parties involved in calculating the waste management budget
c) Parties involved in collecting levies
d) The informal sector involved in waste management
e) Waste Management Operator
f) Community Self-Help Groups (KSM) involved in waste management

For example, the Banjarmasin City Government determines its role in handling waste in Banjarmasin City as follows:

a) Parties involved in waste management
    - Community Self-Help Group (KSM)
    - Non-Governmental Organization (Larva Indonesia)
    - Banua Green Hub
b) Parties involved in calculating the waste management budget
    - Banjarmasin City Environmental Service (DLH)
    - Banjarmasin City Regional Finance Agency, which plays a role in examining the concept of the Work Budget Plan (RKA) and Budget Implementation Document (DPA)
    - Regional Development Planning, Research and Development Agency (Bappeda Litbang), which plays a role in examining the Work Budget Plan (RKA) and Budget Implementation Document (DPA)
c) Parties involved in collecting levies: Banjarmasin City Regional Drinking Water Company (PDAM)

[9] Ministry of Home Affairs (2018). Regulation of the Ministry of Home Affairs No. 79 of 2018 concerning Regional Public Service Agencies [Link]

d) Informal sector involvement
   - Eco Enzyme Banjarmasin-South Kalimantan environmental community
   - Rivercare Generation environmental community
   - Environmental Engineering Student Association
   - Youth Care for a Clean and Beautiful Environment (Pepelingasih)

e) Waste management operator
   - Nineteen (19) supervisors of the Reduce-Reuse-Recycle Waste Processing Facility (3R-WPS)
   - Five (5) Waste Bank Unit Supervisors

f) Community Self-Help Groups: A total of thirteen (13) KSMs have collaborated together in 3R-WPS

3.3. Financial Aspects

The funding and financing conditions of waste management in Indonesia face various challenges, such as planning that is not in accordance with regional characteristics, lack of integration, and more focus on physical aspects than governance and community behavior. Waste data used so far has also not been reliable for waste management planning that is in accordance with existing city or district conditions. In addition, the capacity of budget management agencies and workers needs to be improved, especially in implementing best practices to reduce waste management costs. Existing regulations are not optimal due to weak law enforcement, overlapping regulations, and the implementation of the " *polluter pays* " principle that is not yet optimal. These are the main factors in inhibiting private investment interest. The budget allocation for waste management, which is only 0.42% of the APBD, is also far from sufficient. The governance of city and district waste management still needs improvement, especially related to the politicization of levies, weak revenue collection, and unclear authority between regulators and operators.

To address this challenge, three key steps can be taken:

1) **Increase revenue by improving the retribution system and utilizing non-APBN/APBD funding sources.** The government also needs to complete the implementation of Ministry of Home Affairs Regulation No. 7 of 2021 for efficiency in retribution collection.

2) **Improve the budget prioritization process** by increasing the capacity of local governments to plan and manage budgets proportionally between physical and governance elements. Budget benchmarking needs to be implemented to ensure the availability of funds.

3) **Utilizing a blended finance scheme** to engage the private sector with the principle of sharing risk, financing, and revenue, and increasing the capacity of local governments in sustainable waste management. Sources of funding for waste management can come from:
   a) Local Original Income (PAD), such as waste levies from waste service users (the public and business actors)

b) Central government transfer funds, for example the General Allocation Fund (DAU) and Special Allocation Fund (DAK) for environmental management.
c) Grants from international organizations, NGOs, or the private sector for sustainability programs.
d) Government Cooperation with Business Entities (KPBU) or Public-Private Partnership (PPP) for the procurement of facilities or waste processing.
e) Regional sukuk
f) Municipal Bonds
g) ZISWAF (Zakat, Infaq, Shadaqah, and Waqf)
h) Green Climate Fund (GCF) and Global Environment Facility (GEF)
i) In-kind and in-cash society
j) Waste value recovery

3.4. Operational Technical Aspects

The operational technical aspect serves to identify the 5 operational stages of municipal waste, namely from storage, collection, transfer, transportation, to final processing. In addition, other important components that can be identified from the operational technical aspect are waste generation and composition, material flow analysis, and other advanced analysis.

3.4.1. Waste Generation and Composition

Measurement of waste generation and composition is the basic data needed to determine the load of urban waste management. Waste generation is the amount of waste generated by the city's population, both households and non-households, which is taken from selected collection locations, to be measured for volume, weighed, and identified for composition. Meanwhile, waste composition is the type of waste determined from the physical components of the waste, which are generally divided into 9 types based on SNI 19-3964-1994, namely food waste, paper/cardboard, wood, cloth, rubber, leather, plastic, metal, glass and others . The following are the details of the steps related to measuring waste generation and composition or commonly referred to as waste sampling activities:

A. Sampling Determination for Waste Sampling

Waste samples can be determined based on sources from households or non-households. Based on the classification of waste sources in SIPSN, the details of waste sources consist of households, markets, offices, business centers, public facilities, areas, and others such as street sweeping or drainage cleaning. There are 2 types of methods that can be used in determining waste sampling samples, namely as follows:

1) SNI 19-3964-1994 method

$$S = Cd\sqrt{Ps}$$

S = Number of samples
Ps = Population (people)
Cd = Housing coefficient*
*Cd = 1 if population density is normal
Cd < 1 if population density is sparse
Cd > 1 if the population density is dense

$$K = \frac{S}{N}$$

K = Number of head of household (KK)
N = Number of people per family (4 or 5)

2) Slovin Method (Probability Sampling)

$$n = \frac{N}{1 + Ne^2}$$

n = Number of samples
N = Population Size
e = sampling error*

*example: can use pre-conditions such as the confidence level of data accuracy is 95% with a sampling error of 5% or 0.05

Sampling needs to be done randomly but still pay attention to the proportion based on the existing economic strata, especially for households. After the number of samples is determined, the sample must be divided according to the proportion of economic strata, namely high, middle, and low economic groups. This division is important because between strata generally have significant differences in characteristics. Determining samples based on economic strata is determined by the following equation:

$$S_{ET} = K \times proporsi\ (\%)\ ET$$

$$S_{EM} = K \times proporsi\ (\%)\ EM$$

$$S_{EM} = K \times proporsi\ (\%)\ EM$$

ET = High Economy
EM = Middle Economy
ER = Low Economy
K = Number of KK (total)

An example of determining household samples in Mataram City based on economic strata can be seen as follows:

Figure 3.1 Example of Household Sample Grouping Based on Economic Strata in Mataram City

Determination of economic strata in household samples can be determined based on the area and appearance of the house, electricity category, per capita income, and access to basic facilities such as clean water and sanitation. In addition, additional indicators such as the type of vehicle owned, the education level of the head of the family, and ownership of other household assets can also be used to strengthen the assessment of economic strata. This data is usually collected through surveys or direct interviews with respondents to ensure accuracy or through secondary data.

Please note!

- Secondary data on the number of people in the study location needs to be obtained first to determine the number of samples
- Field observations or interviews need to be conducted to map all sources of waste in the study location
- All waste produced in the study area should be considered in the measurement including waste from parks, canteens, shops, public spaces, etc.

B. Waste Sampling Procedures

The method of waste sampling can refer to SNI 19-3964-1994 on Standard Methods for Collection and Measurement of Generation and Composition of Urban Waste, which includes measuring generation and composition of waste for 8 consecutive days. The waste sampling tools generally needed are:

- Sampling box
- Mini Box
- Hanging Digital Scale
- Digital/Manual Bench Scale
- Gloves
- Face mask
- Boots

- Large size trash bag
- Small size trash bag
- Measurement roll
- Chair
- Tarpaulin
- Whiteboard marker
- Paper
- Clear Duct Tape
- Street Sign
- Pen/Pencil
- Camera/Mobile phone with camera
- Sampling Recording Form

Sampling activities or measuring waste generation and composition have the following stages:

Figure 3.2 Stages of Waste Sampling Activities Based on SNI 19-3964-1994

Based on the SNI-19-3964-1994 guidelines, waste sampling is carried out for 8 consecutive days to reflect daily fluctuations. However, only 7 days of measurement data are used, while the remaining 1 day is used to calculate the standard deviation. According to Damanhuri and Padmi (2016), the implementation in Indonesia is often simplified, for example (a) carried out only one day or (b) carried out every 2-3 days a week. Referring to the Waste Management Assessment Guidebook, waste sampling can be measured for a minimum of five days, with two days used as a buffer[10]

a) **Waste sampling at source** can be done through the following stages:
    1) Provide several plastic bags or trash bags that have been labeled with the sample name and measurement date.
    2) Trash bags that have been labeled are then distributed to each designated source.
    3) Trash bags filled with trash are collected regularly (for 8 days)

[10] Damanhuri and Padmi. 2016. Environmental Engineering Study Program, Faculty of Civil and Environmental Engineering, Bandung Institute of Technology (ITB): Waste Management. [Link]

4) Samples from each source were then weighed and placed into a sampling box (without compaction).
5) Lift the sampling box as high as 20 cm then tap it 3 times towards the ground.
6) Measure the height of the waste after tapping (note: the length and width dimensions of the sampling box have been previously measured and known)
7) The yield values in units of weight and volume for each sample were obtained

Residential areas only:

- The number of people in each sample house needs to be known
- The value of waste generation per person is known by dividing the value of waste generation in the sampled houses by the number of people in each house.
- The average amount of waste generated per person is determined by averaging the value of waste generated for each person used as a sample

b) **Waste sampling at WTS** can be done through the following stages:
1) Weigh the waste as much as 1/5 of the capacity of the cart and/or triseda, ensuring that the volume of waste being weighed is truly equivalent to 1/5 of the cart capacity.
2) The waste that has been weighed is put into *a sampling box* of known size, until it is full (without compaction).
3) Lift *the sampling box* as high as 20 cm then tap it 3 times towards the ground.
4) Measure the height of the waste after tapping (note: the length and width dimensions *of the sampling box* have been previously measured and known)
5) The generation value in weight and volume units is calculated by multiplying the generation result obtained by the multiplier factor. Since the waste measured is only 1/5 of the cart capacity, the multiplier factor is 5.
6) The average waste generation for one cart/triseda is determined by averaging the waste generation values for the carts/triseda that are used as samples

Notes :

- The samples measured are the same mode every day.
- The 1/5 cart and/or triseda standard can be readjusted to the waste conditions in the mode
- The results of the measurement of the generation that is continued to the measurement of the composition, at least amount to 500 liters or around 200 kg. This amount can come from one mode or several modes, depending on the purpose and scope of the study.
- The source of waste in carts and/or triseda needs to be traced to determine the generation units per population equivalent.

c) **Waste Composition** Measurement can be done through the following stages:
1) Pour the waste sample from the waste generation measurement results onto the tarpaulin, then stir until evenly distributed.
2) The sample was then divided into 4 quadrants.
3) Take a sample of about 10-15 liters (3-5 kg) from one quadrant.
4) The waste is then sorted according to type.

5) Each type of waste is weighed and its volume is measured using *a sampling box* (note: if the volume of waste is too small, use a *mini sampling box* or smaller *sampling box)*
6) The composition results of each type of waste are expressed in % wet weight and % volume.

The number of sorting categories can be adjusted to the output to be achieved and the presence of offtakers at the assessment location. As a minimum reference, the type of sorting can follow the SNI-19-3964-1994 standard, which divides waste into 9 types. However, to optimize the economic value of waste, the sorting categories can be made more detailed. Examples of waste composition categories that can be used can be seen as follows:

1) Food waste
2) Wood and garden waste
3) Paper and cardboard
4) Textiles or fabrics
5) Rubber and leather
6) Plastic
7) Metal
8) Glass
9) Hazardous waste
10) Others (such as diapers, cigarette butts, tissues)

Please note!

- It is recommended that the waste sampling area is a shady place, not exposed to rain, and away from strong winds
- An additional 1-2 days as a buffer needs to be done as a trial to prevent non-representative measurement days. Measurement days that are considered to have less representative values can be excluded from the analysis. However, the average waste sampling results are obtained from at least 3 days of measurement.
- Sampling must be carried out on weekdays and weekends to determine the differences in waste generation conditions and composition
- Before sampling, coordination can be carried out first with the homeowner/waste officer/cleaning officer in the study area

3.4.2. Material Flow Analysis

Waste management flow is important information used to provide a clear picture of the journey of waste at the assessment location, both in the current (existing) condition and in the recommended scenario. This data aims to make it easier for participants to understand the process of collecting, transporting, sorting, processing, and final disposal of waste. The presentation of waste management flow is usually presented in the form of a diagram or

scheme to facilitate visualization and analysis of the processes taking place at the location[11]. The following is an example of a waste management flow diagram:

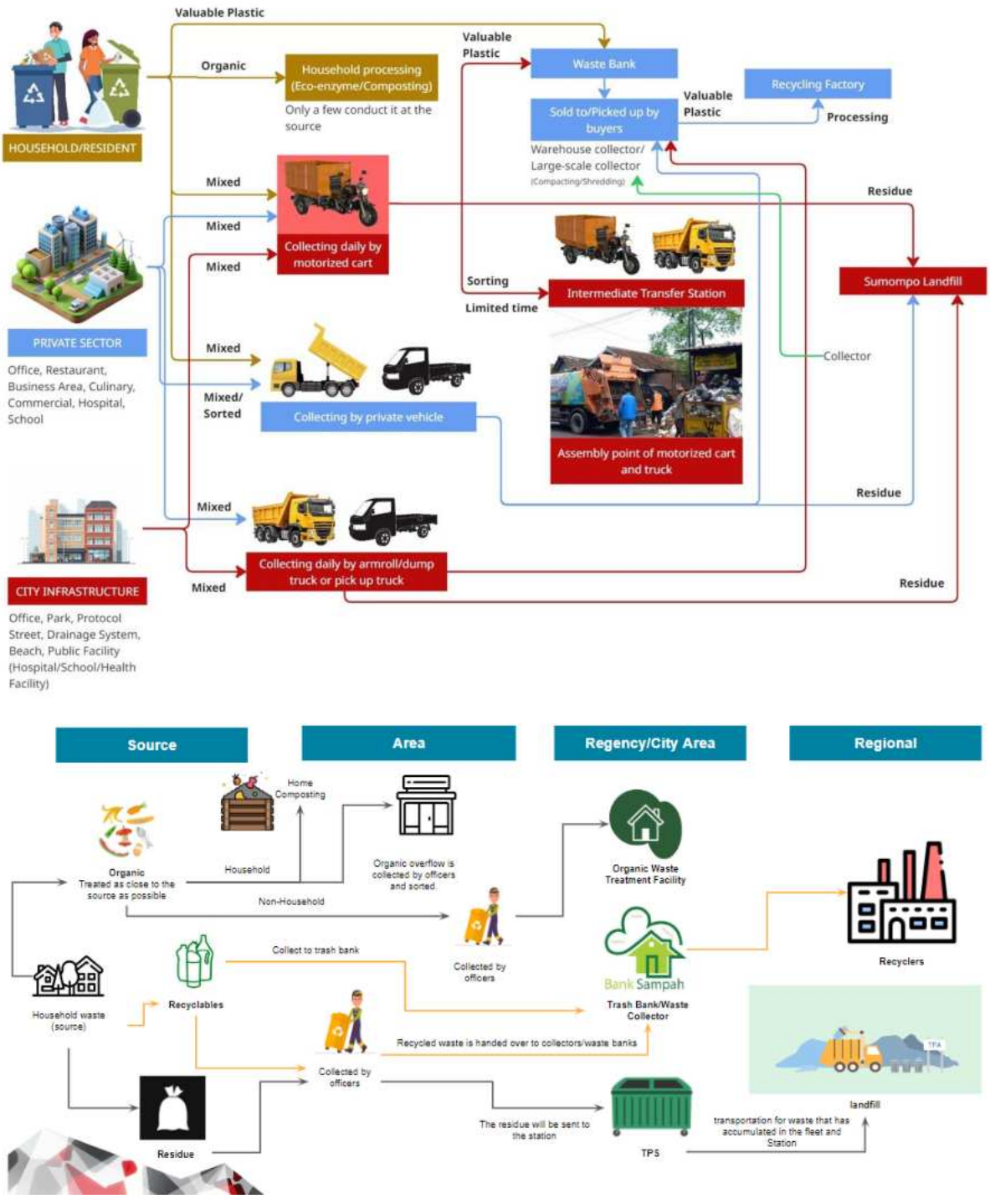


Figure 3.3 Examples of Waste Management Flow in (a) Manado City and (b) Banjarmasin City

[11] Dzulfikar et al. 2019. Kajian Alur dan Proses Pengelolaan Sampah di Daerah Istimewa Yogyakarta. [Link]

In addition to mapping the waste management flow, a representation of the amount of waste generated at each stage of the flow is also needed to help understand the percentage of service at each stage as well as identify potential waste leakage that may occur. This representation is usually presented in the form of a mass balance, which is one of the important components in Material Flow Analysis. By using the MFA approach, this mass balance depiction not only helps visualize the material flow but also provides insight into the efficiency of waste management and areas that require intervention to reduce leakage. The presentation of the mass balance can be displayed in the following format.

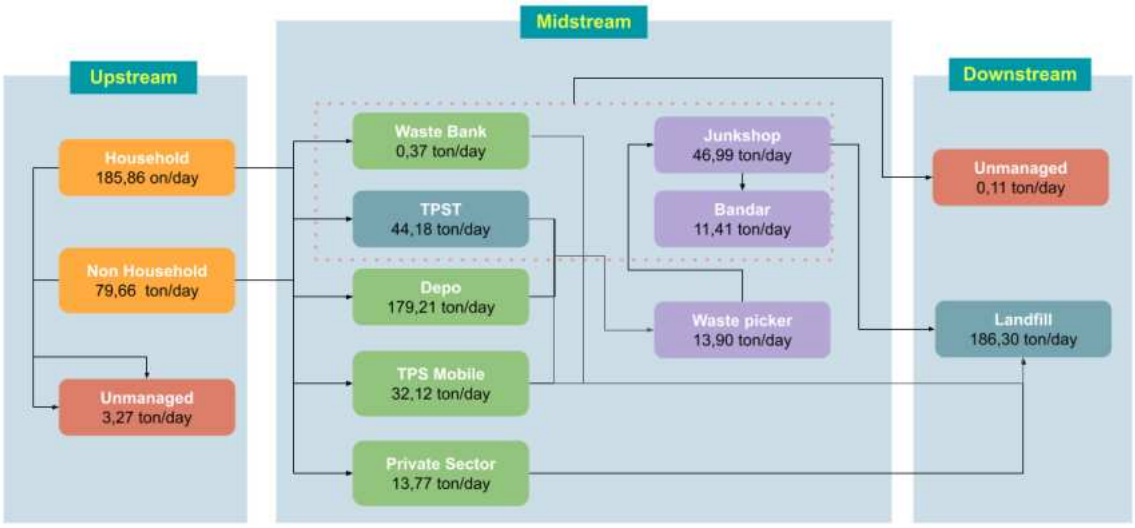


Figure 3.4 Example of Mass Balance of Waste Management in Mataram City

The activity of measuring waste samples and calculating waste generation from each sample that has been carried out can be the basis for determining the flow of waste generation in the mass balance. Therefore, the determination of waste generation must be carried out accurately so that the mass balance of waste management produces consistent and balanced data. Each input that comes in must be in accordance with the output produced, both in the form of processed materials, residual residues, and possible leaks.

It is important to ensure that the method of measuring and calculating waste generation follows applicable standards, so that the results can be compared and relied upon. In addition, the material flow analysis should also include the identification of the most dominant types of waste and critical points where leakage or inefficiency may occur. This will help in planning mitigation measures and improving the overall waste management system, including calculating the total cost of waste processing in the city and determining retributions.

3.4.3. Advanced Technical Operational Analysis

Waste management in Indonesia generally consists of 5 operational stages, namely storage, collection, transfer, transportation, and final processing. Based on these considerations, the following is a further analysis that can be used at each stage:

Table 3.2 Analysis of Waste Management Stages in Indonesia

No.	Stage	Analysis
1.	Containment	• Types of sorting from source • Volume of container • Container material • Container labeling • The quality of waste that can be disposed of in the container (example: plastic bottles must be flattened) • Recommended container visualization example • Number of containers • Container position and mapping
2.	Collection	• Type of mode • Mode volume • Number of modes • Garbage collection itinerary • Waste sorting in mode • How to collect waste for each type of sorting • Waste collection media
3.	Transfer and processing	• 3R-WPS or IWPS infrastructure improvement • 3R-WPS or IWPS area requirements • Methods for processing each type of waste • Supporting facilities • Machine requirements • Number of officers • Waste handling flow at 3R-WPS or IWPS
4.	Transportation	• Waste transportation itinerary • Waste sorting in mode
5.	Final processing	• Residue handling

Advanced analysis is optional but can provide significant benefits in planning waste management financing. This analysis includes identifying assets already owned by the city government, such as the number of fleets or modes of transportation, waste collection itineraries, WTS capacity, and other infrastructure. This data can be used as a basis for adjusting waste management financing needs after calculating the total ideal financing and potential levies that can be obtained.

In addition, this analysis can also help identify operational efficiencies and potential cost savings. For example, optimizing waste transportation routes or using technology to increase fleet productivity. In addition, further analysis can also provide insight into the need for additional investment, such as the procurement of new fleets or upgrading waste processing facilities, thus assisting in the preparation of a more sustainable waste management strategy.

3.5. Stakeholder Participation Aspects

To support the successful implementation of the retribution calculator, active participation from various stakeholders is an element that cannot be ignored. Stakeholders include local governments, communities, business actors, Community Self-Help Groups (KSM), and the informal sector. Their active role is needed to create a system that is inclusive and responsive to local needs. The following are details of the roles of each stakeholder:

3.5.1. Local Government Involvement

The role of local government in waste management is very strategic because it is the main actor responsible for setting policies, managing operations, and ensuring that the management system runs in accordance with applicable regulations. The government also has the authority to regulate and provide the necessary resource support for the sustainability of the waste management program.

- Local governments are responsible as the main organizers who manage the planning, implementation, and supervision of waste management in their areas. They also provide relevant data and resources to support the calculation of retribution rates.
- The role of the government is not only limited to operations but also involves the preparation of supporting policies and regulations, such as the creation of regional regulations on waste levies.
- Socialization to the community is an important part of the government's responsibility to increase public understanding and compliance with implemented policies.

3.5.2. Community Involvement

As a major component in the waste management system, the community has an equally important role. Their involvement can strengthen policy implementation by providing feedback, supporting waste reduction at source, and increasing compliance with the management policies in place. Education is an important step to ensure public awareness of their role.

- As beneficiaries of services, the public has an important role in providing feedback on the quality of services and the fairness of the rates applied. This participation can be facilitated through satisfaction surveys or public discussion forums.
- Public education needs to be carried out to increase awareness that their contribution through payment of fees will support the sustainability of waste management services.
- Communities can also actively participate in programs such as recycling, composting, or reducing waste at source to support more efficient waste management.

3.5.3. Business Actor Involvement

Business actors, especially those that produce large amounts of waste, play an important role in supporting sustainable waste management.

- Business actors, especially those who produce large amounts of waste, have an obligation to comply with regulations related to waste management fees. They are also expected to contribute to sustainable waste management efforts through innovation or CSR programs.

- As part of the solution, business actors can develop waste management technology or provide environmentally friendly raw materials to reduce the burden on the waste management system.

3.5.4. Involvement of Community Self-Help Groups

Community Self-Help Groups (CWGs) are an important element in waste management, especially in community empowerment and increasing environmental awareness. These organizations often act as effective intermediaries between communities and the government to voice local aspirations and needs.

