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# **FINAL REPORT**



**Designing  
Integrated & Sustainable  
Waste Management**

**Genggelang Village  
Gangga District,  
North Lombok Regency**

**Designing Integrated & Sustainable Waste Management**  
**Genggelang Village, Gangga District,**  
**North Lombok Regency**



# Executive Summary

## Introduction

In 2019 UNDP Indonesia support to rebuild Genggelang Market in Gangga North Lombok with the construction finished in Dec 2020. Genggelang market is categorized as village market (Pasar Desa) that operated weekly on Thursday. This market is very important for 11,530 residents, for it is the closest place to buy groceries. The development of this market is expected to improve the livelihood activities of the community. The village government plan to operate it daily, so it can affect the economic and livelihood condition of the community. However, the growth of the market will lead the increase of waste generation.

Throughout Indonesia, waste management is a serious problem that is manifested in all phases of the waste management cycle. Among the immediate challenges are lack of waste data, poor service coverage (especially in low-income areas), insufficient segregation of recyclables, dangerous working conditions for operational staff, illegal and environmental damaging disposal practices, inefficient designs/locations of transfer stations, lack of sanitary final disposal sites and engineered treatment facilities and limited exploitation of the energy and resource contents of the waste. Nowadays, solid waste has become a global issue that must be managed in a comprehensive and integrated way. Solid waste generation continues to increase as the population growth but otherwise, the unbalance amount of infrastructure, the limitation of land for final disposal sites, and the high cost of waste collection and transportation became challenges in solid waste management itself. It needs efforts to handle and process the waste since the waste source to reduce the burden of final disposal sites (landfills). One of the strategies is by developing the 3R approach (reduce, reuse, recycle) at the community level. The issue of proper waste management is a shared responsibility that includes the citizens and households, as well as the government. The largest stream of municipal solid waste in Indonesia flows from households followed by traditional markets.

## National Waste management Strategis

Law No. 18/ 2008 has been issued by the Government of Indonesia as an umbrella for national waste management policy and practice in Indonesia. The government created the derived regulations as guidance to the waste management implementation. The derived regulations include Government Regulation No 81/2012; Perpres No 97/2017; and ministry regulation. According to the regulations, solid waste management is divided into two fundamental activities include waste reduction and waste handling. The waste management in Indonesia have been adopting circular economic concept since 2020. Furthermore, the national government has formulated a regulation on Extended Producers responsibilities in December 2019 (MoEF Regulation No P.75/2019 in Roadmap to Waste Reduction by producers.

The regulations mentioned the solid waste producer include household activities, garbage (commercial area, industrial area, special arena, social facility, school, etc.); and specific solid waste (including solid hazardous waste, building debris due to the disasters). Hence, the government created the derivative rule as technical guidance

for solid waste management especially for municipal waste called Government Regulations No 81/2012 about municipal solid waste management.

### General Condition of Genggelang Village

Genggelang village is a part of Gangga Sub District, North Lombok West Nusa Tenggara Province. The area of this village approximately 29,21 km<sup>2</sup> equal to 18,56 % of the total area Gangga Sub District. This village is divided into 12 sub village. The land use is divided into 4 types including rice fields about 0,41 km<sup>2</sup>, industrial plantation about 6,89 km<sup>2</sup>, of settlement areas ab public space about 0,8 km<sup>2</sup>, and forests about 21,83 km<sup>2</sup> which dominated by industrial forestry. Agriculture is the main livelihood of the community followed by trading. The average income about Rp 900.000 per harvest. The number has verified with the survey to the community. Around 87,9% of the respondents answer that they earn around IDR 2.000.000 per month.

The solid waste in Genggelang is managed with traditional methods include burnt (82%); dumped to the river (3%); segregated (12%); and dumped to the backyard (3%). urrent waste management in Genggelang village. The waste stream in Genggelang village is presented in the following picture. Most of the respondents willing to consider waste segregation if the information how to segregate available. Approximately 81,8% of the respondents answered agree that waste segregation is important. However, 18% of the respondents consider to segregate the waste regularly, and around 52% of them chose to answer sometimes as well as most of the time (12%). Likely, the answer is influenced by the main livelihood of the community. They spend most of their times to work in the farm.

About 67% of the respondent interest to use the waste management service. Approximately 21% of them very likely to use the service. Based on the interview, most of the respondents willing to pay less than Rp 5000,00 for the service equal to 0,06% of the community income per harvest. According to the responses to the questionnaires, if appropriate mechanisms, incentives, and technical information are provided, the majority of respondents agree to play future roles, such as segregate the waste (join the waste bank) and being involved in the organic waste management.



Figure 1. Waste Stream in Genggelang Village



The waste producer in Genggeling village include households, tourism, Genggeling market, industry, and offices, and it produce about 3488 tons of waste. The number is gradually increase from 2021 to 2050. The waste forecast was calculated based on population data of Genggeling village from 2016 – 2020. According to the District Regulation No 9/2020, Genggeling village is divided into two villages include Genggeling and Segara Katon. However, the population forecast was calculated based on population data before the regulation from 2016 – 2020. The population and waste forecast are presented in the following table.

Table 1. Population and Waste Forecast in Genggeling

Year	Population	Waste generation (kg/ person/ day)	Waste quantity (kg/day)	Waste quantity m <sup>3</sup> /day)
2020	11.626	0,3	3.488	13.951
2025	12.156	0,3	3.647	14.587
2030	12.680	0,3	3.804	15.216
2035	13.204	0,3	3.961	15.845
2040	13.728	0,3	4.118	16.474
2045	14.252	0,3	4.276	17.102
2050	14.776	0,3	4.433	17.731

Source: Analysis by UNDP, 2021

Table 2. Waste Composition

Waste Types	North lombok	Gangga and Tanjung
Organic Waste	59,90%	79,86%
Cardboard/papers	17,40%	4,53%
plastics	17,60%	12,83%
glass	3,00%	0,48%
metal	1,40%	0,17%
Other	0,80%	2,13%

Source: Danida (2019) and Simorangkir (2019)

The waste composition in Gangga is dominated by organic material that constitutes around 79,86% of the total waste. Organic waste consists of food leftover and plant litter. Plastic and paper dominated the inorganic waste.

Due to tourism activities, the production of inorganic waste is expected to increase over the years. Based on the field assessment, there are a few coffee shops in the tourism area. They mostly sell instant coffee and instant noodle that will produce inorganic waste from the package. The plastics package for instant food is made from multilayer plastics which categorized as non-recyclable plastic. This means that the waste management strategy has to consider the waste reduction program.

## Gap Analysis

The social analysis shown that the main problem in Genggeling is the community perception towards waste segregation and recycle. They assumed that the best solution to manage the waste is burnt it. Moreover, some of local authorities

(dukuh) suggest the community to burnt the waste than dumped to the river. Budget planning aspects: The waste sector still has an obstacle related to the internal competition among which own development programs. Waste management is not as highly prioritized as other sectors. This is worsened by a general low understanding on waste management aspects by the key people, on district level and village levels. In fact, there are actually many funding sources which could be used provided that the mechanisms are properly applied.

According to Pak Al-Maududi, the community has urged the village government to make the Village Regulation for waste management. They have complained about lack of the waste collection service from the government. The village government plan to develop the regulation, and they will hand over the waste management to BUMDES as a new business activity.

However, the Bumdes of Genggelang has just elected the management team a few month ago, so they still need an assistance to implement of waste management in the village. As result of the interview with the management team, they still lack of knowledge about waste management. Moreover, they don't understand yet that they can make the waste management system as an additional business.

#### **Objectives and targets Masterplan**

Considering the social and economic condition of the community, the waste management in Genggelang is proposed to combine TPS 3R concept and waste bank. The objective of this system is to provide the waste management system that sustainable and accessible for the community from various income and social condition. The waste management system should be developed in such manner that adopted the economic resources of the community, and it can assure the collection, treatment, and disposal suitable with the capacity of different economic actor to pay.

The target of this planning document is determined based on the interest of the community to use the waste management service offer by Bumdes, willingness to segregate the waste, and willingness to pay the service. The village government targeted around 1000 households will attracted and join the program in the early stage, and they expect it will gradually increase year by year.

#### **Waste collection options**

Based on the field observation and willingness to pay, the block collection system is the most suitable system that can be implemented in Genggelang Village. Block collection system has chosen as the best solution for the waste collection because it suitable with the requirement includes limited of vehicle availability, unable to control the personnel, contour of the area is undulating, and not accessible, high community participation, irregular settlement.

The community should be encouraged to transport the waste from the house to the collecting point or temporary shelter (TPS-Tempat Penampungan Sementara). The collection point has to be placed to the most accessible area, so it can be accessed by various type of vehicle. The collection point location was determined using spatial analysis considering the distance to the TPS 3R location, main road, and service area. The collection network as follow:

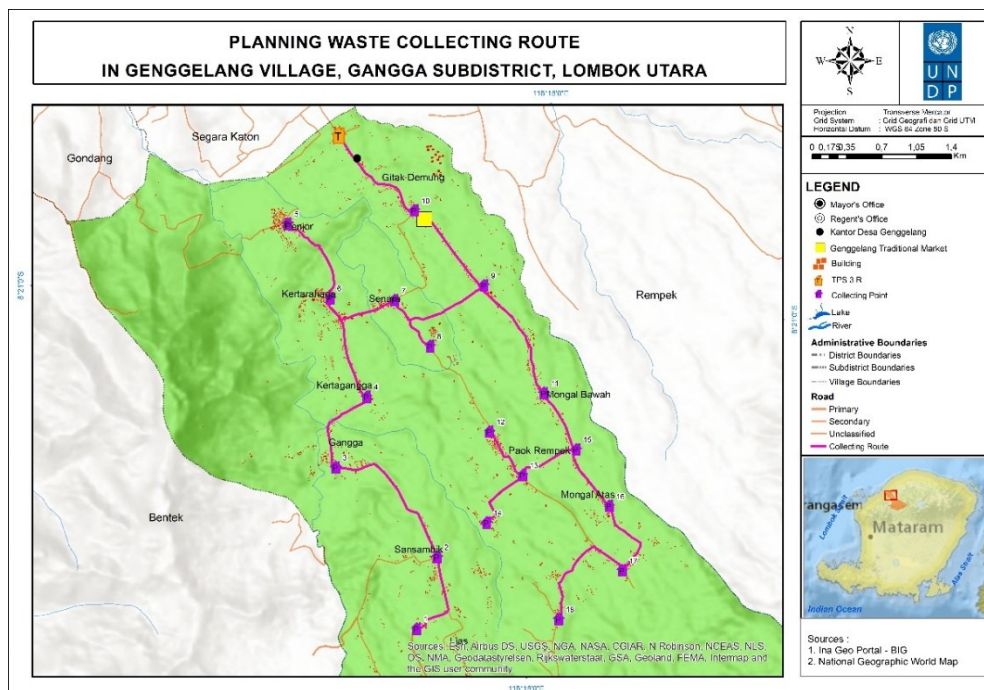


Figure 2. Waste Collection network

The most important equipment is vehicle to transport the waste from the collecting point to the TPS 3R. The District Government committed to provide 2 unit of three wheeled motor with container to collect the waste. Moreover, Penjor sub village had already owned it since 2019. The assumption, the vehicle to transport the residue from TPS 3R to the landfill will be conducted by District Government (Environmental Agency) as mentioned in the regulation and district waste management masterplan. The equipment needs

Table 3. Equipment needs to collect the waste in Genggelang Village

Equipment need	qty	Waste handling capacity	Frequency of Service	Daily waste handling (m3)
Waste container in the collecting point for 40 hh (SNI 19-2454-2002)	18	500 m <sup>3</sup>	emptied daily	9000
three-wheeled motor with container (maximum 1500 m3 of waste per trip)	3	1600	3 trip/day/vehicle	9600
TPS 3R/ waste processing site	1	8800 m <sup>3</sup> or 2 tons of waste/day	Managed daily	8800

Source: Analysis by UNDP. 2021

## Policy for Waste Management

### Waste Reduction

The proposed system prioritises the principle to reduce, reuse and recycle (3R). It will seek to meet target of 30% waste diversion at the source by 2025 as required by



the PR No. 97/2017. The strategy to improve the waste reduction form the source as follow:

- Facilitate the sub village to develop waste bank or bank sampah unit to provide an incentive to the community who willing to segregate the waste and listed as a waste bank member
- Training of waste reduction and waste handling for households (composting, bsf maggot training, training to make handicraft from the waste)
- Provide Bank Sampah Desa (waste bank for village level) as an end buyer of the waste that collected by bank sampah unit

### Waste Handling

Refer to District Regulation No 3/2018 about waste management, the waste must be collected and properly treated. The waste management proposed include collecting, segregation in the TPS 3R, organic waste treatment, inorganic waste recycle, and transporting the residual waste to the official landfill (Jugil). The recommended approaches to address these objectives are given below.

The waste management system in Genggelang should be implemented with a combination of business and community-based approaches. The waste management that is managed as a business is a waste collection and transportation system that will gain revenue from the tipping fee. The regulation will encourage the community to treat the waste appropriately using the 3R concept. They have to segregate the waste, then they must put the residual waste in the TPS/collecting point. The waste will be collected by the collector from TPS3R. The collector will transport it to the facility.

### Strategy of Waste Management

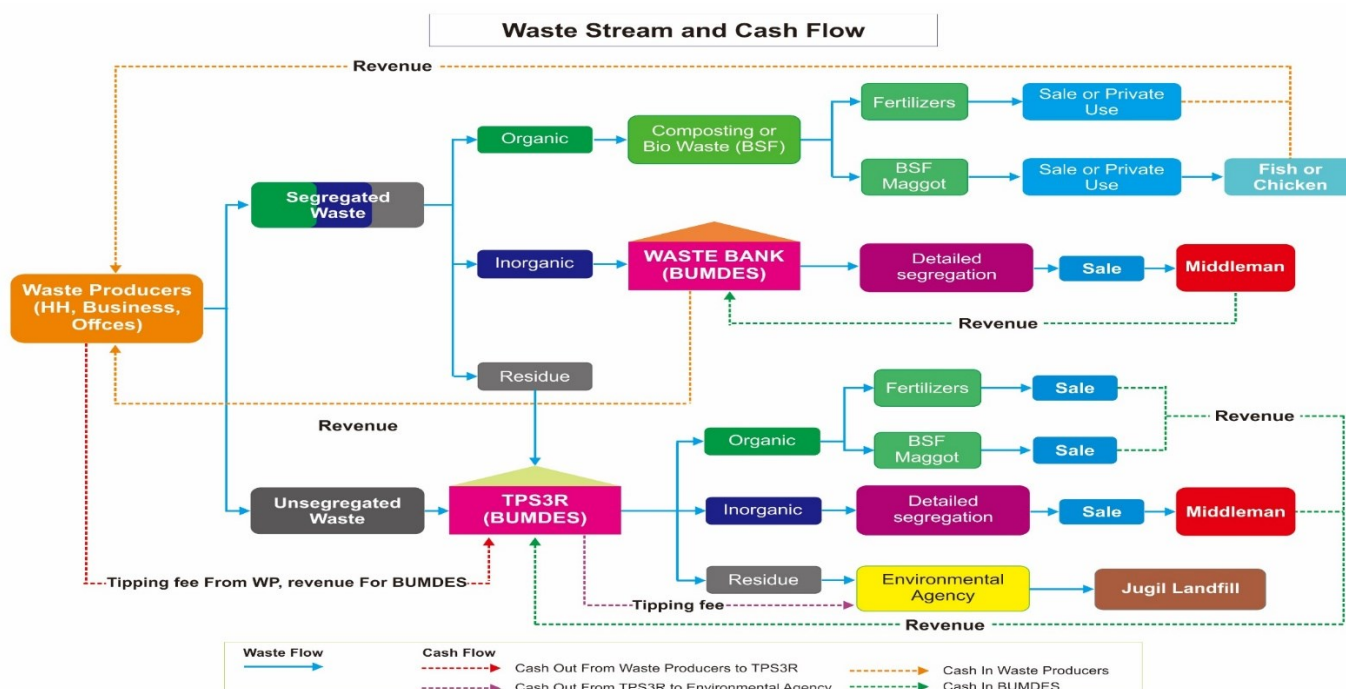


Figure 3. Expected waste stream and revenue stream of MSW Management in Genggelang Village

## Strategy Approach

Generally, success TPS3R in Indonesia has been implemented with business approach. Based on the social condition of Genggelang village, the waste management should be conducted with socio-entrepreneur approach. The implementation of waste collection and transportation service is operated with business approach. In contrast, the waste bank is implemented with community-based approach. The business model canvassing for waste management using combination of TPS3R and Waste bank as follow:

Key Partners	Key Activities	Value propositions	Customer relationship	Customer Segments:
<ul style="list-style-type: none"> <li>- Middleman/end buyer for recyclable waste</li> <li>- Waste bank unit who sell the inorganic waste to the Bumdes</li> <li>- Other TPS3R in North Lombok</li> <li>- Potential donors and sponsors who support the environment</li> <li>- District Government (Environmental Agency and Public Work Office)</li> </ul>	<ul style="list-style-type: none"> <li>- Waste collection and transportation</li> <li>- Waste segregation</li> <li>- Organic waste processing</li> <li>- BSF maggot production</li> <li>- Compost production</li> <li>- Waste bank unit development</li> <li>- Waste bank for village level (valuable waste buyer for waste bank unit)</li> <li>- Sale and marketing for service, compos, maggot, valuable waste</li> <li>- Research and development</li> <li>- Monitoring and evaluation</li> </ul>	<ul style="list-style-type: none"> <li>- Community involvement in the business through waste bank</li> <li>- Competitive price</li> <li>- Environmental benefit</li> <li>- Commitment to sustainability</li> <li>- Additional income from inorganic waste for HH who join waste bank</li> <li>- Guarantee to the utilization of compost and BSF maggot</li> </ul>	<ul style="list-style-type: none"> <li>- Dissemination by village government or Bumdes to the community</li> <li>- Monthly meeting of women organization (PKK) in each sub village</li> <li>- Monthly meeting of Youth organization</li> <li>- Training and assistance program for each sub village</li> </ul>	<p>Mass market:</p> <ul style="list-style-type: none"> <li>- Households about 2242 (middle income and high income as TPS3R customers; low income as waste bank customer)</li> <li>- Business (market, industries, hotels, homestay, etc.)</li> </ul> <p>Niche market:</p> <ul style="list-style-type: none"> <li>- Tourists</li> <li>- Business to business market</li> </ul>
<p>Key resources</p> <ul style="list-style-type: none"> <li>- Rumah Pilah (TPS3R building and equipment)</li> <li>- Vehicle (waste collection and transportation)</li> <li>- BSF installation</li> <li>- Compost installation</li> <li>- Administration and waste bank Building</li> <li>- manpower</li> </ul>		<p>Channels:</p> <ul style="list-style-type: none"> <li>- advertisement through bulletin board in the village</li> <li>- announcement from the local authorities</li> <li>- social media ads</li> <li>- word of mouth marketing (WOM Marketing)</li> </ul>		
<p>Cost structure:</p> <ul style="list-style-type: none"> <li>- infrastructure cost (ADD/Village budget plan)</li> <li>- vehicle and transportation cost</li> <li>- manpower cost</li> <li>- operational cost</li> <li>- inorganic waste cost for waste bank</li> </ul>		<p>Revenue stream:</p> <ul style="list-style-type: none"> <li>- tipping fee from waste collection service</li> <li>- compost sale</li> <li>- maggot sale</li> <li>- recyclable waste sale</li> <li>- other services: benchmarking service, waste management training, BSF maggot training</li> </ul>		

Figure 41. Business Model Canvas for TPS3R in Genggelang Village

## Temporary Waste Processing site with 3R facilities (TPS3R)

Community groups/CBOs/TPS3R management group, has a role in the implementation of solid waste management at the community level, transmit 3R lifestyle to the society and raise their awareness, and become the initiator, leader, a motivator in the implementation of waste management at community level. The TPS3R

should provide unloading area, sorting area, waste crusher area, composting area, residual collection site, warehouse for recyclable waste, washing area. The activity in the TPS3R include waste segregation, composting, and recyclable waste packing. The residue of municipal solid waste management usually includes infectious waste (diapers, sanitary pad), batteries, multi-layer plastics, etc.), and it have to be handled properly. According to the district regulation no 3/2018, the residue will be collected and handled by the government in the landfill.

#### Waste Bank

This document proposed waste bank should be adopted as business unit of the Bumdes. Hence, the waste management system will cover all of the community with different level of income. This option is provided to the community who willing to sort the waste and want to receive incentive from the recyclable waste. In order to reach the target of waste reduction, this document combined TPS3R and waste bank system. Waste bank is aimed to provide waste management system for the community who refuse to join the waste collection program from TPS3R due to the income reason.

#### Capacity Building

Most of the community is unconcerned about plastic waste pollution in the river. Burnt waste is pretty common in this village. Moreover, some local authorities (head of sub-village) suggest the community burn the waste rather than dump it in the river. This behavior is a result of a lack of awareness of the impact of waste on the environment and the unavailability of the waste management program in this village. Hence, the first phase of the program has to introduce the importance of waste management to the community, and the benefit of waste segregation. The activities to attract the community to the waste management program include:

- waste bank training: management of the waste bank, waste segregation, marketing
- training on waste recycling: handicrafts using recyclable materials, composting training, black soldier fly cultivation training, etc.
- assist the village government and village council to develop waste management regulation

#### Woman involvement in the waste management

As result of the interview, women have very important role for waste management in Genggelang Village. The survey was conducted for households, but it was mostly answered by the wife. The questions about their behavior to manage the waste, the willingness to join the waste bank, willingness to pay, and the importance of waste segregation are mostly answered by women. Moreover, about 64% of the respondents are women.

Waste Banks in Indonesia have been popular with women - and expanding the business potential of waste banks and increasing their financial sustainability will encourage increased and more consistent gender participation. In the Philippines too, women could benefit from opportunities to expand operations. Local agencies, such as ENDA in Vietnam working directly with waste sector workers and junk shops, report that efforts to build leadership skills amongst women as well capacity building efforts for existing waste businesses will positively impact the women working in waste in Vietnam (Placeholder1) (Krishnan & Backer, 2019).



## Financing and Costing

Based on the data of community interest to the waste management program, and willingness to pay the service, we estimate the waste stream and target for 2040. This document proposed about 55% of the waste generated in 2040 is managed by TPS3 totally. Target of the community who join the TPS3R and become waste bank member about 33%. We estimated about 12% of the community willing to reduce the waste through waste bank. In expectation, they willing to manage the organic waste privately. The estimation waste stream in 2040 is shown in the following table.

Table 41. Waste stream analysis 2025 – 2040

Waste management target	2025			2030			2035			2040		
	Man	Red	kg/day	Man	Red	kg/day	Man	Red	kg/day	Man	Red	kg/day
Manage through TPS3R	35%		794	45%		1.068	48%		1.195	61%		1.588
TPS3R user who join to waste bank	22%		511	22%		533	33%		832	33%		865
Waste bank member		6%	139		7%	174		8%	212		12%	314

Man: managed

Red: Reduced

Source: Analysis by UNDP, 2021

Based on the interview with local authorities, the financing of the waste management has included in the RKPDes (Village Working Plan). The temporary waste processing site is listed as Gudang Pengelola Sampah. The building will be facilitated by district government in 2022. The cost to provide the waste management equipment was calculated based on the waste quantity in 2040. The budget is divided into two categories:

- Investment cost includes mechanical equipment, civil works and other costs related to the investment such as permits etc.
- Operation cost include expenses, which are directly depending on costs related to treatment of the waste, these expenses includes maintenance, manpower. This covers the expenses which will vary per ton treated waste, these are costs related to the treatment such as additives needed for the process to work, e.g. water, waste water, transport of reject, transport of digestate etc.

The calculation of investment cost is estimated for 2040, so it represents maximum equipment. The investment cost as follow:

Table 52. Estimation of Investment Cost

Investment Cost	Unit	Frekw	Cost/unit (IDR)	Total Cost (IDR)
TPS3R Building	1	1	Rp 680.000.000	Rp 680.000.000
Vehicle (three wheeled motor with container (capacity	3	1	Rp 35.000.000	Rp 105.000.000
Waste collecting point/TPS (3 container/TPS)	18	1	Rp 1.800.000	Rp 32.400.000
Maggot Installation (100 kg/day)	1	1	Rp 16.000.000	Rp 16.000.000

Investment Cost	Unit	Frekw	Cost/unit (IDR)	Total Cost (IDR)
				Rp 732.800.000

Source: Calculated by UNDP, 2021

The cost and revenue calculation result are presented in the following table:

Table 63. Cost and revenue estimation

Remarks	Item	Total (IDR)				
		2021	2025	2030	2035	2040
Cost						
Fixed expenditure	manpower					
	segregator (1 person/1000 kg)	24.000.000	24.000.000	46.800.000	46.800.000	46.800.000
	waste handler	12.000.000	12.000.000	15.600.000	15.600.000	15.600.000
	Waste bank officer	12.000.000	12.000.000	15.600.000	15.600.000	15.600.000
	Waste collector	28.800.000	28.800.000	54.000.000	54.000.000	54.000.000
variable expenditure	residual waste treatment (tipping fee to DLH) weekly collection	1.800.000	1.800.000	1.800.000	1.800.000	1.800.000
	organic waste treatment (ton)	28.800.925	28.800.925	42.967.916	43.358.425	57.632.776
	Gasoline (5 litre/vehicle/day)	27.540.000	13.770.000	13.770.000	27.540.000	41.310.000
	vehicle maintenance	800.000	400.000	400.000	800.000	1.200.000
	BSF installation maintenance	250.000	250.000	250.000	250.000	250.000
	miscellaneous (R and D, training, etc)	6.000.000	24.000.000	24.000.000	36.000.000	36.000.000
Total Cost		141.990.925	145.820.925	215.187.916	241.748.425	270.192.776
Revenue						
Waste collection	tipping fee	74.841.847	78.253.697	92.038.601	121.601.638	126.427.392
organic waste sale	maggot (Rp 1.500.000/ton)	6.171.627	6.171.627	9.207.411	9.291.091	12.349.881
	compost (Rp 5000/kg)	84.288.422	84.288.422	125.749.359	126.892.217	168.667.350
inorganic waste sale	Segregated waste (assumed IDR 1000/kg)	84.560.945	84.560.945	103.744.131	131.402.730	159.047.169
	Total revenue	165.301.895	168.713.746	226.995.371	257.784.945	307.444.622
Expected profit for Bumdes	Profit (revenue - cost)	23.310.970	22.892.821	11.807.454	16.036.520	37.251.847

Source: Calculated by UNDP, 2021

## Institutional Setup

According to the village government, the waste management will be involved to the Bumdes business unit. Bumdes has been handling the Genggeling Market, and they plan to manage tourism and waste management next year. The institutional of the waste management division have to designed based on the local condition. The following picture presented an example of the waste management institutional set up. The institutional set up of the waste management in Genggeling village should be localized.

