Integrated Sustainable Waste Management:

WASTE DATA BASELINE REPORT, BANYUWANGI REGENCY, INDONESIA

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Abbreviations

CLOCC	-	Clean Oceans through Clean Communities
ISWA	-	International Solid Waste Association
InSWA	-	Indonesia Solid Waste Association
ISWM	-	Integrated Sustainable Waste Management
ISWMP	-	Integrated Sustainable Waste Management Plan
MSW	-	Municipal Solid Waste
SWM	-	Solid Waste Management
tpd	-	Tonnes per day

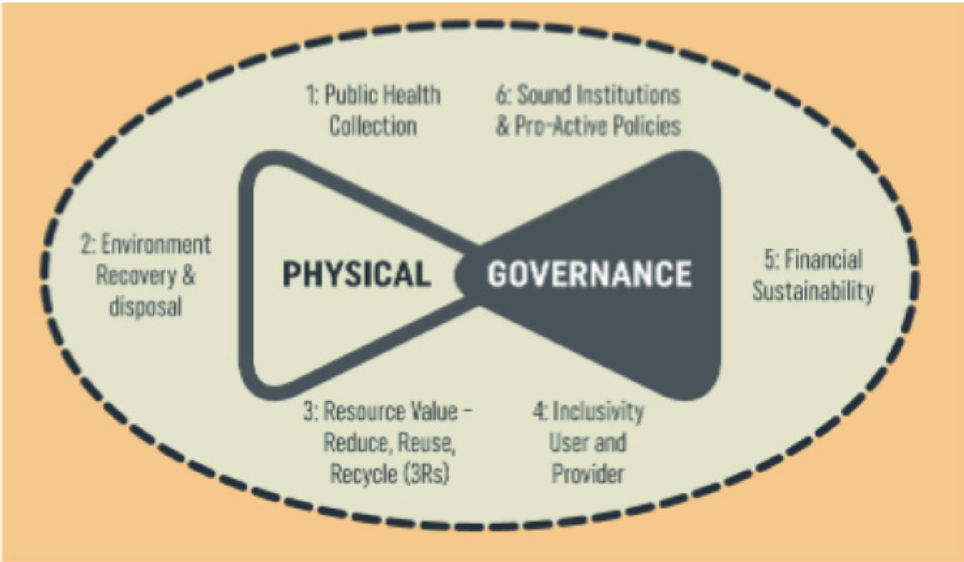
Glossary

Desa	-	Village
Jakstrada		Kebijakan dan Strategi Daerah dalam Pengelolaan Sampah (Local Strategy Policy on Waste Management)
Jakstranas		Kebijakan dan Strategi Nasional dalam Pengelolaan Sampah (National Strategy Policy on Waste Management)
Kecamatan	-	Sub-District
Kelurahan	-	Urban Village
Rukun Tetangga	-	Neighbourhood Association
Rukun Warga	-	Community Association
BPS	-	Badan Pusat Statistik - Central Bureau of Statistics

PTMP	-	Perencanaan Teknis Manajemen Persampahan – waste management technical plan (master plan)
TPS3R	-	Tempat Pengolahan Sampah Reduce, Reuse, Recycle – Transfer station 3R
TPS		Tempat Penampungan Sementara - Bring site/temporary shelter / communal collection area for waste
TPST	-	Tempat Pengelolaan Sampah Terpadu – Integrated Waste Processing Center
TPA	-	Tempat Pemrosesan Akhir – Landfill
DLH		Dinas Lingkungan Hidup - Environmental Agency

EXECUTIVE SUMMARY

Introduction



(a) ***The 'two triangles' representation of the Integrated Sustainable Waste Management (ISWM) analytical framework***. *Source:* (Wilson, et al., 2013)

ISWM Framework used by CLOCC

This report presents the results of the first phase of developing a new Integrated Sustainable Waste Management Plan (ISWMP) for Banyuwangi regency. This phase establishes a waste data baseline for Banyuwangi regency with data collected in 2020-2021, under the auspices of the Clean Oceans through Clean Communities (CLOCC) programme. The purpose of the data collection is to provide a waste data baseline to enable effective waste management planning.

The CLOCC programme is a community and network driven initiative which was established by Avfall Norge[1] in 2018, with International Solid Waste Association as the project partner and Indonesia Solid Waste Management Association as the local partner.

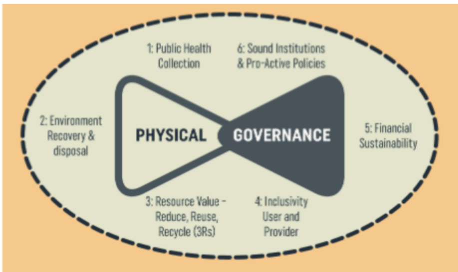
Under the CLOCC project, the Banyuwangi regency was selected for support as the regency actively signalled a desire to improve its solid waste management planning, waste practices and environmental protection. The regency is in a strong position to make positive changes to its waste management planning and implementation, and develop a fully integrated waste management system.