- Community Self-Help Groups (CWGs) have an important role in supporting community education on sustainable waste management. They can also be a liaison between the community and the government in voicing aspirations.
- In addition, this organization often plays a role in advocating for policies that support environmental sustainability and assisting the government in implementing waste management programs.

3.5.5. Informal Sector Involvement

The informal sector, such as scavengers and waste collectors, have a major contribution to supporting efficient waste management. Their role is often not formally recognized, even though they help reduce the burden of waste management through the collection and sorting of economically valuable waste.

- The informal sector, such as scavengers and waste collectors, contributes greatly to collecting and sorting waste of economic value, such as plastic, paper and metal, thereby supporting efficient waste management.
- The informal sector can partner with local governments and KSMs to expand the scope of waste management services, including waste collection from areas that are difficult to reach by official services.
- Technical training and recording of informal sector contributions in official data are needed to improve the quality of work output and reflect their real potential in sustainable waste management.

3.5.6. Multi-Stakeholder Collaboration

Cross-stakeholder collaboration is needed to ensure that the vision and goals of waste management can be achieved together. Synergy between parties can produce innovative solutions, both in management and in a more efficient retribution system.

- Cross-stakeholder collaboration is essential to align visions, goals, and efforts in waste management. Discussion forums or deliberations can be a place to solve common challenges and promote innovation.
- The development of technology to support an efficient retribution system, such as a digital payment application or online-based reporting system, could be a beneficial outcome of collaboration.

- Joint evaluation mechanisms need to be implemented to ensure the sustainability of better waste management policies and services.

04

Determination of Flowchart or Waste Service Scheme

4. Determination of Flowchart or Waste Service Scheme

The determination of the flow diagram or waste service scheme aims to provide systematic operational guidance in the waste management process, as well as a basis for calculating retribution. Based on Law Number 18 of 2008, the waste management components in the service scheme consist of:

1. **Waste reduction** is the activity of using reusable materials, recyclable materials, and/or materials that are easily decomposed by natural processes. Therefore, waste reduction includes limiting waste generation, recycling waste, and/or reusing waste.
2. **Waste management** includes the following activities:
    - **Sorting:** the activity of grouping and separating waste according to the type, quantity and/or nature of the waste.
    - **Collection:** the collection and transfer of waste from the waste source to a temporary storage area or integrated waste processing facility.
    - **Transportation:** the activity of carrying waste from the source and/or from a temporary waste storage area or from an integrated waste processing area to the final processing area.
    - **Processing:** the act of changing the characteristics, composition, and quantity of waste.
    - **Final waste processing:** the activity of returning waste and/or residue from previous processing to the environmental media in a safe manner.

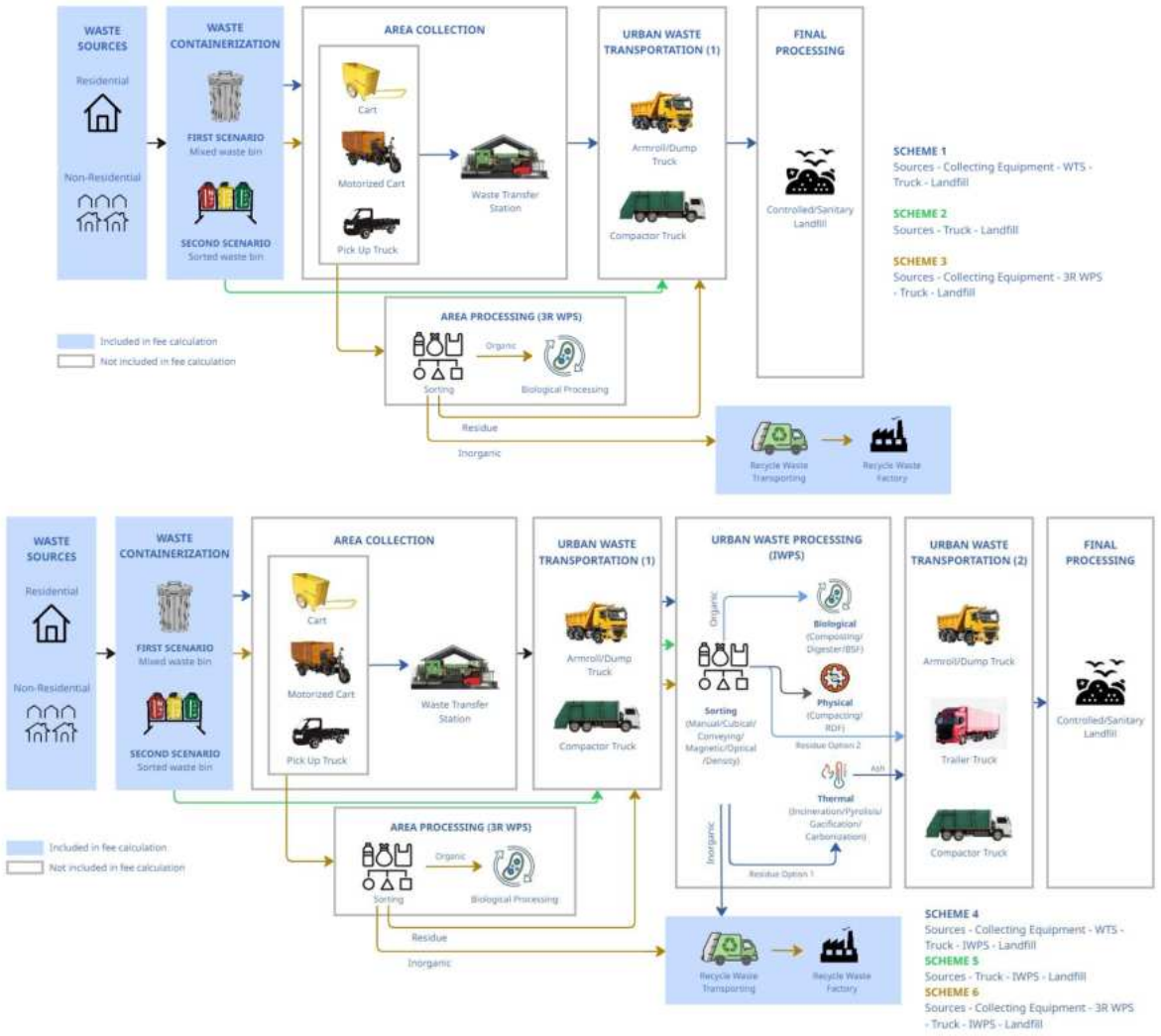


Figure 4.1 Waste management scheme in Indonesia

Generally, there are six waste management schemes in Indonesia which can be seen in Figure 4.1. This management scheme will determine the costs in each sub-system according to their respective capacities. In the cost calculation referring to Ministry of Home Affairs Regulation Number 7 of 2021, the container aspect of the source is not part of the waste management cost calculation.

The waste management scheme generally includes a series of processes starting from the waste source to management at the final processing site. This process begins with management at the source, including sorting and storing waste into places that are appropriate for the type of waste. Furthermore, waste is collected from various locations, then transferred to processing facilities or transit stations for further processing. After that, the waste is transported using a special fleet to the final processing site, such as recycling facilities, 3R waste management sites (3R-WPS), integrated waste processing sites (IWPS), and final processing sites (landfill). Each stage in this scheme is interrelated and designed to ensure that waste is handled properly, as this has a direct impact on the sustainability of the operation of the waste management system.

The first thing to do in calculating the cost of waste management using a waste cost calculator is to identify the scheme planned/used in a city/regency. Each stage in the waste management

scheme is an important component in determining the amount of costs charged to the community. This scheme will determine the cost of waste management in each sub-system, according to their respective capacities.

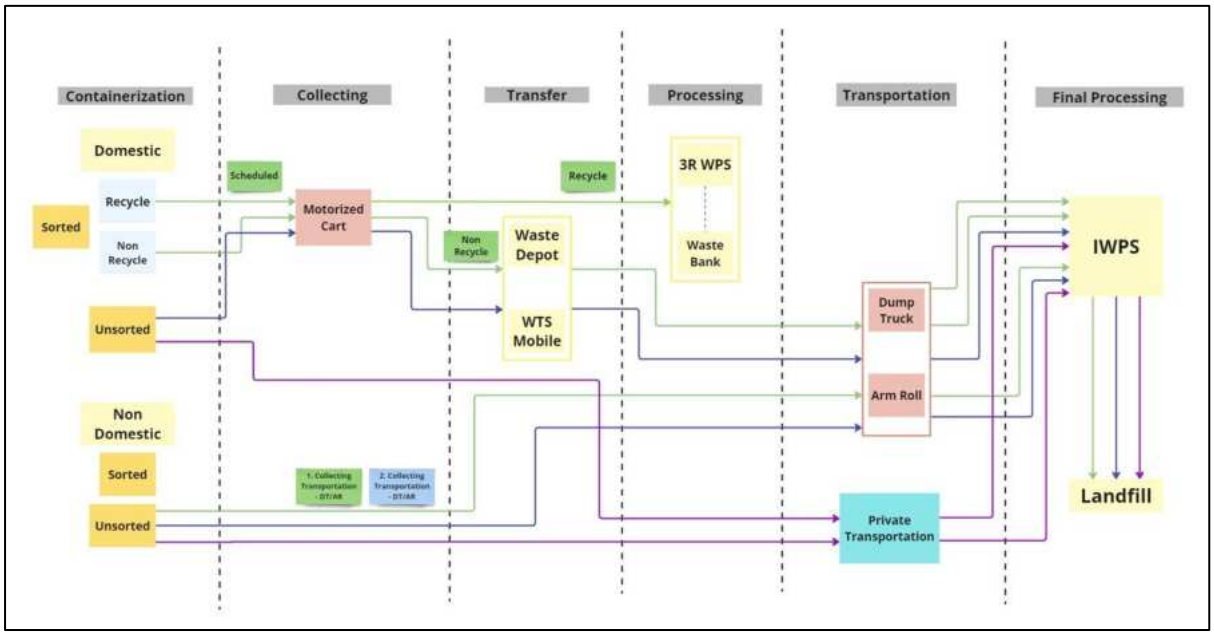


Figure 4.2 Example of Waste Management Scheme in Mataram City

The first stage in the scheme, namely the container, will affect the calculation of waste handling costs according to the needs of the sorted waste bins, while the processing stage of the area such as 3R-WPS requires investment in technology and human resources for the sorting and recycling process. On the other hand, transportation requires a fleet and fuel, the costs of which will increase with the distance and volume of waste transported.

In Figure 4.2 Example of Waste Management Scheme in Mataram City, there are three scheme flows resulting from adjustments to the regional conditions of a city/district. Each flow has its own service area and handling capacity. A well-designed waste management scheme not only supports operational efficiency but also helps to ensure that the rates charged reflect the real costs of the services provided, while encouraging community participation in waste management.

05

General Guide to Calculator Filling Procedures

5. Calculator Filling Procedures

Waste management is one of the important priorities in sustainable development. As regulated in Law No. 18 of 2008 concerning Waste Management, waste management is one of the important activities in waste management. Article 22 states that waste management consists of 5 stages, namely sorting, collecting, transporting, processing, and final processing (see Table 5.1).[12]

Each of these stages involves the use of infrastructure, technology, and human resources that require structured funding allocation. To determine waste handling fees that are in accordance with field conditions, a data-based fee calculator is needed. **This calculator works through two main components: first, calculating the total ideal waste handling costs using a handling cost calculator; second, calculating fees based on the results of these costs**. With this approach, the calculator is designed to ensure that fee calculations are carried out transparently, accurately, and in accordance with local conditions.

Table 5.1 Stages of Waste Management along with Definitions and Examples of Implementation

No	Waste Handling Stages	Definition	Implementation Example
1	Sorting	The process of grouping and separating waste according to type, quantity and/or nature	Sorting organic, inorganic and residual waste
2	Collection	Collection and transfer of waste from the waste source to a temporary storage site (TPS), 3R waste processing site (3R-WPS), or integrated waste processing site (IWPS)	Collection of household or non-household waste at TPS, 3R-WPS, or IWPS
3	Transportation	Carrying waste from the source, TPS, 3R-WPS, or IWPS to the final processing site (landfill)	Garbage transportation using carts, three-wheeled motorbikes, pick-ups, dump trucks and armrolls
4	Processing	Changing the characteristics, composition and quantity of waste	Waste processing using refused derived fuel (RDF) technology, composting, incineration, and gasification
5	Final processing	Returning waste and/or residue from previous processing to the environmental media safely	Returning residue to the environment, either through sanitary landfill methods or other methods.

In general, waste management fees cover various components, such as investment costs, operational and maintenance costs, total waste management costs, and waste management costs per household.[13] The following is a detailed explanation of each cost component.

[12] Undang-Undang No.18 Tahun 2008 tentang Pengelolaan Sampah [Link]
[13] Kementerian PUPR. (2019). Panduan Perhitungan Biaya Penanganan Sampah. [Link]

Table 5.2 Components of Waste Management Fee Costs

No	Cost Components	Information	Unit
1	Investment costs	Costs of procuring physical infrastructure, for example waste transport vehicles, TPS, IWPS, and landfill	• Rp/year • Rp/ton
2	Operational and Maintenance Costs	Costs for running daily activities, including operator salaries, fuel, and equipment/facility maintenance.	• Rp/year • Rp/ton
3	Total Cost of Waste Handling	The sum of investment costs and operating costs	• Rp/year • Rp/ton
4	Waste Management Cost per Household	Fees charged to each household	Rp/KK/month

Based on the stages, the calculation of waste handling fees starts from the calculation of the collection sub-system, transportation sub-system, processing sub-system, to the final processing sub-system. To produce waste handling fee figures according to field conditions, there are several data required for each sub-system.[14] The following is a detailed explanation of the data requirements for each sub-system and an example of data content can be seen in chapter 6, namely filling in input data.

Table 5.3 Data Requirements for Each Sub-system

No	Stages Sub-system	Data Requirements
1	Collection sub-system	• **Cart:** Operator Salary, BPJS Health Insurance, Cart Price, K3 PPE Price per Person per Year, Volume Capacity per Cart, Number of Cart Trips per day and Number of Operators (people) per Cart. • **Motorized Cart:** Operator Salary (person), BPJS Health Insurance, Garbage Motorized Cart Price, Fuel Price per liter of Garbage Motorized Cart, Garbage Motorized Cart Tax Extension Price per Year, K3 APD Price per Person per Year, Volume Capacity per Garbage Motorized Cart, Number of Garbage Motorized Cart Trips per day, Trip Distance traveled and Number of Operators (person) per Garbage Motorized Cart. • **Pick-up:** Operator Salary (person), BPJS Health Insurance, Pick-up Price, Fuel Price per liter Pick-up, Tax Extension Price per Pick-up Year, Pick-up KIR Price per Year, K3 APD Price per Person per Year, Volume Capacity per Pick-up, Number of Pick-up Trips per day, Trip Distance traveled and Number of Operators (person) per Pick-up. • **TPS/Depot:** Landing Investment Price per Container, Container Investment Price and Volume Capacity per Container. ○
2	Transportation sub-system	• **Dump Truck, Armroll Truck and Compactor Truck:** Operator Salary (person), BPJS Health Insurance, Truck Price, Truck Tire Price, Truck Fuel Price per liter, Truck Tax Payment Price per Year, Truck KIR Price per Year, K3 APD Price per Person per Year, Volume Capacity per Truck, Number of Truck Trips per day, Trip Distance traveled and Number of Operators (person) per Truck.
3	Processing sub-system	• **3R-WPS:** ○ **Basic data input:** Operator Salary (person), BPJS Health Insurance, 3R-WPS Building/Investment Price, Water Pump Machine Price, Scale Price, Office Equipment Price, Fuel Price per liter, Electricity Price per kWh, K3 APD Price per Person per Year.

[14] Kementerian PUPR. (2019). Panduan Pengisian Kalkulator Standar Biaya Penanganan Sampah Rumah Tangga dan Sampah Sejenis. [Link]

No	Stages Sub-system	Data Requirements
		○ **Input Data for Selected 3R WTSTechnology:** according to the conditions of each region • **IWPS:** ○ **Basic Data Input:** Operator Salary (person), BPJS Health Insurance, IWPS Building/Investment Price, Electricity Price per kWh, Fuel Price per liter, Building Technical Age, Electricity Usage per day, Fuel Usage per day, Number of Operators (person) and Number of Working Days. ○ **Basic Investment Data Input:** Land cost, civil cost, mechanical equipment cost, electrical equipment cost, turbine and generator cost, APC (Air Pollution Control) cost, and other costs. ○ **Basic Maintenance & Care Data Input:** Total salary, building maintenance cost, electricity usage cost, fuel usage cost, environmental monitoring cost, consumables cost and other costs. ○ **Input Data for IWPS Technology Options:** according to the conditions of each region
4	Final processing subsystem	• **Landfill** ○ **Data Input:** Operator Salary (person), BPJS Health Insurance and K3 PPE Price per Person per Year. ○ **Basic Data Input:** Landfill Investment Price, IPL Investment Price, Supporting Building Investment Price, Generator Investment Price, Pump Machine Investment Price, Car Wash Pump Machine Investment Price and Weighbridge Machine Investment Price. ○ **Heavy Equipment Data Input** : Heavy Equipment Fuel Price, Heavy Equipment Lubricant Price, Heavy Equipment Price, Heavy Equipment Power and Heavy Equipment Blade and Bucket Volume Capacity. ○ **Other Operations:** Water Costs per Year, Telephone Costs per Year and Stationery Costs per Year. ○ **Land Cover Technical Options:** Cover Soil, Tarpaulin and Gravel. ○ **Bio Gas Control Installation:** Gas Pipe, Gas Pipe Casing and Crushed Stone/Gravel. ○ **Leachate Treatment Installation Version I:** Investment price of recirculation pump, recirculation pump capacity, drainage and repair of wastewater treatment plant per year, price of leachate laboratory test per year, price of chemicals, price of seed-acclimatization, number of acclimation ponds, price of bioactivator. ○ **Leachate Treatment Installation Version II (Advance):** Leachate processing capacity, biofilter media price, MBR price per unit, sludge price, biofilter pond detention time (days), MBR detention time (days), MBR volume per m3, COD weight in aerobic pond per day and TSS weight in aerobic pond per day. ○ **Disease Vector Control Costs:** Price of insecticide per liter per month, price of disinfectant per liter per month, price of fogging gas spraying per kg per month. ○ **Environmental Quality Monitoring Costs:** Ambient air sample lab testing, gas emission sample lab testing, leachate water lab testing, groundwater lab testing, surface water lab testing.

To simplify the process of calculating waste management fees, this waste management cost calculator and fee calculator are made in Microsoft Excel format with several interconnected worksheets. This waste management cost calculator is designed to be easy to use and structured according to the stages and sub-systems of waste management. The calculator file

consists of 11 sheets, each of which has a specific function.[15] The following is a detailed explanation of each sheet along with the obligation to fill it in.

Table 5.4 Explanation of Sheets in the Waste Management Fee Calculator

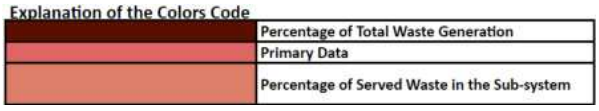
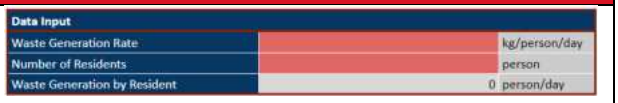
No	Sheet Name	Information	Replenishment Obligation
1	Sheet 1: Service Balance Sheet	Contains basic data on the scope and scheme of waste management services in the region.	☑
2	Sheet 2: Data Input	Contains data on calculating the costs of the waste handling sub-system.	☑
3	• Sheet 3a: Motorized Cart (Collection Sub-System) • Sheet 3b: Pick-Up (Collection Sub-System) • Sheet 3c: Armroll (Collection Sub-System)	Contains data on calculations of waste generation and investment, operational and waste collection costs using motor carts, pick-ups and armrolls or other types of collection fleets.	☒ (automatically filled)
4	Sheet 4: TPS/Depot	Contains data on waste generation calculations as well as investment and waste management costs at TPS.	☒ (automatically filled)
5	Sheet 5: 3R-WPS	Contains data on investment and operational costs calculations for 3R-WPS	☒ (automatically filled)
	• Sheet 5a: Armroll (WTSMobile) • Sheet 5b: Armroll (TPS/3R-WPS - IWPS)	Contains data on waste generation calculations and investment, operational and waste transportation costs using armrolls.	☒ (automatically filled)
6	Sheet 6: IWPS	Contains data on IWPS investment and operational cost calculations	☒ (automatically filled)
7	Sheet 7: Dump Truck (IWPS – landfill)	Contains data on calculations of waste generation and investment, operational and waste collection costs using dump trucks or compactor trucks.	☒ (automatically filled)
8	Sheet 8: Landfill	Contains data on landfill investment and operational cost calculations	☒ (automatically filled)
9	Sheet 9: Closure of landfill	Contains data on the calculation of the cost of closing the landfill with a combination of materials. This sheet must be filled in if an area plans to close the landfill and is optional if there is no plan to close the landfill.	☑

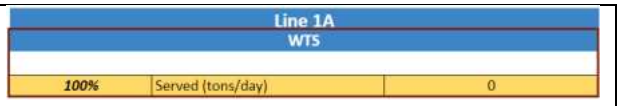
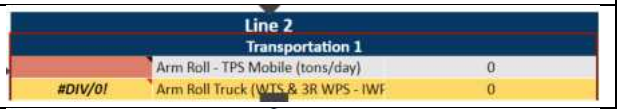
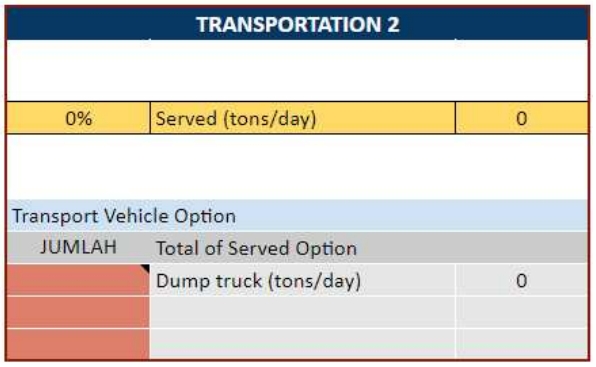
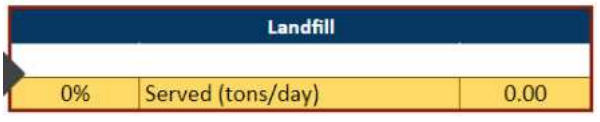
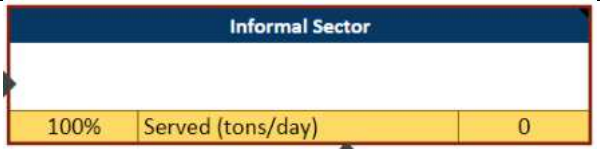
[15] Kementerian PUPR. (2019). Panduan Pengisian Kalkulator Standar Biaya Penanganan Sampah Rumah Tangga dan Sampah Sejenis. [Link]

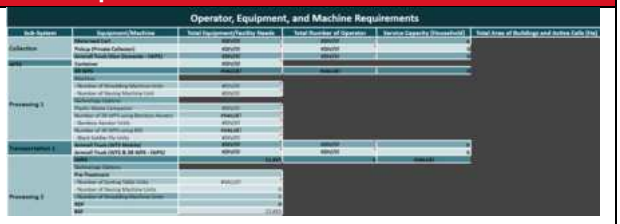
No	Sheet Name	Information	Replenishment Obligation
10	Sheet 10: Output Data Requirements	Contains a recapitulation of the needs for facilities, operators, services and land for each waste management sub-system.	☒ (automatically filled)
11	Sheet 11: Summary of Calculation Results	Contains a recapitulation of investment costs, operational costs, and total costs of all sub-systems.	☒ (automatically filled)

Next, here are the steps to use the waste management retribution calculator, starting with understanding the color code in the input column to avoid errors in filling in data. Next, the user fills in **Sheet 1 Service Balance and Sheet 2 Input Data** according to local conditions. After all data is input, the calculator automatically produces a recapitulation of equipment, operator, and cost requirements on Sheet 10 Output Data Requirements and a recapitulation of management costs for each sub-system on Sheet 11 Recapitulation of Calculation Results.