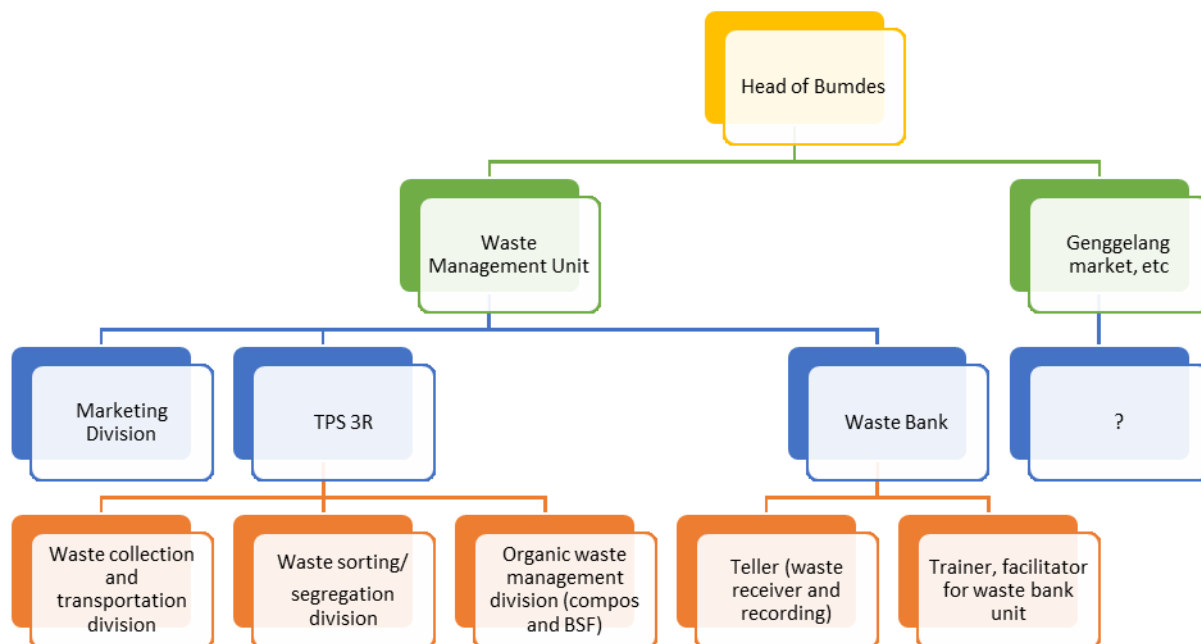


Figure 4. Institutional Set Up Example

The conclusion of this study as follow:

1. The waste stream in Genggeling Village and Genggeling Maket about 95% does not managed properly. The community mostly managed the waste by burnt (82%).
2. The municipal solid waste in Genggeling Village has been managed traditionally which around 82% of waste was burnt. This behaviour is a result of the unavailability of waste management programs from the government in this area.
3. The village government plan to develop sustainable waste management and they are supported by the community. The waste management will be involved to the Bumdes as a new business unit.
4. Approximately 67% of the community interested to use the waste management service from the Bumdes who around 93% of them willing to pay less than Rp 5000.
5. Considering the social and economic condition of the community, waste management system in Genggeling Village is proposed with combination of TPS3R and waste bank. Waste collection service from TPS3R is provided for business (market, tourism, industries, offices, and schools) and community who attracted. The community who not interested yet will be encouraged to join the waste bank program, so they can manage their waste at home.



# Designing Integrated & Sustainable Waste Management

## Genggelang Village, Gangga District, North Lombok Regency

### Recommendations

Implementation of sustainable waste management in Genggelang should be divided into three phases. The recommendation of this research as follow:

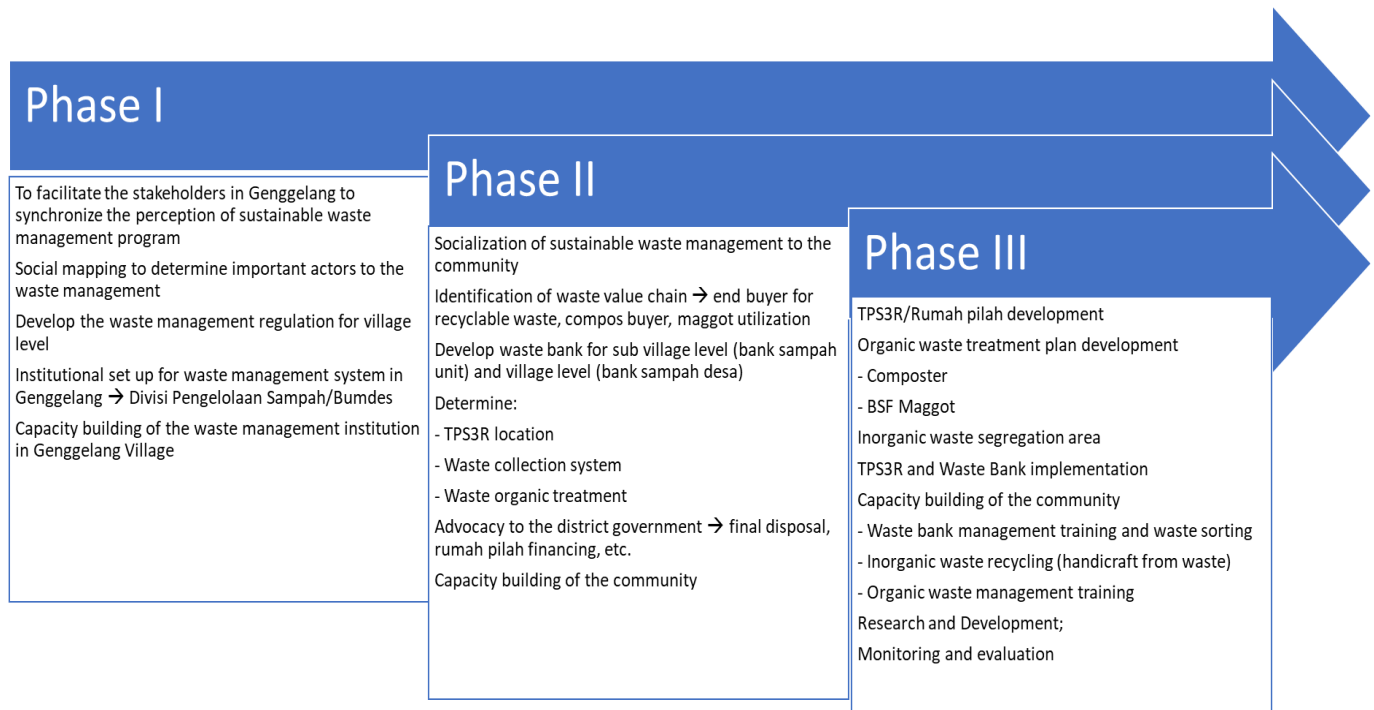


Figure 5. Waste Management Phases in Genggelang Village

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## List of Abbreviation

3R	: Reduce, Reuse, Recycling
ADD	: Anggaran Dana Desa
APBD	: Anggaran Pendapatan dan Belanja Daerah
BAPPENAS	: Badan Perencanaan Pembangunan Nasional
BNPB	: Badan Nasional Penanggulangan Bencana
BPD	: Badan Permusyawaratan Desa
BSF	: Black Soldier Fly
BUMD	: Badan Usaha Milik Daerah
BUMDES	: Badan Usaha Milik Desa
CBO	: Community Based Organization
CBSWM	: Community-based Solid Waste Management
COVID	: Coronavirus disease
DLHK	: Dinas Lingkungan Hidup dan Kehutanan
DLHKPKP	: Dinas Lingkungan Hidup Permukiman dan Perumahan
FGD	: Focus Group Discussion
GHG	: greenhouse gases
GR	: Government Regulation
HDPE	: High-density polyethylene
IDR	: Indonesian Rupiah
JAKSTRANAS	: Kebijakan Strategi Nasional
KEMENLHK	: Kementerian Lingkungan Hidup dan Kehutanan
KEMENPUPR	: Kementerian Pekerjaan Umum dan Perumahan
KSM	: Kelompok Swadaya Masyarakat
MoEF	: Ministry of Environment and Forestry
MoHA	: Ministry of Home Affairs
MoPWH	: Ministry of Public Works and Housing
MSW	: Municipal Solid Waste
Mt	: Metric Tonne
NTB	: Nusa Tenggara Barat
PERDA	: Peraturan Daerah
PET	: Polyethylene terephthalate
PETRA	: Programme for Earthquake and Tsunami Infrastructure Reconstruction Assistance
POKDARWIS	: Kelompok Sadar Wisata
PPP	: Public Private Partnership
PSP	: Private-Sector Participation



RKPDes	: Penyusunan Rencana Kerja Pemerintah Desa
RT	: Rukun Tetangga
RW	: Rukun Warga
SILPA	: Sisa Lebih Pembiayaan Anggaran Tahun
TPA	: Tempat Pembuangan Akhir
TPS	: Tempat Penampungan Sementara
TPS3R	: Tempat Pengelolaan Sampah 3R
TPST	: Tempat Pemrosesan Sampah Terpadu
UNDP	: United Nations Development Programme
WASERDA	: Warung Serba Ada
WtE	: Waste to Energy
WTP	: Willingness to Pay

# I. Introduction

## I.1 Project Background

The two major disasters in 2018, earthquake, tsunami, and liquefaction ravaged Central Sulawesi and West Nusa Tenggara (NTB). Particularly, the liquefaction affected Palu and caused approximately 10.000 people lost their homes. Hundreds of thousands of people lost their jobs and livelihood options. Disasters triggered by earthquakes, tsunami, and liquefaction caused substantive damage to community infrastructures, including buildings, roads, bridges, market facilities, irrigation canals, and drinking water schemes. The damaged infrastructures became almost non-operational, prompting the risk of migration for affected communities.

To accelerate the rehabilitation and reconstruction process in both areas, UNDP is implementing the Sulawesi/Lombok Programme for Earthquake and Tsunami Infrastructure Reconstruction Assistance (PETRA). The goal of PETRA is to contribute to the rehabilitation and reconstruction of key infrastructure to support the resilient recovery of disaster-affected communities in both provinces. It addresses the need to accelerate the restoration of critical public services (such as health and education), improve economic livelihood opportunities for affected communities, while, at the same time, enhancing resilience to future shocks in both provinces. It will be guided and informed by the post-disaster needs assessments and will be fully aligned with relevant national and sub-national recovery plans. Beyond the immediate humanitarian and relief assistance, the KfW and UNDP have initiated engagements with national and local governments to support Central Sulawesi and NTB's recovery efforts. Key government partners include BNPB, BAPPENAS, Ministry of Finance, Ministry of Public Works, the Provincial governments of Central Sulawesi and NTB, and the local governments of all ten districts and cities impacted by the disasters. PETRA will deliver two outputs, namely: (1) Rehabilitation and reconstruction of partially and fully damaged

infrastructure for critical public services; and (2) Rehabilitation of affected communities' economic infrastructure to promote more resilient and sustainable livelihoods.

In 2019 UNDP Indonesia support to rebuild Genggelang Market in Gangga North Lombok with the construction finished in Dec 2020. Genggelang market is categorized as village market (Pasar Desa) that operated weekly on Thursday. This market is very important for 11,530 residents, for it is the closest place to buy groceries. The development of this market is expected to improve the livelihood activities of the community. The village government plan to operate it daily, so it can affect the economic and livelihood condition of the community. However, the growth of the market will lead the increase of waste generation.

Throughout Indonesia, waste management is a serious problem that is manifested in all phases of the waste management cycle. Among the immediate challenges are lack of waste data, poor service coverage (especially in low-income areas), insufficient segregation of recyclables, dangerous working conditions for operational staff, illegal and environmental damaging disposal practices, inefficient designs/locations of transfer stations, lack of sanitary final disposal sites and engineered treatment facilities and limited exploitation of the energy and resource contents of the waste. This leads to harmful exposures to living organisms, releases of excess greenhouse gases, pollution of soil, waterways, and the sea. Jenna Jambeck (2015) ranked this country as the world's second-worst marine plastic polluter for allowing about 1.29 million tons of plastic waste to enter the ocean in 2010 as a result of improper waste management ([www.thejakartapost.com](http://www.thejakartapost.com)).

Nowadays, solid waste has become a global issue that must be managed in a comprehensive and integrated way. Solid waste generation continues to increase as the population growth but otherwise, the unbalance amount of infrastructure, the limitation of land for final disposal sites, and the high cost of waste collection and transportation became challenges in solid waste management itself. It needs efforts to handle and process the waste since the waste source to reduce the burden of final disposal sites (landfills). One of the strategies is by developing the 3R approach (reduce, reuse, recycle) at the community level. The issue of proper waste management is a shared responsibility that includes the citizens and households, as well as the government. The

largest stream of municipal solid waste in Indonesia flows from households followed by traditional markets.

## 1.1 Objective

The objective of this project includes:

- Provide sustainable waste management system with the involvement of the community both direct and indirect.
- Designing comprehensive and integrated sustainable waste management system in Genggelang market and village, North Lombok
- Developing strategy of community based solid waste management program using 3R (reduce, reuse, recycle) approach

## 1.2 Project Location

The project location is in Genggelang market known as Pasar Desa Genggelang, Gangga North Lombok.

## 1.3 Scope of Works

Scope of works of this research includes:

- Detailing designs and strategy of integrated and sustainable waste management for Genggelang market
- Identify integrated solid waste management as comprehensive waste prevention, recycling, composting, and disposal program and consider how to prevent, recycle and manage solid waste in ways to effectively protect human health and the environment.
- Identify waste flow from upstream to downstream
- Identity complete waste management process including waste collection method; transfer and transport method; waste treatment methods and facilities; waste segregation; disposal site/waste bank; identification waste characteristic
- Identifying and coordinate local government authority and relevant stakeholders regarding the waste management



- Establishing contact with local government authorities and relevant stakeholders regarding the strategy of waste management.
- Identify government regulation and key policies related to the waste management (village, sub-district, and district level) and also institutional capacity.
- Prepare strategy approach of community-based waste management.

## II. Methodology

### II.1 Method

This research was carried out as an empirical survey including data collection, field observation, small Focus Group Discussion (FGD) and interview. The data collection includes physical and social economic condition of Genggelang village. The collected data are used to explore the details of the facts about the issue, and it utilizes to analyse the facts of the previous research. The results of the comparison results would give information about the recent condition and the influencing factors that could be used to make decisions.

### II.2 Approach

The development of sustainable waste management system in Genggelang village was be conducted with both socio-economic and technical approach. The analysis includes technical, financial, socio-political, legal, and institutional aspect as related to the effectiveness of waste management in the village level. The analysis results presented a possible solution for current and future solid waste management scenario. According to the term of references, the design covers Genggelang Market. However, the market only operates weekly, so the waste management system has improved for the village area including tourism, households, offices, and industries. The document scenarios of integrated and sustainable solid waste management for village level. As a tourism village, the waste generation from the tourism activities need to be handling properly.

### II.3 Geographical Scope

The project location is in Genggelang market known as Pasar Desa Genggelang, Gangga North Lombok. The project location is presented in the following pictures:

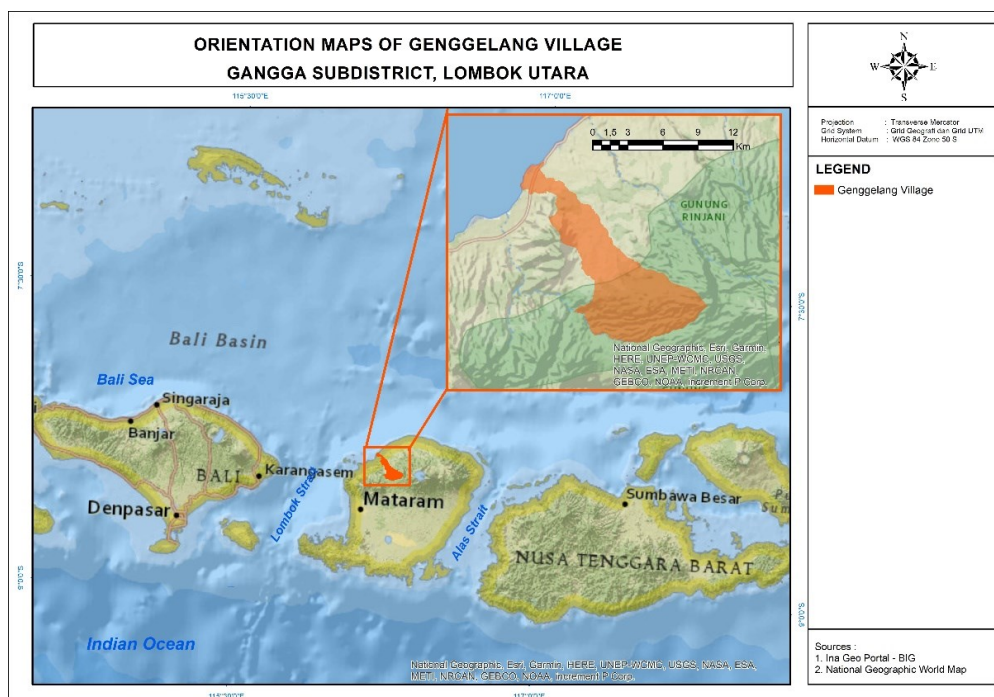


Figure 2. Orientation Map of Genggeling Village

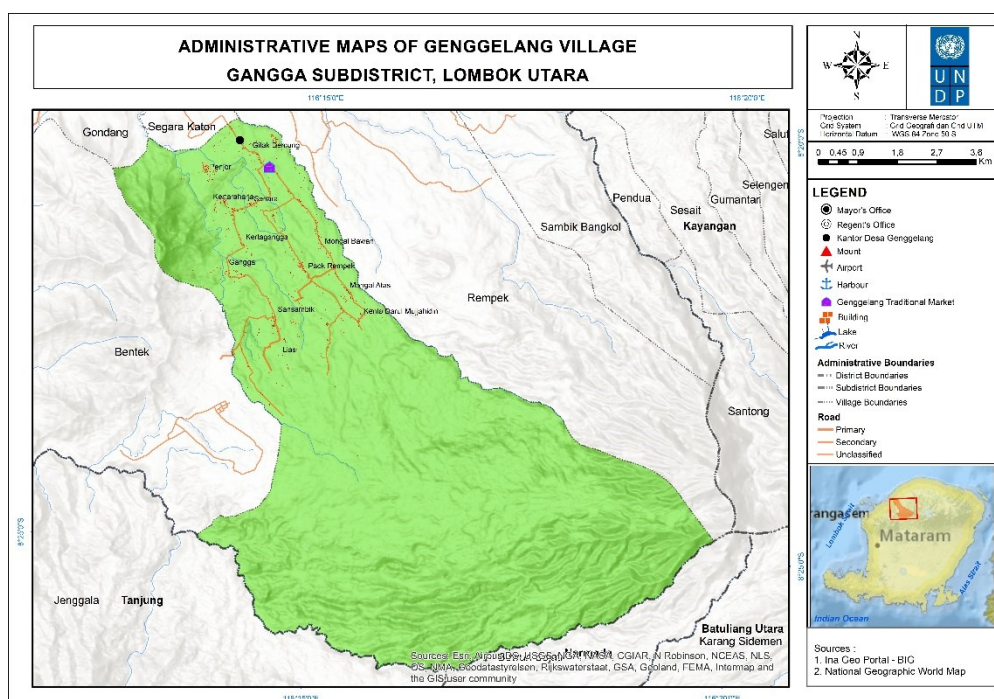


Figure 3. Administrative Map of Genggeling Village

Genggeling village is located in Gangga Sub District with the area approximately 29,21 km<sup>2</sup> equal to 18% of the Gangga Sub District area. Total population in 2020 around 11626 people that distributed in 108 RT (neighbourhoods) (BPS, 2020). The population

density approximately 398 people/km<sup>2</sup>. The Sasak people are indigenous to Lombok and form the majority of North Lombok's residents, other groups such as the Samawa, Mbojo, Bima, Bali and Jawa people also populate the region. Genggelang market is located in the middle of village with the distance from the final disposal area (Jugil landfill) approximately 15,3 km.

The North Lombok Regency has a beautiful natural landscape and a distinctive culture. This supports the rapid growth of business in the tourism sector, and contributes significantly to the regional revenue (Pendapatan Asli Daerah-PAD). North Lombok Regency has a total of 53 tourism destinations, divided into two types: (i) natural tourism and (ii) cultural tourism (DANIDA, 2019). The Head of North Lombok District inaugurated Genggelang village as tourism area with several tourism destinations (i.e. Tiuq Pitu waterfall, wisata Kampung Cokelat Senara, Tree House, Kerta Gangga waterfall). The village government reported that approximately 60.000 tourist visited this village before pandemic (Anonim, 2020).

## II.4 Logical Frameworks

The municipal solid waste management masterplan is prepared as a stand-alone document. Usually, the development of the document comprised steps as follow:

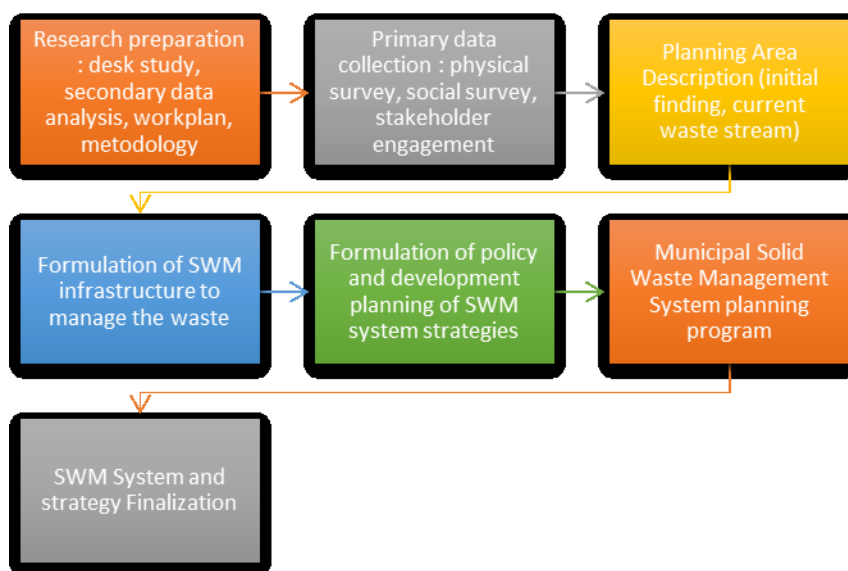


Figure 4. Sustainable SWM masterplan development phases



a. Preparation

The preparation process includes:

- Synchronize a perception and paradigm towards sustainable SWM in the project location through kick off meeting between UNDP field staff and the consultant
- To collect the baseline data (RPJMDes, thematic maps, demographic, sanitation strategic document, MSW masterplan of North Lombok, Gangga in Figure, etc).
- To create the detail methodology
- To collect secondary data from previous research, journal, maps, article etc

b. Primary data collection:

The primary data collection was be conducted through field survey include social survey, physical survey, and institutional survey. Social survey is aimed to collect information of community behaviour to manage the waste, perception, awareness, willingness to segregate the waste, willingness to pay the tipping fee, etc. Physical survey is conducted to collect the physical data include:

- complete waste management process including waste collection method;
- transfer and transport method; waste treatment methods and facilities;
- waste segregation; disposal site/waste bank; identification waste characteristic

Due to the COVID 19 pandemic, the physical survey to determine waste generation and composition was elaborated with the social survey.

Institutional survey to identify government regulation and key policies related to the waste management (village, sub-district, and district level) and also institutional capacity.

c. Planning area description

The collected data were used to analyse the current condition of the project location. The activities in this process include:

- Waste generation and composition
- Waste forecast
- Identification of current condition of solid waste management in Genggelang village and market including waste stream (upstream and downstream)

- Community behaviour and perception toward municipal solid waste management
- Willingness to pay
- Gap determination
  - community, local authority, and relevant stakeholders
  - technically and financially
- Carry out financial and environmental analysis

d. Report development

Data analysis and reporting as a part of the report development. The main activity on this phase is identification the gap and the solution. Integrated waste management document was developed as a masterplan for village level. The development process includes:

- Municipal Solid Waste Management System planning program based on the waste characteristics and waste generation
- Formulation of policy and development planning of SWM system strategies
- Formulation of SWM infrastructure to manage the waste
- Identify integrated solid waste management as comprehensive waste prevention, recycling, composting, and disposal program and consider how to prevent, recycle and manage solid waste in ways to effectively protect human health and the environment.