[1] https://avfallnorge.no/om-avfall-norge

The Banyuwangi waste management planning process under CLOCC is based on an Integrated Sustainable Waste Management (ISWM) approach. ISWM is an internationally recognised method to help waste management planning[2], which integrates the physical and governance requirements of a waste management system. The ISWM framework shows that baseline data is a key input to ISWM planning. This report forms the waste data baseline for the Banyuwangi regency waste planning process.

The waste data baseline for Banyuwangi regency uses the WasteWise Cities Tool (WaCT)[3] and integrates the National Indonesia Standard on waste sampling. WaCT is a diagnostic tool, developed by UN-Habitat enabling cities to standardise how they monitor and report progress against Sustainable Development Goal Indicator 11.6.1 on "municipal solid waste (MSW) collected and managed in controlled facilities". An experienced waste sampling team collected data for the project (December 2020 to March 2021), following the WaCT 7-steps (below) which included physical sampling, weighing and facilitated surveys.

In addition the CLOCC project undertook stakeholder engagement activities which supported and verified the waste data baseline sampling. This included a waste behaviours survey of 189 villages and stakeholder workshops to discuss waste challenges and aspirations.



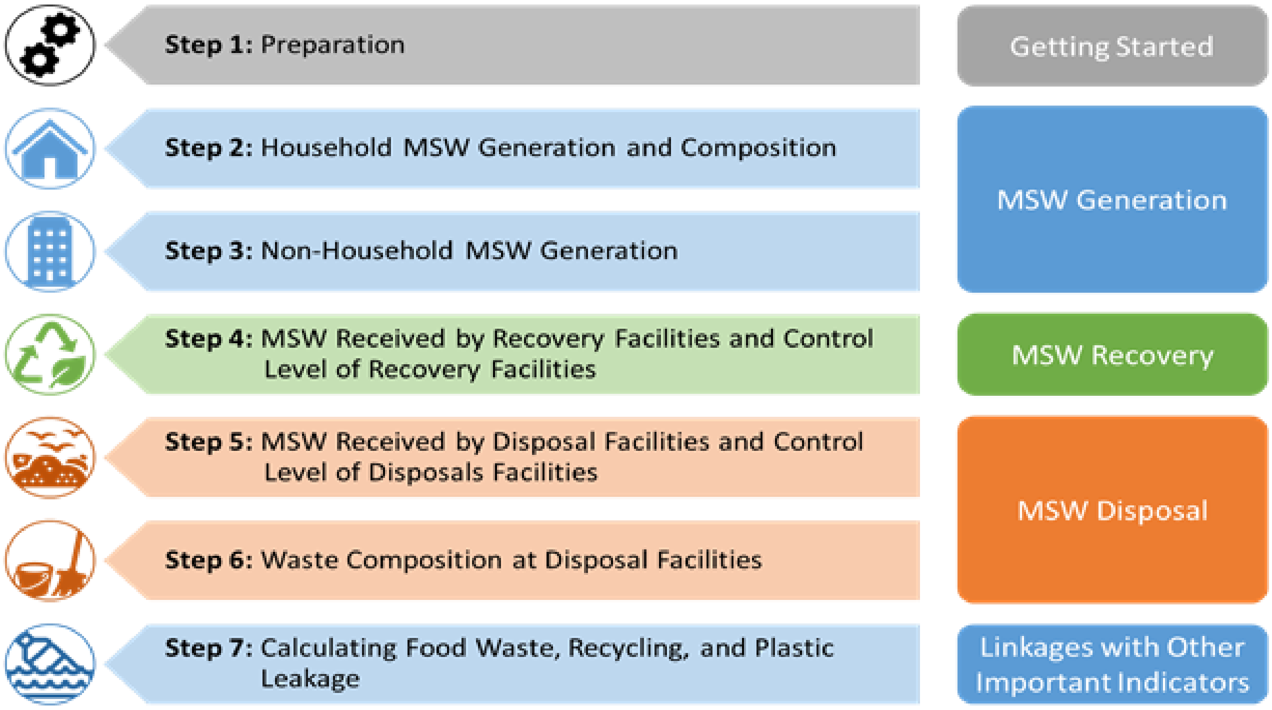
(a) ***The 'two triangles' representation of the Integrated Sustainable Waste Management (ISWM) analytical framework.*** *Source:* (Wilson, et al., 2013)

The ISWA 2 triangles framework illustrates the ISWM approach. Original source Wilson et al., 2013. This version redrawn for Whiteman et al., 2021 by Ecuson Studio. The inverted triangle representation was first used by Wilson, 1996. This version has been adapted from UNEP and ISWA, 2015 by Whiteman et al., 2021, and redrawn by Ecuson Studio.

[2] ISWM concept taken from United Nations Environment Programme (2015) Global Waste Management Outlook.