Table 5.5 Steps for Using the Waste Management Fee Calculator

No	Information	Picture
1	**Understanding Data Input Colors:** The calculator has different data input colors: • **Red:** Primary data that must be filled in according to regional conditions. • **Orange** , **Dark Blue** , and **Light Blue** : **Cannot be filled** because it is locked and contains calculation formulas. It is forbidden to enter or change data because it can affect the calculation results.	
Sheet 1 Service Balance Sheet		
2	**Sheet 1 Service Balance:** Enter the data 'Waste generation rate (kg/person/day)' and 'Number of residents (persons)' in the 'Input Data' table. If both data have been filled in, the value of 'Total waste generation (tons/day)' will appear automatically.	
3.	**Total Table of Served Options Collection from Source:** If street sweeping calculation is not required, fill in the "Served" column with the number 100% or according to local conditions **.**	
4.	**Table 1 Collection Line:** Enter the percentage data of collection fleet used in the area or according to the existing waste handling scheme in the 'Collection Equipment Options' column.	

5.	**Table of Line 1A TPS/Depot:** There is no data input that needs to be filled in this table. The percentage and tonnage will appear automatically from the calculation results of the remaining unprocessed waste at 3R-WPS and IWPS.	
6.	**Table of Line 1B 3R-WPS:** • Enter the percentage data 'Served (tons/hr)' first. • Enter the respective percentages of 'Organic Waste (tons/day)' and 'Recyclable Waste (tons/day)'. • The "Residue (ton/hr)" column will be filled in automatically based on the calculator calculation results.	
7.	**Transportation Route Table 2 1:** Enter the percentage data of transportation equipment according to the conditions in the area.	
8.	**IWPS Line Table 2A:** • Enter the percentage data 'Served (tons/hr)' first. • Enter the respective percentages of 'Organic Waste (ton/day)', 'Recycled Waste (ton/hr)' and 'Incinerated Waste (ton/hr)'. • Enter the percentage of 'Other Options (RDF and Thermal)' in the 'RDF Fluff' and 'Pyrolysis' columns based on the conditions in the area.	
9	**Transportation Route Table 2:** Enter the percentage data of transportation equipment according to the conditions in the area.	
10	**landfill Table: No need to enter data in this table.** The calculation results will appear automatically from the calculations of the previous tables.	
11	**Informal Sector Table: No need to enter data in this table** . The calculation results will appear automatically from the calculations of the previous tables.	
Sheet 2 Input Data		

12	**Sheet 2 Input Data:** • Consists of seven parts: Collection Sub-System 1, TPS/Depot, 3R-WPS, Transportation Sub-System 1, IWPS - Pre-Treatment, Transportation Sub-System 2, and landfill. • Entering primary data in the form of real numbers based on needs and conditions in the area. • **Red** colored columns are required. • **Orange** , **Dark Blue** , and **Light Blue** columns are prohibited from being filled because they have been locked as table titles or data component names.	
Sheet 10 Output Data Requirements		
13	**Sheet 10 Output Data Requirement:** • The recapitulation of needs includes the need for tools/machines, number of operators and service capacity of each waste handling sub-system based on the previous sheet calculations. • **There is no need to fill in or change data on this sheet.**	
Sheet 11 Summary of Calculation Results		
14	**Sheet 11 Summary of Calculation Results:** • Recapitulation of costs per waste management sub-system consisting of investment costs, operational costs (operational and maintenance) and investment + operational costs (operational and maintenance) based on the previous sheet calculation. • **There is no need to fill in or change data on this sheet.**	

Next, so that users better understand the data entry process, this section will explain the technical steps for entering data into the calculator using case examples. This explanation aims to provide users with a more concrete picture of how to enter data and ensure that the data entered is in accordance with field conditions.

1. **Calculating the Waste Generation of the Population**
   As a first step, enter the population's waste generation data. For example, in a City X there are 3,000,000 people with waste generation of 0.6 kg/person/day. This data is entered into the 'Waste Generation Figure (kg/person/day)' and 'Number of Population

   Total Waste Generation (tons/day)

   = Population × Waste Generation per Person ÷ 1,000

   = 3,000,000 × 0.6 ÷ 1,000

   = 1,800 tons/day

(people)' columns on the Service Balance Sheet. The total waste generation will be calculated automatically using the following formula.

Figure

Figure 5.1 Population Waste Generation Data Input

2. Serviced Waste Options

Enter the percentage data of the collection and transportation options according to the local conditions. The collection tools include carts, motor carts, and pick-ups. Then, the transportation tools include dump trucks, arm roll trucks, and compactor trucks. Make sure the total percentage of collection and transportation tools reaches 100%. The calculator will validate the data input and the "TOTAL MUST BE 100%" indicator will change to "100%" if the data is correct.

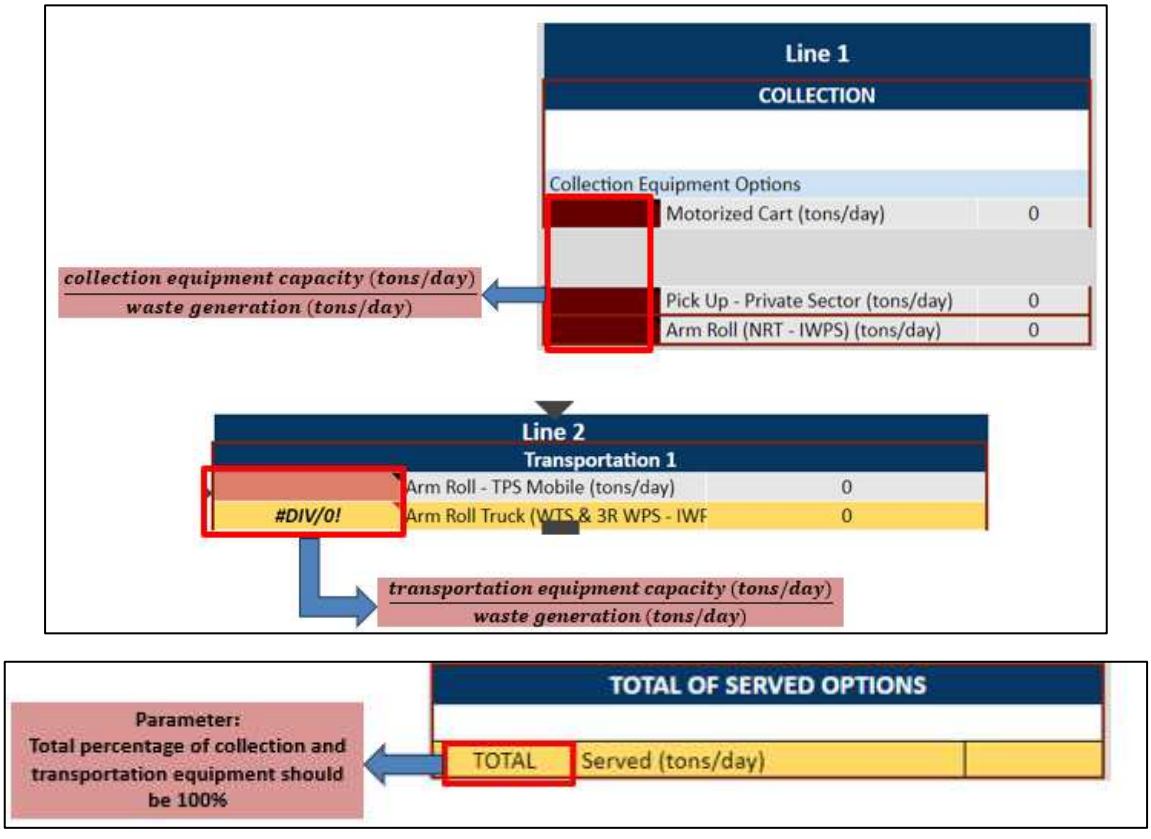


Figure 5.2 Input Data for Waste Service Options

3. **3R-WPS Data Input**

The first step: enter the input data of the percentage of waste generation into the 3R-WPS Table. For example, City X has 10 3R-WPS each with a capacity of 2 tons/day. The composition of waste in 3R-WPS is as follows:

- Food waste : 40%
- Garden waste : 10%
- Plastic waste : 15%
- Paper waste : 10%
- Metal waste : 5%
- Other waste (residue) : 20%

Enter this data in the '3R-WPS' table with the following steps:

a. Fill in the percentage of 'Organic Waste (tons/day)' (food waste + garden) by 50%.
b. Fill in the percentage of 'Recyclable Waste (tons/day)' (plastic + paper + metal) by 30%.
c. The 'Residue (tons/day)' column will be automatically filled by 20%.

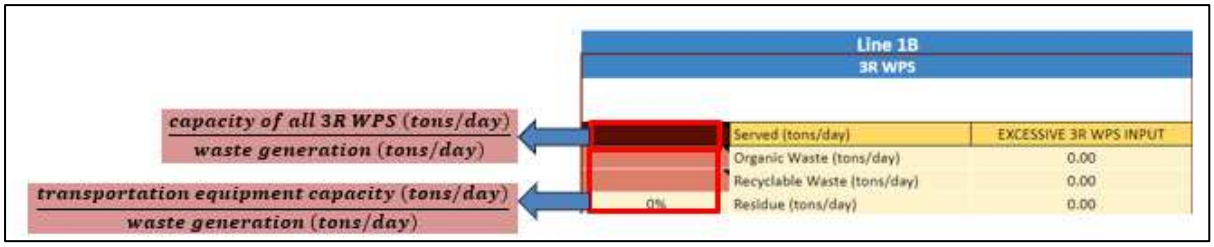


Figure 5.3 Input Data on Percentage of Waste Generation at 3R-WPS

Figure

Step two: inputting technology data at 3R-WPS. For example, Based on the type of technology applied, 3R-WPS in City X is divided into four types:

- Type A: 2 units using bamboo aerator composting technology and compactor machine.
- Type B: 3 units using hollow brick composting technology and compaction machine.
- Type C: 1 unit using biodigester.
- Type D: 4 units using Black Soldier Fly (BSF) technology.

Enter this data in the 'Organic Processing Options' table using the following steps:

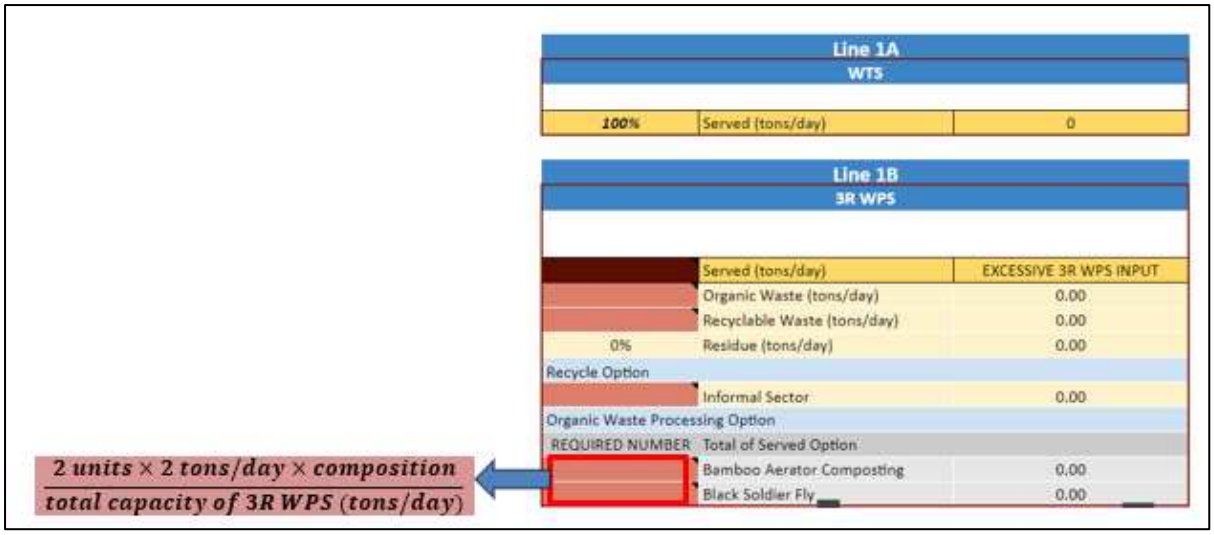


Figure 5.4 Technology Data Input at 3R-WPS

4. IWPS Data Input

Filling in data on the calculator related to waste management at IWPS requires an understanding of the type, tonnage, and waste processing process. The following are case examples and data filling steps to help users understand this process in general.

Case study: City X also has 1 TPST where the tonnage managed is 180 tons/day with waste processed in composting of 36 tons/day, recycled of 9 tons/day, processed with an incinerator of 108 tons/day, and residue of 27 tons/day. TPST operates 340 days/year.

Residue from WTS3R and TPST is transported by dump trucks as much as 80% and transported by armroll as much as 20% to the landfill. The landfill that handles waste from City X uses a sanitary landfill system with daily landfill closure using landfill and an advanced Leachate Treatment Installation system with biofilters and membrane bioreactors (MBR). All equipment at the landfill uses diesel fuel.

Figure 5.5 Case Study and Data Filling Steps

Enter this data in the 'IWPS' table with the following steps

a. **Incoming Waste Tonnage:** Enter data in the input cell at the top left to determine the tonnage of waste entering the IWPS. This value is a percentage of the total waste generation in the city/district.
b. **Composition of Processed Waste:** Enter the percentage of organic waste, recyclable waste, and combustible waste processed at the IWPS. This percentage is calculated based on the total waste entering the IWPS (180 tons/day). The percentage of residue has been determined at 15% of the total IWPS tonnage.
c. Waste Processing with WTE (Waste to Energy) Technology: Enter the percentage of combustible waste processed with WTE technology, such as RDF Fluff, Incineration, or Gasification. This percentage is calculated based on the combustible waste entering the IWPS. The calculator will calculate the residue automatically.

d. **Minimum Limits for WTE Units:** Please note the minimum tonnage limits for each type of WTE unit:
   - RDF : ≥120 tons
   - Incineration : ≥100 tons
   - Gasification : ≥300 tons

   If the amount of waste entered is less than the minimum limit, the calculator will display an "ERROR" message and the calculation result will not be displayed as waste tonnage.

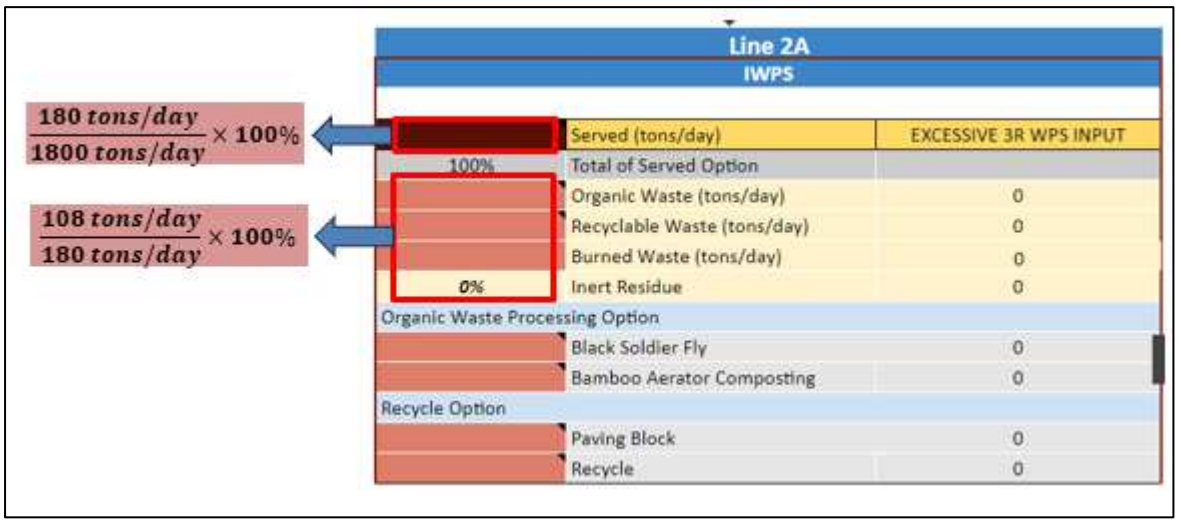


Figure 5.6 IWPS Data Input

06

Filling in Data (Input) in the Calculator

6. Filling in Data (Input) in the Calculator

Another important part of several data filling components in the Waste Management Cost Calculation Calculator after 'sheet 1' Service Balance is on ' sheet 2' Input Data . If the City/District Government has filled in sheet '1. Service Balance', then the second step is to enter primary data on sheet '2. Input Data'. On sheet '2. Input Data', there are six data input sections consisting of the Collection Sub-system, TPS, 3R-WPS, IWPS, Transportation Sub-system, and landfill.

Input data is primary data entered by the City/District Government in the form of real numbers based on the needs and conditions in each City/District. In the sheet '2. Input Data', the data that can be filled in is related to the operator's salary and health insurance figures as well as investment prices in each region that can be filled in for collection, transportation, processing (3R-WPS and IWPS) and waste processing (landfill Sampah).

There are several things that need to be considered when inputting data into this calculator, including:

1. **PLEASE NOTE DATA ENTRY:** Data entry **CAN ONLY** be done in the colored columns and adjusted to the needs and conditions in each City/Regency. Data entry **CANNOT** be done in the colored columns and because both are the Data Input Table Title and Data Component Name that have been locked by the Calculator Development Team.

2. **NOTE SECTION/SUB-SYSTEM:** There are six data input sections that are sequentially on the page in the sheet '2. Data Input', namely **'Collection Sub-system', 'TPS', '3R-WPS', 'IWPS', 'Transportation Sub-system',** and **'landfill'** . The City/District Government must **MAKE SURE** to slide the page in the sheet **'2. Data Input'** to the right until the 'landfill' table appears and fill in the data according to the needs and conditions of each City/District.

6.1. Collection Sub-System

Data entry in the collection sub-system consists of carts, motor carts and pick-ups. The term collection system is adjusted to the conditions of each region. If a region does not use one of the collection systems (eg: carts), then write the number 0 on each data input (eg: carts). The following is the procedure for filling in the data input for each collection system:

6.1.1 Cart

In the Cart Table on the sheet '2. Input Data', the data entry stages that need to be carried out by the City/District Government consist of:

1. Enter the collection data for the Gerobak operational vehicle according to the conditions of each region in the ‘Input Data’ table in the colored column which can be seen in Figure 6.1.

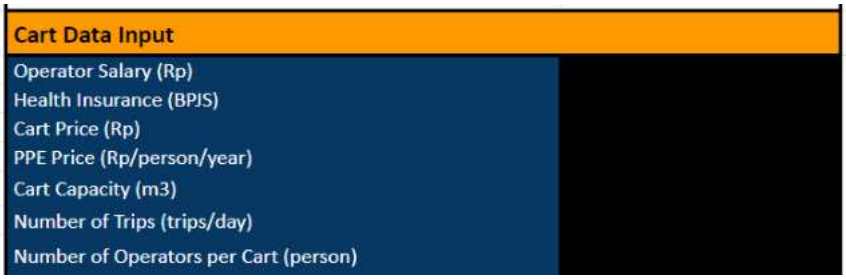


Figure 6.1 Cart Data Input

There are several indicators of the Input Data above, namely: Operator Salary, BPJS Health Insurance, Cart Price, K3 APD Price per Person per Year, Volume Capacity per Cart, Number of Cart Trips per day and Number of Operators (people) per Cart. The data entry MUST be adjusted to the existing conditions and needs of each operational indicator of the Cart as a transportation fleet.

2. Data collection for operational vehicles Carts that have been entered into Sheet '2. Input Data', will appear on Sheet '3a. Carts' especially in the 'Waste Generation of All Carts' Table, the 'Investment Costs of All Carts' Table, and the 'Operational Costs - Maintenance of All Carts' Table which are marked with the column color

3. The 'Waste generation per day' data in the 'Waste Generation of All Carts' table is obtained from the tonnage of waste generation for the Cart Collection Tool Option in ' 1. Service Balance' which can be seen in Figure 6.2.

Total Waste Generation from All Motorized Carts		
Ideal Number of Motorized Carts (nmotor)		**units**
Motorized Cart Capacity (K)		m3
	0	tons/day
Number of Trips per Day (R)		rit
Waste Density in Motorized Carts (Ms)	0.2	tons/m3
Waste Generation per Day (Ts,m)	**0**	tons/day
Waste Generation per Year (Ts,m)	**0**	**tons/year**

Figure 6.2 Waste Generation from All Carts

4. Data that is not included in the 'Input Data' list is a variable whose numbers cannot/MAY NOT be changed because they have been determined based on calculations carried out by the Calculator Compilation Team.

5. To find out the data on the 'Ideal Number of Carts', 'Total Number of Operators' and 'Service Capacity (KK)' that must be owned by the City/District Government in handling Waste Generation in its area, you can check the sheet '11. Output Data Requirements'.

6. The calculation results for 'Investment Cost', 'Operational Cost (OP)' and 'Investment Cost + OP' on the Cart can be checked in sheet '12. Recap of Calculation Results'.

6.1.2 Motor Cart

In the Motorized Cart Table in the '2. Data Input' sheet, the data entry stages that need to be carried out by the City/District Government consist of:

1. Enter the collection data for operational vehicles for Motor Carts according to the conditions of each region in the 'Input Data' table in the colored columns as seen in Figure 6.3 which consists of:

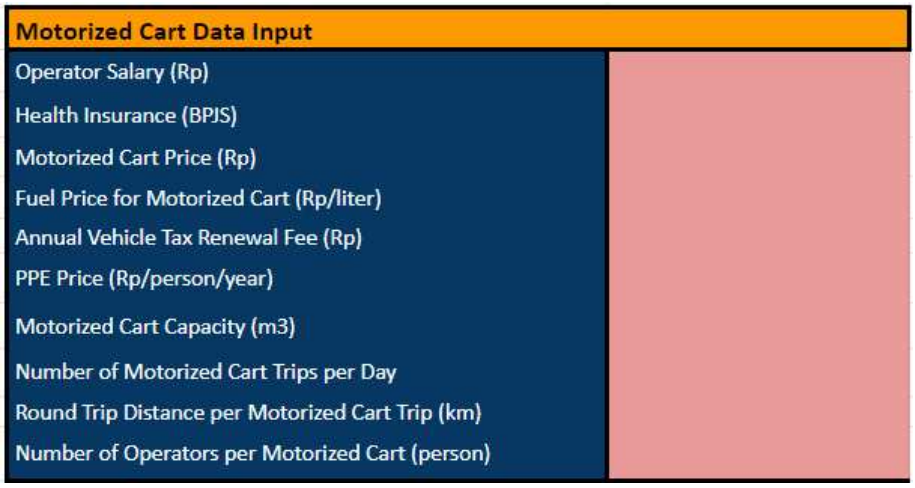


Figure 6.3 Motor Cart Data Input

There are several indicators of the Input Data above, namely: Operator Salary (person), BPJS Health Insurance, Garbage Motor Cart Price, Fuel Price per liter of Garbage Motor Cart, Garbage Motor Cart Tax Extension Price per Year, K3 APD Price per Person per Year, Volume capacity per Garbage Motor Cart, Number of Garbage Motor Cart Trips per day, Trip Distance traveled and Number of Operators (person) per Garbage Motor Cart. The data entry MUST be adjusted to the existing conditions and needs of each Garbage Motor Cart operational indicator.