## II.5 Fieldwork Timeframe

The duration of this project within 40 days start from 3 June 2021 to 29 July 2021. The activities include field survey and observation, in-depth interview, and desk study. Due to the Covid-19 pandemic, the FGD was conducted with strict health procedure, and maximum 3 – 4 people. Regarding the limited project duration, the fieldwork timeframe was arranged for two weeks. The field activities include preliminary survey, test the questionnaire, stakeholders mapping, field observation, and social survey. The fieldwork timeframe is presented below.

[illegible]

## II.6 Survey and Sampling Size

Primary data collection was conducted with survey, small focus group discussion, and field observation. Survey was conducted to collect social data include community perception, behaviour, knowledge towards waste management, and willingness to pay. The waste generation per person per day was being confirmed during the survey. The surveyor brings the balance to measure the waste production of each respondent to confirm the result of waste generation which calculated with secondary data.

Considering the strict schedule in the development of this document, approximately 50 respondents had been interviewed. Respondents are divided into three categories include community, local authority, and business. The respondent from business includes Pokdarwis, Genggeling Market, and junk dealer. Approximately 30 respondents from the community were interviewed with questionnaire as guidance for the surveyor. In contrast, the interview with stakeholders was conducted with in-depth interview.

The interview was conducted with support from the local personnel. They responsible to the questionnaire survey that must be conducted door to door. The involvement of local personnel was decided to reduce the Covid-19 risk. The village is categorized as green zone of Covid 19. They have to minimize contact with stranger, so the involvement of local team for survey will help to collect all of the data from the household. Moreover, the survey includes confirmation of the waste generation per household, so it should be conducted in afternoon (after 3 pm). The calculation of waste weight is more accurate in the afternoon.

The questionnaire included both open and closed questions. The closed questions were designed for ease of answering by the respondents with the aim of collecting the maximum appropriate responses, whereas the open questions were intended to encourage respondents to provide further elaboration on certain questions.





Figure 5. Social and Physical Survey in Genggelang

## II.7 Data and source

This research used both primary and secondary data. Primary data were collected through the field survey and FGD. Secondary data were collected from the various sources include District Government, North Lombok Statistical Bureau, Village Government, and Sub-village Government. The information from the sub-village government was collected through questionnaire and in-depth interview. Data and data sources are presented in the following table.

Table 5. Data and Data Sources

No	Data	Type of Data	Collection methods	Sources
1	Physical Condition of Genggelang Village and Market	Primary data	Field observation and GIS analysis	Secondary data: Google Earth Satellite image Primary data: survey results

No	Data	Type of Data	Collection methods	Sources
2.	Social and economic condition of Genggelang Village	Primary data	Questionnaire In-depth interview	Respondents Village government
3	Village monographic and Government Plan	Primary data	Questionnaire In-depth interview	Respondents from local authorities (RT, Dukuh, head of Bumdes) Village government
4	MSW Masterplan of North Lombok	Secondary data	Institutional Survey	North Lombok Government
5	Waste generation and composition	Primary and Secondary data	Institutional survey	North Lombok Government and previous researchs
6	Sub District in Figures	Secondary data	Institutional Survey	North Lombok Statistical Bureau
7	Previous research (journals, report, fact sheet, etc)	Secondary data	Desk study	Internet, library, Government

## II.8 Strength and Limitations

This research adopts qualitative and quantitative methods (mix). The methods have chosen to accommodate the large of project location, time limitation, and total population. The qualitative methodology intends to understand a complex reality and the meaning of actions in a given context. On the other hand, the quantitative methodology seeks to obtain accurate and reliable measurements that allow mathematical analysis. However, this research has strength and limitation as follow:

Table 6. Strength and Limitation of this research

Strength	Limitation
This research was conducted in rural area with no waste management service, so the development of program, strategy, and policy was done without adjustment with the previous system	Rural community usually embarrassed to explain their perspective and livelihood, so the interview should be involved villager as an interviewer
The result of this research can be implemented in the other locations with similar social and economic condition	The project duration and Covid-19 pandemic caused FGD with key actors of waste management couldn't be conducted, so the information was collected with in-depth interview.

Strength	Limitation
Findings can be generalised if selection process is well-designed and sample is representative of study population	Related secondary data is sometimes not available or accessing available data is difficult/impossible. Some of secondary data was collected through remote sensing analysis (settlement type), and interview with the key informants (local authorities)
This research provides the calculation of cost and revenue of the waste management system in Genggelang village	Some of the calculation based an assumption due to the secondary data availability. The assumption based on the previous research that conducted in other location with similar condition and MSW masterplan of North Lombok.

## III. Theoretical Background

### III.1 Solid Waste Management in Indonesia

The generate of municipal solid waste is the main environmental problem in Indonesia. The Indonesian Ministry of Environmental and Forestry reported that the total volume of solid waste in Indonesia reach around 187,2 million tons per year. The population growth and lack of land availability has caused the increase of municipal solid waste volume (Effendy, 2018). Municipal Solid Waste (MSW) problem, particularly in big cities, is one of the most challenging urban issues for city administrators. Population growth and ever-increasing activities in major cities entails the increase of waste generation and all of the inherent consequences. It was estimated, that of the entire wastes generated, at most only around 60% - 70% that could be transported to final disposal by the institutions responsible in handling wastes and cleanliness, such as Public Works Office or Districts/Cities Environmental Agencies. The rest would be handled by the community through their self-effort, or spread and systematically disposed all over the city (Damanhuri, 2008). As results, the mountain of rubbish multiply in several areas where the government facilities unavailable, it is found accumulate in the rivers as well.

Municipal solid waste (MSW) is an important waste stream to determine the waste handling solution type. The common municipal solid waste (MSW) management method in Indonesia is a collect-transport-disposed. The local government usually use open dumping or control landfill for the final disposal sites. This system caused damage of the surrounding environment. In addition, the district/city has its limitations in the provision and presentation of data related to waste management in their territory (Dewi , 2017). Solid waste is mostly produced by human activities in the terrestrial area, and it have to be managed without single materials leak to the water bodies. Some researcher reported that plastics in the ocean will outweigh fish pound for pound in 2050.

People have produced around 8,3 metric tonne (Mt) plastics since 1950. There are a lot of industries using plastic as raw materials for various goods, for instance, kitchen utensil, food wrap, engineering tools, computer, etc. Jenna Jambeck (2015)

stated that 2,5 billion MT of MSW was produced in 2010 by 6,4 billion people who live in 192 countries. Approximately 11% of the total waste generation is plastic. According to that research, 83% of solid waste in Indonesia is mismanaged which 10.1% is plastic waste. Furthermore, around 0.48 – 1.29 Million Metric ton/years leak to the ocean through channel and river. According to the reports, more than 70 percent of the plastic we produce is either put in a landfill or lost to the world's waterways and other infrastructure. Plastic production accounts for 6 percent of global oil consumption (a number that will hit 20 percent in 2050) and 1 percent of the global carbon budget (the maximum amount of emissions the world can produce to prevent global temperatures from rising more than 2 degrees Celsius). In 2050, the report says, we'll be spending 15 percent of our carbon budget on soda bottles, plastic grocery bags and the like (Kaplan, 2016)

In view of the general challenges of the sector, as described in the Introduction, the *Ministry of Public Works and Housing has formulated the goal of "Universal Access"*: Indonesia intends to achieve 100% public access to water supply service, 0% of slum area, and 100% of public access to sanitation services (which includes municipal solid waste management) all to be reached by the end of 2019. Indonesia has also incorporated waste disposal in its national climate change strategy. The Government of Indonesia strives to reduce its greenhouse gases (GHG) emissions by 29 % before 2030 compared to a business-as-usual scenario. The strategies for the municipal solid waste management sector include reduction of solid waste through 3R (reduce-reuse-recycle), orderly waste management at the landfill sites, improvement/ construction/ rehabilitation of the landfill sites, and waste to energy (WtE).

Many districts/cities that are motivated to look up hygiene and sanitation conditions of their city, among others because of the program Adipura Award which is given to district/city that can manage to maintain the cleanliness of their environment. There has been a fundamental change in the political and governance, such as decentralization system and local autonomy which influence the division of tasks in government level (Damanhuri, 2008). In accordance with the implementation of the decentralization policy, the municipality takes over the authority and responsibility for waste management from the central and provincial governments. Local government has



to adjust many policies and considering to the conditions in their respective areas, especially in the institutional aspects.

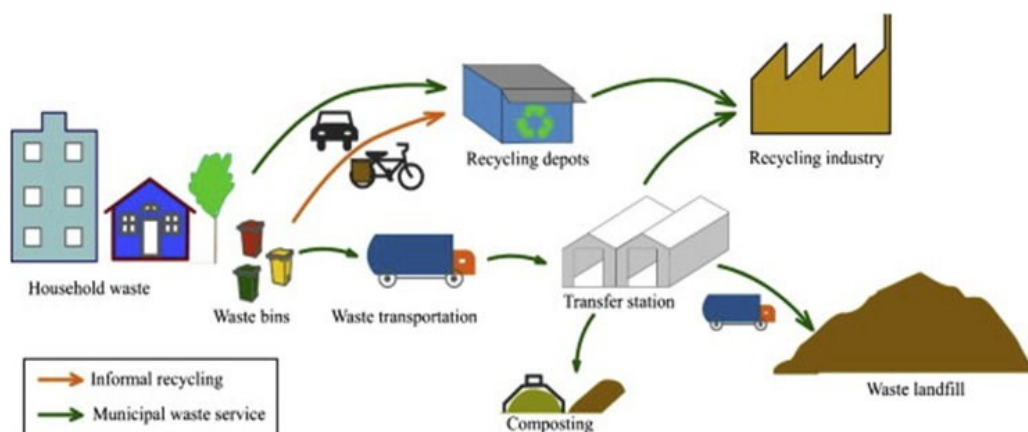


Figure 6. Waste Management Cycle

The government of Indonesia recently adopted Presidential Decree No.97/2017 on National Policy & Strategy on Management of Household Waste and Household-like Waste. This policy called Indonesia Bebas Sampah (Indonesia Clean from Waste) in 2021, and it is aimed to reduce plastic pollution radically. This regulation is a roadmap towards Waste Management with the plan include to reduce 30% of the waste from the source through 3R; to handle and manage 70% of the waste with segregation, collection, transportation, treatment, and final processing in order to avoid accumulation in the landfill, and all must be achieved in 2025 (Sidik, 2018).

Two flagship programs that promote by the central government related to community-based solid waste management are waste bank program and TPS3R (transfer station with 3R facilities – Tempat Pengolahan Sampah Reduce-Reuse-Recycle) program. The District Government plan to have 40 waste banks within the district by the end 2019.

## III.2 Solid Waste Management Regulations in Indonesia

### III.2.1 National Waste Management Regulations

Law No. 18/ 2008 has been issued by the Government of Indonesia as an umbrella for national waste management policy and practice in Indonesia. The government created the derived regulations as guidance to the waste management implementation. The derived regulations include Government Regulation No 81/2012;

Perpres No 97/2017; Keppres No 61/1993 and No 47/2005; and ministry regulation. According to the regulations, solid waste management is divided into two fundamental activities include waste reduction and waste handling. The waste management in Indonesia have been adopting circular economic concept since 2020. Furthermore, the national government has formulated a regulation on Extended Producers responsibilities in December 2019 (MoEF Regulation No P.75/2019 in Roadmap to Waste Reduction by producers).

<b>National Law</b>	UU No 18/2008 Law on Solid Waste Management	UU No 32/2009 Law on Environmental Protection and Management		
<b>Government Regulation</b>	PP No 81/2012 Government Regulation on Management of Household and Household-like Waste	PP No 101/2014 Government Regulation on Management of Household and Household-like Waste	Draft Government Regulation on Excise on Plastic	Draft Government Regulation on Specific Waste Management
<b>Presidential Regulation</b>	Perpres No 97/2017 Presidential Regulation on National Policy and Strategy of Household Waste and Household-like Waste	Perpres No 83/2018 Presidential Regulation on Marine Debris Management	Perpres No 18/2015 President Regulation on Income Tax Facilities for Investment in Certain Business Fields and/or in Certain Regions	Perpres No 35/2018 President Regulation on Acceleration of Development Waste to Energy Installation using Environmentally Sound Technology
<b>Presidential Decree</b>	Keppres No 61/1993 and No 47/2005 Presidential Decree on Ratification of the Basel Convention on the Control of the Transboundary Movement of Hazardous Waste and The disposal			
<b>Ministerial Regulation</b>	Ministry of Trade Regulation No 31/2016 on Non Hazardous Waste Import	Ministry of Public Works Regulation No 3/2013 on Implementation of Solid Waste Infrastructure and Facilities	Ministry of Environmental and Forestry Regulation No P75/2019 in Roadmap to Waste Producers	Draft Ministry of Environmental and Forestry Regulation on Shopping Plastic Bag Reduction
	Minister of Environment Regulation No. 13 of 2020 concerning Guidelines for Implementing Reduce Reuse Recycle Through Waste Banks	Ministry of Trade Regulation No 48/2015 on General Provisions in the Import Sector	Ministry of Trade Regulation No 70/2015 on Importer Identification Number	Ministry of Industrial Regulation No 48/2015 Requirement for Tax Facilities Implementation
<b>Local Regulation</b>	West Nusa Tenggara Province published Province Regulation No 5/2019 (Perda No 5/2019) about solid waste management	District Regulation No 3/2018. This regulation is obtained from GR No. 81/2012 about Solid Waste Management		Ministry of Home Affairs (MoHA) Regulation No. 33/2010 giving a Guideline of Waste Management

Figure 7. Waste Management in Indonesia (Ratnawati, Tahar, & Sidik, 2020 modified by UNDP, 2021).

The regulations mentioned the solid waste producer include household activities, garbage (commercial area, industrial area, special arena, social facility, school, etc.); and specific solid waste (including solid hazardous waste, building debris due to the disasters). Hence, the government created the derivative rule as technical guidance for solid waste management especially for municipal waste called Government Regulations No 81/2012 about municipal solid waste management. Government Regulations No 81/2012 has mentioned several roles of MSW management as follow:

- policy and strategy of solid waste management;
- implementation of solid waste management;
- incentive and disincentive;
- applied research;
- information system;
- community role; and
- development.

The technical guidance mentioned that Provincial Government and District Government (Kabupaten/Kota) have to develop municipal solid waste masterplan for 10 years. The contents of masterplan include reduce, recycle, reuse of solid waste; segregation system; collecting system; management system, transportation system; solid waste final processing system; and tipping fee. The solid waste has to be managed from the upstream (source of the waste) to the downstream (the final processing area). Article 16 explained that the solid waste management are include segregation, collection, transportation, processing, and final disposal. The waste producers have to segregate the waste into five categories as follow:

- hazardous waste
- degradable waste
- reusable waste
- recyclable waste
- others

The waste management using 3R system has aimed to reduce the solid waste generation in the landfill. This regulation mentioned the district government is obliged to develop material recovery facility (MRF) called TPS3R (*TPST 3R: temporary disposal site with reduce-reuse-recycle concept, and it is completed with equipment (wheelbarrow, motorbike, truck, manpower etc.)*). The requirements of the TPS 3R facility include:

- facilities to segregate the waste into 5 type are available
- land availability and appropriate capacity
- accessible
- non polluted environment; and

- scheduled collection and transportation

The District Government responsible to transport residual waste from TPS3R to the landfill. The hazardous materials from the municipal solid waste include dead batteries, fluorescent lamp, broken glass, diapers, electronics, and others non-recyclable materials. The waste management in district level can be arrange with public private partnership with the private sector. The expected waste stream in Indonesia is shown in the following diagram.

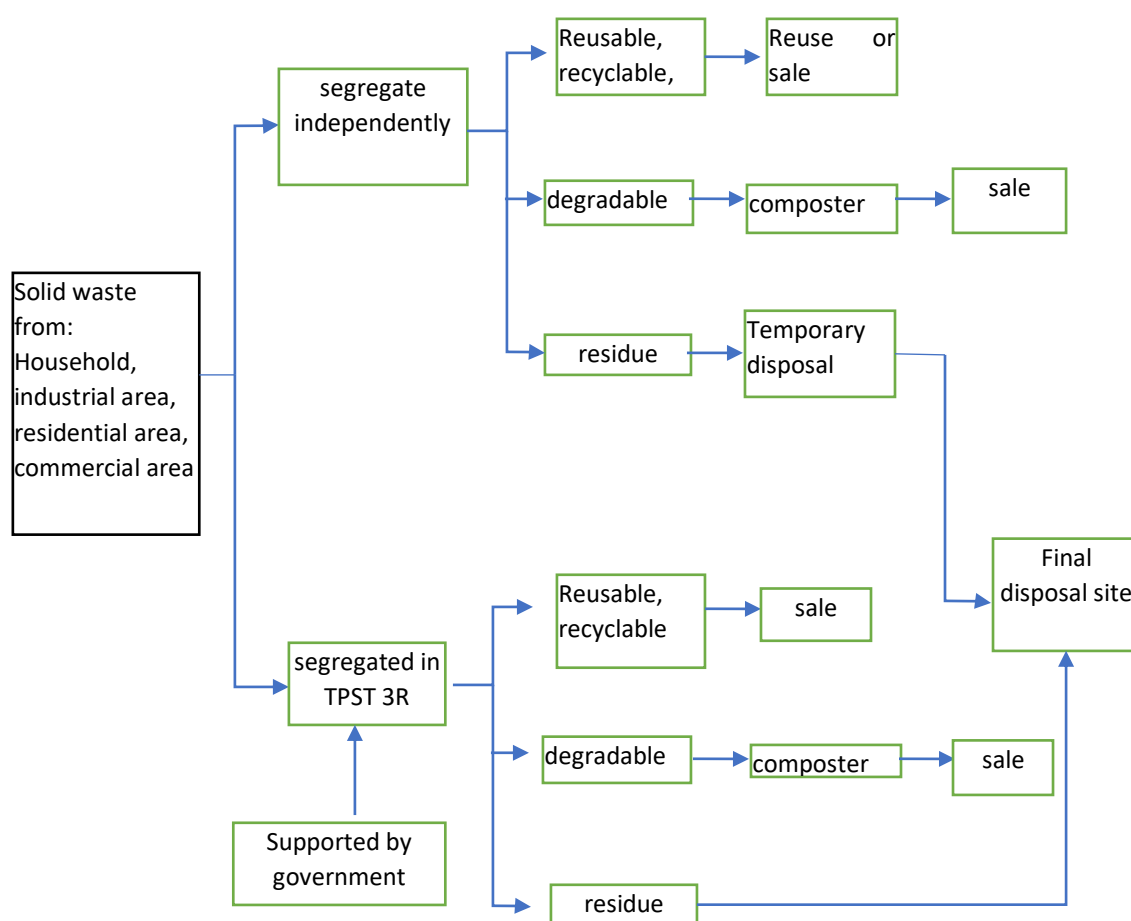


Figure 8. Waste management scheme according to the regulation

Planning and budgeting of waste management have to be established by district government. District government is allowed to determine tipping fee or tariff. The tipping fee is calculated progressively based on characteristics and volume of the waste. The district government has encouraged to improve the solid waste management system through research and development of the environment friendly technology. The

research and development could be undertaken independently or in cooperative with university, research agencies, or non-governmental organization. They were suggested to provide appropriate information system about municipal solid waste management. The content of information system is shown as follows:

- waste sources
- accumulation
- composition
- characteristics, and
- the facilities

The information must be accessible for everyone.

According to the regulation, waste management system should be developed with community based solid waste management concept. The participation in the waste management in the district level include:

- provide a suggestion and consideration of the waste management for the local level
- provide a suggestion and consideration to formulate waste management policy
- implement the waste management system independently or in cooperation with the government
- Waste management assistance program to change the community behavior towards waste management

#### **A. Ministry of Public Work and Housing Regulation No.3/PRT/M/2013 about The Implementation of Waste Management Infrastructure**

This regulation consists of technical requirement of the waste management infrastructure. Waste infrastructure hereinafter referred to as infrastructure, shall be basic facilities that may support implementation in waste handling activities. This Regulation of the Minister is meant to:

- a. accomplishes effective implementation of municipal solid waste with environmental insight;
- b. improve coverage of waste handling service;
- c. improve the level of community's health and environmental quality;



- d. protect water resource, the land, and air from pollution and mitigate weather change; and
- e. formulate waste as resource.

The technical aspects in the waste management include:

- a. waste generation restriction
- b. waste recycling
- c. waste reusing
- d. waste segregation
- e. waste collection
- f. waste transportation
- g. waste process, and
- h. final processing

Based on this regulation, the waste processing must be conducted by any person at its source; the management of residential area, commercial area, industrial area, special area, public facilities, social facilities, and other facilities; district government. Regency/Municipality administration shall be obliged to provide waste processing facilities at the locations includes TPS 3R (transfer station with 3R facilities); SPA (transfer station); TPA (final disposal); and/or TPST (final processing). Transfer station with 3R facilities (TPS3R) is the most appropriate for village level. Moreover, this system can be integrated with other system in the village (Bumdes, waste bank, agriculture, etc).

Article 30 mentioned that the requirements for TPS 3R referred to this regulation, must comply with the technical requirements such as:

- a. area of TPS 3R, must be larger than 200 m<sup>2</sup>;
- b. available facilities for sorting out the waste to at least five (5) types of waste;
- c. TPS 3R must be equipped with sorting space, making organic compost, and/or bio-gas producing unit, supporting area, and not disrupting aesthetic and traffic.
- d. type of construction to accommodate remnants of the waste processing at the TPS3R must not be permanent;

- e. TPS 3R must be located as close as possible to the service area within radius not exceeding 1 km;
- f. area of the location and capacity must be based on need;
- g. the location must easily accessible;
- h. must not cause environmental pollution; and
- i. must have schedule of collection and transportation.

The TPS 3R referred to in paragraph (1) including scale of residential environment shall be exercise using method based on the community's decision. The existence of TPS 3R referred to in paragraph, may be integrated with waste processing system based on the community's need such as waste bank.

#### **B. Ministry of Environment and Forestry Regulation No 13/2012 about Guidance of Waste Reduction, Reuse, Recycling through Waste Bank System**

A waste recovery mechanism that has been developed in Indonesia is a garbage savings-selling mechanism, better known as "waste bank", which is managed by the citizens in the form of cooperatives. The organizations formed will receive the valuable dry inorganic waste collected by the citizens, and it will be sold to the garbage collectors who come to the cooperatives. Money from the sale of the waste will be deposited in the accounts of people who deposit their garbage in the cooperative. Most of the profits from this transaction will be earnings for the neighborhood.

The aim of MoEF Regulation No 13/2012 is to provide a guidance in the implementation of reduce, reuse, recycling of waste through waste bank activities. The waste bank mechanism according to this regulation include waste segregation, waste delivery to the waste bank, waste weighing, record the waste in the saving book, profit sharing from the waste price.

The waste bank can serve as implementing the "3Rs" of Reduce, Reuse and Recycle. It is clearly stated that the requirement to establish waste bank should have a building and management system. The management system required in the waste bank is the name of the waste bank, the address of the waste bank, the waste bank depositor, the waste collector, the waste buyer, the recycling industry, waste management in the waste bank, and the role of the waste bank administrator. The waste bank working

mechanism includes waste sorting, waste delivery to waste bank, weighing of waste, recording, waste result of sale submitted into saving book, and sharing of waste sale between depositor and executor. The implementation of the waste bank includes the determination of working hours, withdrawal of savings accounts, borrowing money, savings books, waste collection services, saving types, waste type, pricing, waste conditions, minimum weight, and waste containers. The waste bank administrators have a role as facilitator in construction and implementation of the waste bank, providing waste collector and buyer data for the waste bank, providing recycling industry data, providing the reward for the waste bank.

### III.2.2 West Nusa Tenggara Regulation

North Lombok District became a new administrative entity in 2008 as a part of West Nusa Tenggara Province. Prior to the formation of the North Lombok Regency, this territory was part of the West Lombok Regency. In 2019, the West Nusa Tenggara Province published Province Regulation No 5/2019 (Perda No 5/2019) about solid waste management. The regulation is derived from Law no 18/2008 and Government Regulation No 81/2012 both about Solid Waste Management.

The Perda No 5/2019 regulates the waste management problems in cross-boundary issues. Hence is the provincial government obliged to react to the waste problems in the regional area by providing a regional landfill. Article 6 indicates that the provincial government is obliged to

- facilitate inter-regional cooperation, public private partnerships, and regional waste;
- establish any regional waste management institution;
- establish waste management operational standards based on the central government minimum standards;
- issue permits for regional waste management facilities;
- provide technical assistance regarding solid waste management and community based solid waste management;
- improve the capacity of the waste management administration;
- develop a regional waste management masterplan;
- facilitate the resolution of inter-region conflicts regarding the solid waste;

- evaluate, monitor, and control of waste management development programs in the regencies; and
- evaluate the achievement of waste management activities at the regional level.

According to article 8, the provincial government is obliged to provide a regional landfill. The location of landfill must be in harmony with the spatial planning regulations. The government is permitted to establish waste management institutions organised as either:

- Regionally-Owned Enterprises (Badan Usaha Milik Daerah),
- In cooperation with private sector or the community, or
- In cooperation with the regencies

The provincial government launched the zero-waste program in 2019 as an implementation of this regulation. A zero-waste program means solid waste is treated as a resource. The aim of this program is to treat 70% and reduce 30% of the waste by 2025. The zero-waste program in NTB include community based solid waste management, waste recycling, waste reduction, and circular economy concept (NTB, 2021). The implementation of MSW management in the zero-waste program will be involved community (CBO) and private sector with public private partnership mechanism. Waste management industry in NTB include waste recycle industry; waste to energy industry, and hazardous waste management industry.