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

Waste Wise Cities Tool's Seven STEPS



Household waste management

The village survey undertaken by the CLOCC project on waste behaviours supports the waste data collection results. It shows that the most common waste disposal practice is burning (48% of responses) with disposal on vacant land and in rivers being the second and third most common practices (14% and 13% of responses respectively). 15% of people surveyed consider their waste behaviours as 'good'. These waste practices reflect that only 54 villages (29%) have a formal SWM system and 18 villages had a TPS3R of which eight were operational.

The village survey and a women only survey (25 women) consistently show common waste challenges. These same challenges were highlighted in a CLOCC Stakeholder Workshop, where stakeholders outlined the key waste management issues in the regency to include institutional, legal, cultural, technical and financial aspects.

Waste data baseline results

Waste composition. Waste composition analyses for domestic rural and urban locations in the survey show that the composition is broadly comparable across all income levels; the main fraction for all is food/kitchen waste (average 56% for domestic waste) with plastic representing 15% by weight. For non-domestic waste, food/kitchen waste is 28% with plastic at 15%. The final residual waste at the landfill showed a composition of 15% plastic and over 70% organic, including kitchen and garden waste.

Waste generation. The results show an average of 0.37 kg/person/day based on urban and rural sampling. Applying population data, this gives the total domestic waste generation for the regency as follows:

Estimated waste generation

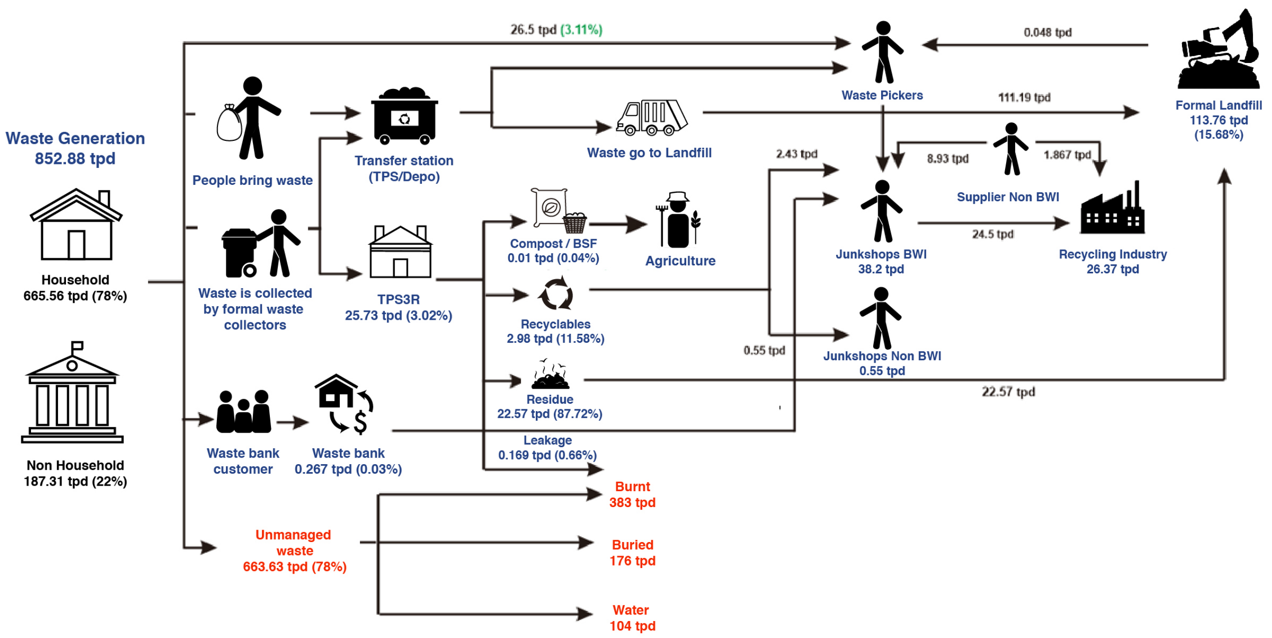
Regency Population (Total 25 sub-districts)	Waste generation			
	kg/person/day	l/person/day	tonne/day	m³/day
1,788,112	0.37	2.63	665.56	4,705

Non-domestic waste generation, based on nine categories of sources including shops, religious sites and markets, show that 187 tonnes/day of waste is produced from these sources.

Waste recovery. The data collection included an assessment of the formal and informal recycling industry. 13 recycling businesses, 47 junk shops, 18 TPS3Rs and 16 waste banks were identified by the survey team in Banyuwangi regency. The results show varied rates of effective recovery, with waste banks utilising all the waste deposited at their sites, however TPS3Rs accept 26 tonnes/day of recyclable material, but of this, 88% is disposed of as residual waste.

Waste disposal. The regency has one formal landfill which has limited controls and no weighbridge. The estimate of 133 tonnes/day of waste deposited at the site is used in this report. The site also has informal waste pickers, collecting on average 48 kg/day/picker of recyclable materials that are sent to junk shops.

Waste mass balance.