2. Data collection for operational vehicles Motor Carts that have been entered into 'Input Data', will appear on Sheet 3a. Motor Carts, especially in the 'Waste Generation of All Motor Carts' Table, the 'Investment Cost of All Motor Carts' Table, and the 'Operational Costs - Maintenance of All Motor Carts' Table which are marked with the column color

3. The 'Waste generation per day' data in the 'Waste Generation from All Motorized Carts' table is obtained from the tonnage of waste generation for the Motorized Cart Collection Tool Option on the '1. Service Balance' sheet which can be seen in Figure 6.4.

Total Waste Generation from All Motorized Carts		
Ideal Number of Motorized Carts (nmotor)		**units**
Motorized Cart Capacity (K)		m3
	0	tons/day
Number of Trips per Day (R)		rit
Waste Density in Motorized Carts (Ms)	0.2	tons/m3
Waste Generation per Day (Ts,m)	**0**	tons/day
Waste Generation per Year (Ts,m)	**0**	**tons/year**

Figure 6.4 Waste Generation from All Motorized Carts

4. Data that is not included in the 'Input Data' list is a variable whose numbers cannot/MAY NOT be changed because they have been determined based on calculations carried out by the Calculator Compilation Team.

5. To find out the data on the 'Ideal Number of Motorized Carts', 'Total Number of Operators' and 'Service Capacity (KK)' that must be owned by the City/District Government in handling Waste Generation in its area, you can check the sheet '11. Output Data Requirements'.

6. The calculation results for 'Investment Cost', 'OP Cost' and 'Investment Cost + OP' on Motor Carts can be checked in sheet '12. Recap of Calculation Results'.

6.1.3 Pick Up

Pick Up Fleet can be included as one of the collection fleets if it is in accordance with the existing conditions of waste collection services from sources in the city/district or the pick up fleet can also be assumed as a collection fleet used by the private sector. In the Pick Up Table on sheet '2. Input Data', the stages of data entry that need to be carried out by the City/District Government consist of:

1. Enter collection data for operational PickUp vehicles according to the conditions of each region in the 'Input Data' table in the colored columns as seen in Figure 6.5, which consists of:

Pick Up Data Input - Private Collector	
Operator Salary (Rp)	
Health Insurance (BPJS)	
Pick Up Truck Price (Rp)	
Fuel Price for Pick Up Truck (Rp/liter)	
Annual Vehicle Tax Renewal Fee (Rp)	
Annual KIR and Administration Fee (Rp)	
PPE Price (Rp/person/year)	
Pick Up Truck Capacity (m3)	
Number of Pick Up Truck Trips per Day (trips/day)	
Round Trip Distance per Pick Up Truck Trip (km)	
Number of Operators per Pick Up Truck (person)	

Figure 6.5 Pick Up Data Input

There are several indicators of the Input Data above, namely: Operator Salary (person), BPJS Health Insurance, Pick-up Price, Fuel Price per liter Pick_up, Tax Extension Price per Pick-up Year, Pick-up KIR Price per Year, K3 APD Price per Person per Year, Volume Capacity per Pick-up, Number of Pick-up Trips per day, Trip Distance traveled and Number of Operators (people) per Pick-up. The data entry MUST be adjusted to the existing conditions and needs of each operational indicator Pick Up.

2. Transportation data for operational Pick Up vehicles that have been entered into 'Input Data' will appear on Sheet 3b. Pick Up, especially in the ' Waste Generation of All Pick Ups' Table, the 'Investment Costs of All Pick Ups' Table, and the 'Operational Costs - Maintenance of All Pick Ups' Table which are marked with the column color

3. The 'Waste generation per day' data in the 'Waste Generation from All Pick Ups' table is obtained from the tonnage of waste generation for the Pick Up Collection Equipment Option on the '1. Service Balance' sheet which can be seen in Figure 6.6.

Total Waste Generation from All Pick Up Trucks		
Ideal Number of Pick Up Trucks (npickup)		**units**
Pick Up Capacity (K)		m3
	0	tons/day
Number of Trips per Day (R)		rit
Waste Density in Pick Up Trucks (Ms)	0.3	tons/m3
Waste Generation per Day (Ts,m)	**0**	**tons/day**
Waste Generation per Year (Ts,m)	0	tons/year

Figure 6.6 Total Waste Generation from Pick Ups

4. Data that is not included in the 'Input Data' list is a variable whose numbers cannot/MAY NOT be changed because they have been determined based on calculations carried out by the Calculator Compilation Team.

5. To find out the data on the 'Ideal Number of Pick Ups', 'Total Number of Operators' and 'Service Capacity (KK)' that must be owned by the City/District Government in handling Waste Generation in its area, you can check the sheet '11. Output Data Requirements'.

6. The calculation results for 'Investment Cost', 'OP Cost' and 'Investment Cost + OP' on Pick Up can be checked on sheet '12. Recap of Calculation Results'.

6.2 TPS

In the WTSTable on sheet '2. Input Data', the data entry stages that need to be carried out by the City/District Government consist of:

1. Enter WTSdata according to the conditions of each region in the 'Input Data' table in the colored columns as seen in Figure 6.7, which consists of:

Data Input	
Landing Investment Cost per Container (Rp)	
Container Investment Cost (Rp)	
Container capacity (m3)	

Figure 6.7 WTSData Input

There are several indicators of Input Data above, namely: Landing Investment Price per Container, Container Investment Price and Volume Capacity per Container. The data entry MUST be adjusted to the existing conditions and capacity of each WTSoperational indicator.

2. WTSdata that has been entered 'Input Data' will appear on Sheet 4. TPS, especially in the 'All WTSWaste Generation' Table and the 'WTSInvestment Costs' Table which are marked with the column color

3. The 'Waste generation per day' data in the 'Waste Generation of All TPS' table is obtained from the tonnage of waste generation for the WTSTemporary Shelter Option in '1. Service Balance' which can be seen in Figure 6.8.

Total Waste Generation from All Waste Transfer Station		
Ideal Number of Containers (ncontainer)		units
WTS Container Capacity (K)		m3/day
	0	tons/day
Waste Density at WTS (Ms)	0.45	tons/m3
Waste Generation per Day per WTS (Ts,m)	0	tons/day
Waste Generation per WTS (Ts,m)	0	tons/year

Figure 6.8 Waste generation in all WTS

4. Data that is not included in the 'Input Data' list is a variable whose numbers cannot/MAY NOT be changed because they have been determined based on calculations carried out by the Calculator Compilation Team.

5. To find out the data on the 'Ideal Number of Containers' that must be owned by the City/District Government in handling Waste Generation in its area, you can check the sheet '11. Output Data Requirements'.

6. The calculation results for 'Investment Cost', 'OP Cost' and 'Investment Cost + OP' on the WTScan be **checked** on sheet '12. Recap of Calculation Results'.

6.3 3R-WPS

In the 3R-WPS Table on sheet '2. Input Data', the data entry stages that need to be carried out by the City/District Government consist of:

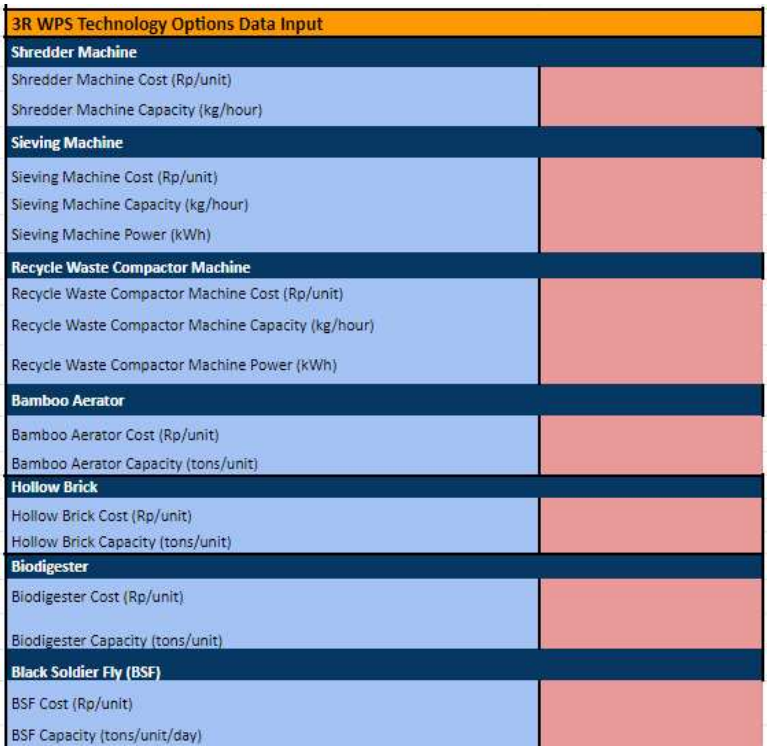
1. Enter the 3R-WPS management data according to the conditions of each region in the 'Input Data' table in the colored columns as seen in Figure 6.9, which consists of:

Input Data	
Operator Salary (Rp)	
Health Insurance (BPJS)	
3R WPS Investment Cost (Rp)	
Water Pump Machine Cost (Rp)	
Scale Cost (Rp)	
Office Equipment Cost (Computer, Printer, Desk, Chair, etc) (Rp)	
Fuel Price (Rp/liter)	
Electricity Price (Rp/kWh)	
PPE Cost (Rp/year)	
Capacity per 3R WPS (tons/day)	

Figure 6.1 3R-WPS Data Input

There are several indicators of the Input Data above, namely: Operator Salary (person), BPJS Health Insurance, Building Price/Investment 3R-WPS, Water Pump Machine Price, Scale Price, Office Equipment Price, Fuel Price per liter, Electricity Price per kWh, K3 APD Price per Person per Year. The data entry MUST be adjusted to the existing conditions and costs of each operational indicator of 3R-WPS. Write the number 0 if the indicator in the table above does not exist/is not used.

2. Enter the 3R-WPS technology selection data according to the conditions of each region in the 'Input Data for 3R-WPS Technology Selection' table in the colored columns that can be seen in Figure 6.10 consisting of:



3R WPS Technology Options Data Input	
Shredder Machine	
Shredder Machine Cost (Rp/unit)	
Shredder Machine Capacity (kg/hour)	
Sieving Machine	
Sieving Machine Cost (Rp/unit)	
Sieving Machine Capacity (kg/hour)	
Sieving Machine Power (kWh)	
Recycle Waste Compactor Machine	
Recycle Waste Compactor Machine Cost (Rp/unit)	
Recycle Waste Compactor Machine Capacity (kg/hour)	
Recycle Waste Compactor Machine Power (kWh)	
Bamboo Aerator	
Bamboo Aerator Cost (Rp/unit)	
Bamboo Aerator Capacity (tons/unit)	
Hollow Brick	
Hollow Brick Cost (Rp/unit)	
Hollow Brick Capacity (tons/unit)	
Biodigester	
Biodigester Cost (Rp/unit)	
Biodigester Capacity (tons/unit)	
Black Soldier Fly (BSF)	
BSF Cost (Rp/unit)	
BSF Capacity (tons/unit/day)	

Figure 6.9 Selected Data Inputs for 3R-WPS Technology

There are several Technology Options above, namely: Shredder, Sieving Machine, Compactor, Bamboo Aerator, Hollow Brick, Biodigester and Black Soldier Fly (BSF). Fill in the data on the technology to be selected, MANDATORY to be adjusted to existing

conditions, available technology, and capacity on each 3R-WPS Technology indicator. Write the number 0 if one of the technologies in the table above is not an option.

3. 3R-WPS management data that has been entered into 'Input Data' and 'Input Data for 3R-WPS Technologist Choice', will appear on Sheet 5. 3R-WPS, especially in the 'Waste Generation for All 3R-WPS' Table, the 'Investment Costs for All 3R-WPS' Table, and the 'Operational Costs - Maintenance for All 3R-WPS' Table which are marked with column colors can be seen in Figure 6.11.

Data		
Shredding Machine Price at 3R WPS (Hiu)		Rp/Unit
- Shredding Machine Capacity (m)		kg/hour
Sieving Machine Price (Hiu)		Rp/Unit
- Sieving Machine Capacity (m)		kg/hour
Non-Organic Waste Compactor Machine Price (Hiu)		Rp/Unit
- Waste Generation Served (Ts,m compactor)		ton/hari
- Compactor Machine Capacity (m)		kg/hour
Bamboo Aerator Price (Hiu)		Rp/Unit
- Waste Generation Served (Ts,m aerator)		ton/day
- Bamboo Aerator Capacity (m)		ton/unit
BSF Price (Hiu)		Rp/Unit
- Waste Generation Served (Ts,m BSF)		ton/day
- BSF Capacity (m)		ton/unit/day
Number of Shredding Machine Units (ncacah)		**Unit**
Number of Sieving Machine Units (nayak)		**Unit**
Number of Plastic Waste Compactor Machine Units (npemadat)		**Unit**
Number of Bamboo Aerator Units (naerator bambu)		**Unit**
Number of BSF Units (nBSF)		**Unit**

Figure 6.10 3R-WPS Data

4. The 'Waste Processed Capacity' data below in the 'Data' table is obtained from the tonnage of waste generation for the Organic Processing Option and the Recycling Option in '1. Service Balance'.

5. 5. Data that is not included in the 'Input Data' list of **'Input Data for Selected 3R-WPS Technology'** are variables whose numbers cannot/MAY NOT be changed because they have been determined based on calculations carried out by the Calculator Compilation Team.

6. To find out the data on 'Number of Shredder Units', 'Number of Plastic Waste Compactor Units', 'Number of Bamboo Aerator Units', 'Number of Hollow Brick Machine Units', 'Number of Biodigester Machine Units' and 'Number of BSF Machine Units' that must be owned by the City/District Government in handling Waste Generation in its area, you can check sheet '11. Output Data Needs'.

7. The calculation results for 'Investment Cost', 'OP Cost' and 'Investment Cost + OP' on 3R-WPS can be checked on sheet '12. Recap of Calculation Results'.

6.4 IWPS

In the IWPS Table on sheet '2. Input Data', the data entry stages that need to be carried out by the City/District Government consist of:

1. Enter IWPS management data according to the conditions of each region in the 'Basic Data Input' table in the colored columns as seen in Figure 6.12, which consists of:

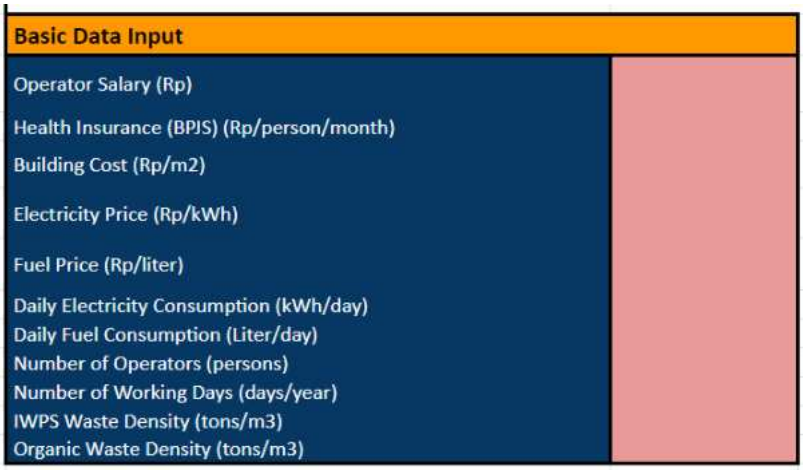


Figure 6.11 Basic IWPS Data Input

There are several indicators of Basic Data Input above, namely: Operator Salary (person), BPJS Health Insurance, IWPS Building/Investment Price, Electricity Price per kWh, Fuel Price per liter, Building Technical Age, Electricity Usage per day, Fuel Usage per day, Number of Operators (person) and Number of Working Days. The data entry **MUST** be adjusted to the existing conditions and needs of each IWPS basic operational indicator. The IWPS waste density figures and organic waste density used can be adjusted from the results of waste *sampling* or other relevant data sources.

2. Enter IWPS management data according to the conditions of each region. It should be noted that the IWPS calculator sheet has separate costs for Pre-treatment, Biological, and Thermal processing. Thus, enter IWPS management data in the **'Basic Investment Data Input' table** for each technology. The contents of the colored columns can be seen in Figure 6.13 which consist of:

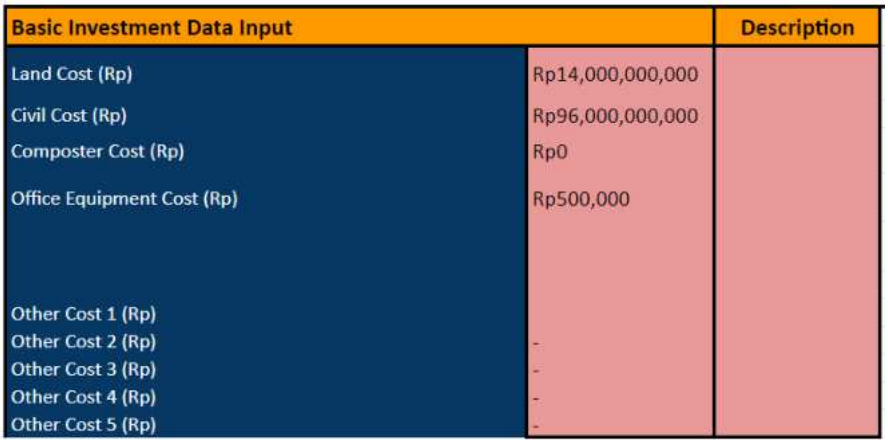


Figure 6.12 Example of Basic Investment Data Input for Composting Technology

There are several indicators of Basic Investment Data Input above, namely: Land costs, civil costs, mechanical equipment costs, electrical equipment costs, turbine and generator costs, APC (Air Pollution Control) costs, and other costs (adjusted to the additional needs of each region). Fill in the data **MANDATORY** adjusted to the Cost of each indicator of Basic Investment Data for IWPS Pre-treatment operations. If there are other investment costs that need to be added, the name of the cost description **MUST be included in the 'Description'** column in the relevant row.

3. Enter IWPS management data according to the conditions of each region in the **'Basic Operational & Maintenance Data Input' table** in the colored columns as seen in Figure 6.14, which consists of:

Basic Operational and Maintenance Data Input		% of Investment	Description
Total Salary (Rp/year)	Rp145,248,000		
Building Maintenance Cost (Rp/year)	Rp762,964,167		
Maggot Maintenance Cost (Rp/year)	Rp87,142,315		
PPE Cost (Rp/year)			
Office Equipment Cost (Rp/year)	Rp500,000		
Consumable Goods Cost (Rp/year)	-		
Chemical Cost (Rp/year)	-		
Environmental Monitoring Cost (Rp/year)	-		
Lubricant Oil Cost (Rp/year)	-		
Other Cost 1 (Rp/year)	-		
Other Cost 2 (Rp/year)	-		

Figure 6.13 Basic Operational & Maintenance Data Input

There are several indicators of Basic Operational & Maintenance Data Input above, namely: Total salary, building maintenance costs, electricity usage costs, fuel usage costs, environmental monitoring costs, consumables costs and other costs (adjusted to the additional needs of each region). The data entry **MUST** be adjusted to the existing conditions and costs of each Basic Operational Maintenance & Maintenance Data indicator for Pre-treatment IWPS. If there are other basic maintenance and maintenance costs that need to be added, the name of the cost description **MUST** be included in the description column in the relevant row. Leave the **'% of Investment' column blank** if the maintenance and maintenance cost figures are known. If there is maintenance and maintenance cost data that is not/not yet known when filling in the calculator, the user can fill in the percentage of operational data costs based on the percentage of the total IWPS investment cost.

4. IWPS management data that has been entered into **'Input Data'** will appear on Sheet 6. IWPS, especially in the **'Investment Costs of All IWPSs' Table** and the **'Operational Costs - Maintenance of All IWPSs' Table**.

5. Data that is not included in the **'Input Data' and 'Input Data for Selected IWPS Technology' lists** are variables whose numbers cannot/MAY NOT be changed because they have been determined based on calculations carried out by the Calculator Compilation Team.

6. The calculation results for 'Investment Cost', 'OP Cost' and 'Investment Cost + OP' on IWPS can be checked on sheet '12. Recap of Calculation Results'.

6.5 Transportation Sub-System

Data entry in the transportation sub-system consists of dump trucks, armroll trucks and compactor trucks. In the transportation sub-system entry guide, all three types of trucks have the same data input components. Although the example table shown in sub-chapter 6.5 uses a Dump Truck, other types of fleets have the same filling procedure. The difference found in the calculator is that each dump truck, armroll truck and compactor truck has a different Data Input Table and Sheet.

The filling of the transportation system is adjusted to the conditions of each City/Regency. If an area does not use one of the transportation systems (eg: compactor truck), then write the number 0 on each data input (eg: compactor truck).

6.5.1 Dump Truck, Armroll Truck and Compactor Truck

In the Dump Truck, Armroll Truck and Compactor Truck Tables in the '2. Input Data' sheet, the data entry stages that need to be carried out by the City/District Government consist of:

1. Enter transportation data for operational truck vehicles according to the conditions of each region in the 'Input Data' table in the colored columns as seen in Figure 6.15, which consists of:

Dump Truck Data Input (IWPS - LANDFILL)	
Operator Salary (Rp)	
Health Insurance (BPJS)	
Dump Truck Cost (Rp)	
Dump Truck Tire Cost (Rp)	
Fuel Price for DumpTruck (Rp/liter)	
Annual Vehicle Tax Renewal Fee (Rp)	
Annual KIR and Administration Fee (Rp)	
PPE Cost (Rp/person/year)	
Dump Truck Capacity (m3)	
Number of Dump Truck Trips per Day (trips/day)	
Round Trip Distance per Dump Truck Trip (km)	
Number of Operators per Dump Truck (person)	

Figure 6.14 Truck Data Input

There are several indicators of the Input Data above, namely: Operator Salary (person), BPJS Health Insurance, Truck Price, Truck Tire Price, Truck Fuel Price per liter, Truck Tax Payment Price per Year, Truck KIR Price per Year, K3 APD Price per Person per Year, Volume Capacity per Truck, Number of Truck Trips per day, Trip Distance traveled and Number of Operators (person) per Truck. The data entry MUST be adjusted to the existing conditions and needs of each type of Truck.

2. Transport data for operational vehicles Trucks that have been entered into 'Input Data' will appear on Sheet 7. Dump Trucks, especially in the 'All Truck Waste Generation' Table, the 'All Truck Investment Costs' Table, and the 'All Truck Operational - Maintenance Costs' Table which are marked with the column color

3. The 'Waste generation per day' data in the 'Waste Generation by All Trucks' table is obtained from the tonnage of waste generation for the Truck Transport Equipment Option in '1. Service Balance' which can be seen in Figure 6.16.