### III.2.3 North Lombok Regulation

Waste management regulation of North Lombok is stated in the District Regulation No 3/2018. This regulation is obtained from GR No. 81/2012 about Household Waste and Household-like Waste Management and Ministry of Home Affairs (MoHA) Regulation No. 33/2010 giving a Guideline of Waste Management. MoHA Regulation No.33/2010 focused to the role, duties, and responsibilities of the District Government in the waste management. The technical guidance of the waste management has mentioned in the GR No 81/2012. The waste management as mentioned in Article 1 of GR No 81/2012 is systematic, holistic, and sustainable activities, and it cover waste reduction and waste handling. The aim of waste management in this regulation include:

- Community health improvement;
- Support environmental sustainability and quality; and
- Improvement of community and business participation to reduce and manage waste in environmentally friendly.

As mentioned in the previous paragraph, the implementation of solid waste management consists of two main activities include:

**1. Waste reduction involves waste prevention, recycle, and reuse**

The District Government strategies to minimize the waste generation include (1) establish waste reduction target; (2) facilitate the implementation of environment-friendly product labelling; (3) actively reuse and recycle; (4) assist the distribution of recycled products.

**2. Solid waste managing includes waste segregation, collection, transportation, processing, and disposal**

Waste segregation must be done by waste producers from the sources such as, settlements, commercials, industrial areas, special areas, public facilities, social facilities, other facilities, and government offices. Instead of five types of waste as mentioned in the Government Regulation No 81/2012. To comply with the regulation, District Regulation No 3/2018 divided the waste into three fractions, as follow:

- green container for organic waste
- yellow container for inorganic waste, and
- red container for hazardous waste (B3)

Municipal solid waste (MSW) collection is held in cooperation with local authorities (RT and RW), and village government. The waste collection for local level usually conducted by community-based organization (CBO) that formed by the head of RT or RW. The collection of solid waste from public facilities, roads, and TPS/transfer station is undertaken by District Government.

This regulation mentioned that the MSW from the specific areas (i.e. real estate, industrial estate, commercial estate, etc.) under responsibility of the area's administrator. They are obliged provide suitable waste segregation facilities, and they have to transport the waste to the transfer station with appropriate vehicle. The MSW



management in the specific area can be implemented with public private partnership with waste management CBO. The waste transportation process from the transfer station to landfill is undertaken by Environmental Agency (DLHK).

This regulation mentioned, the waste processing in the TPS3R and Landfill are conducted with change the waste characteristics, composition, and/or volume using environmentally technology. The processing activities include compacting, composting, recycling, and waste to energy. Both waste generators and local government able to implement waste management from the sources of waste.

Article 18 states the District Government responsible to provide final processing area or landfill. The final processing of waste/residual waste in the landfill is conducted to restore the waste safely to the environment. Article 34 states the landfill methods that allowed to be operated as follow:

- a. controlled landfill
- b. sanitary landfill
- c. environmentally friendly technologies

The operation of a landfill includes the following activities: (a) piling/ compaction; (b) land cover; (c) leachate treatment; and (d) gas (methane) trapping.

The **Waste collection** for household waste is made through the cooperation with officials of the neighbourhood association (RT), or the community group (RW) consisting of several RTs, village officials, and local government officials at the subdistrict level through a Waste Management Institution (Lembaga Pengelola Sampah – LPS). The LPS at the RT and RW level is formed by the head of the RT or the RW, it serves to collect waste at the source and transport it to the collection point, the TPS or the TPS 3R. Waste collection from roads, public parks and cemeteries and to the collection point is undertaken directly by the local government through the cleanliness division.

**Waste Processing/Treatment** is organised in the TPS3R, TPST or landfill by changing the waste characteristics, composition, and/or volume using environmentally friendly technologies. Activities for waste processing include compacting, composting, recycling and waste to energy. Waste processing can be implemented by all waste generators, as well as by the Local Government.

The regulation about tariff/retribution of general service specifically in waste management services and public health is mentioned in the Head of Regency Regulation No. 29/2015 on Regional Retribution of General Services. The waste management tariff as mentioned in the regulation is presented below.

Table 7. General Tariff for Waste Management in North Lombok

Remarks		IDR
<b>PUBLIC/SOCIAL FACILITIES</b>		Rp 10,000 / month
<b>NON-COMMERCIAL</b>		
Household (21-45 m <sup>2</sup> )		Rp 7,500 / month
Household (more than 45 m <sup>2</sup> )		Rp 10,000 / month
Government Institution		Rp 15,000 / month
<b>COMMERCIAL</b>		
Type A (small enterprises, homestay, losmen, is on the edge of a regency and/or small road)		Rp 15,000/month
Type B (small enterprises, homestay, losmen, is on the edge of Major Arterial Road, provincial and /or national road)		Rp 10,000/month
Clinic		Rp 30,000/month
Type C (medium enterprises, Bank, State-Owned Enterprise, Local-Owned Enterprise, contractor services)		Rp 100,000/month
<b>Type D</b>		
	1-star hotel	Rp 250,000/month
	2-star hotel	Rp 300,000/month
	3-star hotel	Rp 400,000/month
	More than 3-star hotel	Rp 600,000/month
	Hospital	Rp 300,000/month
	Maternity Hospital	Rp 300,000/month
	Golf course	Rp 200,000/month
	Supermarket	Rp 300,000/month
	Mall	Rp 1,250,000/month
	Bus Station	Rp 150,000/month
<b>INDUSTRIES</b>		
	Small industry	Rp 15,000/month
	Medium industry	Rp 75,000/month
	Big Industry	Rp 350,000/month
<b>SPECIAL TARIFF</b>		
	Traditional Market	
	Non-permanent trader	Rp 600/week
	Permanent trader	Rp 2,500/week
	Street trader	Rp 7,000/week

Remarks	IDR
Shop	Rp 7,000/week

Source: Head of Regency Regulation No. 29/2015

The waste management licensing is regulated by Head of Regency Regulation No. 1/2019 on Waste Management Licensing. This regulation is about procedures for licensing and provisions for waste management providers, whether private sector, individuals or community-based organizations (CBO). Waste management activities consist of waste minimization and/or waste handling. This regulation emphasizes that individuals/private sectors/ CBO who provide waste management activities must have a Waste Management License from the Regent or the appointed government agency, i.e. the DLHPKP. The licenses are valid for 5 years and can be extended. The phases of legalized the waste management license as follow:

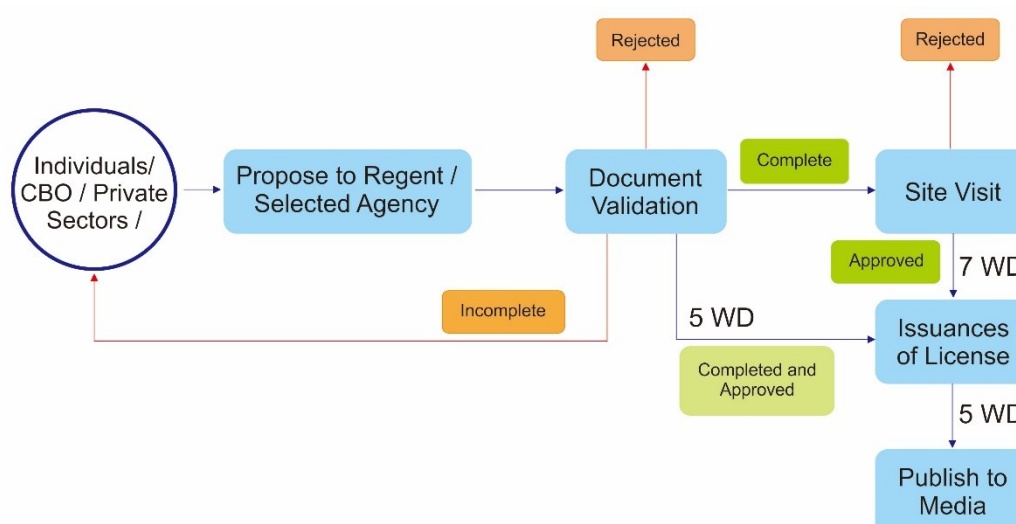
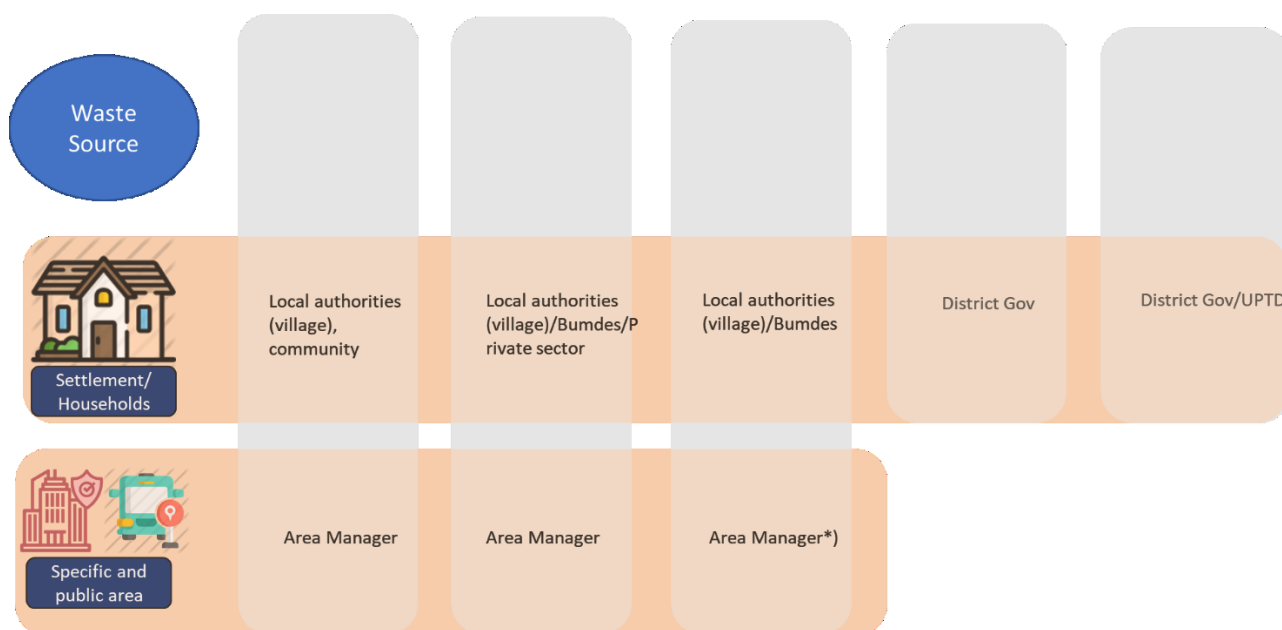


Figure 9. Licensing Procedures for Waste Management Institutions

### III.3 Current Role Sharing of Stakeholders

According to GR No. 81/2012, the role sharing between government, community, and private sector should be as presented below



\*) only provide TPS/TPS3r in the managed areas (station, offices, commercial area, estate, private tourism, etc.

Figure 10. Role sharing of the stakeholders

The waste management actors in Indonesia include central government, provincial government, district government, local authorities (village, RT/RW), community (households, junk dealers, community-based organization/KSM). They have role and responsibilities in the waste management based on the coverage area. The central government responsible to coordinate and provide a guidance to local government by:

- Provide norms, standards, procedures and criteria
- Dissemination/awareness raising of laws and regulations
- Education and training
- Facilitation of implementation on technical assistance to develop waste management infrastructures and facilities

The provincial government responsible to handle the waste management in the boundary between cities/regencies. The role of provincial government includes:

- Provide technical support and technical guidance
- Raising awareness of regional regulations
- Education and training
- Facilitating resolution of waste management disputes among regencies/cities

The sharing role of the local stakeholders is in the implementation of waste management from the segregation to the final processing. The involvement of the community, CBO/KSM, and private sectors to segregate the waste in the source is the most important role in the waste management as mentioned in the regulation. The role sharing of the local stakeholders as follow.

Table 8. Roles and Responsibilities of the local stakeholders in the waste management

No	Stakeholder	Roles and responsibilities
1	Community	<ul style="list-style-type: none"> <li>- Segregate waste from the source</li> <li>- Participate by giving input, considerations and/or suggestions to the Government and/or local government in waste management activities</li> <li>- Education, training, awareness raising by community groups to communities overall</li> </ul>
2	Private Sectors	<ul style="list-style-type: none"> <li>- Segregate waste from the source</li> <li>- Recycling of the waste</li> <li>- Extended producer responsibility</li> </ul>
3	Community Based Organization (Youth Organization, Pokdarwis)	<ul style="list-style-type: none"> <li>- Waste producer</li> <li>- Waste segregator</li> <li>- Waste management system implementer</li> </ul>
3	Area manager	<ul style="list-style-type: none"> <li>- The Area Manager is the institution that has the responsibility to manage its area such as residential areas, commercial areas, industrial estates, special areas, public facilities, social facilities, and other facilities:</li> <li>- Collecting waste</li> <li>- o Provide TPS, TPS 3R and collecting equipment for segregate the waste</li> </ul>
4	Village government	<ul style="list-style-type: none"> <li>- Provide TPS3R with or without the support from District/City Government for village level</li> <li>- Provide waste collection service from the household/source to TPS3R through Bumdes</li> <li>- Establish partnerships with business entities, communities and other local governments or formed waste management institutions</li> <li>- Establish waste bank from local level (RT/RW/Sub village) to the village level</li> </ul>
5	District/city government (Dinas Lingkungan Hidup)	<ul style="list-style-type: none"> <li>- Provide TPS, TPS 3R in settlement area</li> <li>- Provide waste transportation from TPS/TPS 3R to landfill</li> <li>- Provide Waste Transfer Station</li> <li>- Provide and operate waste treatment facilities and final processing facilities</li> <li>- Establish partnerships with business entities,</li> </ul>



No	Stakeholder	Roles and responsibilities
		<p>communities and other local governments or formed waste management institutions</p> <ul style="list-style-type: none"> <li>- Collect the cost-recovery fee (retribution) from everyone for the services provided</li> </ul>

Source: Danida, 2019 modified by UNDP, 2021

## IV. Survey Results

### IV.1 General Condition of Genggelang Village

#### IV.1.1 Physical Condition

Genggelang village is a part of Gangga Sub District, North Lombok West Nusa Tenggara Province. The area of this village approximately 29,21 km<sup>2</sup> equal to 18,56 % of the total area Gangga Sub District. This village is divided into 12 sub village. Distance to the capital of Ganggal Sub District about ±8 Km where the distance to the capital of North Lombok about ± 15 Km. The boundary of the village as follow:

North side	= Rempek village, Gangga Sub District
East side	= Kecamatan Narmada
South Side	= Segara Katon, Bentek villages and Tanjung Sub district
West Side	= Lombok Strait

The area of Genggelang Village is elongated from the Northwest to the Southeast. The Northwest is a coastal area. In contrast, the Northwest is a part of Rinjani Mountain. Hence, the topography of this village various from coastal areas with altitudes about 0-10 meters above sea level (m.asl), gradually elevated to more than 500 meters m.asl. Therefore, residential settlements in Genggelang Village developed at an altitude of about 1 to 500 m asl.

Table 9. Land Uses in Genggelang Village

Land use & Land Cover	Luas	
	Km <sup>2</sup>	%
<b>Forests</b>	21,83	74,73%
<b>Plantations</b>	6,89	23,59%
<b>Rice Field and Seasonal Rice field</b>	0,41	1,41%
<b>Settlement and Public Space</b>	0,08	0,27%
	29,21	100,00%

Source: Ina Geoportal BIG

The land use is divided into 4 types including rice fields about 0,41 km<sup>2</sup>, industrial plantation about 6,89 km<sup>2</sup>, of settlement areas ab public space about 0,8 km<sup>2</sup>,

and forests about 21,83 km<sup>2</sup> which dominated by industrial forestry. Land use of Genggelang village as follow:

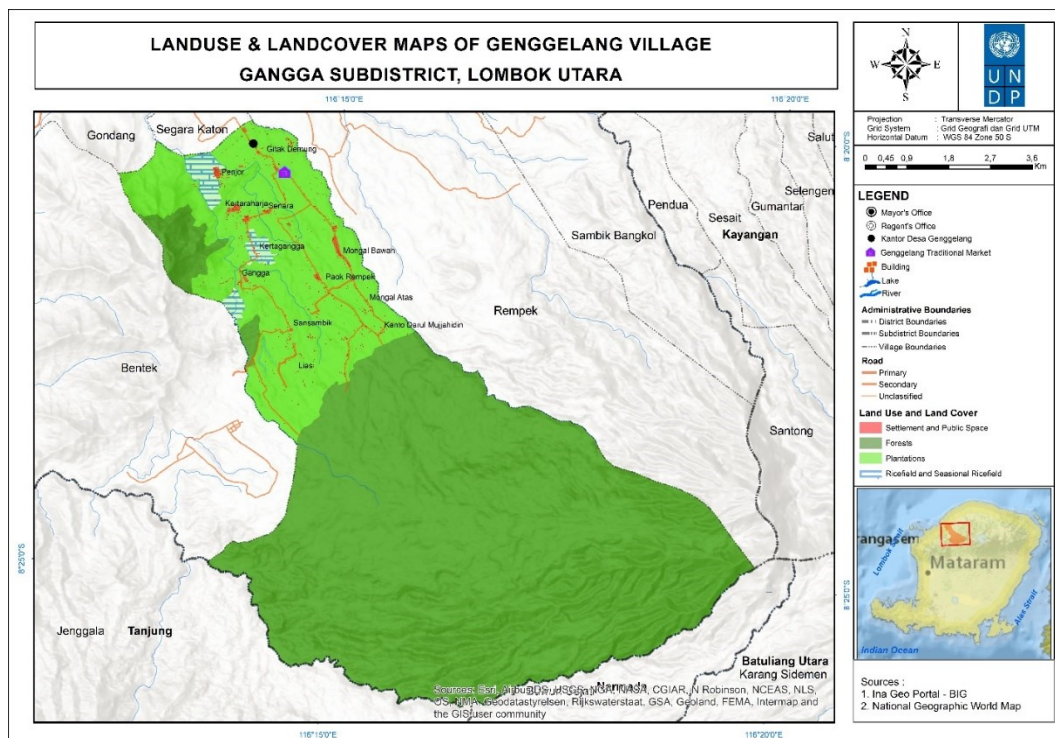


Figure 11. Landuse map of Genggelang Village

#### IV.1.2 Social and Economic Condition

The result of social survey indicated that the waste in the household is managed by woman. It has showed in the respondents are dominated by female approximately 64%. In contrast, the male respondent only around 36% of the total respondent. The respondents age dominated by 30 – 40 years old, and they mostly graduated from the senior high school. However, approximately 6% of the respondent illiterate who dominated by old people. General information about respondent in Genggelang Village is presented in the following picture.

In Indonesian culture, women handle household waste. Women role as household managers plays an essential role in reducing food waste. However, this does not mean that women will automatically deal with waste properly. The way women manage waste is influenced by several factors, such as sociocultural processes, education, environmental awareness and women involvement in the community. It can

be claimed that in Indonesia, women's undertaking household waste is influenced by their activities in the neighborhood.

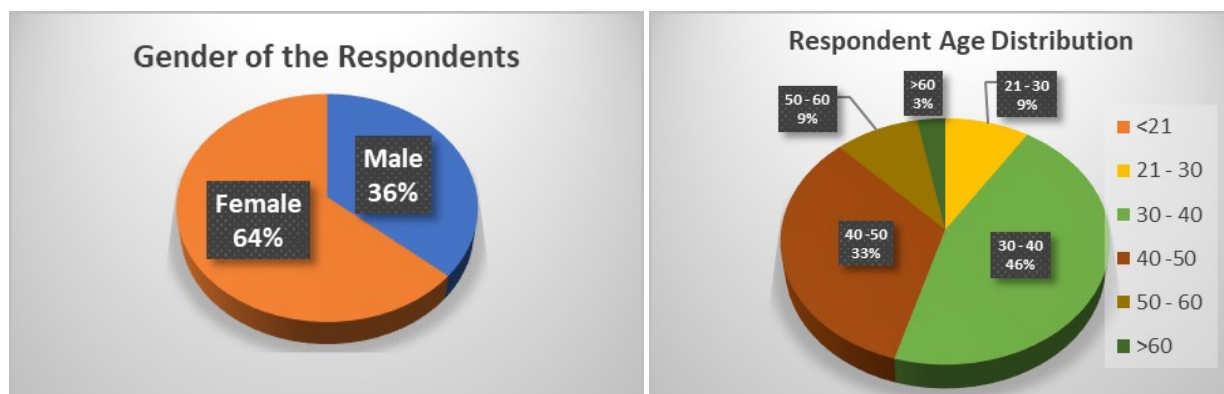


Figure 12. Gender and Age of the Respondents

Based on the interview with the local authority, farming is become the main livelihood of the community.

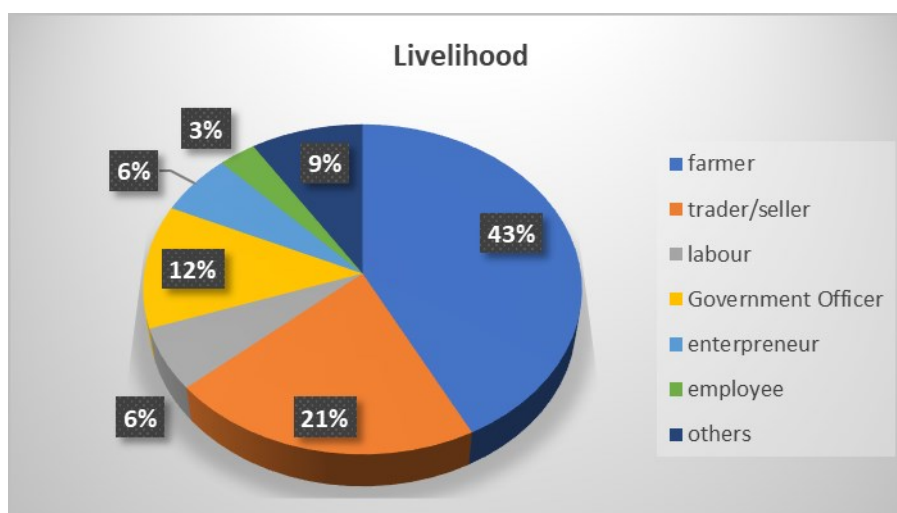


Figure 13. Livelihood of the community in Genggeling Village

The previous figure shown that agriculture become the main livelihood of the community followed by trading. Hartanto reported that agriculture is the main livelihood of the community. The average income around Rp 900.000 every harvest. Likely, the community plant more than one commodity in their land. Based on the field observation, the community plants cloves, cocoa, coffee, coconut, and bananas. The commodities have exported to Bali and Central Market in Tanjung. Its means that the monthly average income more than Rp 900.000 per month. The number has verified

with the survey to the community. Around 87,9% of the respondents answer that they earn around IDR 2.000.000 per month.

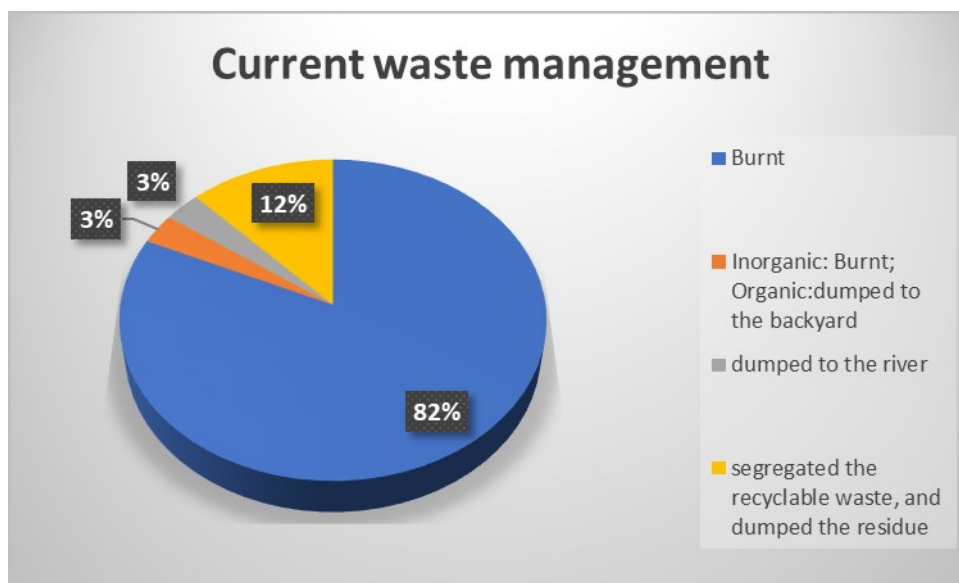


Figure 14. Current Waste Management System in Genggelang Village

Figure 12 indicated that the current waste management in Genggelang village. Most of the community burnt the waste after dried it in the backyard. The waste is usually flowing to the river during the rainy season. According to Mr Gede from Genggelang Market, the waste management in the market followed the community behaviour. He collects the waste to the side of the parking area to dry, and he burnt the waste after two or three days.





Figure 15. Dried and burnt the waste

Regarding the waste segregation, most of the community (72,73%) never conduct waste segregation at home. They prefer to burn the waste as well as dumped to the river. The impact of it is not a part of this research, for it needs specific research separated with the masterplan. Moreover, they perceive that burning the waste is better than throwing it into the river. The respondents who have not yet practiced waste sorting agree that they know how to sort waste properly, but there is still a lack of information on the advantages of segregation. Around 27,27% of the respondents answered that they segregate their waste organic and inorganic. The aim of waste segregation is to dry the waste before they burn it. However, they agree to segregate the waste if the information available, and they willing to join the assistance program.