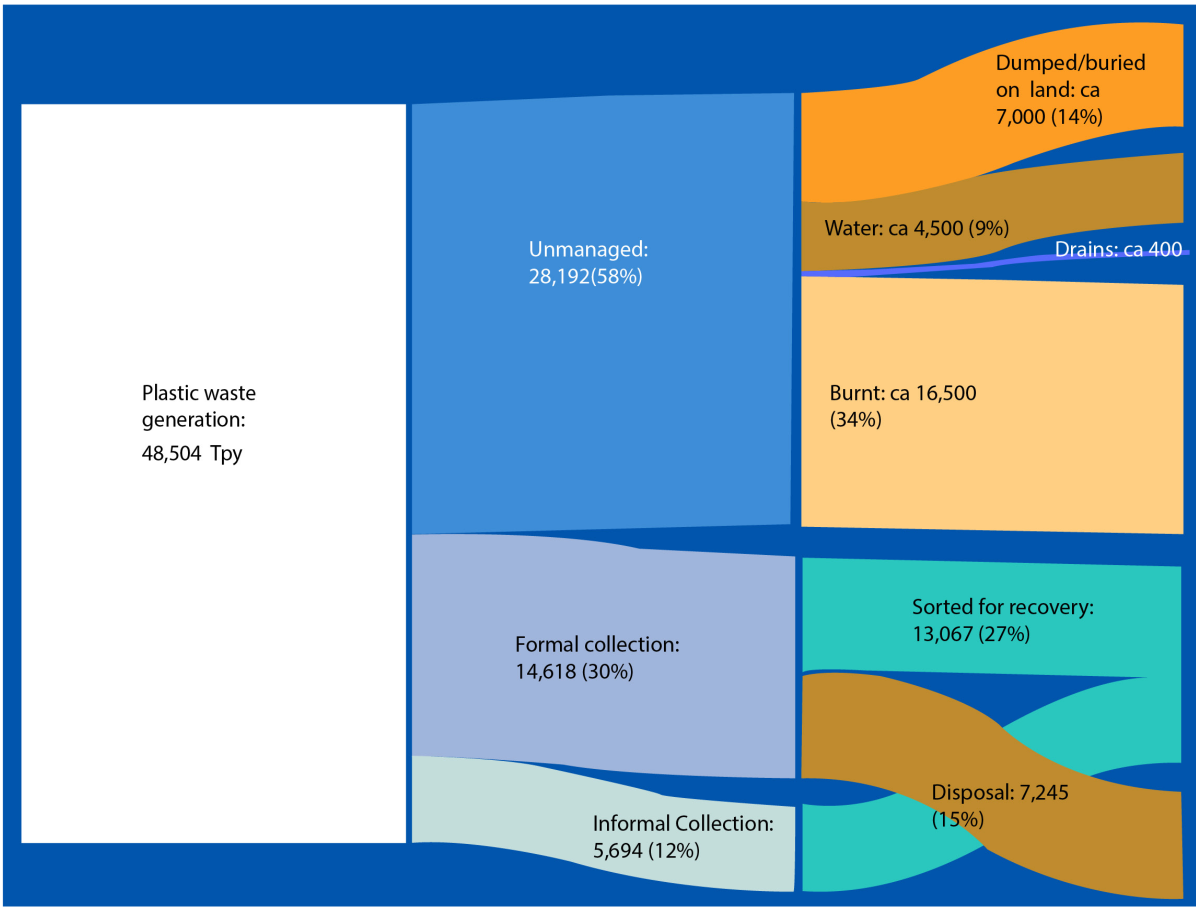
Banyuwangi waste mass balance

The mass balance shows that 853 tonnes of waste is generated daily in Banyuwangi regency; 666 tonne/day (78%) is from domestic waste sources and 187 tonne/day (22%) is from non-domestic waste sources.

Calculations from the waste data collection process indicate that over 78% or 666 tonne/day of waste is leaking into the environment, through burial, burning, disposal on waste ground or into water bodies. This is supported by the results of community surveys and discussions. This means over 243,000 tonnes of waste annually is not managed and requires further controls.

The waste composition analysis indicates approximately 15% of waste is plastic, from all waste sources. This corresponds to 48,500 tons per year, of which approximately 20,000 tons is collected for recycling or disposal, and the remaining 28,500 tons is not managed and could leak into the environment. Combining these data with the findings from the common practices survey we estimate that approximately 4,500 tonnes of plastics per year leaks to waterways and most likely end up in the ocean, 7,000 tonnes per year is dumped or buried on land and 16,500 tonnes is openly burnt.