Waste Generation from All Dump Trucks		
Ideal Number of Dumo Trucks (nt)		units
Dump Truck Capacity (K)		m3
	0	tons/day
Number of Trips per Day (R)		rit
Waste Density in Dump Trucks (Ms)	0.45	tons/m3
Waste Generation per Day (Ts,m)	0	tons/day
Waste Generation per Year (Ts,m)	0	ton/year

Figure 6.15 Total Waste Generation from Trucks

4. Data that is not included in the 'Input Data' list is a variable whose numbers cannot/MAY NOT be changed because they have been determined based on calculations carried out by the Calculator Compilation Team.

5. To find out the data **on the 'Ideal Number of Trucks', 'Total Number of Operators' and 'Service Capacity (KK)**' that must be owned by the City/District Government in handling Waste Generation in its area, you can check the sheet '11. Output Data Requirements'.

6. The calculation results for 'Investment Cost', 'OP Cost' and 'Investment Cost + OP' on Trucks can be checked in sheet '12. Recap of Calculation Results'.

6.6 Landfill

In the landfill Table on sheet '2. Input Data', the data entry stages that need to be carried out by the City/District Government consist of:

1. Enter landfill management data according to the conditions of each region in the 'Input Data' table in the colored columns as seen in Figure 6.17, which consists of:

Data Input	
Operator Salary (Rp)	
Health Insurance (BPJS)	
Electricity Price (Rp/kWh)	
PPE Cost (Rp/person/year)	

Figure 6.16 landfill Data Input

There are several indicators of Input Data above, namely: Operator Salary (person), BPJS Health Insurance and Price of K3 PPE per Person per Year. Fill in the data MANDATORY adjusted to the Cost of each landfill operational indicator.

2. Enter landfill management data according to the conditions of each region in the 'Basic Data Input' table in the colored columns as seen in Figure 6.18, which consists of:

Figure 6.17 Basic Data Input for landfill

There are several Basic Data Input indicators above, namely: Landfill Investment Price, IPL Investment Price, Supporting Building Investment Price, Generator Investment Price, Pump Machine Investment Price, Car Wash Pump Machine Investment Price and Weighbridge Machine Investment Price. The data entry MUST be adjusted to the existing conditions and costs of each landfill investment indicator. Write the number 0 if the Basic Data Input indicator in the table above does not exist or is not used.

3. Enter landfill management data according to the conditions of each region in the 'Heavy Equipment Data Input' table in the colored columns as seen in Figure 6.19, which consists of:

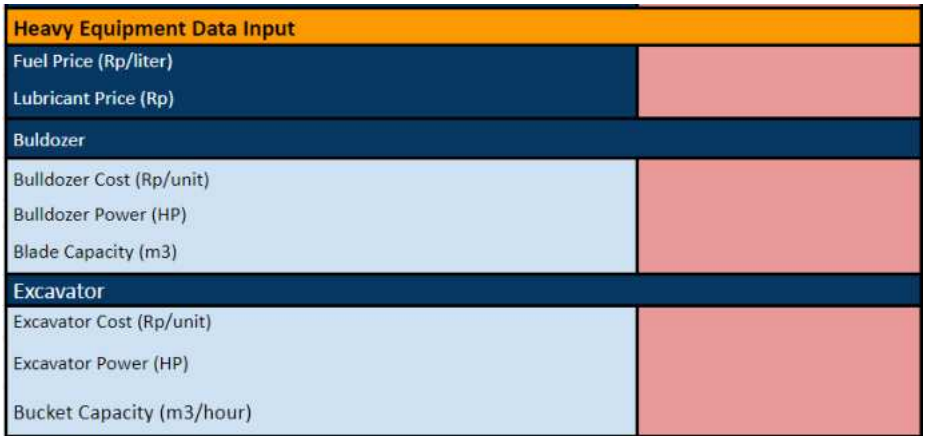


Figure 6.18 landfill Data Input: Heavy Equipment

There are several Heavy Equipment Data Inputs above, namely: Heavy Equipment Fuel Price, Heavy Equipment Lubricant Price, Heavy Equipment Price, Heavy Equipment Power and Blade Volume Capacity and Heavy Equipment Bucket. The data entry MUST be adjusted to the Cost and Capacity of each Heavy Equipment indicator. Write the number 0 if the Heavy Equipment in the table above is not an option or is not used.

4. Enter landfill management data according to the conditions of each region in the 'Other Operations' table in the colored columns as seen in Figure 6.20, which consists of:

Figure 6.19 landfill Data Input: Other Operations

There are several other operational indicators, namely: Water Cost per Year, Telephone Cost per Year and Stationery Cost per Year. Fill in the data MANDATORY adjusted to the cost of each other operational indicator at the landfill.

5. Enter landfill management data according to the conditions of each region in the 'Technical Land Cover Options' table in the colored columns as seen in Figure 6.21, which consists of:

Figure 6.20 Landfill Data Input: Land Cover Technical Options

There are several indicators of Land Cover Technical Options, namely: Cover Soil, Tarpaulin and Gravel. The data entry on the Land Cover Technical to be selected, MUST be adjusted to the existing conditions and costs for each indicator of land cover technical options. Write the number 0 if the land cover technical indicator in the table above is not an option.

6. Enter the landfill management data according to the conditions of each region in the 'Bio Gas Control Installation' table in the colored column as seen in Figure 6.22. Which consists of:

Figure 6.21 Data Input: Biogas Control Installation

There are several indicators of Bio Gas Control Installation Costs, namely: Gas Pipe, Gas Pipe Casing and Crushed Stone/Gravel. Fill in the data on the Bio Gas Control Installation, MANDATORY to be adjusted to the costs of each Bio Gas Control Installation indicator.

Write the number 0 if the Bio Gas Control Installation indicator in the table above does not exist/is not used.

7. Enter landfill management data according to the conditions of each region in the 'Leachate Treatment Plant Version I' table in the colored columns as seen in Figure 6.23, which consists of:

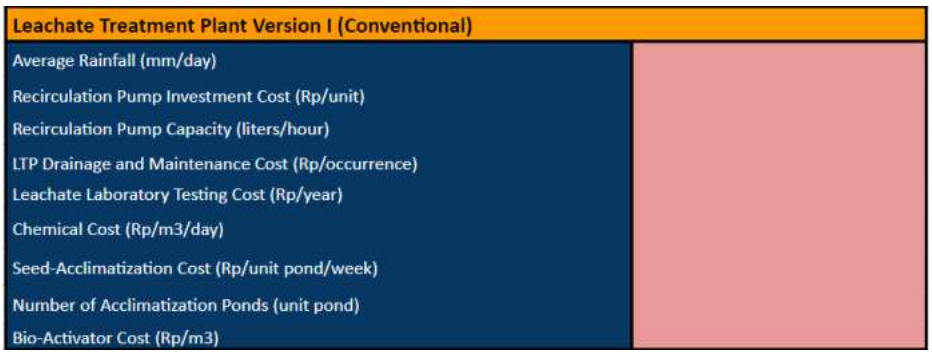


Figure 6.22 Landfill Input Data: Leachate Treatment Installation Version I (Conventional)

There are several indicators of Leachate Treatment Installation Version 1, namely: Investment price of recirculation pump, recirculation pump capacity, drainage and repair of WWTP per year, price of leachate lab test per year, price of chemicals, price of seed-aclimitation, number of acclimation ponds, price of bioactivator. Fill in the data on Leachate Treatment Installation Version 1, MANDATORY to be adjusted to the Cost and Capacity of each indicator of Leachate Treatment Installation Version 1. Write the number 0 if the Leachate Treatment Installation Version 1 indicator in the table above does not exist / is not used, and if Leachate Treatment Installation Version 1 is not used / used then all indicators are written as 0.

8. Enter the landfill management data according to the conditions of each region in the 'Leachate Treatment Plant Version II' table in the colored columns as seen in Figure 6.24, which consists of:

Figure 6.23 landfill Data Input: Leachate Treatment Plant Version II (Advance)

There are several indicators of Leachate Treatment Installation Version II (Advance), namely: Leachate processing capacity, biofilter media price, MBR price per unit, mud price, biofilter pond detention time (days), MBR detention time (days), MBR volume per m3, COD weight in aerobic pond per day and TSS weight in aerobic pond per day. Data entry in Leachate Treatment Installation Version 2, MUST be adjusted to the Cost and Capacity of each Leachate Treatment Installation Version 2 indicator. Write the number 0 if the Leachate Treatment Installation Version 2 indicator in the table above does not exist / is not used, and if the Leachate Treatment Installation Version 2 is not used / used then all indicators are written as 0.

9. Enter landfill management data according to the conditions of each region in the 'Operational Disease Vector Control' table in the colored columns as seen in Figure 6.25, which consists of:

Figure 6.24 Data Input: Disease Vector Control Operations

There are several indicators of Disease Vector Control Costs, namely: Price of insecticide per liter per month, price of disinfectant per liter per month, price of fogging gas spraying per kg per month. Fill in the data on Disease Vector Control, MUST be adjusted to the existing conditions and costs for each Disease Vector Control indicator. Write the number 0 if the Disease Vector Control indicator in the table above does not exist / is not used, and if Disease Vector Control is not used / used then all indicators are written as 0.

10. Enter landfill management data according to the conditions of each region in the 'Operational Monitoring of Environmental Quality' table in the colored columns as seen in Figure 6.26, which consists of:

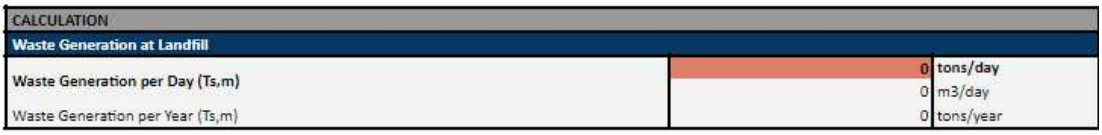
Figure 6.25 landfill Data Input: Operational Monitoring of Environmental Quality

There are several indicators of Environmental Quality Monitoring Costs, namely: Ambient air sample lab tests, gas emission sample lab tests, leachate water lab tests, groundwater lab tests, surface water lab tests. Fill in the data on Environmental Quality Monitoring, it MUST be adjusted to the Costs for each Environmental Quality Monitoring indicator. Write

the number 0 if the Environmental Quality Monitoring indicator in the table above does not exist / is not used, and if Environmental Quality Monitoring is not used / used then all indicators are written as 0.

11. landfill management data that has been entered into 'Input Data' will appear on Sheet 8. landfill, especially in the 'All landfill Waste Generation' Table, the 'All landfill Investment Costs' Table, and the 'All landfill Operational - Maintenance Costs' Table which are marked with the column color

12. The 'Waste Generation per Day' data below in the 'Calculation: Landfill Waste Generation' table is obtained from the tonnage of waste generation served in '1. Service Balance'. Can be seen in Figure 6.27.



CALCULATION		
Waste Generation at Landfill		
Waste Generation per Day (Ts,m)	0	tons/day
	0	m3/day
Waste Generation per Year (Ts,m)	0	tons/year

Figure 6.26 Landfill Waste Generation

13. Data that is not included in the list of 'Input Data', 'Basic Input Data', 'Heavy Equipment Input Data', 'Other Operations', 'Land Cover Technical Options', 'Bio Gas Control Installation', 'Leachate Treatment Installation Version I', 'Leachate Treatment Installation Version II', 'Disease Vector Control Operations', and 'Environmental Quality Monitoring Operations' are variables whose numbers cannot/MAY NOT be changed because they have been determined based on calculations that have been carried out by the Calculator Compilation Team.

14. To find out the data on the 'Number of Units' for Bulldozers, Excavators and Recirculation Machines that must be owned by the City/District Government in handling Waste Generation in its area, you can check sheet '11. Output Data Requirements'.

15. The calculation results for 'Investment Cost', 'OP Cost' and 'Investment Cost + OP' on landfill can be checked on sheet '12. Recap of Calculation Results'

07

Calculation of Total Cost of Ideal Waste Handling

7. Calculation of Total Cost of Ideal Waste Handling

The calculation of the total cost of waste handling is one of the main outputs of this retribution calculator. The total cost is obtained from sheet 11 'Recapitulation of Calculation Results.' This sheet will be filled in automatically after the need for tools, facilities, or fleets for collection, transportation, and processing; the total number of operators; and service capacity have been identified. Therefore, ' Sheet 2 Input Data' and 'Sheet 1 The Service Balance Sheet must be filled in completely first so that the waste handling cost calculator can produce an accurate total cost figure. In general, the stages of producing the ideal total waste handling cost are as follows:

1) Fill in Sheet 01. Service Balance completely and in accordance with the existing or planned waste management service scheme in the local city/district

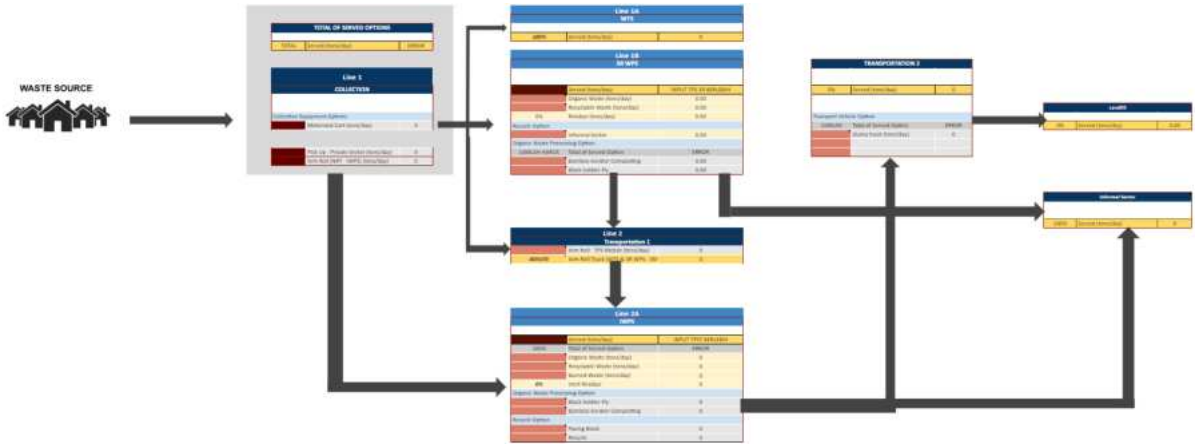


Figure 7.1 Example of a Completely Filled-in Waste Management Service Balance Sheet

2) Fill in the data on **Sheet 02. Input the data** completely and in accordance with the existing primary data available in the field in the form of real numbers

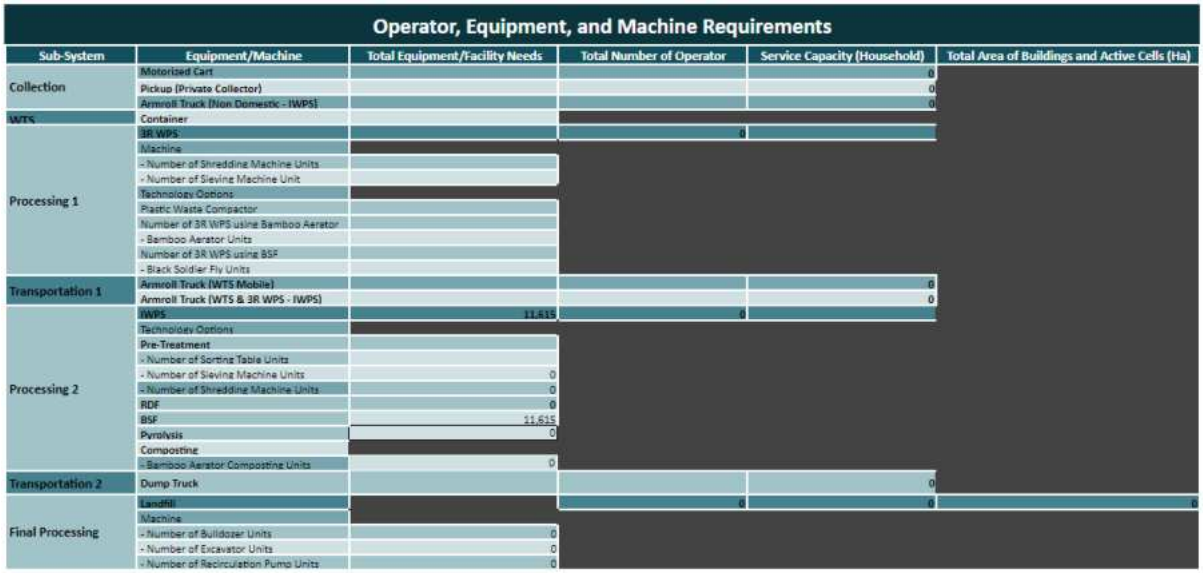
Figure 7.2 Example of Display of Filled Input Data

3) Ensure that the calculation of the number of fleets/equipment/facilities and other data is correct and accurate on one of the sheets, such as the transportation fleet or waste processing facility, **Sheet (n). Name of the Fleet or Waste Processing Facility to be checked** as a *back-end calculation sheet*.

Figure 7.3 Example of Back End Calculation Display for Motorized Carts Related to Data on Facilities and Infrastructure Needs, Investment and Operational Cost Calculations

4) Ensure that **Sheet 11. Output Data Requirements** such as the number of equipment/facilities required, total number of operators, service capacity, and building

land area are filled in automatically and in accordance with the calculations on the *back end sheet* for each transportation fleet or processing facility.



Operator, Equipment, and Machine Requirements

Sub-System	Equipment/Machine	Total Equipment/Facility Needs	Total Number of Operator	Service Capacity (Household)	Total Area of Buildings and Active Cells (Ha)
Collection	Motorized Cart			0	
	Pickup (Private Collector)			0	
	Armroll Truck (Non Domestic - IWPS)			0	
WTS	Container				
Processing 1	3R WPS		0		
	Machine				
	- Number of Shredding Machine Units				
	- Number of Sieving Machine Unit				
	Technology Options				
	Plastic Waste Compactor				
	Number of 3R WPS using Bamboo Aerator				
	- Bamboo Aerator Units				
	Number of 3R WPS using BSF				
	- Black Soldier Fly Units				
Transportation 1	Armroll Truck (WTS Mobile)			0	
	Armroll Truck (WTS & 3R WPS - IWPS)			0	
Processing 2	IWPS	11,615	0	0	
	Technology Options				
	Pre-Treatment				
	- Number of Sorting Table Units				
	- Number of Sieving Machine Units	0			
	- Number of Shredding Machine Units	0			
	RDF	0			
	BSF	11,615			
	Pyrolysis	0			
	Composting				
	- Bamboo Aerator Composting Units	0			
Transportation 2	Dump Truck			0	
Final Processing	Landfill		0	0	0
	Machine				
	- Number of Bulldozer Units	0			
	- Number of Excavator Units	0			
	- Number of Recirculation Pump Units	0			

Figure 7.4 Example of Display of Output Requirements for Operators, Tools, and Machines in Sub-collection, Sub-transportation, and Sub-processing

5) Ensure that **Sheet 12. Recap of Calculation Results** such as investment costs, operational and maintenance costs, and investment + operational costs have been filled in automatically and are in accordance with the calculations on the *back end sheet* for each transportation fleet or processing facility.

COST PER WASTE MANAGEMENT SUB-SYSTEM

		Investment Cost		Operational Cost			Investment + Operational Cost		
		Rp/Year	Rp/Ton	Rp/Year	Rp/Ton	Rp/Household/Month	Rp/Year	Rp/Ton	Rp/Household/Month
COLLECTION	Motorized Cart	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0
	Pick Up (Private Collector)	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0
	Arm Roll Truck (Non Domestic - IWPS)	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0
WTS		Rp0	Rp0				Rp0	Rp0	Rp0
3R WPS	3R WPS + Bamboo Aerator Composting	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0
	3R WPS + BSF	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0
	Compactor Machine Only (Without 3R WPS Facilities)	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0
TRANSPORTATION 1	Arm Roll Truck - WTS Mobile	Rp0	Rp0	Rp0	Rp.0	Rp.0	Rp0	Rp0	Rp0
	Arm Roll Truck (WTS & 3R WPS - IWPS)	Rp0	Rp0	Rp0	Rp.0	Rp.0	Rp0	Rp0	Rp0
IWPS	RDF Fluff	Rp0	Rp0	Rp0	Rp.0	Rp.0	Rp0	Rp0	Rp0
	Composting	Rp0	Rp0	Rp0	Rp.0	Rp.0	Rp0	Rp0	Rp0
	BSF	Rp0	Rp0	Rp0	Rp.0	Rp.0	Rp0	Rp0	Rp0
	Pyrolysis	Rp0	Rp0	Rp0	Rp.0	Rp.0	Rp0	Rp0	Rp0
TRANSPORTATION 2	Dump Truck	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0
LANDFILL	Controlled Landfill + LTP Version I (Conventional)	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0
	Sanitary Landfill with Soil + LTP Version I (Conventional)	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0
	Sanitary Landfill with Tarpaulin + LTP Version I (Conventional)	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0
	Controlled Landfill + LTP Version II (Advanced)	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0
	Sanitary Landfill with Soil + LTP Version II (Advanced)	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0
	Sanitary Landfill with Tarpaulin+ LTP Version II (Advanced)	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0
TOTAL COST		Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0	Rp0

Figure 7.5 Example of Display of Recapitulation of Results of Waste Management Financing Calculations

As stated in chapter 6 regarding general guidelines, the total cost of waste handling is obtained from:

a) Investment Costs
b) Operational and Maintenance Costs
c) Investment + Operational Costs

Which is calculated into 3 units, namely Rp/Year, Rp/Ton, and Rp/KK/Month. The following is an explanation of the logic of calculating investment costs, operational costs, and combined investment and operational costs in the waste management cost calculator. Although the calculation formula is automatically available in the spreadsheet, understanding this logic is important to ensure accuracy and optimal use of the calculator.

7.1. Investment Costs

Investment costs in waste management include all initial expenditures required to build infrastructure and supporting facilities. These costs include the purchase of equipment, machinery, or fleets used in the process of collecting, transporting, and processing waste, the number of units needed, and the cost of purchasing or clearing land. In addition, the cost of construction services for the construction of facilities such as Integrated Waste Processing Sites (IWPS) or other waste processing sites is also included in the investment cost component. It is important to consider factors such as inflation rates, Bank Indonesia (BI) interest rates, and projections of future needs so that investment plans remain relevant and sustainable. With careful investment planning, waste management can be carried out more efficiently and effectively, supporting environmental goals and improving public services.