Most of the respondents willing to consider waste segregation if the information how to segregate available. Approximately 81,8% of the respondents answered agree that waste segregation is important. However, 18% of the respondents consider to segregate the waste regularly, and around 52% of them chose to answer sometimes as well as most of the time (12%). Likely, the answer is influenced by the main livelihood of the community. They spend most of their times to work in the farm. The picture of willingness to segregate is presented below.

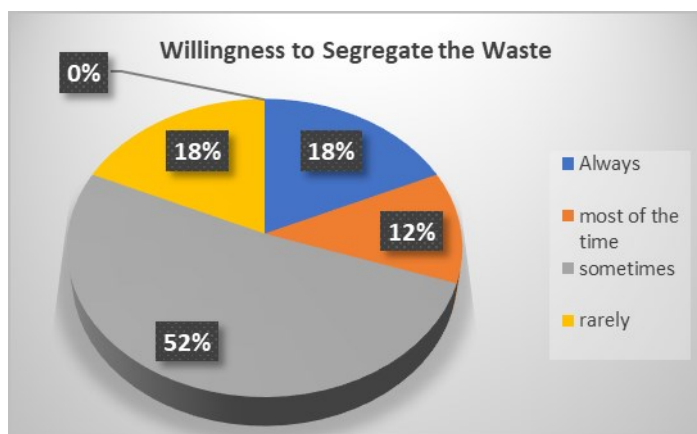


Figure 16. Community Willingness to Segregate the Waste

Willingness to pay (WTP) provides an indication of the extent to which segregate at the source is perceived as a cost for the household and of the size of this cost in monetary terms. The determinants of the WTP for improved SWM system have been widely suggested to have significant influence on the willingness of the respondents to pay for waste collection (Tassie, Endalew, & Behzadian, 2020). Based on the interview with Head of Village, the community from Penjor, Gangga and Kerta have asked waste collection service from the government. They have no place to manage the waste except burnt or dumped to the river. Moreover, the waste become a huge problem for the tourism eventually after the rain. The willingness to pay of the community for waste management service as follow.

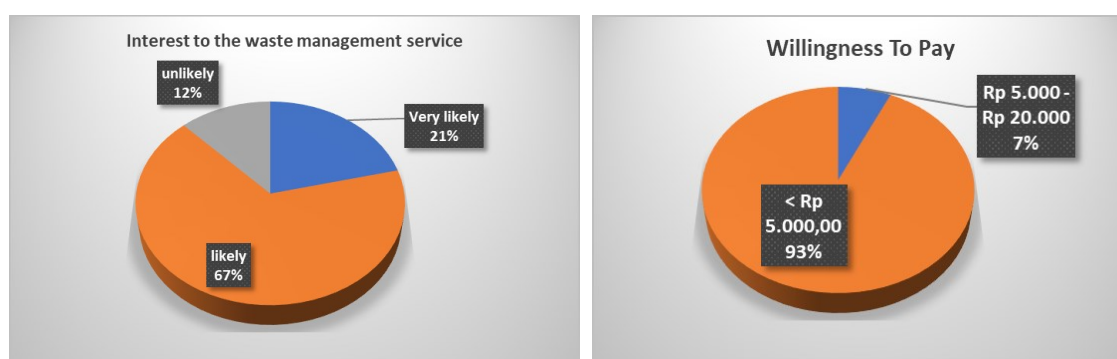


Figure 17. Willingness to pay

The previous picture indicated that more than 67% of the respondent interest to use the waste management service. Approximately 21% of them very likely to use the service. Based on the interview, most of the respondents willing to pay less than Rp 5000,00 for the service equal to 0,06% of the community income per harvest. According

to the responses to the questionnaires, if appropriate mechanisms, incentives, and technical information are provided, the majority of respondents agree to play future roles, such as segregate the waste (join the waste bank) and being involved in the organic waste management.

#### IV.1.3 Population

Regarding the waste segregation, most of the community (72,73%) never conduct waste segregation at home. They prefer to burn the waste as well as dumped to the river. The release of greenhouse gasses from the fire should be conducted separately, for it need specific expertise. Moreover, they perceive that burning the waste is better than throwing it into the river. The respondents who have not yet practiced waste sorting agree that they know how to sort waste properly, but there is still a lack of information on the advantages of segregation. Around 27,27% of the respondents answered that they segregate their waste organic and inorganic. The aim of waste segregation is to dry the waste before they burn it. However, they agree to segregate the waste if the information available, and they willing to join the assistance program.

The Genggelang village had divided into two villages in 2020 include Genggelang Village (old village) and Segara Katon (new village). However, the population data series from Indonesia Statistical Bureau is available from the old village. In result, the population forecast was calculated using the data which cover Genggelang and Segara Katon. The result of population forecast projection was used to determine the waste generation from 2021 to 2040. Total waste generation will be used calculate the waste management infrastructure needs. The population forecast is presented in the following table.

Table 10. Population forecast in Genggelang Village

Year	Population	
	Gangga	Genggelang
2020	43172	11626
2025	44240	12156
2030	45284	12680
2035	46329	13204
2040	47373	13728

Year	Population	
	Gangga	Genggelang
2045	48418	14252
2050	49462	14776

Source: calculated by UNDP, 2021

## IV.2 Current Waste Management System in Genggelang Village

Based on the field assessment and interview of the key stakeholders, the community does not properly manage their waste. Approximately 82% of the waste was burnt and about 3% leak to the river. The community usually collect the waste in the backyard or drainage system, and they expect the moisture content will decrease with the light of the sun. Furthermore, they will burn the dried waste. During the rainy season, the waste will be carried the runoff to the river. In compare with the result of community survey, the village government estimated only 5% of the waste burnt. However, the waste stream in Genggelang Village about 95% not be managed properly. The waste stream in Genggelang village is shown below.



Figure 18. Waste Stream in Genggelang Village

The brief interview result indicates the community have no choice than to burn the waste. They have been expecting the waste collection service from the government since 2015, yet they get no answer.



## IV.2.1 Waste Producers in Genggelang Village

### A. Genggelang Market

Genggelang market is very important for the community in the village, for it a place to interact and socialize. The market operates once a week every Thursday, and it uses as transfer area for agriculture products (banana, coconut, etc) from the farmer to the middleman. This market has been operating since 1987. The service area includes Rempek, Gondang, Genggelang, and Bentek. The market activities are shown below.



Figure 19. Genggelang Market

The market buildings were heavily damaged hit by the earthquake in 2018. The damage disturbed the trading activities, so UNDP Indonesia rebuilt the WASERDA (community convenience store) to restore the market activities. The village government has managed the market, but they plan to delegate the market management to the BUMDES (Village owned company) in 2021. Yet transitional process does not finish. The institutional of the BUMDES need to be ratified by BPD (village community council). The market information is presented in the following table.

Table 11.. Field observation results in Genggelang Market

Field Observation parameters	Condition
<b>Total market area</b>	1943,046 m <sup>2</sup>
<b>Total building</b>	384 m <sup>2</sup>
<b>Waserda area</b>	64 m <sup>2</sup>
<b>Number of sellers</b>	29
➤ <b>households' utensils</b>	2 sellers
➤ <b>clothes</b>	2 sellers
➤ <b>fruits</b>	2 sellers
➤ <b>vegetable</b>	6 sellers
➤ <b>protein (fish and meat)</b>	3 sellers
➤ <b>salt and spices</b>	1 seller



Field Observation parameters	Condition
<b>Waste characteristics</b>	
➤ <b>organics</b>	Food leftover Rotten vegetables and fruits Plant litters
➤ <b>inorganics</b>	Sigle used plastics (sheet) Multilayer plastics (sachet) PET (polyethylene) or mineral water bottle PP (polypropylene) or mineral water glass High definition polyethylene (bucket and jerry can) Cardboards Papers

Source: field survey UNDP, 2021

The waste has been handling by Pak Huna and Pak Gede voluntary who work as labour in the market. Pak Gede is a member of the Village Council as well. The current waste management in the market is similar with the community surrounding. They burnt the dry waste in the market backyard. The sellers expect the solid waste managed by the market management, and they willing to pay the tipping fee around Rp 500 to Rp 1000 per day for waste management. At the moment, the market building is unused. Instead of using the building, they chose to place the goods near the gate.

There is a seller who collect the recyclable waste after the market operation. She collected cardboards and papers, and she will sell to the junk dealer in Tanjung. She mentioned the price of cardboard around Rp 2500 per kg. The price of PET bottle (mineral water bottle) around Rp 3000 per kg or Rp 300 per pieces (dry and clean).

#### B. Households

The municipal solid waste in Genggleng mostly produced by households' activities. Total household around 2242. Based on the survey, the households produced 2,5 kg/day of solid waste per day mixed from the house and yard, so the waste production from household around 5910,7 kg/day or equal to 6 ton/day. This number is higher than the calculation about 3488 kg/day which calculated based on waste generation kg/person/day about 0,3 (Danida, 2018). This number is more suitable for Genggelang village, so it used to predict waste forecast. At the moment, waste

collection service unavailable in Genggelang village, so the community managed the waste by themselves by burning and dumping (backyard or drainage system).



Figure 20. Waste production measurement in the Households

### C. Tourism

Tourism become the side income for the community and village. Head of North Lombok District inaugurated Genggelang as a tourism village in December 2020 (Sofiyan & Marsam, 2021). Mr Al Mududi explained that there are 4 tourism spots in Genggelang include Tiu Pituq waterfall, Kertagangga waterfall, Rumah Pohon (tree house), and Kampung Coklat Senara (Cocoa kampung Senara). Total tourist approximately 45000 people within 2019. The income from tourism reach 40 million in a month. The number of tourists decreased significantly during COVID 19 global pandemic.

Lack of municipal solid waste management in the village affects the tourism areas. According to the POKDARWIS (kelompok sadar wisata – conscious tourism group), the waste that leaks into the water will accumulate in the waterfall. The accumulated municipal waste in the drainage system float to the river through run-off in the rainy season. A lot of the solid waste has stuck in the rock, and it floats in the natural reservoir under the waterfall. Hence, the POKDARWIS have to clean up the river soon after the rain. According to Koko (Pokdarwis), foreign tourists often scold the staff, for they found plastics float in the water. Waste accumulation in the waterfall is presented in the following picture.



Figure 21. Plastics waste in the river

#### D. Offices, Schools, and Industry

Based on the interview with the village government, there is one home industry available in Genggelang village called chocolate industry Kampung Senara. The solid waste from this industry mostly organic waste. The other waste sources include schools and offices. Indonesia Statistical Bureau reported that around 24 schools and 1 government office in Genggelang. The village government office managed the solid waste by burnt. The schools in Genggelang is shown below.

Table 12. Number of Schools in Genggelang

Schools	Unit
TK/RA	3
SD/MI	12
SMP/MTS	5
SMA/MAN/SMK	4
Total	24

Source: BPS, 2021

## IV.2.2 Waste Generation and Compositions

### IV.2.2.1 Assumptions

Indonesian Ministry of Environment and Forestry through No P.10/Menlhk/setjen/PLB.0/4/2018 about Technical Guidance to Develop the Policy and Strategy of Solid Waste Management regulated that the waste quantity should be estimated by population and waste generation per person per day at around 0,7 kg/person/day or based on local estimation. This number is equal to the Indonesia National Standard No 19.3989.1995 around 0,7 – 0,8 kg/person/day for medium city, and 0,625 – 0,7 for small city. World Bank estimated the waste generation in Indonesia around 0,52 kg/cap/day which is lower than the government estimation.

The calculation of waste generation in this document based on the local estimation that reported by Provincial Government around 0,3 kg/cap/day which assumed as the most accurate to the calculation. Based on the field observation, the project location is categorized as rural area. The waste productivity in the rural area is lower than urban area (Ciuta, Apostol, & Rusu, 2015). The waste generation in North Lombok is presented in the following table.

Table 13. Waste Generation of North Lombok from Various Sources

Source Information	Litre/person/day	waste density	kg/cap/day
<b>MSW Masterplan of North Lombok</b>	1,91	0,25	0,478
<b>Dinas LHK NTB</b> ( <a href="https://dis-lhk.ntbprov.go.id">https://dis-lhk.ntbprov.go.id</a> )	1,2	0,25	0,300
<b>Simorangkir, 2019</b> (Gangga and Tanjung)	1,2	0,18	0,216

Calculation of waste production from the household based on the population forecast. However, the waste quantity calculation has to consider the waste production from public facility, schools, and tourism. The waste generation from Genggelang Market and tourism activities are estimated in the Indonesia National Standard No 19-3983-1996 about Quantity and specification for small and medium city which shown in the following table:



Table 14. Waste Generation based on the waste source component

No	Waste sources	Unit	volume (liter)	weight (kg)
1	permanent houses	per person/day	2.25 - 2.5	0.35 - 0.4
2	semi-permanent house	per person/day	2 - 2.25	0.3 - 0.35
3	non-permanent house	per person/day	1.75-2	0.25-0.3
4	office	per officer/day	0.5 - 0.75	0.025-0.1
5	shop	per worker/day	2.5 - 3	0.15 - 0.35
6	school	per student/day	0.1 - 0.15	0.01-0.05
7	secondary road	per meter/day	0.10 - 0.15	0.01 - 0.02
8	collector road (secondary)	per meter/day	0.1 - 0.15	0.01 - 0.05
9	local road (alley)	per meter/day	0.05 - 0.1	0.005 - 0.025
10	market	per square meter/day	0.2 - 0.6	0.1 - 0.3

Source: Indonesia National Standard No 19-3983-1996

Based on the field assessment, the waste sources in Genggelang Village include households, market, offices, schools, and the tourism area. The tourism area contributes the waste generation more than the market. In contrast, the tourism spot become the most affected area of the improper waste management service and behaviour in the village.

The waste generation from the tourism activities must be estimated as well. The waste production per tourist is depend on the location, and duration of the tourist stay in Genggelang. In assumption, the visitor usually stays in the village less than 24 hours, so the waste generation equal to the waste generation in the office around 0,025 – 0,1 per person per day.

#### IV.2.2.2 Waste Quantity Forecast

World Bank reported that there is a positive correlation between waste generation and income level. Daily per capita waste generation in high-income countries is projected to increase by 19 percent by 2050, compared to low- and middle-income countries where it is expected to increase by approximately 40% or more. Waste generation initially decreases at the lowest income levels and then increases at a faster rate for incremental income changes at low income levels than at high income levels. The total quantity of waste generated in low-income countries is expected to increase



by more than three times by 2050 (Worldbank, 2021). Genggelang was declared as tourism village with the expectation the income of the community will increase due to the tourism activity. Hence, the waste generation will increase following the gain of the income and tourism activities.

The waste forecast was calculated based on population data of Genggelang village from 2016 – 2020. According to the District Regulation No 9/2020, Genggelang village is divided into two villages include Genggelang and Segara Katon. However, the population forecast was calculated based on population data before the regulation from 2016 – 2020. The population and waste forecast are presented in the following table.

Table 15. Population and Waste Forecast in Genggelang

Year	Population	Waste generation (kg/person/ day)	Waste quantity (kg/day)	Waste quantity m <sup>3</sup> /day)
2020	11.626	0,3	3.488	13.951
2025	12.156	0,3	3.647	14.587
2030	12.680	0,3	3.804	15.216
2035	13.204	0,3	3.961	15.845
2040	13.728	0,3	4.118	16.474
2045	14.252	0,3	4.276	17.102
2050	14.776	0,3	4.433	17.731

Source: Analysis by UNDP, 2021

The waste forecast tourism activities could not be calculated due to the data available for one year only. Furthermore, the parameter to calculate waste generation from the market activity is the area in m<sup>2</sup>. The waste quantity from market and tourism are presented in the following table.

Table 16. Waste Calculation from Market and Tourism

No	Remarks	Total
1	Waste from Genggelang market	
	Market area (m <sup>2</sup> )	2095
	Operation	Once a week (every Thursday
	Waste generation kg/m <sup>2</sup> /day	0,1
	Total waste generation	209,5
	m <sup>3</sup> /Thursday	838
2	Waste from Tourism activity	
	Number of tourists in 2019	40000

No	Remarks	Total
	waste generation/tourist/day	0,025
	Total waste generation from tourism	1000
	<b>m<sup>3</sup>/year</b>	<b>4000</b>
	<b>m<sup>3</sup>/day</b>	<b>10,96</b>

Source: Analysis by UNDP, 2021

The calculation of waste quantity forecast will be used to calculate the waste management infrastructure in the village. However, the number of populations decrease due to the territorial separation, the waste forecast is estimated based on the previous data.

#### IV.2.2.3 Waste Composition

The baseline data of waste composition was collected from various report, and it was verified with physical survey on 24 to 29 June 2021. The waste composition of North Lombok has been reported by Danida (2019) and Simorangkir (2019). The waste composition by Danida (2019) was estimated from the study for Lombok in 2004 made by JICA. Likely, the percentage organic waste from that report is more applicable for Mataram. Based on the field assessment, the organic waste percentage is likely higher than the reported. In contrast, the waste composition which reported by Simorangkir more reasonable for Genggelang. Moreover, the survey was conducted in Tanjung and Gangga with the similar condition with Genggelang. The calculation of waste composition will be used to calculate the cost and financing of the waste management system. The waste composition in some locations are shown in the following table.

Table 17. Waste Composition

Waste Types	North lombok	Gangga and Tanjung
<b>Organic Waste</b>	59,90%	79,86%
<b>Cardboard/papers</b>	17,40%	4,53%
<b>plastics</b>	17,60%	12,83%
<b>glass</b>	3,00%	0,48%
<b>metal</b>	1,40%	0,17%
<b>Other</b>	0,80%	2,13%

Source: Danida (2019) and Simorangkir (2019)

The waste composition in Gangga is dominated by organic material that constitutes around 79,86% of the total waste. Organic waste consists of food leftover and plant litter. Plastic and paper dominated the inorganic waste.

Due to tourism activities, the production of inorganic waste is expected to increase over the years. Based on the field assessment, there are a few coffee shops in the tourism area. They mostly sell instant coffee and instant noodle that will produce inorganic waste from the package. The plastics package for instant food is made from multilayer plastics which categorized as non-recyclable plastic. This means that the waste management strategy has to consider the waste reduction program.

### IV.3 Current Recycle Activities

The village government reported that there are two scavengers in Genggelang village. They collect the plastics and papers from the dumpsite, and they sell it to the junk dealer (recyclable materials middleman). Unfortunately, both of the scavengers quit the job due to the age and health condition. Hence, we found a couple who work as junk dealer in Gangga sub-village called Ripah and Kamarudin.

Kamarudin seek the recyclable materials door to door from the households, offices and schools in Gangga Sub District. He will buy the recyclable both segregated or unsegregated. The recyclable materials that can be sold in North Lombok include plastics, papers, metals, and electronics. He regretted that the Genggelang village community had not realized the value of the waste they had burned, especially plastic and paper waste. The couple managed all of the inorganic waste except sheet plastic (single used plastics), Styrofoam (Polystyrene), and multilayer plastics (sachet).



Figure 22. Discussion with the Junk Dealer (Ibu Ripah and Pak Kamarudin)

Kamarudin explained the buy price of the recyclable materials from the end buyer various depend on detailed of the segregation. The price will increase when the materials homogenous, dry, and clean. He agreed to cooperate with Bumdes to manage the recyclable waste. He happily to be an end buyer of the segregated waste, for he will get the material easily. The waste price list is presented below.

Table 18. Recyclable Waste Price List

Materials	Condition	Buy Price	Sale Price	Source Information
<b>Cardboard</b>	Good	Rp 2000 – Rp 2500 /kg	Rp 3500/kg	Kamarudin
<b>Cardboard</b>	Bad	Rp 2000 /kg	Rp 2500/kg	Kamarudin
<b>PET Bottle</b>	Dry	Rp 1500 /kg	Rp 3000/kg	Kamarudin
<b>PET Bottle (1500 ml)</b>	Dry, clean	Rp 300 / piece	n/a	Haji Basri (Lingsar)
<b>PET Bottle (600 ml)</b>	Dry, clean	Rp 100 /piece	n/a	Haji Basri (Lingsar)
<b>PP</b>	Dry	Rp 1500 / kg	Rp 3500/kg	Kamarudin
<b>Zinc roof</b>	Dry	Rp 1700/kg	n/a	Kamarudin
<b>Cooper</b>	Dry	Rp 45.000/kg	n/a	Kamarudin
<b>Aluminium</b>	Dry	Rp 9000 / kg	n/a	Kamarudin
<b>Brass</b>	Dry	Rp 45.000 / kg	n/a	Kamarudin

Source: field survey UNDP, 2021

## IV.4 Gap Analysis

### IV.4.1 Technical and Financial

#### A. Technical Gap

Based on the waste hierarchy principle in Indonesia, the municipal solid waste must be handle using new scheme “sorting – collecting – handling – recycling – dispose”. The priority of waste handling process should be adopting the following options:

- Reduction: the waste must be reduced at source
- Reuse: use the reusable materials if waste cannot be prevented
- Recycle: Waste materials should then be recycled or reprocessed into a form that allows them to be reclaimed as a secondary raw material
- Turn into energy: the energy content of the waste should be used as substitute for nonrenewable energy resources

- Disposal: the latest option for residual waste that cannot be recycle, this should only be undertaken in a controlled manner.

The social analysis shown that the main problem in Genggelang is the community perception towards waste segregation and recycle. They assumed that the best solution to manage the waste is burnt it. Moreover, some of local authorities (dukuh) suggest the community to burnt the waste than dumped to the river.

Regarding the recycle process, the community willing to segregate the waste from the house if the proper information how to segregate the waste available. They think waste segregation useless and uneconomically, for they have to bring the recyclable waste to Tanjung.

#### B. Financial Gap

Budget planning aspects: The waste sector still has an obstacle related to the internal competition among which own development programs. Waste management is not as highly prioritized as other sectors. This is worsened by a general low understanding on waste management aspects by the key people, on district level and village levels. In fact, there are actually many funding sources which could be used provided that the mechanisms are properly applied.

However, the Genggelang Village already set the waste management as a planning for 2022, and they will involve Bumdes to manage the waste. According to the Head of Village (Mr. Al-Maududi), they plan to build sustainable waste management system in 2020. The District government committed to support with 2 unit of three-wheeled motor with container and 1 unit of waste container as mentioned in the RPJMDES 2022 (Rencana Pembangunan Jangka Menengah Desa 2022 – Village Medium Term Development Plan 2022). The waste container will be placed in the market.

Moreover, they already have 1 unit three-wheeled motor located in Penjor Sub Village. Based on the analysis of RKPDes of Genggelang Village, total budget for waste management around Rp 525.000.000 that focused mostly for collection and transportation equipment. They plan to implement waste capacity building of waste management program include waste management counseling and training. However, the program was developed without planning and assessment of waste management in



the village. Hence, the TPS3R building/Warehouse/Rumah Pilah yen not available in the budget plan. The gap analysis on the financial of waste management is presented below.

Table 19. Financial Gap Analysis

Waste Management Equipment	availability	IDR	Qty	Remarks
Rumah Pilah/TPS3R building	committed by the government	gap	-	
Motor cargo (waste collection and transportation tools)	committed by district government	Rp 350.000.000,00	3	2 unit committed, 1 unit available in Penjor
Composter and equipment	not available	gap		
BSF Installation	not available			
Waste container and segregation equipment	committed by the government	Rp 125.000.000,00		RKPDDes 2022
community assistance program of waste management (training, assistance)	committed by the government	Rp 50.000.000,00		RKPDDes 2022
		Rp 525.000.000,00		

Source: Interview by UNDP (2021) and RKPDDes (2021)

The previous table indicated that some of waste management equipment not listed yet in the government plan. The equipment and program will be listed and analyzed in the following chapter to conclude the waste management scenarios that can be implemented in Genggelang Village.

#### IV.4.2 Institutional Gap

Waste management actors in Genggelang Village include waste producers (market, community, tourism, offices/schools); village government; Bumdes (village owned company); District Government; informal scavengers; and informal junk dealer. Each actor has important role to the waste management in the village. Each role of the actors as follow.

Table 20. Actors Role in the Waste Management

No	Actors	Role
1.	Community	Waste producers

No	Actors	Role
		waste segregators
2.	Community based organization	Waste bank implementer for RT/RW level (bank sampah unit) organic waste handling (communal)
2	Market	Waste producers Waste segregator
3	Village government	Waste management regulator for village level Planning and budgeting Monitoring and Evaluation Determine the target
4	Bumdes (Village Owned Company)	Waste collector and transportation service Waste bank implementer for village level (bank sampah desa) Waste segregator (detailed segregation based on recycle factory needs)
5	District Government	Technical support dissemination of legislation and guidelines in the field of waste management; education and training in the field of waste management; provision of facilities for waste bank; monitoring and evaluation of waste banks; and/or TPS 3R help the marketing of 3R activities.

Source: Analysis by UNDP, 2021

According to Pak Al-Maududi, the community has urged the village government to make the Village Regulation for waste management. They have complained about lack of the waste collection service from the government. The village government plan to develop the regulation, and they will hand over the waste management to BUMDES as a new business activity.

However, the Bumdes of Genggelang has just elected the management team a few month ago, so they still need an assistance to implement of waste management in the village. As result of the interview with the management team, they still lack of knowledge about waste management. Moreover, they don't understand yet that they can make the waste management system as an additional business.

## V. Waste Management in Genggelang, Potential Options for Collection, Treatment and Disposal

### V.1 Objectives and Targets

#### V.1.1 Objectives

Sustainable waste management plan development for village level must be taken to ensure the plan is suitable with social and economic condition of the village. This means that proposed measures and initiative should respect the local wisdom as well as principle laid out in national and regional plans.