Plastic waste overview, tonnes per year[4]

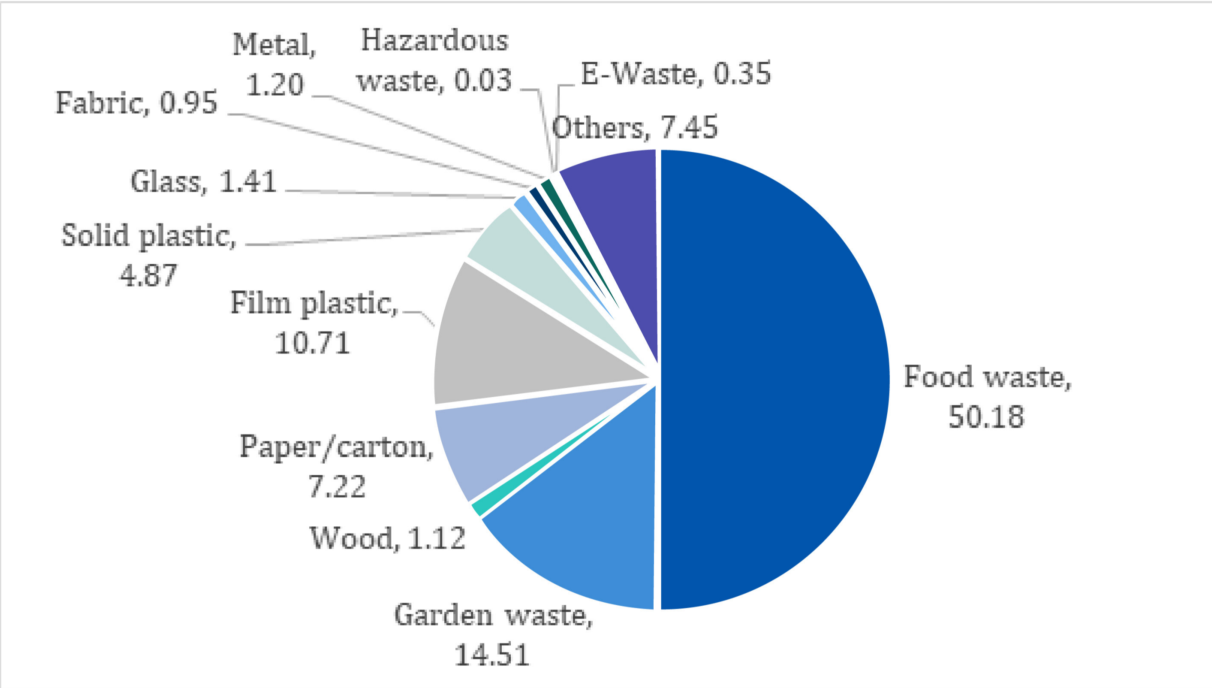


[4] GIZ, University of Leeds, Eawag-Sandec, Wasteaware (2020). Toolkit: Waste Flow Diagram (WFD): A rapid assessment tool for mapping waste flows and quantifying plastic leakage. Version 1.0. February 2020. Principal Investigator: Velis C.A. Research team: Cottom J., Zabaleta I., Zurbruegg C., Stretz J. and Blume S. Zurich, Switzerland and Leeds, UK. Obtain from: plasticpollution.leeds.ac.uk

Approximately 16,500 tonnes of plastic is being burnt without energy recovery, if that amount of plastics had been recycled instead it would have saved more than 58,000 tonnes of CO2eq. emissions per year[5]. Even a 50% diversion from burning to recycling would save almost 30,000 tonnes of CO2eq. each year, which corresponds to the annual emissions from 10,000 cars. In addition comes methane emissions from landfilling of organic wastes, the GHG emissions from this is not quantified in this report.

Waste composition

Waste composition of all MSW, household and non-household combined



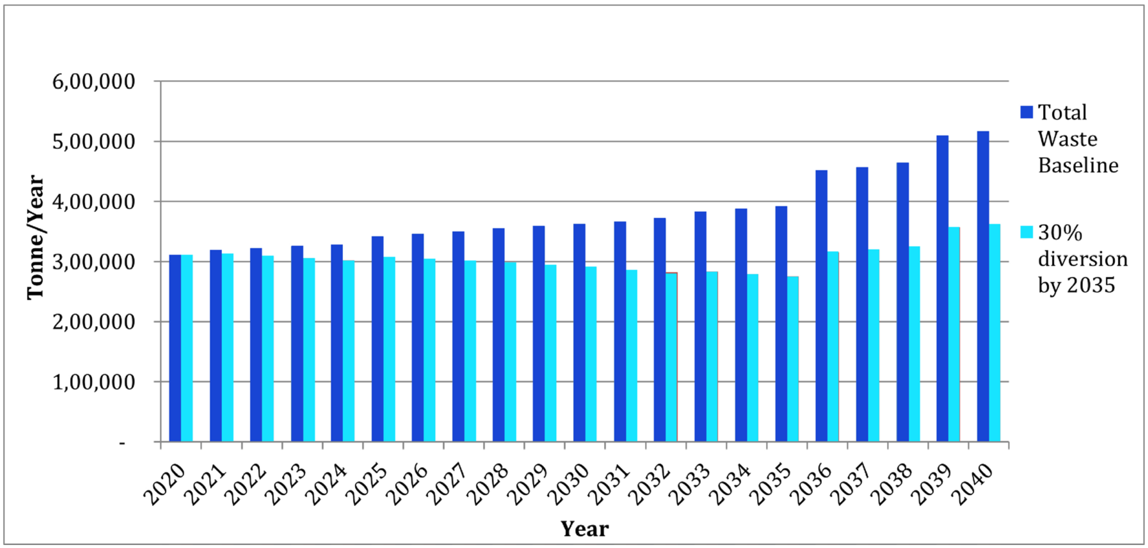
This shows a waste composition for the household and non-household waste stream, including rural and urban areas, and housing of all income levels. The combined waste composition shows a significant organic waste fraction (nearly 75%) comprising food and garden waste, with a plastics fraction including solid and film plastics of over 15%.