The calculation of investment costs for sub-transportation and collection, with sub-waste processing has a little difference. Each calculation of investment costs for sub-transportation/collection and sub-processing is explained as follows:

A. Investment Cost of Sub-Transportation or Sub-Waste Collection

In general, the details of investment costs for waste transportation and collection sub-sectors are as follows:

Table 7.1 Components of Sub-Transportation or Collection Investment Cost Details

Cost Category	Unit
Fleet unit price (H_{iu})	Rp
Fleet technical age (U_t)	Year
Total Number of Fleet Required (n_t)	Fruit
Inflation per year (I)	%/year
Bank Indonesia Interest Rate (Sb)	%/year
Total Investment Cost (Bi)	Rp/year

Total Investment Cost Calculation (Rp/Year) =

$$\frac{(Total\ number\ of\ fleet \times (Unit\ price\ of\ fleet \times (1+Inflation\ rate) \times (1+Interest\ rate)))}{(Technical\ age\ of\ fleet)}$$

The following is an example of calculating the total investment cost of a fleet of motorized carts for waste collection in City X:

Table 7.2 Example of Details of Motorized Cart Investment Costs in City X

Cost Category	Mark	Unit
Fleet unit price (H_{iu})	40,000,000,-	Rp
Fleet technical age (U_t)	5	Year

Total Number of Fleet Required (n_t)	232	Unit
Inflation per year (I)	3.01	%/year
Bank Indonesia Interest Rate (Sb)	5.81	%/year

Total Investment Cost of Motor Cart Fleet (Rp/Year)

$$= \frac{(Total\ number\ of\ fleet \times (Unit\ price\ of\ fleet \times (1+Inflation\ rate) \times (1+Interest\ rate)))}{(Technical\ age\ of\ fleet)}$$

$$= \frac{(232\ Units \times (Rp\ 40{,}000{,}000 \times (1+3.01\%) \times (1+5.81\%)))}{(5\ years)}$$

= Rp 2.022.944.991,- / year

If the capacity of the motor cart is 67,628 tons/year. Then the investment cost of the motor cart per ton is Rp 29,913/Ton.

B. Sub-Waste Processing Investment Costs

In general, the details of investment costs for waste sub-processing are as follows:

Table 7.3 Components of Investment Cost Details for Waste Sub-Processing

Cost Category	Unit
Building Price Facilities (Shark)	Rp
Unit Price of Machine/Tool (Hi)	Rp
Total Number of Machines/Tools Required (n_t)	Fruit
Total Price of Machine/Tool	Rp
Technical Age of Facility Building (Ut)	Year
Technical Age of Machine/Tool (Ut)	Year
Inflation per year (I)	%/year
Bank Indonesia Interest Rate (Sb)	%/year
Total Investment Cost (Bi)	Rp/year

Total Investment Cost Calculation (Rp/Year) =

$$\frac{(Number\ of\ Facilities\ \times\ (Building/Machine\ Price\ \times\ (1+Inflation\ Rate)\ \times\ (1+Interest\ Rate)))}{(Technical\ Age\ of\ Building/Machine)}$$

The following is an example of calculating the total investment costs for 3R-WPS facilities for waste processing in City X:

Table 7.4 Example of Details of Investment Costs for 3R-WPS Facilities in City X

Cost Category	Mark	Unit
3R-WPS Building Price (H_{iu})	500,000,000,-	Rp
3R-WPS Building Technical Age (Ut)	20	Year
3R-WPS Engine Technical Age (Ut)*	5	Year
Office Supplies Prices (Shark)	12,000,000,-	Rp
Price of Shredder Machine (Shark)	25,000,000,-	Rp
Number of Shredders (nt)	1	Unit
Price of Sieving Machine (Shark)	27,230,500,-	Rp
Number of Sieving Machines (nt)	1	Unit
Scale Price (Shark)	2,737,000	Rp
Water Pump Machine Price (Shark)	3,500,000	Rp
Bamboo Aerator Price (Shark)	200,000,-	Rp
Number of Bamboo Aerators (nt)	5	Unit
Bamboo Aerator Age (Ut)	2	Year
Inflation per year (I)	3.01	%/year
Bank Indonesia Interest Rate (Sb)	5.81	%/year

*Machine Technical Age applies to office equipment and other machines, except bamboo aerators.

a) 3R-WPS Building Investment Cost =

$$\frac{(number\ of\ TPS3R \times (TPS3R\ building\ price \times (1+Inflation\ rate) \times (1+Interest\ rate)))}{(TPS3R\ building\ technical\ age)}$$

$$= \frac{(1\ unit \times (Rp\ 500{,}000{,}0000 \times (1+3.01\%) \times (1+5.81\%)))}{(5\ years)}$$

= Rp 27.248.720,- / year

b) Office Equipment Investment Cost =

$$\frac{(quantity \times (Office\ equipment\ price \times (1+Inflation\ rate) \times (1+Interest\ rate)))}{(TPS3R\ Machine\ Technical\ Age)}$$

$$= \frac{(1\ unit \times (Rp\ 12{,}000{,}000 \times (1+3.01\%) \times (1+5.81\%)))}{(5\ years)}$$

= Rp 2.615.877 / year

c) Scale Investment Cost =

$$\frac{(quantity \times (Weighing\ Price \times (1+Inflation\ Rate) \times (1+Interest\ Rate)))}{(TPS3R\ Machine\ Technical\ Age)}$$

$$= \frac{(1\ unit \times (Rp\ 2{,}737{,}000 \times (1+3.01\%) \times (1+5.81\%)))}{(5\ years)}$$

= Rp 596.638 / year

d) Water Pump Machine =

$$\frac{(quantity \times (Water\ Pump\ Machine\ Price \times (1+Inflation\ Rate) \times (1+Interest\ Rate)))}{(TPS3R\ Machine\ Technical\ Age)}$$

$$= \frac{1\ unit \times \left(Rp\ 3.500.000 \times (1+3.01\%) \times (1+5.81\%)\right)}{5\ years}$$

= Rp 762.964 / year

e) Investment Cost of Shredder Machine =

$$\frac{(quantity \times (Price\ of\ Shredder\ Machine \times (1+Inflation\ Rate) \times (1+Interest\ Rate)))}{(TPS3R\ Machine\ Technical\ Age)}$$

$$= \frac{1\ unit \times \left(Rp\ 25.000.000 \times (1+3.01\%) \times (1+5.81\%)\right)}{5\ years}$$

= Rp 4.904.770 / year

f) Investment Cost of Sieving Machine =

$$\frac{(quantity \times (Price\ of\ Sieving\ Machine \times (1+Inflation\ Rate) \times (1+Interest\ Rate)))}{(TPS3R\ Machine\ Technical\ Age)}$$

$$= \frac{1\ unit \times \left(Rp\ 27.230.500 \times (1+3.01\%) \times (1+5.81\%)\right)}{5\ years}$$

= Rp 5.342.373 / year

g) Bamboo Aerator Composting Investment Cost =

$$\frac{(quantity \times (Bamboo\ Aerator\ Price \times (1+Inflation\ Rate) \times (1+Interest\ Rate)))}{(TPS3R\ Machine\ Technical\ Age)}$$

$$= \frac{5\ unit \times \left(Rp\ 200.000 \times (1+3.01\%) \times (1+5.81\%)\right)}{5\ years}$$

= Rp 544.974 / year

h) Total Investment Cost of 3R-WPS =
3R-WPS Building Investment Cost + Office Equipment Investment Cost + Scale Investment Cost + Water Pump Machine Investment Cost + Shredder Machine Investment Cost + Sieving Machine Investment Cost + Bamboo Aerator Composting Investment Cost
= Rp 27,248,720 + Rp 2,615,877 + Rp 596,638 + Rp 762,964 + Rp 4,904,770 + Rp 5,342,373 + Rp 544,974
= Rp. 42,016,317 / year

If the capacity of 3R-WPS in City X is 676 tons/year. Then the investment cost of 3R-WPS per ton is Rp 245,229 / ton

7.2. Operating costs

Operational costs in waste management refer to all daily expenses required to ensure the continuity of waste collection, transportation, and processing activities. This cost component covers various important aspects, such as:

- Equipment and vehicle maintenance, including routine repairs and replacement of parts to ensure optimal operation.
- Human resource costs, including operator salaries, benefits, and health insurance for both direct and indirect workers.
- The cost of fuel or energy, such as diesel or electricity, used in waste collection vehicles and processing machines.
- Extension of legal documents, such as vehicle tax, operational permits, or heavy equipment certification.
- Utilities, including electricity, water and other operational costs.

A thorough understanding of these operational cost components is essential to effectively use the waste management retribution calculator. By taking all these cost components into account, the calculator can help determine fair, transparent and sustainable retribution rates according to operational needs and service capacity. Like investment costs, the calculation of operational costs for sub-transportation and collection, with sub-waste processing, has slight differences as follows:

A. Operational Costs of Sub-Collection and Sub-Transportation of Waste

In general, the details of the operational costs for waste transportation and collection are as follows:

Table 7.5 Components of Sub-Transportation or Collection Operational Cost Details

Cost Category	Unit
Operator Salary	Rp
Total number of operators	Person
Health Insurance (A)	Rp/Person/Month
Total Number of Fleet Required (n_t)	Unit
Fleet Unit Price	Rp
Fleet Maintenance Percentage (P)	%/year
Fleet Trip Distance (Jt)	km/trip
Number of Fleet Trips per Day (R)	Ritation/Day
Fuel Consumption (kbbm)	L/km
Fuel Price (Hbbm)	Rp/L
Price of K3 PPE (Hapd)	Rp
Vehicle tax renewal price per year (Hpt)	Rp

a) Operator Fee (Bo) =

$$(Salary \times Number\ of\ Operators \times 12) + (Health\ Insurance\ Cost \times Number\ of\ Operators \times 12)$$

b) Machine/Equipment/Fleet Maintenance Cost =

$$\%\ Fleet\ Maintenance\ \times\ Fleet\ Price\ \times\ Number\ of\ Fleets$$

c) Fuel Cost =

$$Number\ of\ Fleets\ \times\ Trip\ Distance\ \times\ Number\ of\ Trips\ per\ day\ \times\ Fuel\ Consumption\ \times\ Fuel\ Price\ \times\ 365$$

d) Vehicle Tax Fee =

$$Fleet\ Tax\ Extension\ Price\ \times\ Number\ of\ Fleets$$

e) PPE costs =

$$PPE\ Price\ \times\ Number\ of\ Operators$$

The following is an example of calculating the total operational costs of a fleet of motorized carts for waste collection in City X:

Table 7.6 Example of Details of Motorized Cart Operational Costs

Cost Category	Mark	Unit
Operator Salary	1,500,000,-	Rp
Total number of motor cart operators	464	Person
Health Insurance (A)	26,000,-	Rp/Person/Month
Total Number of Motor Carts Required (n_t)	232	Unit
Motor Cart Price	40,000,000,-	Rp
Motor Cart Maintenance Percentage (P)	5	%/year
Motorized Garbage Cart Trip Distance (Jt)	2.8	km/trip
Number of Motor Cart Trips per Day (R)	2	Ritation/Day
Fuel Consumption (kbbm)	0.07	L/km
Fuel Price (Hbbm)	10,000	Rp/L
Price of K3 PPE (Hapd)	350,000	Rp
Vehicle tax renewal price per year (Hpt)	600,000	Rp

a) Operator Fee (Bo) =

$$(Salary\ \times\ Number\ of\ Operators\ \times\ 12) + (Health\ Insurance\ Cost\ \times\ Number\ of\ Operators\ \times\ 12)$$

$$= (Rp\ 1.500.000\ \times\ 464\ people\ \times\ 12) + (Rp\ 26.000/person/month\ \times\ 464\ person\ \times\ 12)$$

= Rp 8.496.768.000/year

b) Machine/Equipment/Fleet Maintenance Cost =

$$\%\ Fleet\ Maintenance\ \times\ Fleet\ Price\ \times\ Number\ of\ Fleets$$

$$= 5\%/year\ \times\ \ Rp40.000.000\ \times\ 232\ unit$$

= Rp 464.000.000/year

c) Fuel Cost =

$$Number\ of\ Fleets\ \times\ Trip\ Distance\ \times\ Number\ of\ Trips\ per\ day\ \times\ Fuel\ Consumption\ \times\ Fuel\ Price\ \times\ 365$$

= $232\ units \times\ 2.8\ km/trip \times\ 2\ trips/day \times\ 0.07\ L/km \times Rp\ 10{,}000/L\ \times\ 365\ days$

= Rp 331.945.600/year

d) Vehicle Tax Fee =

$$Fleet\ Tax\ Extension\ Price\ \times\ Number\ of\ Fleets$$

= $Rp\ 600.000 \times\ 232\ units$

= Rp 139.200.000/year

e) PPE costs =

$$PPE\ Price\ \times\ Number\ of\ Operators$$

= $Rp\ 350.000 \times\ 464\ people$

= Rp 162.400.000/year

f) Total Operational Cost of Motorized Cart = Operator Cost + Maintenance Cost + Fuel Cost of Motorized Garbage Cart + Annual Vehicle Tax Extension Cost + K3 Personal Protective Equipment Cost

= Rp 8.496.768.000 + Rp 464.000.000 + Rp 331.945.600 + Rp 139.200.000 + Rp 162.400.000

= Rp 9.594.313.600 / year

If the capacity of the motor cart is 67,628 tons/year. Then the operational cost of the motor cart per ton is Rp 141,868/Ton. Meanwhile, if the number of people per house is 5 people per Head of Family (KK) and the waste generation is 0.6 kg/person/day. Then the operational cost of the motor cart for collecting waste at the source every month is:

g) Waste collection costs per household

$$= Fleet\ operational\ costs\ per\ ton\ \times\left(\frac{Waste\ generation\left(\frac{kg}{person}/day\right)}{1000}\right)\ \times\ 5\ person\ \times\ 30\ days$$

$$= Rp\ 141.689/ton\ \times\left(\frac{0{,}6\frac{kg}{person}/day}{1000}\right)\ \times\ 5\ person\ \times\ 30\ days$$

= Rp 12.768 /household/month

B. Operational and Maintenance Costs of Waste Sub-Processing

In general, the details of the operational costs of waste sub-processing are as follows:

Table 7.7 Components of Sub-Processing Operational Cost Details

Cost Category	Unit
Operator Fees	Rp
Building and other Machinery Maintenance Costs	
Electricity cost	
K3 PPE Costs	
Water Pump Maintenance Costs	
Machine Maintenance Cost	
Organic Technology Maintenance Costs	

The following is an example of calculating the total operational costs of the 3R-WPS Facility in City X with a capacity of 2 tons/day:

Table 7.8 Example of Calculation of Total Operational Costs for 3R-WPS with a Capacity of 2 tons/day

Cost Category	Mark	Unit
Operator Fees	73,248,000	Rp/Year
Building and other Machinery Maintenance Costs	25,736,850	
Electricity cost	6,356,022	
K3 PPE Costs	63,000,000	
Water Pump Maintenance Costs	1,359,352	
Shredder Machine Maintenance Costs	6,307,447	
Sieving Machine Maintenance Cost	3,339,273	
Organic Technology Maintenance Costs	50,000	

a) 3R-WPS Operational Costs per Year =

(3R-WPS capacity per day x (Operator Cost + Building and other Machine Maintenance Cost + Electricity Cost + K3 PPE Cost + Water Pump Maintenance Cost + Shredder Maintenance Cost + Sieving Machine Maintenance Cost)) + Organic Technology Maintenance Cost

= (2 ton/day x (Rp 73.248.000 + Rp 25.736.850 + Rp 6.356.022 + Rp 63.000.000 + Rp 1.359.352 + Rp 6.307.447 + Rp 3.339.273)) + Rp 50.000

= Rp 161.462.250 / year

b) 3R-WPS Operational Cost per ton

$$= \frac{TPS3R\ operational\ costs\ per\ year}{TPS3R\ capacity\ per\ day \times 365\ days}$$

$$= \frac{Rp\ 161.462.250/year}{2\ ton/day \times 365\ days}$$

= Rp 942.377/Ton

Meanwhile, if the number of people per house is 5 people per Head of Family (KK) and the waste generation is 0.6 kg/person/day. Then the operational and maintenance costs of 3R-WPS per KK are:

c) Waste collection costs per household

$$= TPS3R\ operational\ costs\ per\ ton \times \left(\frac{Waste\ generation\ \left(\frac{kg}{person}/day\right)}{1000}\right) \times 5\ person \times 30\ days$$

$$= Rp\ 942.377/ton \times \left(\frac{0{,}6\frac{kg}{person}/day}{1000}\right) \times 5\ person \times 30\ days$$

= Rp 4.964 /household/month

7.3. Investment + Operational Costs

The total cost of waste management consists of investment costs and maintenance operational costs that have been calculated previously. The total cost of investment and operations can be calculated as costs per year, costs per tonnage, and costs per household.

A. Investment Cost + Operational Cost of Sub-Waste Collection or Transportation

The formula for calculating the total investment and operational costs for waste collection and transportation sub-districts is as follows:

a) Total Fleet Cost per Year = Fleet Investment Cost per Year + Fleet Operational and Maintenance Cost per Year

b) Total Fleet Cost per Tonnage = Fleet Investment Cost per Tonnage + Fleet Operational and Maintenance Cost per Tonnage

c) Total Fleet Cost per Head of Family (KK) =

$$Total\ investment\ and\ operational\ costs\ of\ the\ fleet\ per\ ton \times \left(\frac{Waste\ generation\ \left(\frac{kg}{person}/day\right)}{1000}\right) \times 5\ peron \times 30\ days$$

Looking at the examples in Sub-Chapter 7.1 and 7.2, the calculation of the total investment and operational costs of motorbike carts in City X is as follows:

a) Total Financing of Motor Cart per year
   = Fleet Investment Cost per Year + Fleet Operational and Maintenance Cost per Year
   = Rp 2,022,944,991/Year + Rp 9,594,313,600/Year
   = Rp. 11,617,258,591/Year

b) Total Financing of Motor Cart per Tonnage
   = Fleet Investment Cost per Tonnage + Fleet Operational and Maintenance Cost per Tonnage
   = Rp 29,913/Ton + Rp 141,869/Ton
   = Rp. 171,782/Ton

c) c) Total Financing of Motorized Carts per Family (Waste generation = 0.6 kg/person/day, 1 Family = 5 people)

$= Rp\ 171.782\ /ton \times \left(\frac{0.6\left(\frac{kg}{person}/day\right)}{1000}\right) \times 5\ person \times 30\ days$

= Rp 15.460/household

B. Investment + Operational Costs of Sub-Waste Processing

The formula for calculating the total investment and operational costs of waste sub-processing is as follows:

a) Total Cost of Facilities per Year = Investment Cost of Facilities per Year + Operational and Maintenance Cost of Facilities per Year

b) Total facility cost per Tonnage = Facility Investment Cost Per Tonnage + Facility Operational and Maintenance Cost per Tonnage

c) Total facility costs per Head of Family (KK) =

$$Total\ investment\ and\ operational\ costs\ of\ facilities\ per\ ton \times \left(\frac{Waste\ generation\ \left(\frac{kg}{person}/day\right)}{1000}\right) \times 5\ person \times 30\ days$$

Looking at the examples in Sub-Chapter 7.1 and 7.2, the calculation of the total investment and operational costs of 3R-WPS in City X is as follows:

a) Total 3R-WPS financing per year
= 3R-WPS Investment Cost per Year + 3R-WPS Operational and Maintenance Cost per Year
= Rp. 42,016,317 + Rp. 161,462,250
= Rp. 203,478,566/Year

b) Total 3R-WPS Financing per Tonnage
= 3R-WPS Investment Cost per Tonnage + 3R-WPS Operational and Maintenance Cost per Tonnage
= Rp. 245,229 + Rp. 942,377
= Rp. 1,187,606/Ton

c) Total 3R-WPS Financing per Family (Waste generation = 0.6 kg/person/day, 1 Family = 5 people)

$= Rp\ 1.187.606/ton \times \left(\frac{0.6\left(\frac{kg}{person}/day\right)}{1000}\right) \times 5\ person \times 30\ days$

= Rp 106.885/household

08

Calculation of Retribution Fees

8. Calculation of Retribution Fees

The calculation of waste management retribution fees refers to the provisions of Ministry of Home Affairs Regulation No. 7 of 2021 concerning the Calculation Method of Retribution Fees in Waste Management Implementation. The waste management retribution fee is determined as the difference between the total ideal annual waste management cost and the allocation of waste management costs covered by non-retribution sources (see Figure 8.1). The ideal waste management cost is calculated based on the total waste generation per year, converted into the total waste management cost per ton. This cost includes all waste management stages, from collection, transportation, processing, to final disposal (see Figure 8.2).

The waste management costs covered by non-retribution sources are budget allocations from other sources beyond retribution. Examples include General Allocation Funds (DAU), Special Allocation Funds (DAK), Revenue Sharing Funds (DBH), central government assistance, grants, or other local revenue (PAD). Once the total retribution fee is determined, the next step is to divide this value by the number of households and business entities that are the target of retribution collection in the area. This calculation aims to produce a fair tariff that aligns with the community's affordability while effectively covering waste management costs.

Figure 8.1 Formula for Calculating Waste Management Retribution Fees

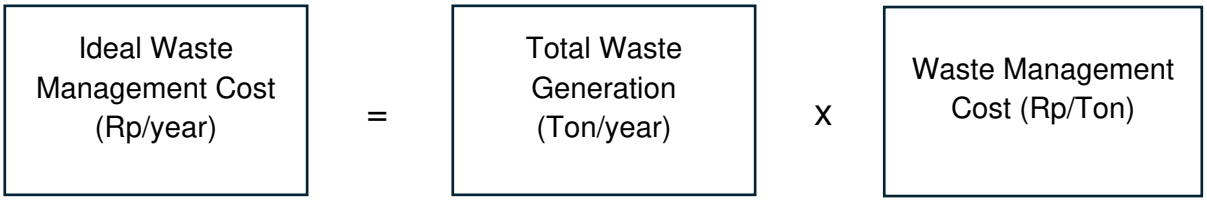


Figure 8.2 Formula for Calculating Ideal Waste Management Costs

8.1 Method of Calculating Retribution Fees

The calculation of retribution fees requires relevant data. The data serves as the basis for determining a fair and proportional fee based on the provided service. The retribution fee calculation is part of the input data processing in **Sheet 1: Data Input**. The data required for the calculation of waste service retribution fees consists of several components. There are:

1. General Data of Waste Service Area
2. Ideal Waste Management Cost Data
3. Waste Management Costs Covered by Non-Retribution Sources
4. Total Retribution Needs per Source Category
5. Retribution Fee per Class Category

Input the percentage values or primary data manually into **Sheet 2: Retribution Fee Calculation Calculator** is not allowed. The input data is a mandatory component that must

be provided and completed in **Sheet 1: Data Input** and is automatically linked to **Sheet 2: Retribution Fee Calculation Calculator**, marked with blue table columns. The output data is the automatic calculation result from the calculator, which must not be altered, modified, or deleted. This output data appears in red-colored columns. The explanation of the retribution fee calculation process is as follows:

8.1.1 General Data of Waste Service Area

Each region must provide and complete general data related to the waste service area to support the calculation using the retribution calculator. This data includes: 1) total population, 2) total number of households, 3) waste generation rate per capita, and 4) Waste source categories in the city/regency. This information is inputted as a data component in **Sheet 1: Data Input**, ensuring that all waste generators, both households and non-households, fulfill their obligation to pay retribution. The general data components of the waste service area are outlined in Table 8.1:

Table 8.1 General Data of Waste Service Area

No	Parameter	Notation	Unit	Mark
1.1	Total Population	**A**	Person	
1.2	Total Number of Households	**B**	HH	
1.3	Per Capita Waste Generation Rate	**C**	Kg/person/day	
1.4	Number of People per Household	**D=A/B**	Person	
1.5	Total Waste Generation	**E=A*C**	Ton/day	
1.6	Total Waste Generation Annual	**F = E * 365**	Ton/year	
1.7	Waste Source Categories:			
a	Household	**G1**	%	
b	Office	**G2**	%	
c	Business Centre	**G3**	%	
d	Market	**G4**	%	
e	Public Facilities	**G5**	%	
f	Other Areas			
g				
h				
i				
j				
1.8	Total Percentage of Waste Sources		%	

Note:

Input columns : Data entry should reflect the actual conditions of each region

Output columns : Automatic calculation results from the calculator (should not be modified).