Considering the social and economic condition of the community, the waste management in Genggelang is proposed to combine TPS 3R concept and waste bank. The objective of this system is to provide the waste management system that sustainable and accessible for the community from various income and social condition. The waste management system should be developed in such manner that adopted the economic resources of the community, and it can assure the collection, treatment, and disposal suitable with the capacity of different economic actor to pay.

#### V.1.2 Targets

According to the Presidential Decree No.97/2017, the government targeted to manage 70% of the waste and reduce 30% by 2025 while North Lombok only collect 15% of the waste in 2019 (Danida, 2019). However, the target of this planning document is determined based on the interest of the community to use the waste management service offer by Bumdes, willingness to segregate the waste, and willingness to pay the service. Refer to the Governor Regulation No 14/2020 about Policy & Strategy on Management of Household Waste and Household-like Waste, waste reduction is targeted about 30% by 2025. However, the waste collection service should be targeted

gradually within 5 years due to the equipment and tools availability. The village government targeted around 1000 households will attracted and join the program in the early stage, and they expect it will gradually increase year by year.

## V.2 Waste Collection Options

### V.2.1 Waste Collection System

Waste collection is the collection of solid waste from the point of generation also called the source. Genggelang village is categorized as rural area with cluster/nucleoid and linear settlements type. The cluster settlement type includes Penjor, Kerta, and Gangga sub-villages. The linear settlement spreading in the settlement surrounding the forests. The characteristics of cluster settlements include old, high density, and accessible from the main road. The community who live in the clustered settlement almost 100% dumped the waste into the river, for they do not own a large area. In contrast, the community in the linear type settlement chose to burn the waste due to the backyard availability. The head of village confirmed that Penjor, Kerta, and Gangga sub-villages are the first settlement in the village. Hence, the waste collection has to be chose the most suitable for that condition as well as economically.

For collection, the most productive and economical approach is often a combination of methods – different methods to be applied in different parts of the area or towards different categories of users. Variable factors can be type of receptacles (or none!), placement of receptacles, frequency of collection, type of collection vehicles. Such factors should be dictated by e.g. the desired level of service, the physical structures, traffic considerations, and consumers' willingness to pay.

The collection from the sources in the city can happen in several ways, the four following examples as follow:

Table 21. Overview of the collection systems

System/ Description	Costs/Service level	Advantages	Disadvantages
<b>Block collection</b>			
Collector sounds horn or rings bell and waits at specified locations for residents to bring waste to the collection vehicle	Low costs  Low service level, however dependent on walking distance and collection frequency	Less waste on streets. No container to cause complaints  Waste pickers have no access to waste, but segregation can be carried out by collection crew	Waste producers need to be present at collection
<b>Communal containers</b>			
Waste producers bring waste to a shared container which is emptied or removed	Low costs  Fair to good service level, if short walking distance	Producers of waste can bring waste to bin at their own discretion	Waste pickers have easy access to waste  If containers are not maintained they quickly corrode or gets damaged.  Adjacent residents complain about the smell and appearance
<b>Kerbside collection</b>			
Waste is left outside property in a container and picked up by passing vehicle, or swept up and collected by sweeper	Good service level Higher costs if standard solid containers are mandated	Convenient to waste producers  No permanent public storage	Waste pickers have easy access to waste as have animals. Considerable nuisance if collection service is delayed
<b>Door-to-door/yard collection</b>			
Collection labourer enters property to take bin, empties it and replace bin in yard	Very good  High costs	Very convenient to waste producers  No waste in streets  Waste pickers have not access to waste	Requires intensive investments in storage containers and matching collection vehicles  Crew must enter properties

Source: COWI & DANIDA, 2018

Based on the field observation and willingness to pay, the block collection system is the most suitable system that can be implemented in Genggelang Village. Block collection system has chosen as the best solution for the waste collection because

it suitable with the requirement that mentioned in the MoPWH regulation No 3/2013 include:

Based on the field observation and willingness to pay, the block collection system is the most suitable system that can be implemented in Genggelang Village. Block collection system has chosen as the best solution for the waste collection because it suitable with the requirement that mentioned in the MoPWH regulation No 3/2013 include:

- Limited of vehicle availability
- Unable to control the personnel
- Contour of the area is undulating, and not accessible
- high community participation
- irregular settlement

Block collection system is technical recommendation how to collect the waste with limited resources and physical condition of the area. The MoPWH No3/2013 is the technical guidance for community-based solid waste management through TPS3R, and it easy to combine with MoEF regulation about waste bank. In contrast MoHA mostly regulated the government role in the solid waste management without consider community involvement except waste segregation. At the moment, the government changed the waste management paradigm into circular economic with community-based system. The guidance of this concept available in the MoPWH No3/2013 and MoEF No 13/2020.

The community should be encouraged to transport the waste from the house to the collecting point or temporary shelter (TPS-Tempat Penampungan Sementara). The collection point has to be placed to the most accessible area, so it can be accessed by various type of vehicle. The collection point location was determined using spatial analysis considering the distance to the TPS 3R location, main road, and service area. The collection network as follow:



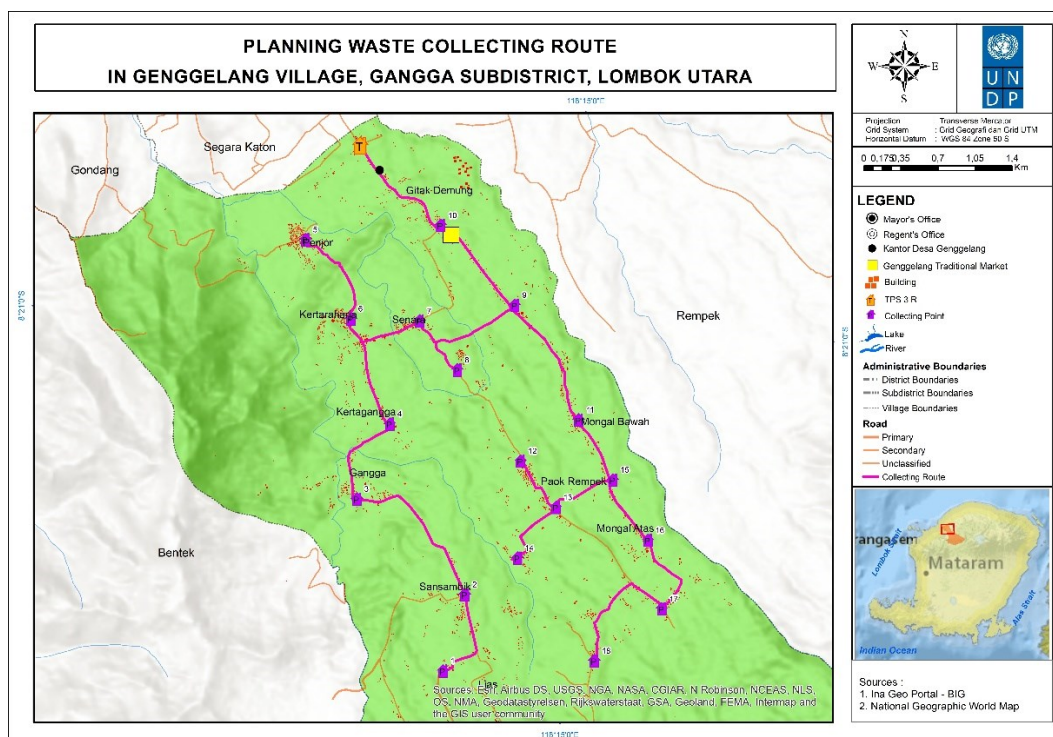


Figure 23. Waste Collection network

The previous figure indicated that the TPS 3R location is proposed in the north part of the village as the most accessible location. The official final disposal site of North Lombok called Jugil landfill that located in Sambik Bongkol, Gangga. The landfill was built in 2018. The distance of the TPS 3R to the Jugil Landfill around 15,3 km. The requirement of the TPS 3R location will be described in the next section. Approximately 18 collection point are proposed based on the settlement distribution.

Table 22. Distance of Collecting Point to the TPS 3R

Collecting Point	Location	Distance (Km)
1	Lias	8,2
2	Sasambik	7,29
3	Gangga	5,78
4	Kertagangga	4,84
5	Penjor	5,27
6	Kertaraharja	4,31
7	Senara	3,51
8	Senara	3,51
9	Gitak Demung	2,15
10	Gitak Demung	1,1
11	Mongal Bawah	3,25

Collecting Point	Location	Distance (Km)
12	Paok Rempek	5,62
13	Paok Rempek	4,52
14	Mongal Atas	5,33
15	Mongal Atas	4
16	Mongol Atas	4,67
17	Kento Darul Mujahidin	5,46
18	Kento Darul Mujahidin	6,69
	Total length of road	85,5

Source: Analysis by UNDP, 2021

### V.2.2 Collection Equipment

According to MoPWH Regulation No 3/2013 the waste container type is divided into two types, such as:

- Individual container: intended for high residential areas and commercial areas. The type of container depends on the budget availability and owner need.
- Comunal container: intended for settlement, public space, and market. The type of container decided by the government, for it must sufficient for all of the waste.

The requirement of the container as requested by the regulation include:

- Waterproof and airproof
- Suitable for 500 m<sup>3</sup> of waste from at least 40 households
- Container for sorted waste available



Figure 24. Collecting point with sorting containers (<https://diy-buatansendiri.blogspot.com/>)

The most important equipment is vehicle to transport the waste from the collecting point to the TPS 3R. The District Government committed to provide 2 unit of three wheeled motor with container to collect the waste. Moreover, Penjor sub village had already owned it since 2019. The assumption, the vehicle to transport the residue from TPS 3R to the landfill will be conducted by District Government (Environmental

Agency) as mentioned in the regulation and district waste management masterplan. The equipment needs

Table 23. Equipment needs to collect the waste in Genggelang Village

Equipment need	qty	Waste handling capacity	Frequency of Service	Daily waste handling (m3)
Waste container in the collecting point for 40 hh (SNI 19-2454-2002)	18	500 m <sup>3</sup>	emptied daily	9000
three-wheeled motor with container (maximum 1500 m3 of waste per trip)	3	1600	3 trip/day/ vehicle	9600
TPS 3R/ waste processing site	1	8800 m <sup>3</sup> or 2 tons of waste/day	Managed daily	8800


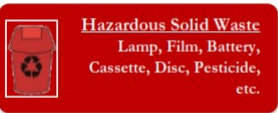



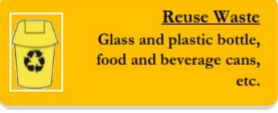

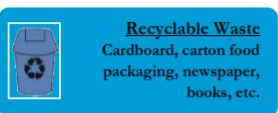

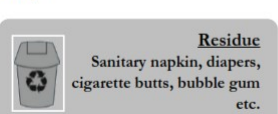
Source: Analysis by UNDP. 2021

According to MoPWH Regulation no 3/2013, the waste collection using vehicle with open container should be conducted with the following steps:

- The decomposable waste must be collected every two days
- The collection of hazardous, reusable, recyclable, and other waste must be scheduled at least once in three days, and it conducted by head of sub village or private sector

The waste collection system in Genggelang Village should be scheduled based on the community agreement and vehicle availability. Recyclable materials from waste bank in sub-village level (bank sampah unit) can be collected fortnightly, so the transportation cost more economically for the Bumdes.

Table 24. Waste Container labelling

No	Waste Categories	Label/ Colour Code
1	Hazardous waste 	<b>HAZARDOUS SOLID WASTE</b> Red 
2	Putrescible waste 	<b>ORGANIC WASTE</b> Green 
3	Reusable waste 	<b>REUSABLE WASTE</b> Yellow 
4	Recyclable waste 	<b>RECYCLABLE WASTE</b> Blue 
5	Other waste 	<b>RESIDUE</b> Grey 

Source: MoPWH No 3/2013

## V.3 Development of Policy, Strategy, and Program

### V.3.1 Policy for waste management

According to the waste management masterplan of North Lombok, the District Government only collects about 15% of the generated waste, while the Presidential Regulation No 97/2017 requires all the waste is diverted, collected and/or treated by year 2025. Moreover, the government service for waste collection and transportation

unavailable in Genggelang, so most of the waste has managed by burnt and dumped to the river.

The District Government developed the masterplan aimed to fulfil the goals, and endeavours to meet the obligations given in Indonesia's waste management regulations. The waste management policy in Genggelang village has developed to support the District Government to fulfil the goals. The waste management policy includes waste reduction and waste handling. Hence, the residual waste from TPS 3R Genggelang village will be collected and transported to landfill by Environmental Agency.

#### *V.3.1.1 Waste Reduction*

The proposed system prioritises the principle to reduce, reuse and recycle (3R). It will seek to meet target of 30% waste diversion at the source by 2025 as required by the PR No. 97/2017. The strategy to improve the waste reduction form the source as follow:

- d. Facilitate the sub village to develop waste bank or bank sampah unit to provide an incentive to the community who willing to segregate the waste and listed as a waste bank member
- e. Training of waste reduction and waste handling for households (composting, bsf maggot training, training to make handicraft from the waste)
- f. Provide Bank Sampah Desa (waste bank for village level) as an end buyer of the waste that collected by bank sampah unit

#### *V.3.1.2 Waste Handling*

Refer to District Regulation No 3/2018 about waste management, the waste must be collected and properly treated. The waste management proposed include collecting, segregation in the TPS 3R, organic waste treatment, inorganic waste recycle, and transporting the residual waste to the official landfill (Jugil). The recommended approaches to address these objectives are given below.

### **V.3.2 Strategy of Waste Management**

The Municipal Solid Waste (MSW) management system in Geggelang Village will create as a community-based solid waste management system. Based on the field assessment, the waste producers in Genggelang are divided into three types include:



- waste producers from the business activities (market, industry, offices, and industry)
- waste producers from high-income households
- the waste producers from the medium and low-income households

The social-economic condition of the community is the most necessary factor to decide the suitable waste management system in the village. Based on the regulation, there is two formal waste management system in Indonesia. The combination between of waste bank and TPS3R will use to develop the waste management system in Genggelang. The waste producers from business activities will be encouraged to use the TPS3R service, for they willing to pay the tipping fee. The waste bank system will provide for the community who eager to segregate the waste from the house. They will receive benefits from the recyclable waste with money or extra balance in the saving book from the waste bank. Both of the mechanisms will be modified as needed by the local community. The system is expected to change the waste stream in Genggelang village, and it can reduce the waste leak to the ocean. Furthermore, the waste management will generate the community income through waste bank system.

The income generation for both waste producers and Bumdes will be reached easily. Bumdes provides waste bank service to the households who expect to gain income from the waste. The Bumdes will train the community to segregate the waste based on the type of material (i.e. PET, PP, cardboard, book etc.). The community will be encouraged to develop waste bank for dusun/sub-village level called Bank Sampah Unit, so they can bring the materials to the waste bank. The waste bank will add the balance to the customer's saving book. The saving becomes entitled of the customers. Bank Sampah Desa as a business unit of Bumdes will collect all of the recyclable materials from the Bank Sampah Unit. The TPS3R will serve the business customers (tourism spots, industry, schools, offices, and markets) that produce a lot of waste. The service for the households is also available in the TPS3R with a special tariff.

The waste management system in Genggelang should be implemented with a combination of business and community-based approaches. The waste management that is managed as a business is a waste collection and transportation system that will gain revenue from the tipping fee. The regulation will encourage the community to treat

the waste appropriately using the 3R concept. They have to segregate the waste, then they must put the residual waste in the TPS/collecting point. The waste will be collected by the collector from TPS3R. The collector will transport it to the facility.

In addition, the Bumdes will encourage the community to join Bank Sampah Unit. The waste bank member will receive additional income from the valuable waste. The Bank Sampah Desa (Village waste bank) will buy the valuable waste from a Bank Sampah Unit, and they will segregate it in more detail as requested by the end buyer. Detail segregation will increase the waste price. The margin price of the waste will become additional revenue for Bumdes.

The community will be trained to manage the organic waste (composting and BSF maggot cultivation). However, the TPS3R provide an organic waste treatment plant to manage the organic waste from the community who are unwilling to treat it by themselves. The result of organic waste treatment will be sold by the Bumdes. The waste stream and revenue stream both for Bumdes and the Households is presented in the following figure. Revenues obtained from the recycling and compost can be used to contribute to the waste collection cost and other community activities, including providing incentives to communities in the form of the provision of waste containers and additional safety measures.

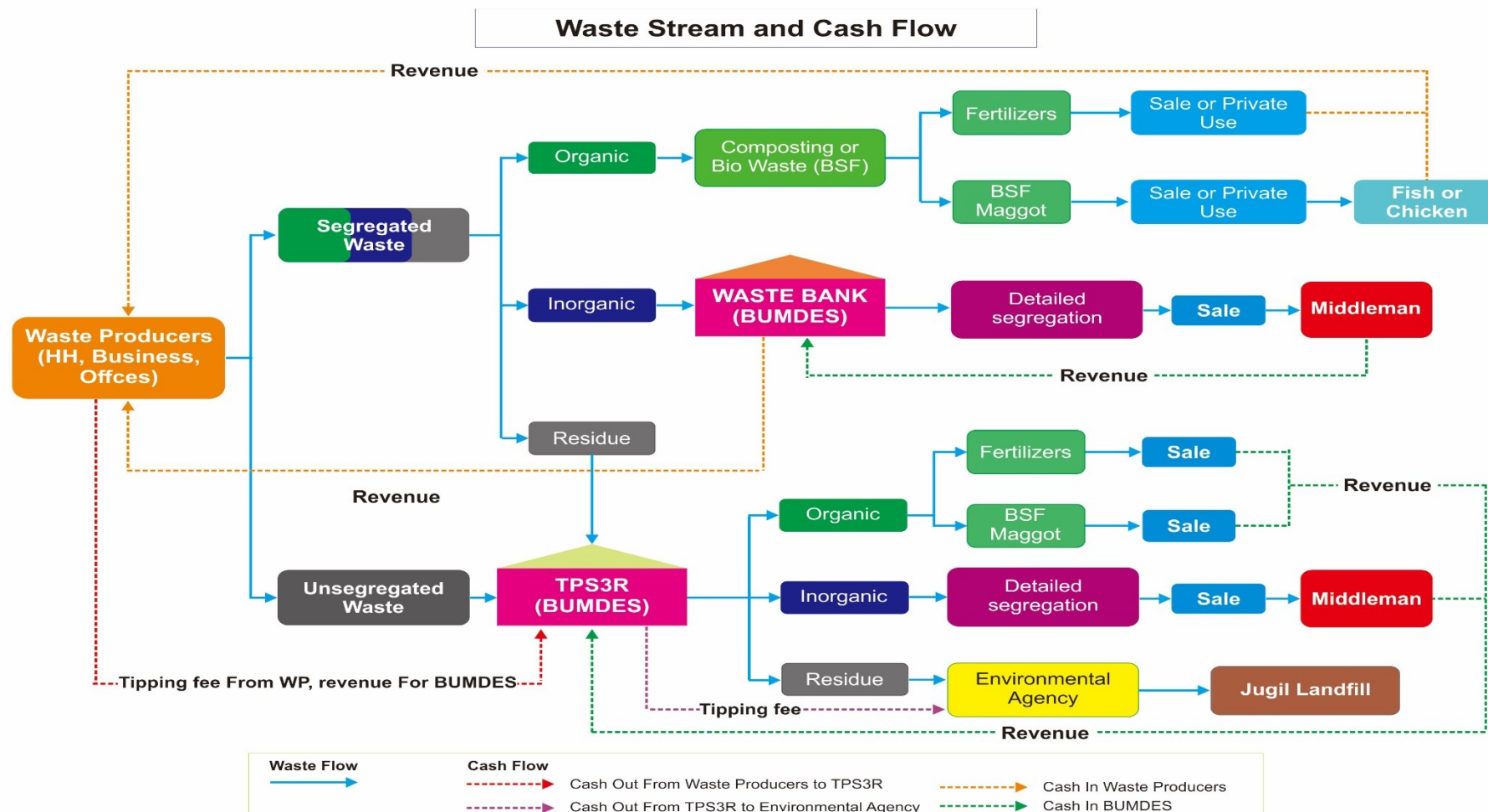


Figure 25. Expected waste stream and revenue stream of MSW Management in Genggelang Village

Government of Indonesia launch the Clean-from-Waste Indonesia Program (Indonesia Bebas Sampah) in 2017 which mentioned in the Indonesian National Strategy Policy (Kebijakan dan Strategi Nasional/Jakstranas) on Managing and Reducing Waste which is stated in Indonesian President Regulation No. 97/2017. The Indonesian government is continually establishing and polishing a model plan in order to:

- reduce the 30% of the waste generation from the source
- process and manage for at least 70% of the country's waste in order to avoid it from being accumulated in the landfill
- all are expected to be achieved in the year 2025.

Hence the government launch two different programs to achieve the goal of the program. Ministry of Public Works and Housing released MoPWH Regulation No 3/2013 about The Implementation of Waste Management Infrastructure of Municipal Solid Waste to regulate the waste management in the settlement area called TPS3R. The TPS3R acronym is Tempat Pengelolaan Sampah - Reduce-Reuse-Recycle (Temporary Waste Processing Site with 3R facilities). In addition, the Ministry of Environmental and Forestry published the MoEF Regulation No 13 about 3R guidance of waste bank system. Waste bank and TPS3R have different approach, but they have the same goals.

Therefore, there are two Bumdes in D.I. Yogyakarta combined those two systems to gain the community and village income and campaign the waste segregation from the source (BUMDES Panggung Lestari, Panggungharjo Village Bantul Yogyakarta, and BUMDES Guwosari Maju, Guwosari Village, Bantul Yogyakarta). They success to generate more than 40 million revenue per month from the waste management service. The difference of Waste Bank and TPS3R is presented in the following table.

Table 25. Difference between TPS3R and Waste Bank

Parameters	TPS3R (Temporary waste processing site with 3R facilities)	Waste Bank (Bank Sampah)	Combination of TPS3R and Waste Bank
<b>Regulator</b>	Ministry of Public Works and Housing	Ministry of Environment and Forestry	Ministry of Public Works and Housing and Ministry of Environment and Forestry
<b>Regulation</b>	MoPWH Regulation No 3/PRT/M/2013 about The Implementation of Waste Management Infrastructure of Municipal Solid Waste	MoEF Regulation No 13 about 3R Guidance of Waste Bank System	Both of the regulation
<b>Initiator</b>	Authorities (district government or village government)	Community	As requested by the community which implemented by Village government through Bumdes
<b>System</b>	KSM/CBO (Community Based Organization) with formal institution (usually BUMDES) Profit oriented (paid workers)	<ul style="list-style-type: none"> <li>➤ Community based which usually start from RT level</li> <li>➤ Formal and informal institution</li> <li>➤ Non-profit (social work)</li> </ul>	<ul style="list-style-type: none"> <li>➤ Community based through waste bank unit and communal composter</li> <li>➤ Formal institution i.e. KSM/CBO (Community Based Organization) with formal institution (usually BUMDES)</li> <li>➤ Profit oriented (paid workers)</li> </ul>
<b>Waste types</b>	Organic Inorganic Residue	Inorganic waste especially for recyclable waste	Organic Inorganic Residue
<b>Revenue stream</b>	Tipping fee Recyclable waste sale Fertilizers	Margin price of recyclable waste	Tipping fee Recyclable waste sale Fertilizers



Parameters	TPS3R (Temporary waste processing site with 3R facilities)	Waste Bank (Bank Sampah)	Combination of TPS3R and Waste Bank
	cattle fodder waste to energy benchmarking tour package		cattle fodder waste to energy benchmarking tour package
<b>hierarchy</b>	not available (independent)	RT/RW → Bank Sampah Unit Desa → Bank Sampah Desa Kabupaten → Bank Sampah Induk	RT/RW/sub village as Bank sampah unit Bumdes as Bank sampah Desa/ Induk and TPS3R
<b>Technical requirement</b>	Waste segregation area (MRF) Organic waste treatment plant (composter, BSF bio-pond, WtE) Waste collection and transportation facilities (containers, three wheeled motor, truck)	➤ Segregation area for recyclable waste only ➤ Administration room	Waste segregation area (MRF) Organic waste treatment plant (composter, BSF bio-pond, WtE) Waste collection and transportation facilities (containers, three wheeled motor, truck) Administration and waste bank office
<b>Sustainability</b>	This system will sustainable if supported by the regulation from the local authorities.	➤ More fragile ➤ The sustainability depends on the community awareness and buyer availability	➤ this system is suitable for rural area ➤ more sustainable than uncombine the system

Source: KEMENPUPR, 2013, KEMENLHK, 2012 modified by UNDP, 2021

#### *V.3.2.1 Strategy Approach*

Development of integrated and sustainable solid waste management approach is a community empowering through waste management training of the stakeholders and the community. In the implementation of integrated and sustainable MSW management should be started with synchronize waste management perception the stakeholders in Genggelang. As result of the discussion with the local leaders (head of sub village), to burn the waste is the best solution in that village. In contrast, the head of Penjor sub-village told that the waste have to be managed with 3R concept. It shown that the synchronization of perception and capacity building of the local authorities is important.

Community participation in solid waste management covers a variety of types, and encompasses several forms of local involvement, including: awareness and teaching proper sanitary behaviour, cost recovery schemes, resource recovery actions, and participating in consultation, administration, and/or management functions. At the most basic level, participation might be providing segregated waste to the waste collector, handing over separated waste at a particular time to the waste collector or granting space to park waste management vehicles.