[5] The Circulate Initiative GHG calculator for Indonesia, https://www.thecirculateinitiative.org/ghg-calculator

Future waste projections

Waste generation is a function of economic activity, for which a proxy of Gross Domestic Product (GDP) is used, and population growth. Based on the following assumptions, the potential future waste arisings is projected, using the waste data baseline:

- **Domestic waste:** 1) Per capita waste increase based on modest rises up to 0.5 kg. 2) population increase[6] of 0.94%.
- **Non-Domestic waste:** 1) Modest rise, up to 3% from 2036 as high waste producing developments such as heavy industries are not anticipated to be the focus of economic development in the regency. 2) Slower start for first few years to reflect COVID-19 recovery.



Banyuwangi waste projection by 2040

The projection shows that by 2040, Banyuwangi regency will generate over 500,000 tons of waste requiring collection, recovery and disposal.

Conclusions and Recommendations

Following analysis of waste data baseline and survey results, the report draws the following conclusions and recommendations:

[6] Based on Banyuwangi Regency Statistics Document (2021)

Report Conclusions

Waste data collection method

- The data collection methodology, resulted in robust data that will satisfactorily serve the planning process.
- The survey team faced considerable challenges with COVID-19 restrictions but due diligence was undertaken.
- There is confidence in the mass balance, accurately showing the leakage of waste to the environment.

Waste recovery

- 90% of waste is considered recoverable either through recycling or composting.
- The recovery network of junk shops, waste banks, waste pickers, TPS3Rs and the recycling industries play a vital role in recovering resources.
- Further support for the recovery network is needed for it to reach the full recovery potential for recovering the available materials.

Mass balance and waste flows

- Leaked waste means that control over the waste has been lost.
- The mass balance and waste flows in the regency are the critical result of the waste data baseline survey.
- Understanding waste flows is a valuable tool for Banyuwangi regency's ISWMP.
- A quantifiable baseline, identifies where improvements can be made and where gaps exist.

Waste management challenges

- There are a range of diverse causes for the waste management system to be performing as it currently is.
- Analysis of these challenges, and with a data driven waste baseline, Banyuwangi regency is in a very strong position.
- Resource management can contribute positively to the regency's economy and environment.

Report Recommendations

Integration

- An integrated approach to overcoming the barriers and challenges for waste management is implemented.
- Without progress on all elements of the ISWM framework including physical and governance requirements, any changes are not likely to be sustainable.

Participation Engagement

- The participatory processes used by the CLOCC project show considerable momentum for change within the Banyuwangi regency community and institutions.
- Continue to capitalise on and the process moved forward.
- This can involve sharing the waste data baseline, ensuring residents, business and institutions understand the future waste challenges and the role they can play in defining and implementing its solutions.

Financing

- Funding ISWMP implementation is essential to delivering improved control over waste in the regency.
- Design affordable financially and environmentally sustainable solutions which can be operated independently of external support.
- Budget planning for waste related capital and operational expenditure should be considered as early as possible in the waste design and planning process.
- Financing waste may include elements of national budget support as well as addressing waste management system fee structures to support the daily operational costs and cautious use of international funding for capital costs.

1. Introduction

1.1 Purpose of the report

This report presents the results of the first phase of developing a solid waste management plan for Banyuwangi regency, in Indonesia. This phase establishes a **waste data baseline**, implemented under the auspices of the Clean Oceans through Clean Communities (CLOCC) programme. The report gives up to date waste management data, waste flows and waste leakage to the environment, which will be used for future waste management planning.

1.2 Context of the report

Indonesia has determined that 72% of plastic pollution originates from medium-density and rural settlements; in addition, the country has set a 2025 target of reducing ocean plastic leakage by 70%, which will necessitate significant changes in solid waste management in smaller cities and rural areas. [7]

The CLOCC programme is a community and network driven initiative which was established by Avfall Norge[8] in 2018, with International Solid Waste Association (ISWA) as the project partner. Indonesia Solid Waste Management Association (InSWA) is the local partner, helping the CLOCC project to achieve its visions of a healthy society and a clean environment.