The data used in the calculation includes:

1.1 Total Population – Notation A

The total number of people in the area based on the latest official statistics from the local statistics bureau or civil registry office.

1.2 Total Number of Households in the Service Area – Notation B

The total number of households based on the latest official statistics.

1.3 Per Capita Waste Generation Rate – Notation C

Determined based on field sampling, latest waste generation standards, or local waste management conditions.

1.4 Number of People per Household– Notation D

Automatically calculated as the ratio of total population to total households using the formula:

$$\text{Number of People per Household (D)} = \frac{\text{Total Population (A)}}{\text{Total Household (B)}}$$

1.5 Total Waste Generation (Ton/Day) – Notation E

Automatically converted from daily waste generation using the formula:

$$\text{Total Waste Generation (E)} \left(\frac{\text{ton}}{\text{day}}\right) = \text{Total Population } (A) \times \text{Per Capita Waste Generation Rate (C)} \times \frac{1 \text{ ton}}{1000 \text{ kg}}$$

1.6 Total Waste Generation (Ton/year) – Notation F

Automatically converted from daily waste generation using the formula:

$$\text{Total Waste Generation (F)} \left(\frac{\text{ton}}{\text{year}}\right) = \text{Total Waste Generation (E)} \times \frac{365 \text{ days}}{\text{year}}$$

1.7 Percentage of Waste Sources Categories – Notation G

Determined based on household and non-household waste proportions by weight. If local data is unavailable, the categories can refer to the tariff classification of PT PLN (Persero) no/ 0002.P-DIR-2015. The waste source categories include:

Household: Waste generated by residential homes and similar establishments.

Business: Waste from commercial activities.

Social: Waste from social institutions such as places of worship, schools, hospitals, and orphanages village halls, schools, student dormitories, hospitals, and so on.

Industry: Waste from processing industries that transform raw materials into finished goods. Economic activities that change basic goods mechanically, physically, chemically or by hand so that they become finished or semi-finished goods or change goods of less value into goods of higher value and whose characteristics are closer to the final user.

Public and Government: Waste from public services, government offices, and public facilities.

1.8 Total Percentage of Waste Sources:

The total percentage weight of all waste sources categorized above.

$$\text{Total PErcemtage of Waste Sources (\%)} = \%\text{Households} + \%\text{Business} + \%\text{Social} + \%\text{Industry} + \%\text{Public and Government}$$

8.1.2 Ideal Waste Management Cost Data

Waste management cost must be completed in **Sheet 1: The Data Input** for each region must be adjusted based on the output of the Ideal Waste Management Cost Calculator. The components of the ideal waste management cost in the calculation calculator can be reviewed in Table 8.2 Ideal Waste Management Cost:

Table 8.2 Ideal Waste Management Cost

No	Parameter	Notation	Unit	Mark
2.1	Ideal Waste Management Cost	**H**	Rp/Ton	
2.2	Ideal Waste Management Cost	**I=F*H**	Rp/Tahun	

Note:

Column : Data input should match the output from the Ideal Waste Management Cost Calculator.

Column : The calculation output is generated automatically by the calculator (no manual changes or input required)

Notation F : Total waste generation (tons per year) as per Table 8.1.

The required data for this calculation includes

1.1 Ideal Waste Management Cost (Rp/Ton) – Notation H

The Ideal Waste Management Cost (Rp/Ton) is an input based on the output of the Ideal Waste Management Cost Calculator (including investment and operational costs). This value has been calculated beforehand and adjusted according to the waste management conditions and needs of each city/regency

1.2 Ideal Waste Management Cost (Rp/Year) – Notation I

The Ideal Waste Management Cost (Rp/Year) is an automatic output generated by the calculator. This is a converted value based on the total waste generation (Ton/Year) and the Ideal Waste Management Cost (Rp/Ton), using the following formula:

$$\text{Ideal Waste Management Cost } \left(\frac{\text{Rp}}{\text{year}}\right) = \text{Total Waste Generation (F)} \left(\frac{\text{Ton}}{\text{year}}\right) \times \text{Ideal Waste Management Cost (H)} \left(\frac{\text{Rp}}{\text{ton}}\right)$$

8.1.3 Waste Management Cost Data Covered by Non-Retribution

The Waste Management Cost not covered by retribution must be entered in Sheet 1 under Data Input for each region. This allocation is specifically intended to support waste management activities and must be adjusted based on the cost components listed in the Ideal Waste Management Cost Calculator. The components of the waste management costs

covered by non-retribution in the calculator can be reviewed in Table 8.3 Waste Management Costs Covered by Non-Retribution:

Table 8.3 Waste Management Costs Covered by Non-Retribution

No	Parameter	Notation	Unit	Mark
3.1	Waste Management Cost*)	**J**	Rp/Year	
3.2	Waste Management Cost	**K=J/F**	Rp/Ton	

*) Waste Management Cost (Non-Retribution) should be adjusted based on the results from the Ideal Waste Management Cost Calculator used (Operational and maintenance costs, with or without investment costs).

Notes:

Column : Data entry should follow the Waste Management Cost covered by non-retribution for each region.

Column : The calculation output is generated automatically by the calculator (no manual changes or input required).

Notation F : Total waste generation (tons per year) as per Table 8.1.

The required data for this calculation includes:

1.1 Waste Management Cost (Rp/Year) – Notation J

The Waste Management Cost covered by Non-Retribution (Rp/Year) represents regional budget allocations specifically designated for operational and maintenance costs of waste management over one year, sourced from non-retribution funding. The operational and maintenance cost components must align with the components outlined in the Ideal Waste Management Cost Calculator.

1.2 Waste Management Cost (Rp/Ton) – Notation K

The Waste Management Cost (Rp/Ton) is an automatic calculation output representing regional budget allocations based on local unit pricing, using the following formula:

$$\text{Waste Management Cost}\left(\frac{\text{Rp}}{\text{Ton}}\right) = \frac{\text{Waste Management Cost}\left(\frac{\text{Rp}}{\text{Year}}\right)}{\text{Waste Generation}\left(\frac{\text{Ton}}{Year}\right)}$$

8.1.4 Total Retribution Fee Requirements

The total retribution fee requirement is calculated as the difference between the total ideal waste management cost per year and the waste management costs covered by non-retribution sources. This total retribution fee requirement serves as the basis for determining retribution rates. Below is the concept for calculating the retribution fee requirement that must be fulfilled by each region

$$\text{Total Retribution Fee Requirement}$$

$$= \text{Ideal Waste Management Cost} - \text{Waste Management Cost Covered by Non} - \text{Retribution}$$

The components of the total retribution fee requirement in the retribution calculator can be reviewed in Table 8.4 Total Retribution Fee Requirement

Table 8.4 Total Retribution Fee Requirement

No	Parameter	Notation	Unit	Mark
4.1	Total Retribution Fee Requirement Rupiah per Ton	**L=H-K**	Rp/Ton	
4.2	Total Retribution Fee Requirement Rupiah per Year	**M= I-J**	Rp/Year	

Keterangan:

Column : Automatically calculated output from the calculator (no manual input needed).

Notation H : Waste management cost data from Table 8.2 (Rp/Ton).

Notation I : Waste management cost data from Table 8.2 (Rp/Year).

Notation J : Waste management cost covered by non-retribution sources from Table 8.3 (Rp/Year).

Notation K : Waste management cost covered by non-retribution sources from Table 8.3 (Rp/Ton).

The required data for this calculation includes:

1.1 Total Retribution Fee Requirement (Rupiah per Ton)

The total retribution fee requirement (Rp/Ton) is an automatically calculated output from the calculator, representing the difference between the ideal waste management cost (Rp/Ton) and the waste management cost covered by non-retribution (Rp/Ton), using the following formula:

$$\text{Total Retribution Fee Requirement}\left(\frac{\text{Rp}}{\text{Ton}}\right)$$

$$= \text{Ideal Waste Management Cost}\left(\frac{\text{Rp}}{\text{Ton}}\right) - \text{Waste Management Cost Covered by Non} - \text{Retribution}\ (\frac{\text{Rp}}{\text{Ton}})$$

4.2 Total Retribution Fee Requirement (Rupiah per Year)

The total retribution fee requirement (Rp/Year) is an automatically calculated output from the calculator, representing the difference between the ideal waste management cost (Rp/Year) and the waste management cost covered by non-retribution (Rp/Year), using the following formula:

$$Total\ Retribution\ Fee\ Requirement\left(\frac{Rp}{Tahun}\right)$$

$$= Ideal\ Waste\ Management\ Cost\left(\frac{Rp}{Tahun}\right) - Waste\ Management\ Cost\ Covered\ by\ Non - Retribution(\frac{Rp}{Tahun})$$

8.1.5 Total Retribution Fee Requirements per Source Category

The total retribution fee requirement per source category is obtained from the calculation of: Waste generation per source category and Retribution fee requirement per source category. The components of waste generation per source category in the retribution calculator can be reviewed in Table 8.5 Waste Generation per Source Category.

Table 8.5 Waste Generation per Source Category

No	Category	% of Waste Source	Waste Generation (Ton/Year)
		S = G	R = S*F
5.1	Household		
5.2	Office		
5.3	Business Centre		
5.4	Market		
5.5	Public Facilities		
5.6	Other area		
5.7			
5.8			
5.9			
5.10			
Total			

Notes:

Column : Input data based on each region's conditions.

Column : Automatically calculated output from the calculator (no manual input needed).

Notation F : Waste generation data (Ton/Year) from Table 8.1.

Notation G : % of waste source category from Table 8.1.

Notation S : % of waste source, equal to % of the waste service category from Table 8.1.

Waste generation per category is derived from the following data:

1.1 Percentage (%) of Waste Source per Category – Notation S

The percentage (%) of waste sources within the service area is an automatically calculated value based on the total household and similar waste generated by various source categories, as determined in Notation G from Table X (Waste Generation per Source Category Table).

1.2 Waste Generation per Category– Notation R

Waste generation per category is an automatically calculated output from the calculator based on the waste source data in the service area (Notation G) and total waste generation per year (Notation F) from Table 8.1, using the following formula:

$$Waste\ Generation\ per\ Category$$

$$= \%Waste\ Source\ per\ Category \times Total\ Waste\ Generation\ (\frac{Ton}{year})$$

The retribution fee requirement per source category is calculated based on the waste source data in the service area (Notation S) and the total annual retribution fee requirement (Notation M). The detailed retribution fee requirement for each source category in the retribution calculator can be found in Table 8.6 Retribution Requirement per Source Category

Table 8.6 Retribution Requirement per Source Category

No	Category	% of Retribution Payment	Retribution Requirement (Rp/Year)
		S=U	V=U*M
5.1	Household		
5.2	Office		
5.3	Business Centre		
5.4	Market		
5.5	Public Facilities		
5.6	Other Area		
5.7			
5.8			
5.9			
5.10			
Total			

Notes:

Column : Input data based on each region's conditions.

Column : Automatically calculated output from the calculator (no manual input needed).

Notation S : % of waste source from Table 8.5.

Notation U : % of retribution payment, equal to % of waste source from Table 8.5.

Notation M : Total retribution fee requirement (Rp/Year) from Table 8.4.

Retribution fee requirement per category is structured based on the following data:

1.1 Retribution Payment Percentage – Notation U

The percentage of retribution payment is an automatically calculated value based on the total household and non-household waste generated by various source categories, as determined in Notation S in Table 8.6 Waste Generation per Source Category Table, using the following formula:

$$\%\text{Retribution Payment per Category (U)} = \%\text{Waste Source per Category (S)}$$

1.2 Retribution Fee Requirement per Category (Rp/Year) – Notation M

The retribution fee requirement per category (Rp/Year) is an automatically calculated output from the calculator based on the retribution payment percentage (Notation U) and the total annual retribution fee requirement (Notation M) from Table 8.4 Total Retribution Fee Requirement, using the following formula:

$$Retribution\ Fee\ Requirement\ per\ Category\left(\frac{Rp}{Year}\right)$$

$$= \%\ Retribution\ Payment\ per\ Category\ (U) \times Total\ Retribution\ Fee\ Requirement(M)(\frac{Rp}{Year})$$

8.1.6 Retribution Fee Rate per Class

The final tariff per class is the end result of the calculation process based on the data and variables input into the retribution calculator.

8.1.6.1 Determination of Classes per Category

The five waste source categories are grouped into several classes based on the level of electricity supply capacity used. This classification serves as the basis for determining the economic class of each category, with the aim of ensuring fairness in the determination of retribution rates. If the class division is deemed appropriate using references other than the electricity capacity set by PLN, the local government may modify the basis for economic class classification according to regional conditions. The class division for each category, based on electricity capacity, is as follows:

a. Households

1) Poor Class: Households with an electricity connection capacity of 450 VA.
2) Lower Class: Households with an electricity connection capacity of 900 VA to 2,200 VA
3) Middle Class: Households with an electricity connection capacity of 3,500 VA to 5,500 VA
4) Upper Class: Households with an electricity connection capacity of 6,600 VA and above

b. Business

1) Small Business: Businesses with an electricity connection capacity of 450 VA to 5,500 VA.
2) Medium Business: Businesses with an electricity connection capacity of 6,600 VA to 200 kVA.
3) Large Business: Businesses with an electricity connection capacity of more than 200 kVA.

c. Social

1) Social-1: Social class designated for users with a very small electricity connection capacity, up to 220 VA.
2) Social-2: Social class designated for medium social institutions such as prayer rooms, mosques, churches, and other places of worship, health centers, orphanages, village halls, schools, dormitories, hospitals, etc., with an electricity capacity of at least 250 VA and at most 200 kVA.

3) Social-3: Social class designated for large social institutions, whether purely social or commercial social, such as mosques, churches, schools, dormitories, hospitals, etc., with an electricity capacity of more than 200 kVA. Pure social institutions refer to social bodies whose operational funding comes from the government budget (APBD/APBN), while commercial social institutions refer to social organizations, excluding places of worship, that are funded by non-government sources.

d. Industry

1) Small/Household Industry: Industries with an electricity capacity of 450 VA to 14 kVA.
2) Medium Industry: Industries with an electricity capacity of more than 14 kVA up to 200 kVA.
3) Upper Medium Industry: Industries with an electricity capacity of 200 kVA.
4) Large Industry: Industries with an electricity capacity of 30,000 kVA and above.

e. Public and Government

1) Public-1: Public and government offices with an electricity capacity of 450 VA to 200 kVA.
2) Public-2: Large government offices with an electricity capacity of more than 200 kVA.
3) Public-3: Public facility offices.

8.1.6.2 Cross-Subsidy Constant

The principle of fairness is reflected in the use of the cross-subsidy constant. This constant is a variable set as a multiplication factor based on fairness principles, adjusted through expert assessment, and aligned with the ideal conditions of each city/regency. The retribution system for each class within each category includes:

Table 8.7 Classification of Categories and Retribution System

No	Category	Class	Cross-Subsidy Constant Range***)	Unit Cost of Retribution	
				Volume System	Flat System
1	Household	Poor Class	0,1 - 0,5	Rp/Kg Rp/m3 Rp/L	Rp/KK/month
		Lower Class	0,5 - 1		
		Middle Class	1		
		Upper Class	Formula-Based		
2	Business Centre	Lower Business	Formula-Based	Rp/Kg Rp/m3 Rp/L	
		Middle Business	1 - 1,2		
		Upper Business	1,3 - 1,5		
3	Social	Social – 1	Formula-Based	Rp/Kg Rp/m3 Rp/L	
		Social – 2	1 - 1,2		
		Social – 3	1,3 - 1,5		
4	Industry	Small / household scale Industry	Formula-Based	Rp/Kg Rp/m3 Rp/L	
		Medium Industry	1 - 1,2		
		Upper Medium Industry	1,2 - 1,5		
		Large Industry	1,3 – 2		
5	Public and Government	Public - 1	Formula-Based	Rp/Kg Rp/m3 Rp/L	
		Public - 2	1 - 1,2		
		Public - 3	1,3 - 1,5		

***) The determination of the cross-subsidy constant can be adjusted according to local conditions and affordability.

8.1.6.3 Waste Density

Waste density is mandatory data for the calculation process. The determination of waste density can refer to the Regional Policy and Strategy Guidebook (Jakstrada), which equates 1 m^3 of waste to 0.33 tons, 0.33 kg/L, or 330 kg/m^3. Alternatively, local data from specific regional studies, such as waste sampling studies on household and non-household waste density, can be used.

Table 8.8 Waste Density Data

No	Parameter	Item	Unit	Mark
	Waste Density	BK1	Kg/L	
	(Jakstrada Guideline)	BK2	Kg/m3	

Notes:

Column : Data entry should be based on the category conditions of each region.

1) Household Waste-Based Fee Per Class (Rp/Kg, Rp/Liter, Rp/m^3) and Fixed Rate System (Rp/Household/Month)

Table 8.9 Household Waste-Based Retribution Fee Per Class

												Verifikasi	
No	Category	Number of Households	%	Waste Generation (Tons/Year)	Cross-Subsidy Constant	% Cross-Subsidy	Retribution Fee (Rp/year)	Retribution Fee (Rp/Ton)	Retribution Fee (Rp/Kg)	Retribution Fee Rp/Liter	Rp/m3	Retribution Fee (Rp/HH/Month)	Waste Generation (Tons/Year)
		W	X=%W	Y=X*R1	Z	AA=X*Z	AB= AA*Y1	AC=AB/Y	AD				
5.1	Household												
	Low-Income Household												
	Lowe-Class Household				0.50								
	Middle-Class Household				1.00								
	Upper-Class Household												
	Total	0				0%	0						0

Notes:

Column : Data entry should be based on each region's category conditions.

Column : Automatic calculation output from the calculator (should not be altered or manually input).

Column : Calculation output for data verification.

Data Required for Fee Calculation Per Class:

a) Number of Households (HH) per Class

The number of households per class must be input based on each region's actual conditions. The determination of HH per class follows the class distribution per category or uses specific regional data.

b) Percentage of Households per Class

The percentage of households per class is automatically calculated based on the number of HHs or units entered, using the formula:

$$\%\ HH = \frac{Number\ of\ HH\ per\ Class}{Total\ Number\ of\ HH\ per\ Class} \times 100\%$$

c) Waste Generation per Class (Tons/Year)

Automatically calculated based on the percentage of HHs or units per class and total waste generation per category. Formulated:

$$Waste\ Generation\ per\ Class\ (Tons/Year) = \%HH\ per\ Class \times Total\ Waste\ Generation\ per\ Category\ (Tons/Year)$$

d) Cross-Subsidy Constant

To be determined based on affordability and willingness to pay per class, assessed by expert judgment or local conditions.

e) Percentage of Cross-Subsidy

Automatically calculated as:

$$\%Cross - Subsidy = \%HH\ per\ Class \times Cross - Subsidy\ Constant$$

f) Retribution Fee per Class (Rp/Year)

The retribution fee per class (Rp/Year) is an automatically calculated output from the calculator, determined based on the cross-subsidy percentage and category retribution fee using the following formula:

$$Retribution\ Tariff\ per\ Class\ (Rp/Year) = Cross - Subsidy\ Percentage \times Category\ Retribution\ Tariff\ (Rp/Year)$$

g) Retribution Fee per Class Based on Weight (Rp/Ton and Rp/Kg)

Automatically calculated based on the cross-subsidy percentage and category fee:

$$Retribution\ Fee\ per\ Class\ (Rp/Ton) = (Retribution\ Fee\ per\ Class\ (Rp/Year))\ /\ (Waste\ Generation\ per\ Class\ (Ton/Year))$$

The retribution fee per class (Rp/Kg) is an automatically calculated output from the calculator, determined based on the retribution fee per class (Rp/Ton) using the following formula:

$$Retribution\ Fee\ per\ Class\ (Rp/Kg) = Retribution\ Fee\ per\ Class\ (Rp/Ton) \times (1\ Ton\ /\ 1000\ Kg)$$

h) Retribution Fee per Class Based on Volume (Rp/L, Rp/m3, and Rp/Household/Month)

The retribution fee per class (Rp/L) and (Rp/m3) are automatically calculated outputs from the calculator, determined based on the retribution fee per class (Rp/Kg) and waste density (Kg/L) or (Kg/m3) using the following formulas:

$$Retribution\ Fee\ per\ Class\ (Rp/L) = Retribution\ Fee\ per\ Class\ (Rp/Kg) \times Waste\ Density\ (Kg/L)$$
$$Retribution\ Fee\ per\ Class\ (Rp/m3) = Retribution\ Fee\ per\ Class\ (Rp/Kg) \times Waste\ Density\ (Kg/m3)$$

The retribution fee per class (Rp/Household/Month) is an automatically calculated output from the calculator, determined based on the annual retribution fee (Rp/Year) and the number of households (KK) using the following formula:

$$Retribution\ Fee\ per\ Class\ (Rp/(Household/Month)) = (Retribution\ Fee\ per\ Class\ (Rp/Year))\ /\ ((12\ Months/Year) \times Number\ of\ Households\ per\ Class)$$

2) Retribution Fee Rate per Business Category Class Based on Volume (Rp/Kg, Rp/Liter, and Rp/m3)

Table 8.10 Retribution Fee Rate per Business Category Class

No	Category	Number of Units	% Units	Waste Generation (Tons)	Cross-Subsidy Constant	% Cross-Subsidy	Retribution Fee (Rp/year)	Retribution Fee (Rp/Ton)	Retribution Fee (Rp/Kg)	Retribution Fee Rp/Liter	Retribution Fee Rp/m3	Retribution Fee (Rp/HH/Month)	Waste Generation (Tons/Year)
		BC	BD=%BC	BE=BD*R5	BF	BG=BD*BF	BH=BG*V5	BI=BH/BE	BJ				
5.5	Business Area												
	Small Business												
	Medium Business				1.10								
	Large Business				1.50								
	Total	0	0%	0		0%	Rp0						0

Keterangan:

Column : Data entry according to each region's category conditions.

Column : Automatically calculated data from the calculator (no need for modification or manual input).