Community-based waste management (CBSWM) projects require institutional support and recognition in order to be successful. An integrated system including waste separation at the source, resource recovery, and composting of organic waste requires the involvement of waste pickers, and integration of the community to work with all stakeholders. Local leaders are often active in the management of the service or maintain close contact with the municipality or community management agency. Women and teens can play crucial roles, such as initiators, managers, operators, political activists, educators, and watchdogs for the community. Some issues can also be addressed by CBSWM such as the following social and management problems; low participation of households, management problems, operational problems, financial difficulties and, lack of municipal cooperation.

Generally, success TPS3R in Indonesia has been implemented with business approach. Based on the social condition of Genggelang village, the waste management should be conducted with socio-entrepreneur approach. The implementation of waste

collection and transportation service is operated with business approach. In contrast, the waste bank is implemented with community-based approach. The business model canvassing for waste management using combination of TPS3R and Waste bank as follow:

Key Partners	Key Activities	Value propositions	Customer relationship	Customer Segments:
<ul style="list-style-type: none"> <li>- Middleman/end buyer for recyclable waste</li> <li>- Waste bank unit who sell the inorganic waste to the Bumdes</li> <li>- Other TPS3R in North Lombok</li> <li>- Potential donors and sponsors who support the environment</li> <li>- District Government (Environmental Agency and Public Work Office)</li> </ul>	<ul style="list-style-type: none"> <li>- Waste collection and transportation</li> <li>- Waste segregation</li> <li>- Organic waste processing</li> <li>- BSF maggot production</li> <li>- Compost production</li> <li>- Waste bank unit development</li> <li>- Waste bank for village level (valuable waste buyer for waste bank unit)</li> <li>- Sale and marketing for service, compos, maggot, valuable waste</li> <li>- Research and development</li> <li>- Monitoring and evaluation</li> </ul>	<ul style="list-style-type: none"> <li>- Community involvement in the business through waste bank</li> <li>- Competitive price</li> <li>- Environmental benefit</li> <li>- Commitment to sustainability</li> <li>- Additional income from inorganic waste for HH who join waste bank</li> <li>- Guarantee to the utilization of compost and BSF maggot</li> </ul>	<ul style="list-style-type: none"> <li>- Dissemination by village government or Bumdes to the community</li> <li>- Monthly meeting of women organization (PKK) in each sub village</li> <li>- Monthly meeting of Youth organization</li> <li>- Training and assistance program for each sub village</li> </ul>	<p>Mass market:</p> <ul style="list-style-type: none"> <li>- Households about 2242 (middle income and high income as TPS3R customers; low income as waste bank customer)</li> <li>- Business (market, industries, hotels, homestay, etc.)</li> </ul> <p>Niche market:</p> <ul style="list-style-type: none"> <li>- Tourists</li> <li>- Business to business market</li> </ul>
<p>Key resources</p> <ul style="list-style-type: none"> <li>- Rumah Pilah (TPS3R building and equipment)</li> <li>- Vehicle (waste collection and transportation)</li> <li>- BSF installation</li> <li>- Compost installation</li> <li>- Administration and waste bank Building</li> <li>- manpower</li> </ul>		<p>Channels:</p> <ul style="list-style-type: none"> <li>- advertisement through bulletin board in the village</li> <li>- announcement from the local authorities</li> <li>- social media ads</li> <li>- word of mouth marketing (WOM Marketing)</li> </ul>		
<p>Cost structure:</p> <ul style="list-style-type: none"> <li>- infrastructure cost (ADD/Village budget plan)</li> <li>- vehicle and transportation cost</li> <li>- manpower cost</li> <li>- operational cost</li> <li>- inorganic waste cost for waste bank</li> </ul>		<p>Revenue stream:</p> <ul style="list-style-type: none"> <li>- tipping fee from waste collection service</li> <li>- compost sale</li> <li>- maggot sale</li> <li>- recyclable waste sale</li> <li>- other services: benchmarking service, waste management training, BSF maggot training</li> </ul>		

Figure 26. Business Model Canvas for TPS3R in Genggelang Village

#### *V.3.2.2 Temporary Waste Processing site with 3R facilities (TPS3R)*

Community groups/CBOs/TPS3R management group, has a role in the implementation of solid waste management at the community level, transmit 3R lifestyle to the society and raise their awareness, and become the initiator, leader, a motivator in the implementation of waste management at community level. The leader or manager of TPS3R has a crucial role in the continuity of TPS3R. Their passion and fighting spirit strongly influence the process and the people around them. It can be concluded that they are the milestones in community-based solid waste management (Dewi , 2017). This concept has proposed. The technical requirement of TPS3R according to MoPWH No 3/2012 as follow:

- 1) area more than 200 m<sup>2</sup>
- 2) using non-permanent construction type for the container to collect waste processing residue (type of waste that couldn't be recycled and reused)
- 3) the location maximum 1 km from the service area or in the same administrative area
- 4) land owned by Government (district government/village government)
- 5) the community actively involve to the waste sorting process
- 6) There must be a sorting area, a composting area, a workshop, and buffer zone

The TPS3R should provide unloading area, sorting area, waste crusher area, composting area, residual collection site, warehouse for recycable waste, washing area. The activity in the TPS3R include waste segregation, composting, and recyclable waste packing. The residue of municipal solid waste management usually includes infectious waste (diapers, sanitary pad), batteries, multi-layer plastics, etc.), and it have to be handled properly. According to the district regulation no 3/2018, the residue will be collected and handled by the government in the landfill.

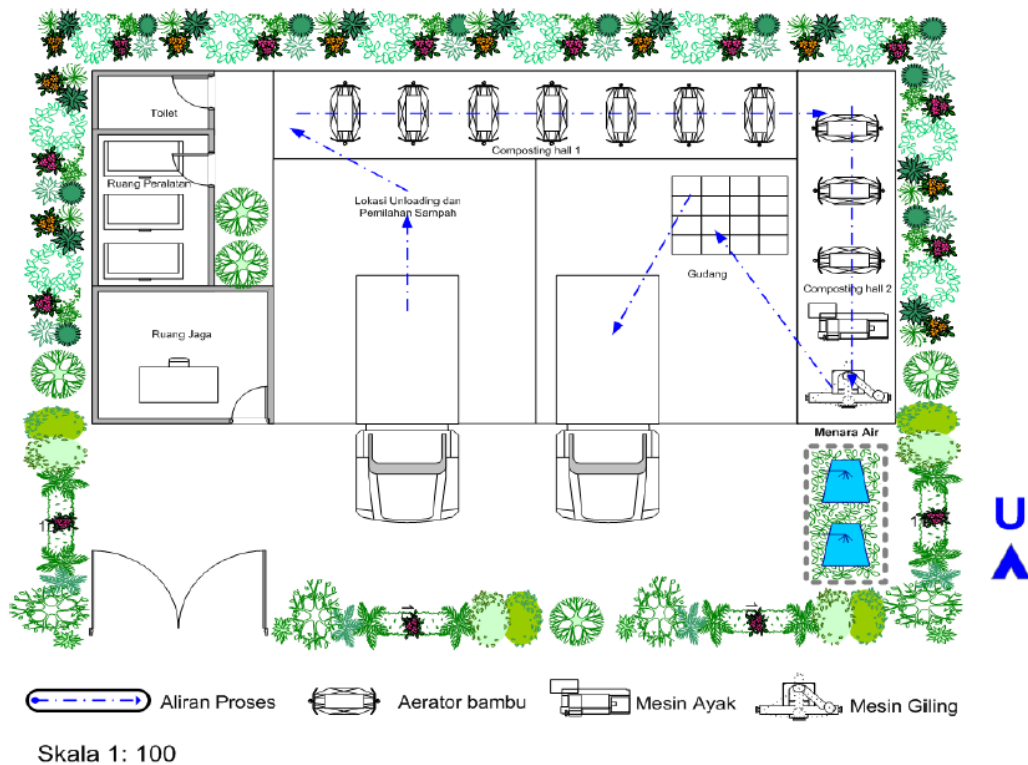


Figure 27. The equipment of TPS3R according to the regulation ( Ciptakarya, 2017)

The recyclable waste will be sold to the junk dealer or recycle factory. The organic waste from the market is dominated by food leftover and rotten fruit, so the organic waste treatment can be modified. The organic waste treatment in Genggelang Village is proposed with two system include composting and biowaste processing using Black Soldier Flies-maggot.





Figure 28. TPS3R design example ([gerai-arsitek.blogspot.com](http://gerai-arsitek.blogspot.com))

## 1. Waste segregation/sorting

Waste sorting in the TPS3R was aimed to segregate the organic waste, inorganic waste, and residual waste. The segregation of inorganic waste that conducted in the facility more detail than the segregation that conducted by the community. Find the inorganic waste segregation catalogue in the appendix. The segregation example is presented in the following picture and diagram.

1	2	3	4	5	6	7
PETE	HDPE	PVC	LDPE	PP	PS	OTHER
polyethylene terephthalate	high-density polyethylene	polyvinyl chloride	low-density polyethylene	polypropylene	polystyrene	other plastics, including acrylic, polycarbonate, polyactic fibers, nylon, fiberglass
soft drink bottles, mineral water, fruit juice containers and cooking oil	milk jugs, cleaning agents, laundry detergents, bleaching agents, shampoo bottles, washing and shower soaps	trays for sweets, fruit, plastic packing (bubble foil) and food foils to wrap the foodstuff	crushed bottles, shopping bags, highly-resistant sacks and most of the wrappings	furniture, consumers, luggage, toys as well as bumpers, lining and external borders of the cars	toys, hard packing, refrigerator trays, cosmetic bags, costume jewellery, audio cassettes, CD cases, vending cups	an example of one type is a polycarbonate used for CD production and baby feeding bottles

Figure 29. Plastics code

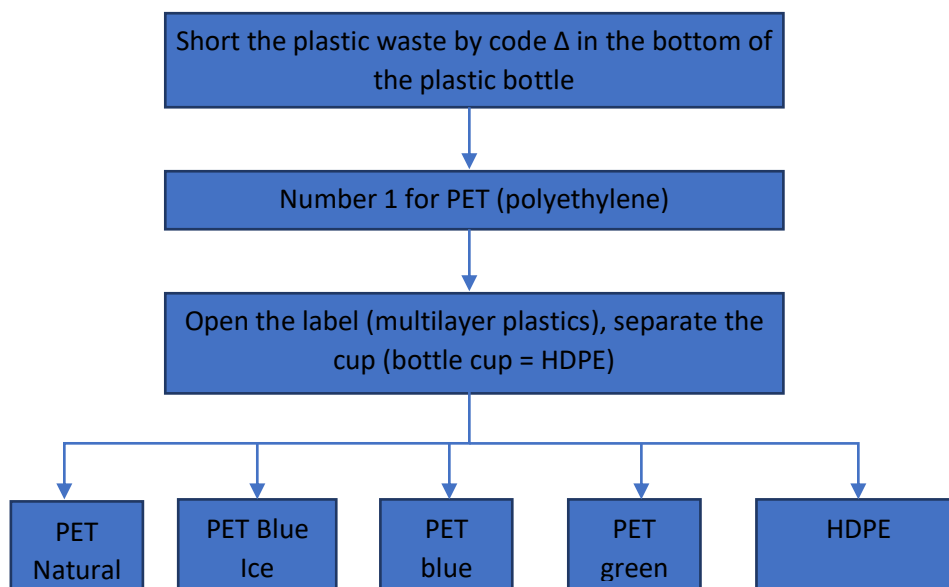


Figure 30. Example of Segregation phases for PET bottle (mineral water bottle)

## 2. Organic waste treatment plant

### Composting

Composting at source is an option in rural areas and is therefore well suited for most of North Lombok Regency. Here it is recommended that composting be encouraged through awareness raising and active participation by women's groups. The composting can, for example, be done using the Takakura Composting Method. This process advocates that the organic waste is chopped up, or in the case of rice, loosened with water. The material is added to the container where it is placed between two bags of rice husks which help absorb moisture. The waste should decompose within a couple of days and the bin must be stirred on a daily basis. If 500 grams of materials are added every day, the bin will be full of compost after six months (DANIDA, 2019).



Figure 31. Takakura container and mesophilic container

A second option would be mesophilic composting which takes place at temperatures between 20° and 45° C. Mesophilic storage units are concrete, brick or metallic storage bins in which the volume and weight of organic waste is reduced by natural processes (bacteria, fungi, larvae, worms). The bins are primarily designed to serve one or a few households. The bins are designed to receive waste that naturally breaks down within a period of about one year (bone and shell are exceptions that will break down over a longer period). Data collected show a 92% reduction in the weight and a 79% reduction in the volume of biodegradable waste.

Waste that can be placed in the bin includes food preparation waste, table scraps, spent bouquets of flowers and small amounts of garden waste. A household bin might receive 3 kg of waste per day, which means that several households can share one bin. The small lid is opened and the waste is thrown into the bin. Mesophilic bacteria and fungi require oxygen. That is why the sides of the bin have aeration holes. But these holes are not enough to keep the contents of the bin fully aerated. A certain amount of stirring is required. It is recommended to stir once a week. Without sufficient stirring, foul odors are created. Once a year, the bin needs to be cleaned out.

#### Biowaste Processing using BSF Maggot

Biowaste processing using Black Soldier Flies maggot more popular recently. The Black Soldier Fly, *Hermetia illucens*, is of the dipteran family Stratiomyidae. It can be encountered in nature worldwide in the tropical and sub-tropical areas (Dortmans, Diener, Verstappen, & Zurbrugg, 2017). The black soldier fly is often associated with the outdoors and livestock, usually around decaying organic matter such as animal waste or

plant material. Since black soldier fly larvae consume decaying matter, they have been used to reduce animal manure in commercial swine and poultry facilities. The wastes bioconversion by the black soldier fly larva (BSFL) has two potential advantages: the larvae can convert the carbon and nitrogen in the biomass waste, and improve the properties of the substrate to reduce the loss of gaseous carbon and nitrogen (Pang, 2020).

The flies grow and reproduce easily, have high feed efficiency and can be reared on bio-waste streams. These are neither pests nor vectors of diseases. Insect meal generally possesses levels of chemical contaminants which are below recommended maximum concentrations. The larvae have antibacterial (*Escherichia coli* O15:H7, *Salmonella enterica* serovar *Enteritidis*) and antiviral (enterovirus and adenovirus) properties. Larvae of BSF could be scaled up easily and possess 40-50% protein content, including some essential amino acids that can be used to replace both fish meal and soybean meal in feed (Wardhana, 2016).

Maggot (BSF) has a smooth mouth without teeth. Therefore, organic waste that can be used as feed is soft-textured organic waste with a water content of > 60%, such as food leftover, rotten fruits, and other organic waste that has been separated from hard-textured organic waste, such as leaves, hard fruit skin, bones. So when it is difficult to separate the hard organic waste from the soft organic waste, an organic waste shredder is needed. The result of biowaste processing with maggot include:

- Fresh maggot (10): protein for animal feed
- Liquid fertilizer (30%)
- Solid fertilizer (compost) (50%)
- Residue (10%)

Biowaste treatment plant equipment as follow:

1. Rearing House/BSF rearing unit

This tool is used for the process of BSF flies mating and laying eggs. This room is very important to maintain the maggot production cycle, because the life span of flies is only around 3-7 days. This room has a condition that it must be exposed to direct



sunlight and a fly perch area, such as wide plant leaves. The design and equipment for the rearing house or fly house are as follows:

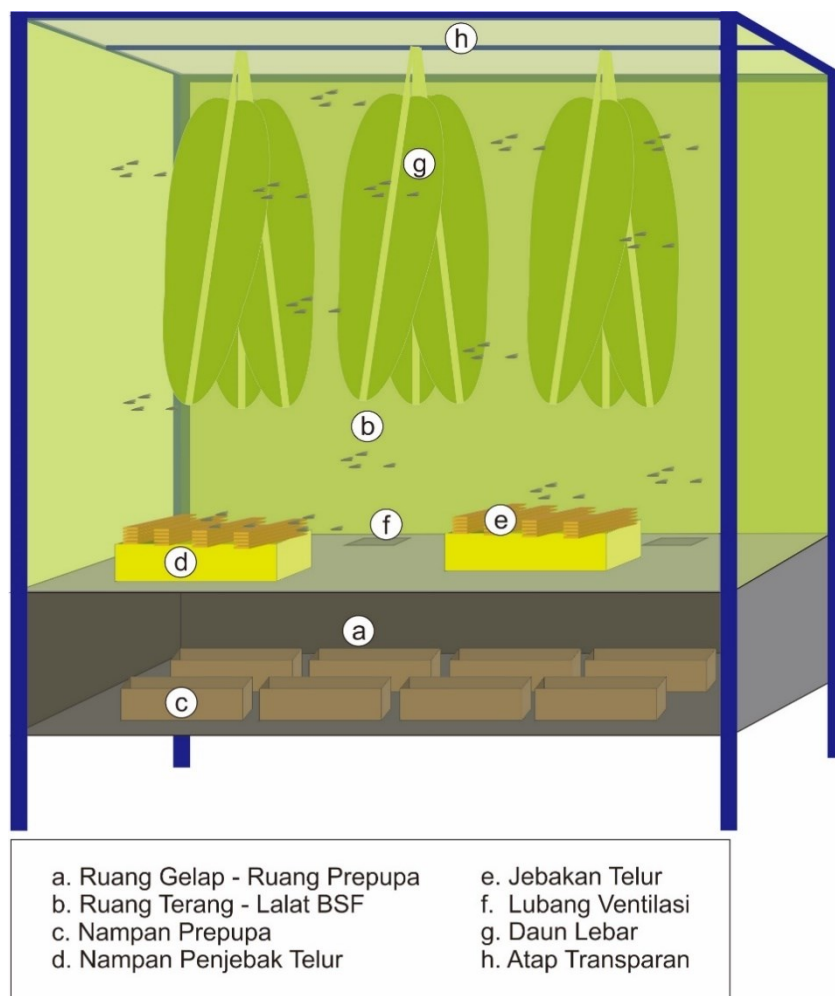


Figure 32. Rearing House of BSF

## 2. Egg hatching and larvae feeding

This tool is used for the hatching of BSF eggs harvested from mating flies in the rearing house. This egg hatching process requires small containers that have been given a feed medium that is soft and easy to penetrate by newly hatched maggots, such as fruits or tofu waste. The ration between eggs and media in 1 container is 3-gram eggs plus 5 kg of moist feed. In order to reduce damaged egg due to the contact with the media, the egg hatching container must be covered with gauze as a barrier. Estimated BSF eggs will hatch and become small maggots is 3 to 4 days. After hatching, let the small maggots eat the feed media, with an estimated 5-7 days calculated after hatching or have reached a



size of 3-4 cm, after which the maggots are transferred to a bio-pond or enlargement room. The design and equipment of the hatchery room are as follows:



Figure 33. Egg hatching container

### 3. Reactor or bio pond (maggot feeding container)

Reactor or bio pond is used to feeding maggot until it turns into prepupa phase. This is the main process of the biowaste processing using bsf maggot. Approximately 1 kg of maggot will consume 2 – 5 kg of organic waste per day.

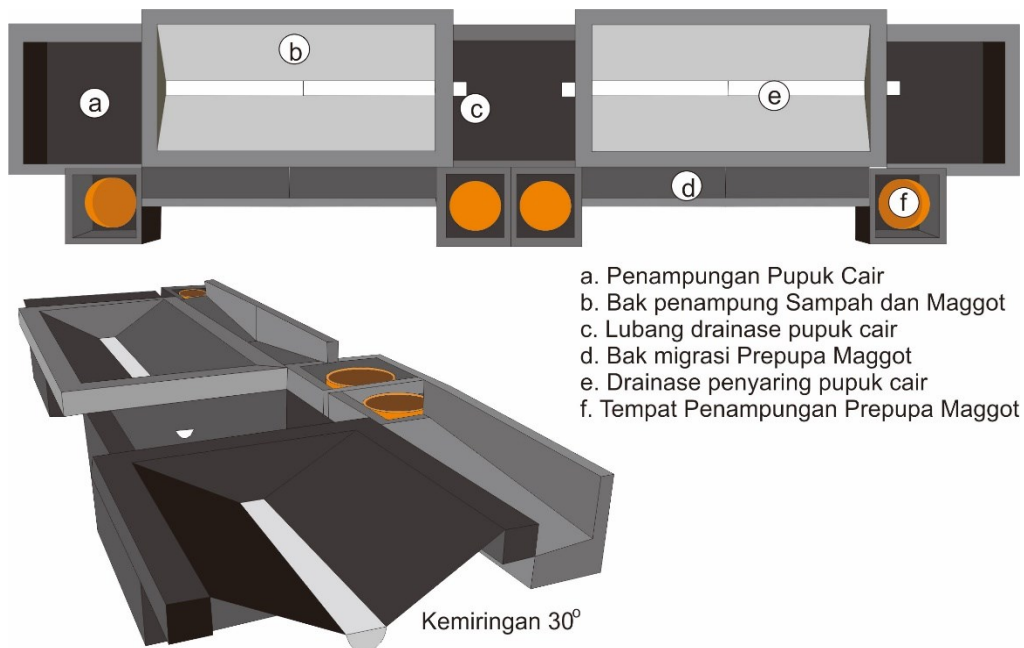


Figure 34. Bio reactor or bio-pond

#### 4. Harvesting

After 12 days of waste treatment by BSF larvae, each larvero is harvested. At this stage, the larvae have reached their maximum weight, but have not yet transformed into prepupae. Their nutritional value is, therefore, at its maximum. Harvesting is the process in which the larvae are separated from the residue. This can be done by using a manual or automated shaking sieve by which the larvae are easily separated from the residue. With a higher shaking frequency, the mesh size of the sieve can be bigger. This is because the larvae have difficulties to position themselves and cannot crawl through

the mesh when there is a high shaking frequency. Automated shaking sieves can achieve higher shaking frequencies than manual sieves and are, therefore, favoured.

#### *V.3.2.3 Waste Bank*

A waste recovery mechanism that has been developed in Indonesia is a garbage savings-selling mechanism, better known as "waste bank", which is managed by the citizens in the form of cooperatives. The organizations formed will receive the valuable dry inorganic waste collected by the citizens, and it will be sold to the garbage collectors who come to the cooperatives. Money from the sale of the waste will be deposited in the accounts of people who deposit their garbage in the cooperative. Most of the profits from this transaction will be earnings for the neighbourhood.

This document proposed waste bank should be adopted as business unit of the Bumdes. Hence, the waste management system will cover all of the community with different level of income. This option is provided to the community who willing to sort the waste and want to receive incentive from the recyclable waste. In order to reach the target of waste reduction, this document combined TPS3R and waste bank system. Waste bank is aimed to provide waste management system for the community who refuse to join the waste collection program from TPS3R due to the income reason.



Figure 35. Waste Bank

#### *V.3.2.4 Capacity Building*

Based on the social survey results, the capacity building program is crucial for this village. District Regulation No 3/2018, the District Government is responsible for the socialization; mentoring and technical assistance; research and development. However,

the district government has yet to implement an assistance program for waste management in Genggeling Village. The community from Penjor, Gangga, and Kerta have requested village regulation from the village government, so the head of the village plans to develop it in 2022.

Most of the community is unconcerned about plastic waste pollution in the river. Burnt waste is pretty common in this village. Moreover, some local authorities (head of sub-village) suggest the community burn the waste rather than dump it in the river. This behavior is a result of a lack of awareness of the impact of waste on the environment and the unavailability of the waste management program in this village. Hence, the first phase of the program has to introduce the importance of waste management to the community, and the benefit of waste segregation. The activities to attract the community to the waste management program include:

- waste bank training: management of the waste bank, waste segregation, marketing
- training on waste recycling: handicrafts using recyclable materials, composting training, black soldier fly cultivation training, etc.
- assist the village government and village council to develop waste management regulation

#### *V.3.2.5 Women Involvement in the Waste Management*

Women play a large role with respect to consumption and generation of waste and constitute almost half of any demographic, it is important to recognize the key motivators that can trigger them to change their disposal habits from littering to binning and from binning to recycling. Furthermore, given that women do perform the task of household waste management, creating campaigns and information that are geared towards them would result in greater and more effective behaviour change. As primary caregivers, they can also be relied upon to share such awareness with the members of their family and children in particular (Krishnan & Backer, 2019).

According to Mut'ali (2014) women have very important role to the waste management in household. About 80% of waste handling has done by women. This is inseparable from the influence of culture, which states that cleaning work is a woman's business. The role of women is carried out directly (doing) and indirectly, namely

providing a process of awareness and education, through the mechanism of ordering, advising, explaining, and setting an example for all family members (Mut'ali, 2014). Women who often separate from wet and dry solid house-holds waste could find out the beneficial one namely plastic or glass bottle and paper. After separating it, women collected and then sold it after a few times for earning money (Yulianti, 2019)

As result of the interview, women have very important role for waste management in Genggelang Village. The survey was conducted for households, but it was mostly answered by the wife. The questions about their behavior to manage the waste, the willingness to join the waste bank, willingness to pay, and the importance of waste segregation are mostly answered by women. Moreover, about 64% of the respondents are women.

Waste Banks in Indonesia have been popular with women - and expanding the business potential of waste banks and increasing their financial sustainability will encourage increased and more consistent gender participation. In the Philippines too, women could benefit from opportunities to expand operations. Local agencies, such as ENDA in Vietnam working directly with waste sector workers and junk shops, report that efforts to build leadership skills amongst women as well capacity building efforts for existing waste businesses will positively impact the women working in waste in Vietnam (Placeholder1) (Krishnan & Backer, 2019).

The presence of a waste bank educated residents to be disciplined in managing their waste and provided extra income from waste collection. Moreover, it strengthened the social cohesion for women within the community. This study shows that local female administrators in family welfare empowerment programmes can be used as role models for other women and can provide a significant impact on waste management (Asteria & Herdiansyah, 2020).