Under the CLOCC project, the Banyuwangi regency was selected for support with integrated sustainable waste management (ISWM) planning. The regency signalled a desire to improve its solid waste management (SWM) planning, waste practices and environmental protection. This resulted in Banyuwangi regency signing a Memorandum of Understanding with InSWA. In addition, Muncar, a coastal city in the regency, has been working to improve plastic waste management in partnership with SYSTEMIQ since 2017.

One of the first steps for the regency is to establish a reliable waste data baseline, which supports planning, developing and implementing a new Integrated Sustainable Waste Management Plan (ISWMP) for Banyuwangi regency. This report presents the baseline data on solid waste management in Banyuwangi regency, collected in 2020-2021.

1.3 Drivers for change in Banyuwangi

Banyuwangi regency is in a strong position to make positive changes to its waste management planning and implementation, and develop a fully integrated waste management system:

- The regency is obligated to have a waste management plan in place.[9] The current waste master plan (2015) only covers urban areas, meaning village waste management is not considered, although is now recognised as needing integration into regency waste planning.
- Solid waste management is currently a low priority in the regency, without service standards, adequate regulations and enforcement. An ISWMP will be a valuable tool to tackle these issues, providing clarity on roles and responsibilities for driving waste management improvements.

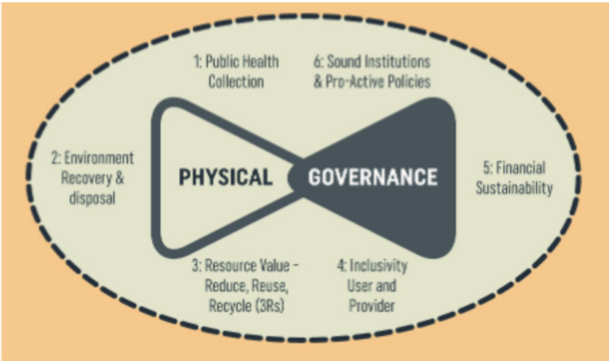
[7] World Economic Forum (2020) Radically Reducing Plastic Pollution in Indonesia: A Multistakeholder Action Plan National Plastic Action Partnership.

[8] https://avfallnorge.no/om-avfall-norge

[9] Regulation of the Minister of Public Work No. 03/2013 Concerning the implementation of Infrastructure and Facilities for Solid Waste handling

- The regency set challenging targets for managing household waste in 2018, which are not yet being achieved, including reducing waste by 18% in 2018 and 30% in 2025, and fully handling the remainder.[10]
- Banyuwangi regency is a domestic and international tourist destination.[11] Increasingly tourists are intolerant of poor waste management, partly fuelled by growing global concerns on marine plastic pollution. ISWM will support the regency's vision of becoming a clean world class tourism destination.

1.4 What is integrated sustainable waste management



(a) ***The 'two triangles' representation of the Integrated Sustainable Waste Management (ISWM) analytical framework**. Source:* (Wilson, et al., 2013)

Figure 1 ISWM framework used by CLOCC

Source: Global Waste Management Outlook.[12]

The Banyuwangi waste management planning process under CLOCC is based on an Integrated Sustainable Waste Management (ISWM) approach. ISWM is an internationally recognised method to help waste management planning.[13] ISWM integrates the physical requirements of a waste management system (waste collection, waste treatment and the 3Rs),[14] and the governance requirements (stakeholder inclusion, financial sustainability, sound institutions and policies). The physical components of ISWM incorporate the main drivers of sound waste management: environmental protection; public health protection; and utilising the resource value of waste. The ISWM framework (Figure 1) shows baseline data is a key input to ISWM planning.

1.5 Participation in integrated solid waste management planning

Establishing a waste data baseline is one step in the ISWMP development process. Under the CLOCC programme, a rigorous participatory planning process was conducted in parallel with data collection, supplementing the information obtained from waste data alone.

A seven step participatory ISWM planning approach was used, which started with stakeholder mobilisation. Stakeholders from eight villages participating in the project contributed to activities that encouraged ownership of, and engagement with, the planning process, as well as allowing a realistic understanding of how the waste system currently functions, or does not function. Activities such as an Appreciate Inquiry workshop[15] enabled

[10] Appendix I Regulation Of Banyuwangi Regency (12th December, 2018) Local Strategy Policy on Waste Management

[11] 2019 Domestic visitors (hotel stay): 703,131; 2019 International visitors (hotel stay): 77,198. Source: -Statistics of Banyuwangi Regency-Banyuwangi Regency in Figures (2021)

[12] UNEP (2015) Global Waste Management Outlook. ISBN: 978-92-807-3479-9. Available from: www.unep.org/resources/report/global-waste-management-outlook

[13] ISWM concept taken from United Nations Environment Programme (2015) Global Waste Management Outlook.

[14] 3Rs approach: Reduce, Reuse, Recycle

[15] Appreciative inquiry is an approach to find solutions to problems through emphasising what has worked well in the past. The ''4D cycle'' was used: discover, dream, design, and deliver. It allowed participants to contribute to solutions to obtain their future vision for the regency.

Stakeholders to contribute their views and visions for waste management planning in the regency.