The data required for calculating the retribution fee per class includes:

a) Number of Units per Class

The number of units per class is an input that should be filled based on the conditions of each region. The determination of unit numbers per class can be based on established class categories or specific regional data.

b) Percentage of Units per Class

The percentage of units per class is an automatically calculated output from the calculator based on the number of input units. The formula is as follows:

$$\%Units\ per\ Class = \frac{Number\ of\ Units\ per\ Class}{Total\ Units\ per\ Class} \times 100\%$$

c) Waste Generation per Class (Ton/Year)

The waste generation per class (Ton/Year) is an automatically calculated output from the calculator, based on the percentage of households or units per class and the waste generation per category (household, business, social, industry, public, and government). The formula for waste generation per class is as follows:

$$Waste\ Generation\ per\ Class\ (Ton/Year) = \%\ Units\ per\ Class \times Total\ Waste\ Generation\ per\ Category\ (Ton/Year)$$

d) Cross-Subsidy Constant

The cross-subsidy constant is an input that must be determined based on the capacity and willingness to pay the retribution fee per class, using expert judgment or the specific conditions of each city or district.

e) Cross-Subsidy Percentage

The cross-subsidy percentage is an automatically calculated output from the calculator, determined based on the percentage of units and the cross-subsidy constant using the following formula:

$$\%Cross - Subsidy = \%Units\ per\ Class \times Cross - Subsidy\ Constant$$

f) Retribution Fee per Class (Rp/Year)

The retribution fee per class (Rp/Year) is an automatically calculated output from the calculator, determined based on the cross-subsidy percentage and the category retribution fee using the following formula:

$$Retribution\ Fee\ per\ Class\ (Rp/Year) = Cross - Subsidy\ Percentage \times Category\ Retribution\ Fee\ (Rp/Year)$$

g) Retribution Fee per Class (Rp/Ton)

The retribution fee per class (Rp/Ton) is an automatically calculated output from the calculator, determined based on the retribution fee per class (Rp/Year) and waste generation (Ton/Year) using the following formula:

$$Retribution\ Fee\ per\ Class\ (\frac{Rp}{Ton}) = \frac{Retribution\ Fee\ per\ Class\ (Rp/Year}{Waste\ Generation\ per\ Class\ (Ton/Year)}$$

h) Retribution Fee per Class (Rp/Kg)

The retribution fee per class (Rp/Kg) is an automatically calculated output from the calculator, determined based on the retribution fee per class (Rp/Ton) using the following formula:

$$Retribution\ Fee\ per\ Class\ \left(\frac{Rp}{Kg}\right) = Retribution\ Fee\ per\ Class\left(\frac{Rp}{Ton}\right) \times \frac{1Ton}{1000Kg}$$

i) Retribution Fee per Class (Rp/L and Rp/m3)

The retribution fee per class (Rp/L) and (Rp/m3) are automatically calculated outputs from the calculator, determined based on the retribution fee per class (Rp/Kg) and waste density (Kg/L) or (Kg/m3) using the following formulas:

$$Retribution\ Fee\ per\ Class\left(\frac{Rp}{L}\right) = Retribution\ Fee\ per\ Class\ \left(\frac{Rp}{Kg}\right) \times Waste\ Density(\frac{Kg}{L})$$

$$Retribution\ Fee\ per\ Class\ \left(\frac{Rp}{m3}\right) = Retribution\ Fee\ per\ Class\ \left(\frac{Rp}{Kg}\right) \times Waste\ Density\ (\frac{Kg}{m3})$$

3) Retribution Fee Rate per Office Category Class Based on Volume (Rp/Kg, Rp/Liter, and Rp/m3)

Table 8.11 Retribution Fee Rate per Office Category Class

No	Category	Number of Units	% Units	Waste Generation (Tons)	Cross-Subsidy Constant	% Cross-Subsidy	Retribution Fee (Rp/year)	Retribution Fee (Rp/Ton)	Retribution Fee (Rp/Kg)	Retribution Fee Rp/Liter	Retribution Fee Rp/m3	Retribution Fee (Rp/HH/Month)	Waste Generation (Tons/Year)
		AE	AF=%AE	AG=AF*R2	AH	AI=AG*AH	AJ=AI*V2	AK=AJ/AG	AL				
5.2	Office Area												
	Small Office												
	Medium Office				1.00								
	Large Office				1.50								
Total		0	0%	0		0%	Rp0						0

Notes:

Column : Data entry according to each region's category conditions.

Column : Automatically calculated data from the calculator (no need for modification or manual input).

The data required for calculating the retribution fee per class includes:

a) Number of Units per Class

The number of units per class is an input that should be filled based on the conditions of each region. The determination of unit numbers per class can be based on established class categories or specific regional data.

b) Percentage of Units per Class

The percentage of units per class is an automatically calculated output from the calculator based on the number of input units. The formula is as follow:

$$\%Unit\ per\ Class = \frac{Number\ of\ Units\ per\ Class}{Total\ Units\ per\ Class} \times 100\%$$

c) Waste Generation per Class (Ton/Year)

The waste generation per class (Ton/Year) is an automatically calculated output from the calculator, based on the percentage of households or units per class and the waste generation per category:

$$Waste\ Generation\ per\ Class\ \left(\frac{Ton}{Year}\right) = \%\ Units\ per\ Class\ \times\ Total\ Waste\ Generation\ per\ Category\ \left(\frac{Ton}{Year}\right)$$

d) Cross-Subsidy Constant

The cross-subsidy constant is an input that must be determined based on the capacity and willingness to pay the retribution fee per class, using expert judgment or the specific conditions of each city or district.

e) Cross-Subsidy Percentage

The cross-subsidy percentage is an automatically calculated output from the calculator, determined based on the percentage of units and the cross-subsidy constant using the following formula:

$$\%Cross - Subsidy\ =\ \%Units\ per\ Class\ \times\ Cross - Subsidy\ Constant$$

f) Retribution Fee per Class (Rp/Year)

The retribution fee per class (Rp/Year) is an automatically calculated output from the calculator, determined based on the cross-subsidy percentage and the category retribution fee using the following formula:

$$Retribution\ Fee\ per\ Class\ (Rp/Year) = Cross - Subsidy\ Percentage\ \times\ Category\ Retribution\ Tariff\ (Rp/Year)$$

g) Retribution Fee per Class (Rp/Ton)

The retribution fee per class (Rp/Ton) is an automatically calculated output from the calculator, determined based on the retribution fee per class (Rp/Year) and waste generation (Ton/Year) using the following formula:

$$Retribution\ Fee\ per\ Class\ \left(\frac{Rp}{Ton}\right) = \frac{Retribution\ Fee\ per\ Class\ (Rp/Year}{Waste\ Generation\ per\ Class\ (Ton/Year)}$$

h) Retribution Fee per Class (Rp/Kg)

The retribution fee per class (Rp/Kg) is an automatically calculated output from the calculator, determined based on the retribution fee per class (Rp/Ton) using the following formula:

$$Retribution\ Fee\ per\ Class\ \left(\frac{Rp}{Kg}\right) = Retribution\ Fee\ per\ Class\left(\frac{Rp}{Ton}\right) \times \frac{1Ton}{1000Kg}$$

i) Retribution Fee per Class (Rp/L and Rp/m3)

The retribution fee per class (Rp/L) and (Rp/m3) are automatically calculated outputs from the calculator, determined based on the retribution fee per class (Rp/Kg) and waste density (Kg/L) or (Kg/m3) using the following formulas:

$$Retribution\ Fee\ per\ Class\left(\frac{Rp}{L}\right) = Retribution\ Fee\ per\ Class\ \left(\frac{Rp}{Kg}\right) \times Waste\ Density(\frac{Kg}{L})$$

$$Retribution\ Fee\ per\ Class\ \left(\frac{Rp}{m3}\right) = Retribution\ Fee\ per\ Class\ \left(\frac{Rp}{Kg}\right) \times Waste\ Density\ (\frac{Kg}{m3})$$

4) Retribution Fee Rate for Commercial Category Based on Volume (Rp/Kg, Rp/Liter, and Rp/m3)

Table 8.12 Retribution Fee Rate per Commercial Category Class

No	Category	Number of Units	% Units	Waste Generation (Tons)	Cross-Subsidy Constant	% Cross-Subsidy	Retribution Fee (Rp/year)	Retribution Fee (Rp/Ton)	Retribution Fee (Rp/Kg)	Retribution Fee		Retribution Fee (Rp/HH/Month)	Waste Generation (Tons/Year)
		AM	AN=%AM	AO=AN*R3	AP	AQ=AN*AP	AR=AQ*V3	AS=AQ/AO	AT	Rp/Liter	Rp/m3		
5.3	Commercial Area												
	Small Commercial Establishment												
	Medium Commercial Establishment				1.10								
	Large Commercial Establishment				1.50								
	Total	0	0%	0		0%	Rp0						0

Notes:

Column : Input data should be adjusted according to the conditions of each category in the region.

Column : Output data is automatically calculated by the calculator (no changes or manual input required).

Required Data for Calculating Retribution Fees per Class:

a) Number of Units per Class

The number of units per class is an input that should be filled based on the conditions of each region. The determination of unit numbers per class can be based on established class categories or specific regional data.

b) Percentage of Units per Class

The percentage of units per class is an automatically calculated output from the calculator based on the number of input units. The formula is as follows:

$$\%Units\ per\ Class = \frac{Number\ of\ Units\ per\ Class}{Total\ Units\ per\ Class} \times 100\%$$

c) Waste Generation per Class (Ton/Year)

The waste generation per class (Ton/Year) is an automatically calculated output from the calculator, based on the percentage of households or units per class and the waste generation per category (household, business, social, industry, public, and government). The formula for waste generation per class is as follows:

$$Waste\ Generation\ per\ Class\ (Ton/Year)\ =\ \%\ Units\ per\ Class\ \times\ Total\ Waste\ Generation\ per\ Category\ (Ton/Year)$$

d) Cross-Subsidy Constant

The cross-subsidy constant is an input that must be determined based on the capacity and willingness to pay the retribution fee per class, using expert judgment or the specific conditions of each city or district.

e) Cross-Subsidy Percentage

The cross-subsidy percentage is an automatically calculated output from the calculator, determined based on the percentage of units and the cross-subsidy constant using the following formula:

$$\%Cross - Subsidy \; = \; \%Units\ per\ Class \; \times \; Cross - Subsidy\ Constant$$

f) Retribution Fee per Class (Rp/Year)

The retribution fee per class (Rp/Year) is an automatically calculated output from the calculator, determined based on the cross-subsidy percentage and the category retribution fee using the following formula:

$$Retribution\ Fee\ per\ Class\ (Rp/Year) = Cross - Subsidy\ Percentage \times Category\ Retribution\ Tariff\ (Rp/Year)$$

g) Retribution Fee per Class (Rp/Ton)

The retribution fee per class (Rp/Ton) is an automatically calculated output from the calculator, determined based on the retribution fee per class (Rp/Year) and waste generation (Ton/Year) using the following formula:

$$Retribution\ Fee\ per\ Class\ (\frac{Rp}{Ton}) = \frac{Retribution\ Fee\ per\ Class\ (Rp/Year}{Waste\ Generation\ per\ Class\ (Ton/Year)}$$

h) Retribution Fee per Class (Rp/Kg)

The retribution fee per class (Rp/Kg) is an automatically calculated output from the calculator, determined based on the retribution fee per class (Rp/Ton) using the following formula:

$$Retribution\ Fee\ per\ Class\ \left(\frac{Rp}{Kg}\right) = Retribution\ Fee\ per\ Class\left(\frac{Rp}{Ton}\right) \times \frac{1Ton}{1000Kg}$$

i) Retribution Fee per Class (Rp/L and Rp/m3)

The retribution fee per class (Rp/L) and (Rp/m3) are automatically calculated outputs from the calculator, determined based on the retribution fee per class (Rp/Kg) and waste density (Kg/L) or (Kg/m3) using the following formulas:

$$Retribution\ Fee\ per\ Class\left(\frac{Rp}{L}\right) = Retribution\ Fee\ per\ Class\ \left(\frac{Rp}{Kg}\right) \times Waste\ Density(\frac{Kg}{L})$$

$$Retribution\ Fee\ per\ Class\ \left(\frac{Rp}{m3}\right) = Retribution\ Fee\ per\ Class\ \left(\frac{Rp}{Kg}\right) \times Waste\ Density\ (\frac{Kg}{m3})$$

5) Retribution Fee Rate for Public Facility Category Based on Volume (Rp/Kg, Rp/Liter, and Rp/m3)

Table 8.13 Retribution Fee Rate per Public Facility Category Class

No	Category	Number of Units	% Units	Waste Generation (Tons)	Cross-Subsidy Constant	% Cross-Subsidy	Retribution Fee (Rp/year)	Retribution Fee (Rp/Ton)	Retribution Fee (Rp/Kg)	Retribution Fee		Retribution Fee (Rp/HH/Month)	Waste Generation (Tons/Year)
										Rp/Liter	Rp/m3		
		AU	AV=%AU	AW=AV*R4	AX	AY=AV*AX	AZ=AY*V4	BA=AZ/AW	BB				
5.4	**Public Facility**												
	Small Public Facility												
	Medium Public Facility				1.00								
	Large Public Facility				1.30								
	Total	0	0%	0		0%	Rp0						0

Notes:

Column : Input data should be adjusted according to the conditions of each category in the region.

Column : Output data is automatically calculated by the calculator (no changes or manual input required).

Required Data for Calculating Retribution Fees per Class:

a) Number of Units per Class

The number of units per class is an input that should be filled based on the conditions of each region. The determination of unit numbers per class can be based on established class categories or specific regional data.

b) Percentage of Units per Class

The percentage of units per class is an automatically calculated output from the calculator based on the number of input units. The formula is as follows:

$$\%Units\ per\ Class = \frac{Number\ of\ Units\ per\ Class}{Total\ Units\ per\ Class} \times 100\%$$

c) Waste Generation per Class (Ton/Year)

The waste generation per class (Ton/Year) is an automatically calculated output from the calculator, based on the percentage of households or units per class and the waste generation per category (household, business, social, industry, public, and government). The formula for waste generation per class is as follows:

$$Waste\ Generation\ per\ Class\ (Ton/Year) = \%\ Units\ per\ Class \times Total\ Waste\ Generation\ per\ Category\ (Ton/Year)$$

d) Cross-Subsidy Constant

The cross-subsidy constant is an input that must be determined based on the capacity and willingness to pay the retribution fee per class, using expert judgment or the specific conditions of each city or district.

e) Cross-Subsidy Percentage

The cross-subsidy percentage is an automatically calculated output from the calculator, determined based on the percentage of units and the cross-subsidy constant using the following formula:

$$\%Cross - Subsidy = \%Units\ per\ Class \times Cross - Subsidy\ Constant$$

f) Retribution Fee per Class (Rp/Year)

The retribution fee per class (Rp/Year) is an automatically calculated output from the calculator, determined based on the cross-subsidy percentage and the category retribution fee using the following formula:

$$Retribution\ Tariff\ per\ Class\ (Rp/Year) = Cross - Subsidy\ Percentage \times Category\ Retribution\ Tariff\ (Rp/Year)$$

g) Retribution Fee per Class (Rp/Ton)

The retribution fee per class (Rp/Ton) is an automatically calculated output from the calculator, determined based on the retribution fee per class (Rp/Year) and waste generation (Ton/Year) using the following formula:

$$Retribution\ Fee\ per\ Class\ (\frac{Rp}{Ton}) = \frac{Retribution\ Fee\ per\ Class\ (Rp/Year}{Waste\ Generation\ per\ Class\ (Ton/Year)}$$

h) Retribution Fee per Class (Rp/Kg)

The retribution fee per class (Rp/Kg) is an automatically calculated output from the calculator, determined based on the retribution fee per class (Rp/Ton) using the following formula:

$$Retribution\ Fee\ per\ Class\left(\frac{Rp}{Kg}\right) = Retribution\ Fee\ per\ Class\left(\frac{Rp}{Ton}\right) \times \frac{1Ton}{1000Kg}$$

i) Retribution Fee per Class (Rp/L and Rp/m3)

The retribution fee per class (Rp/L) and (Rp/m3) are automatically calculated outputs from the calculator, determined based on the retribution fee per class (Rp/Kg) and waste density (Kg/L) or (Kg/m3) using the following formulas:

$$Retribution\ Fee\ per\ Class\left(\frac{Rp}{L}\right) = Retribution\ Fee\ per\ Class\ \left(\frac{Rp}{Kg}\right) \times Waste\ Density(\frac{Kg}{L})$$

$$Retribution\ Fee\ per\ Class\ \left(\frac{Rp}{m3}\right) = Retribution\ Fee\ per\ Class\ \left(\frac{Rp}{Kg}\right) \times Waste\ Density\ (\frac{Kg}{m3})$$

8.2 Retribution Collection Mechanism

After determining the fee amount, retribution collection can be carried out based on mechanisms established by the local government. The following are options for the waste management retribution collection mechanism:

1. **Direct Billing:** Retribution is periodically billed to the community through waste management units (operators) or relevant agencies.
2. **Integration with Other Bills:** Retribution fees are included in other utility bills, such as water or electricity, to facilitate the collection process.
3. **Self-Payment:** The community pays the retribution through digital platforms, official payment counters, or banks in collaboration with the local government.
4. **On-Site Collection:** In some cases, waste management officers may directly collect retribution fees when the service is provided, such as household or business waste collection.

09

Guidelines for Modifying Waste Management Cost Calculator

9. Guidelines for Modifying the Waste Management Cost Calculator

The implementation of waste management often encounters variations in field conditions that do not fully align with the pre-designed calculator framework. Therefore, this chapter provides guidance on modifications, particularly to the waste management cost calculator, to better reflect actual operational conditions and regional needs. These steps are essential to ensure that the calculation results accurately represent real conditions, serving as a reliable basis for determining retribution tariffs. Below are the steps for modifying the waste management calculator:

9.1. Modification of Waste Management Flow

The first step in modifying the calculator is to ensure that the waste management flow aligns with actual field conditions. For example, the default waste management flow in the calculator is:

> Collection → TPS/Depo; WTS3R → **Transportation 1** → TPST → Transportation 2 → Landfill

However, if the local government intends to modify it to:

> Collection → **Transportation 1** → TPS/Depo; WTS3R; TPST → Transportation 2 → Landfill

To implement this modification, follow these steps:

a) Ensure that the waste management stages align with actual field conditions.
b) Select all cells to be moved, such as the Transportation Table 1. Right-click and choose Cut or press Ctrl+X.
c) Move the cursor to the target cell, right-click, and choose Paste or press Ctrl+V.

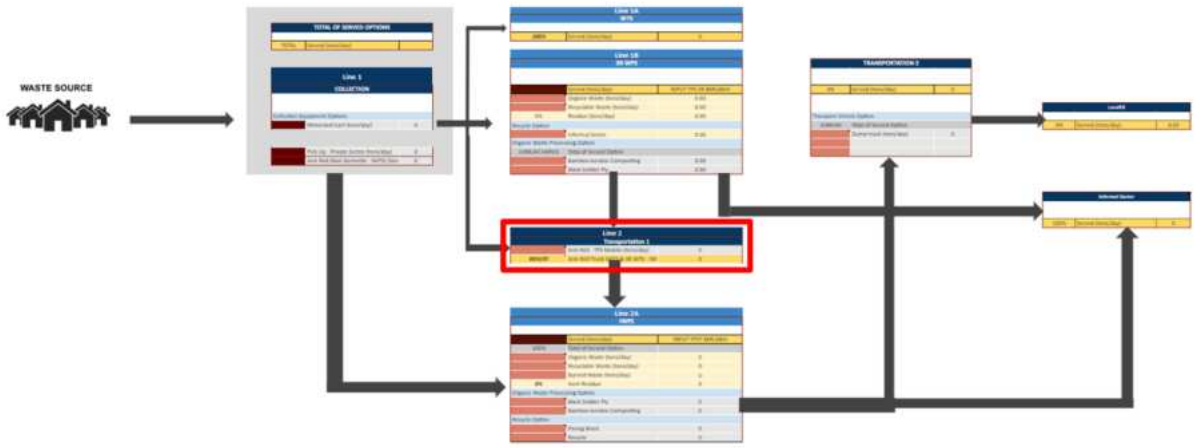


Figure 9.1 Default Waste Management Flow in the Calculator (Before Modification)

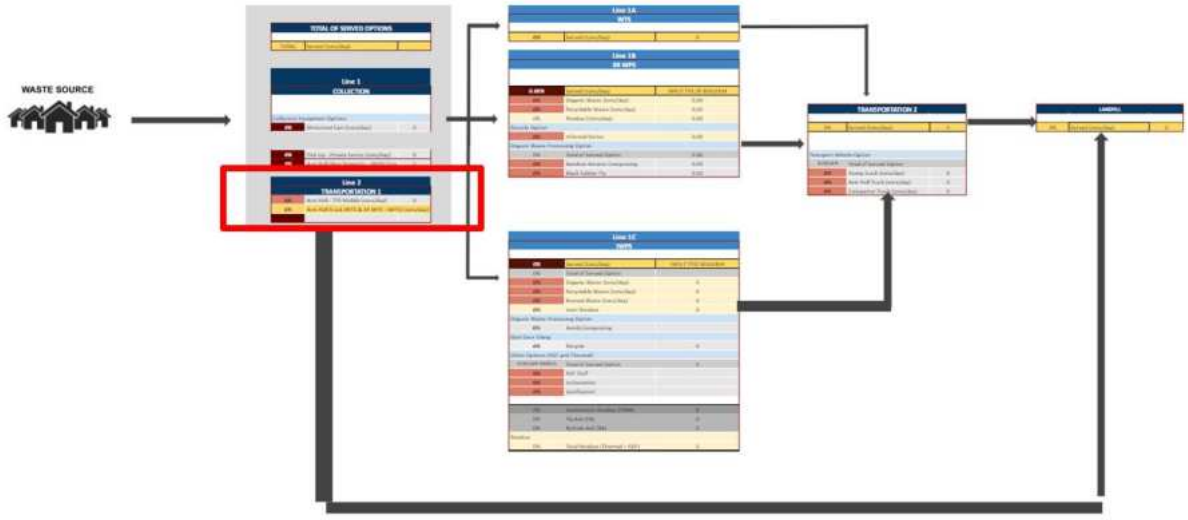


Figure 9.2 Waste Management Flow in the Calculator (After Modification)

9.2. Adjustments to the Input Data Sheet

Once the waste management flow has been updated, the next step is to adjust the order of sub-systems in the Input Data Sheet to maintain consistency with the new flow. This adjustment requires repositioning relevant tables. For example:

- **Default calculator** : TPS/Depo; 3R-WPS → **Transportation 1** → IWPS
- **Actual Condition** : **Transportation 1** → TPS/Depo → 3R-WPS → IWPS

In this case, the Transportation 1 Sub-system Table must be moved from its previous position (after 3R-WPS) to its new location (before 3R-WPS). The procedure is similar to the previous steps:

a) Select all cells to be moved, such as the Transportation 1 Sub-system Table. Right-click and choose Cut or press Ctrl+X.
b) Move the cursor to the target cell, right-click, and choose Paste or press Ctrl+V.

Figure 9.3 Default Order of Waste Management Sub-systems in the Calculator (Before Modification)

Figure 9.4 Order of Waste Management Sub-systems in the Calculator (After Modification)

9.3. Adjustment of Sheet Order

Next, the sheet order in the calculator must be updated to reflect the revised flow. Follow these steps to adjust the sheet positions:

a) Locate the sheet names at the bottom of the screen. For example, if you want to move a sheet so that it appears after the IWPS sheet.
b) Left-click and hold the selected sheet tab. Drag the tab to the desired position by moving the mouse left or right. Release the mouse click when the tab is in the correct position.
c) fter releasing the mouse, check if the sheet order is correct. Repeat these steps for other sheets if necessary.

Figure 9.5 Default Sheet Order in the Calculator (Before Modification)

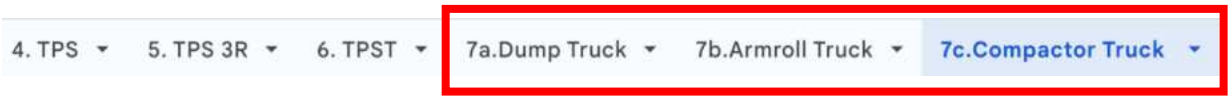


Figure 9.6 Sheet Order in the Calculator (After Modification)

9.4. Adjustment of Formulas and Verification

The final step is to ensure that all formulas in the calculator are correctly linked to the modifications made. For instance, verify that all formulas in the **Output Data Requirement Sheet** are properly connected, ensuring that the summary of requirements—such as equipment/machinery needs, number of operators, and service capacity—automatically reflects the updated conditions. Additionally, check the **Calculation Summary Sheet** accurately displays results according to the revised waste management flow and sub-systems.

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