Formal waste work in Indonesia is dominated by man. The man workers usually responsible to the collection process and dumping to the landfill. In the three Southeast Asian countries studied, it was observed that formal waste collectors were primarily men. In Indonesia and the Philippines this is because the collectors must travel a fair distance away from home on trucks and carry heavy loads, and for similar reasons are preferred by employers. In Indonesia, fewer women participate in the waste collection



chain in general and this is reflected in the lower participation rates (Krishnan & Backer, 2019).

## V.4 Financing and Costing

### V.4.1 Waste Stream Assessment

By the start of the plan period, about 100% of waste generated in Genggelang village are no collected and managed. All of the population does not receive waste collection service. Current waste stream shown about 81,82% of the waste was burnt; 3,03% dumped in the backyard; 3,03% dumped to the river; and 12,2% was segregated by the community. The current waste stream as follow:

Table 26. Waste Stream in 2021

Waste Management by Community	percentage	m <sup>3</sup> /day
<b>Burnt</b>	81,82%	11.414,62
<b>Inorganic: Burnt; Organic: dumped to the backyard</b>	3,03%	422,76
<b>dumped to the river</b>	3,03%	422,76
<b>segregated the recyclable waste, and dumped the residue</b>	12,12%	1.691,05
	100,00%	

Source: Analysis by UNDP, 2021

Based on the data of community interest to the waste management program, and willingness to pay the service, we estimate the waste stream and target for 2040. This document proposed about 55% of the waste generated in 2040 is managed by TPS3R totally. Target of the community who join the TPS3R and become waste bank member about 33%. We estimated about 12% of the community willing to reduce the waste through waste bank. In expectation, they willing to manage the organic waste privately. The estimation waste stream in 2040 is shown in the following table.

Table 27. Waste stream analysis 2025 – 2040

Waste management target	2025			2030			2035			2040		
	Man	Red	kg/day	Man	Red	kg/day	Man	Red	kg/day	Man	Red	kg/day
<b>Manage through TPS3R</b>	35%		794	45%		1.068	48%		1.195	61%		1.588
<b>TPS3R user who join to waste bank</b>	22%		511	22%		533	33%		832	33%		865
<b>Waste bank member</b>		6%	139		7%	174		8%	212		12%	314

Man: managed

Red: Reduced

Source: Analysis by UNDP, 2021

## V.4.2 Financial Analysis

Basically, there are three categories or items included under the Waste Management Performance Development Program, i.e., (i) Provision of waste management equipment and facility, (ii) Improvement of operation and maintenance of waste management equipment and facility, and (iii) Awareness raising of waste management policies. Based on the interview with local authorities, the financing of the waste management has included in the RKPDes (Village Working Plan). The temporary waste processing site is listed as Gudang Pengelola Sampah. The building will be facilitated by district government in 2022. The current potential funding source for waste management in Genggelang as follow:

Table 28 Current/potential sanitation funding sources for village level

Regency/ City Government	Village Government	Others
APBD (Local Budget)	ADD (village budget)	Corporate Social Responsibility
Investment, Local Government Participation (share/ stock, etc)		Private investment (incl. PPP, PSP)
SILPA (Surplus on Financing Budget); Community Development Fund		Grant
Loan		Users contribution

Source: modified by UNDP, 2021

The following infrastructure elements will be built on the site:

- Temporary Waste processing site (TPS3R) that covers 2242 households that generated about 8986 m<sup>3</sup> of waste per day
- Waste collecting point (TPS) about 18 unit that located in the most accessible area
- Inorganic waste warehouse
- Organic waste treatment plan (biowaste plant and communal composter)

The cost to provide the waste management equipment was calculated based on the waste quantity in 2040. The budget is divided into two categories:

- Investment cost includes mechanical equipment, civil works and other costs related to the investment such as permits etc.
- Operation cost include expenses, which are directly depending on costs related to treatment of the waste, these expenses includes maintenance, manpower. This

covers the expenses which will vary per ton treated waste, these are costs related to the treatment such as additives needed for the process to work, e.g. water, waste water, transport of reject, transport of digestate etc.

The calculation of investment cost is estimated for 2040, so it represents maximum equipment. The investment cost as follow:

Table 29. Estimation of Investment Cost

Investment Cost	Unit	Frekw	Cost/unit (IDR)	Total Cost (IDR)
<b>TPS3R Building</b>	1	1	Rp 680.000.000	Rp 680.000.000
<b>Vehicle (three wheeled motor with container (capacity</b>	3	1	Rp 35.000.000	Rp 105.000.000
<b>Waste collecting point/TPS (3 container/TPS)</b>	18	1	Rp 1.800.000	Rp 32.400.000
<b>Maggot Installation (100 kg/day)</b>	1	1	Rp 16.000.000	Rp 16.000.000
				Rp 732.800.000

Source: Calculated by UNDP, 2021

Based on the social interview, the community willing to pay less than Rp 5000 per household for waste collection service. Although the Head of Regency Regulation No. 29/2015 determine the tipping fee for waste collection and transportation service around Rp 7.500 – Rp 10.000 per household. As per discussion with the head of Bumdes and village government, the tariff should be decided as requested by the community. This document proposed Rp 4.500 per household for the tipping fee. The tipping fee for trader in the market was determined based on the regulation around Rp 600 per week. The tipping fee from the tourism area about Rp 10.000 – Rp 15.000 per month.

Cost and revenue were estimated based on the waste generation in 2040. The assumption to calculate the cost and revenue as follow:

Table 30. Assumption to calculate the cost and revenue

Activities	Parameter		Unit
	Total waste generation m3/day (for Genggeling and Segara Katon) with population 13728 (2040)	2.595	kg
	% of new Genggeling Population in 2040 compare to old genggeling	63%	
	Total waste generation m3/day (for Genggeling) with population 7334	1637	kg
<b>Waste collection</b>	cargo motor capacity (700 kg, waste density 0,25)	700	kg
	Total motor cargo	2	unit
	Total trip needed/motor	1	trip
	Number of collection point	18	unit
	gasoline (2 litre/40 km) per day	4,275	litre
	waste transportation	2	trip
	Number of trip/motors	1	trip/motor
	Waste handling/motor	546	kg/day
	length of road (total)	85,5	km
	maximum speed per motor	30	km/hours
	loading-unloading duration/collection point)	0,5	hours
	trip duration/day	3	hours
	number of vehicles	3	unit
	total loading-unloading hour	9	hours
	loading hours/motor	3	hours
<b>Waste handling</b>	Working hours per motor	6	hours
	Waste segregation	8	hours
	segregator (1 person/1000 kg)	3	person
	waste handler	1	person
	Waste bank officer	1	person
	Waste collector	3	person

Source: Analysis by UNDP, 2021.

\*) Note: The assumption of the waste generation is used to calculate the infrastructure and vehicle needs to manage all of the waste. The high of waste generation doesn't mean the revenue for the TPS3R will increase. The revenue for TPS3R mostly from the tipping fee (Figure 35), so it depends on the number of customers.

Dur to the project duration and population data availability, the significant changes of the waste generation throughout the year couldn't be done. The calculation of waste generation through the year should be conducted based on the SNI No 19-3964-1994 or Waste Analysis and Characterization Study (WACS) UN HABITAT. Both of guidance required at least 14-21 days within rainy season and vice versa.

The cost and revenue calculation result are presented in the following table:

Table 31. Cost and revenue estimation

Remarks	Item	Total (IDR)				
		2021	2025	2030	2035	2040
Cost						
Fixed expenditure	manpower					
	segregator (1 person/1000 kg)	24.000.000	24.000.000	46.800.000	46.800.000	46.800.000
	waste handler	12.000.000	12.000.000	15.600.000	15.600.000	15.600.000
	Waste bank officer	12.000.000	12.000.000	15.600.000	15.600.000	15.600.000
	Waste collector	28.800.000	28.800.000	54.000.000	54.000.000	54.000.000
variable expenditure	residual waste treatment (tipping fee to DLH) weekly collection	1.800.000	1.800.000	1.800.000	1.800.000	1.800.000
	organic waste treatment (ton)	28.800.925	28.800.925	42.967.916	43.358.425	57.632.776
	Gasoline (5 litre/vehicle/day)	27.540.000	13.770.000	13.770.000	27.540.000	41.310.000
	vehicle maintenance	800.000	400.000	400.000	800.000	1.200.000
	BSF installation maintenance	250.000	250.000	250.000	250.000	250.000
	miscellaneous (R and D, training, etc)	6.000.000	24.000.000	24.000.000	36.000.000	36.000.000
Total Cost		141.990.925	145.820.925	215.187.916	241.748.425	270.192.776
Revenue						
Waste collection	tipping fee	74.841.847	78.253.697	92.038.601	121.601.638	126.427.392
organic waste sale	maggot (Rp 1.500.000/ton)	6.171.627	6.171.627	9.207.411	9.291.091	12.349.881
	compost (Rp 5000/kg)	84.288.422	84.288.422	125.749.359	126.892.217	168.667.350
inorganic waste sale	Segregated waste (assumed IDR 1000/kg)	84.560.945	84.560.945	103.744.131	131.402.730	159.047.169
	Total revenue	165.301.895	168.713.746	226.995.371	257.784.945	307.444.622
Expected profit for Bumdes	Profit (revenue - cost)	23.310.970	22.892.821	11.807.454	16.036.520	37.251.847

Source: Calculated by UNDP, 2021



## V.5 Institutional Set Up

According to the village government, the waste management will be involved to the Bumdes business unit. Bumdes has been handling the Genggelang Market, and they plan to manage tourism and waste management next year. The institutional of the waste management division have to designed based on the local condition. The following picture presented an example of the waste management institutional set up. The institutional set up of the waste management in Genggelang village should be localized.

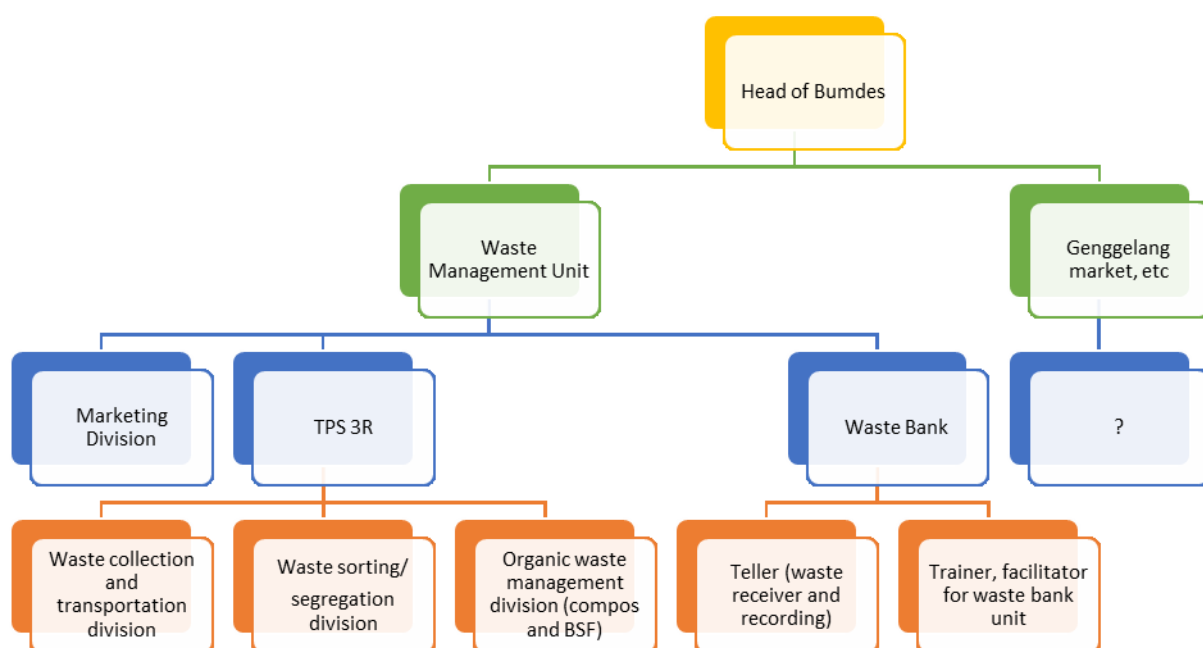


Figure 36. Institutional Set Up Example

## VI. Conclusions and Recommendation

### VI.1 Conclusions

The conclusion of this study as follow:

1. The waste stream in Genggelang Village and Genggelang Maket about 95% does not managed properly. The community mostly managed the waste by burnt (82%).
2. The municipal solid waste in Genggelang Village has been managed traditionally which around 82% of waste was burnt. This behaviour is a result of the unavailability of waste management programs from the government in this area.
3. The village government plan to develop sustainable waste management and they are supported by the community. The waste management will be involved to the Bumdes as a new business unit.
4. Approximately 67% of the community interested to use the waste management service from the Bumdes who around 93% of them willing to pay less than Rp 5000.
5. Considering the social and economic condition of the community, waste management system in Genggelang Village is proposed with combination of TPS3R and waste bank. Waste collection service from TPS3R is provided for business (market, tourism, industries, offices, and schools) and community who attracted. The community who not interested yet will be encouraged to join the waste bank program, so they can manage their waste at home.

### VI.2 Recommendation

Implementation of sustainable waste management in Genggelang should be divided into three phases. The first phase is to facilitate local authorities to develop the waste management system in the village. The main activities for the first phase include:

1. To facilitate the stakeholders in Genggelang to synchronize the perception of sustainable waste management program

This activity aimed to encourage the stakeholders to synchronize their perception to the sustainable waste management that suitable with social and economic condition in Genggelang Village.

2. Social mapping

The objective of social mapping is to identify the key actors in the implementation of waste management in the village. The actors of waste management in village level usually include Bumdes, scavengers, middleman, health cadre (kader kesehatan), Pokdarwis, youth organization, etc.

3. Develop the waste management regulation for village level which include waste reduction, waste segregation, waste handling, and waste collection system.

4. Institutional set up for waste management system in Genggelang (Divisi Pengelolaan Sampah in Bumdes)

5. Capacity building of the waste management institution in Genggelang Village

The second phase involve the community into the development of the sustainable waste management in the village. The community should be encouraged to implement 3R concept in the house as well as join to the waste bank and waste management training. The activities in the second phase as follow:

1. Socialization of sustainable waste management to the community

Based on the previous chapter, the community have to be introduced to the sustainable solid waste management that will be implemented in the village. They will be introduced to the waste segregation and its benefit.

2. Identification of waste value chain

This activity is aimed to identify the potential buyers of the valuable waste in North Lombok as an alternative to sell it. Hence, the compost and BSF maggot utilization must be determined in this process.

3. Develop waste bank for sub village level (bank sampah unit) and village level (bank sampah desa)
4. To determine the waste sorting facilities location (TPS3R building location); waste collection system and scheduling; and organic waste treatment system.
5. Advocacy to the district government

According to the regulation, residual waste disposal must be handled by District Government. The district government collected the residual waste from the TPS3R, and they processed it at Jugil landfill. The village government have to proposed to the district government to collect the residual waste from Genggelang. Therefore, the district government is obliged to provide technical assistance to the village government regarding the waste management.

6. Capacity building of the community

Capacity building of the community should be conducted continuously start from the preparation of the system to the implementation. The capacity building in this phase is focused into community approach through introduction of sustainable waste management concept; waste segregation process and benefit; homebased organic waste treatment.

The last phase includes the implementation of the waste collection, waste transportation, and waste management process by TPS3R or BUMDES. Due to the duration of the construction, the village government usually builds the Rumah Pilah/TPS3R from the first phase. The activities as follow:

1. Development of Rumah Pilah/TPS3R building which include:
  - Organic waste treatment plan development: composter, Black Soldiers Flies plant (biowaste plant), waste to energy (if feasible), etc.
  - Inorganic waste segregation area
  - Administration building and waste bank office
2. Capacity building of the community

The capacity building in this phase is aimed to improve the knowledge about waste management in advance level, for instance waste recycling (handicraft, composting, BSF maggot), waste bank management, TPS3R management, business development, etc.

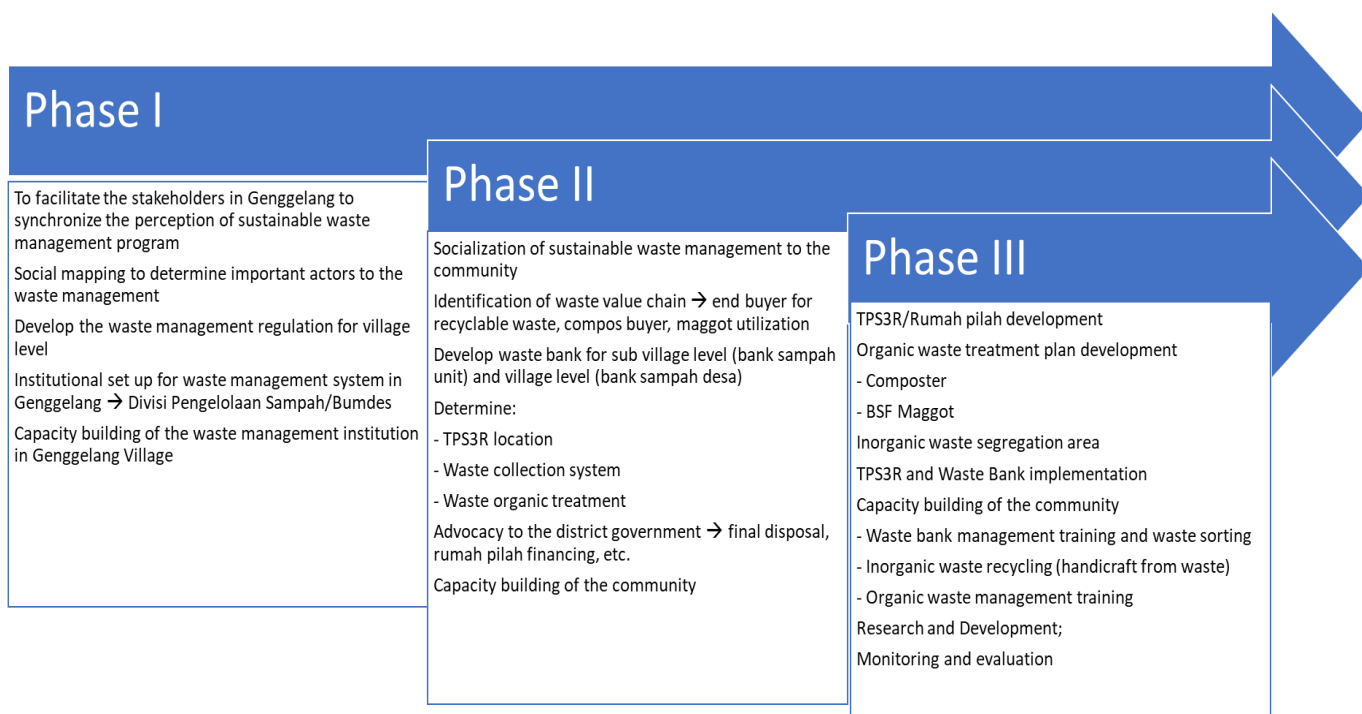


Figure 37. Waste Management Phases in Genggelang Village



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## Appendix 1. Price and end buyer list

Materials	Condition	Buy Price	Sale Price	Source Information
<b>Cardboard</b>	Good	Rp 2000 – Rp 2500 /kg	Rp 3500/kg	Kamarudin
<b>Cardboard</b>	Bad	Rp 2000 /kg	Rp 2500/kg	Kamarudin
<b>PET Bottle</b>	Dry	Rp 1500 /kg	Rp 3000/kg	Kamarudin
<b>PET Bottle (1500 ml)</b>	Dry, clean	Rp 300 / piece	n/a	Haji Basri (Lingsar)
<b>PET Bottle (600 ml)</b>	Dry, clean	Rp 100 /piece	n/a	Haji Basri (Lingsar)
<b>PP</b>	Dry	Rp 1500 / kg	Rp 3500/kg	Kamarudin
<b>Zinc roof</b>	Dry	Rp 1700/kg	n/a	Kamarudin
<b>Cooper</b>	Dry	Rp 45.000/kg	n/a	Kamarudin
<b>Aluminium</b>	Dry	Rp 9000 / kg	n/a	Kamarudin
<b>Brass</b>	Dry	Rp 45.000 / kg	n/a	Kamarudin

Pengepul	Contact	Lokasi
UD Bintang Sejahtera	087865258027	Tatak, Nusa Tenggara Bar. 83573, Tanak Awu, Pujut, Kabupaten Lombok Tengah, Nusa Tenggara Bar. 83573
No Name	082147489463	Gunungsari Mataram Barat
Zuriati		Pejeruk Ampenan Lombok
Siti Aisyah (Bank Sampah NTB Mandiri)	087822596766	JL. Leo no. 24 lingkungan banjar selaparang, Pejeruk, Kec. Ampenan, Kota Mataram, Nusa Tenggara Bar. 83114



## Appendix 2. Recyclable Materials Catalogue

# KERTAS

 <b>Arsip HVS</b>	<p>Kertas yang berwarna putih, tidak berlapis plastik atau mengkilap</p> <p>contoh: arsip, buku, dokumen, naskah skripsi tanpa cover atau bagian depan</p>
 <b>Kertas Buram</b>	<p>Kertas yang mempunyai ciri warna kusam atau buram.</p> <p>contohnya: kertas buram pada buku Lembar Kerja Siswa (LKS), arsip dan dokumen berbahan kertas buram</p>
 <b>Kardus</b>	<p>Kertas dengan ciri berwarna coklat, tebal, berlapis-lapis</p> <p>Contoh: kardus mie instan, kardus elektronik, kardus air mineral, kardus buah, dan lain-lain</p>
 <b>Dupleks</b>	<p>Kertas yang mempunyai ciri: mengkilap dan berwarna-warni</p> <p>Contoh: cover atau halaman depan buku, kemasan / box makanan, majalah, buletin, pamflet, brosur, buku pelajaran berwarna,</p>
 <b>Koran</b>	<p>koran bekas yang masih utuh dan bersih</p>
 <b>Kantong Semen</b>	<p>bekas kantong semen berbahan kertas tanpa lapisan plastik dan bersih dari sisa-sisa semen</p>

# PLASTIK



PET Botol

Botol plastik bekas minuman berwarna bening yang mempunyai Kode 1 (PET)

contoh:  
Botol air mineral



PP Gelas

Plastik yang mempunyai Kode Plastik 5 (PP)

contohnya:  
Gelas Plastik air mineral



Plastik HDPE

Plastik dengan Kode Plastik 2 (HDPE),  
Mempunyai sifat lentur, tebal, tidak mudah patah,

Contoh:  
Plastik kemasan minuman, botol plastik, sabun, plastik ember cat dll



Emberan

Semua jenis plastik berwarna atau bersablon  
Mempunyai sifat lentur, tidak mudah patah,

Contoh:  
biasa digunakan untuk kemasan dan perabotan rumah tangga,  
seperti ember, gayung, rak, kursi, meja plastik



Plastik Keras

Plastik yang mempunyai sifat keras dan mudah patah,

Contoh:  
Plastik bahan barang elektronik, kemasan  
minuman dan makanan yang kaku dan keras



Plastik PS

Plastik berbahan transparan yang tidak lentur dan mudah patah

Contoh:  
Tempat Kaset, tempat CD, toples Nastar, dan

## LOGAM



Kaleng Almunium

Kaleng yang dengan bahan alumunium,  
mempunyai ciri mudah diremas

contoh:  
digunakan sebagai kemasan minuman



Kaleng

Logam dengan ciri keras, tipis, sulit untuk diremas,

contohnya:  
kaleng Biskuit, kaleng susu, kaleng makanan, kaleng minuman



Almunium

Peralatan masak berbahan Alumunium,  
bingkai etalase alumunium, bagian kendaraan berbahan alumunium



Tembaga

Bagian dalam kabel listrik (terpisah dari kulit kabel)  
dan beberapa peralatan yang terbuat dari tembaga



Besi

Besi batangan, besi silinder, besi bagian mesin

## BOTOL KACA



Botol Kaca

Botol Kaca, masih utuh,

Contoh:  
Basa digunakan untuk botol minuman, saos, kecap, sirup, dan lain-lain



# KERTAS



Arsip HVS

Kertas yang mempunyai ciri: berwarna putih, tidak berlapis plastik atau mengkilap, hanya bekas tinta hitam, dan tidak ada bekas cetakan berwarna.

contoh:

arsip, buku, dokumen, naskah skripsi tanpa cover atau bagian depan



Kertas Buram

Kertas yang mempunyai ciri warna kusam atau buram.

contohnya:

kertas buram pada buku Lembar Kerja Siswa (LKS),  
arsip dan dokumen berbahan kertas buram



Kardus

Kertas dengan ciri berwarna coklat, tebal, berlapis-lapis

Contoh:

kardus mie instan, kardus elektronik, kardus air mineral, kardus buah, dan lain-lain



Dupleks

Semua jenis kertas yang mempunyai ciri: mengkilap dan berwarna-warni

Contoh:

cover atau halaman depan buku, kemasan / box makanan,  
majalah, buletin, pamflet, brosur, buku pelajaran berwarna,



Koran

koran bekas yang masih utuh dan bersih



Kantong Semen

bekas kantong semen berbahan kertas  
tanpa lapisan plastik dan bersih dari sisa-sisa semen

### Appendix 3. Handicraft from Waste

	
Bag from bottle cap	Bag from bottle cap
	
Pellets plastic (recycle)	Handicraft from PET bottle
	
Handicraft from multilayer plastics	Handicraft from multilayer plastics
	
Paper bag	Ecobrick