Figure 2 Participatory stakeholder workshops

2. Data Collection Methodology

2.1 Introduction

The waste data baseline for Banyuwangi regency is generated primarily using the WasteWiste Cities Tool (WaCT).[16] WaCT is a diagnostic tool, developed by UN-Habitat, supported by ISWA, enabling cities to standardise how they monitor and report progress against Sustainable Development Goal Indicator 11.6.1. ***"Proportion of municipal solid waste collected and managed in controlled facilities out of total municipal waste generated, by cities".***

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

2.2 Data collection methodology

An experienced waste sampling team was engaged by InSWA to collect data for the project, using the WaCT with adjustments for the national waste data collection methodology. Data collection Period 1 (December 2020) sampled household and non-household waste, and Period 2 (February-March 2021) obtained recovery and disposal facility data. The results of the sampling team's output are available in a separate report[17].

2.2.1 Waste wise cities tool (WaCT) approach

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

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

[17] Butik Daur Ulang Project B Indonesia, CLOCC, InSWA (2021) Final Report: Waste management survey in Banyuwangi regency, Periode I November s/d Desember 2020, Periode II Februari s/d Maret 2021

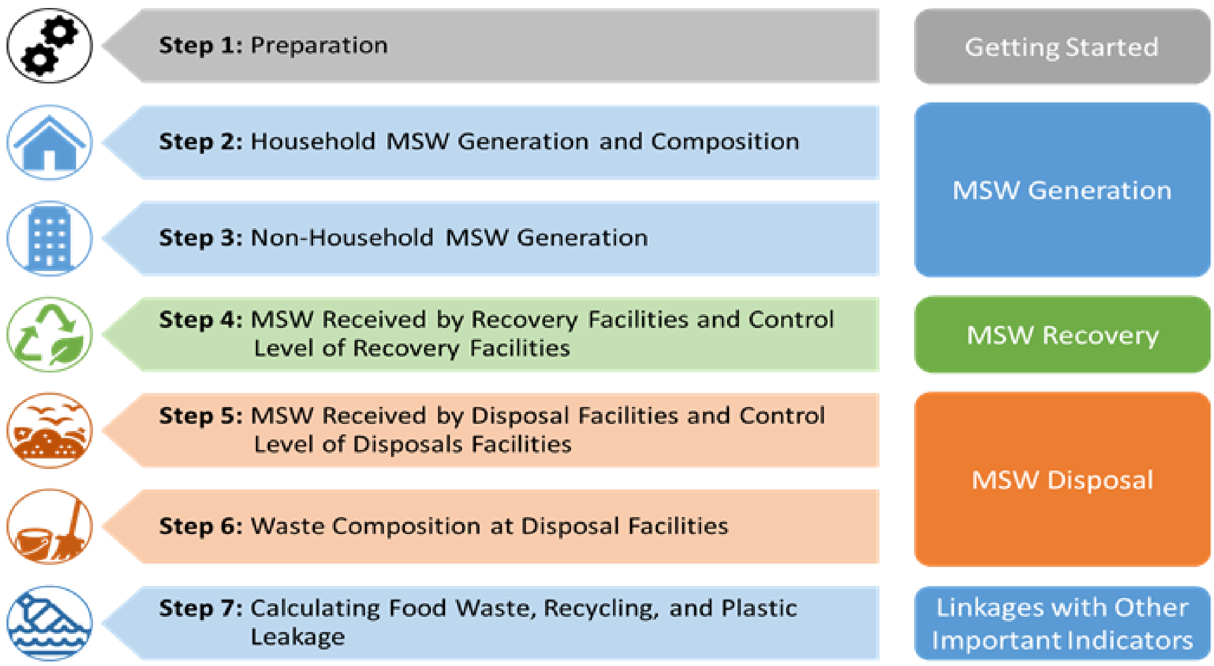


Figure 3 Waste Wise Cities Tool's Seven Steps

- Step 1 in WaCT included the engagement of the data collection (survey) team by InSWA and identification of stakeholders including formal and informal participants in the existing waste management system e.g. waste collections, private companies, value chain enterprises and local authorities. Robust additional data sources were also identified, such as population statistics and business registers.
- Steps 2 and 3 included a composition analysis for domestic (household) waste and non-domestic waste generation.
- Step 4 assessed the wastes received at recycling facilities.
- Step 5 and 6 assessed waste at disposal facilities including a further waste composition analysis.
- Step 7 combined and analysed the data to calculate waste flows and leakages.

2.2.2 Project implementation of the WaCT

Table 1 Sample and site numbers

Waste Generation Source	Number of samples	
	Village	Regency-wide
Household	80	60
Non-household	37	77
Total	117	137

Type of recovery facility	Number of sites
Waste Bank	16
TPS3R	18
Recycling industry	13
Junk shop	47
Total	94

Domestic waste sampling: For WaCT Step 2, eight villages in Banyuwangi regency were selected; these were villages already participating in CLOCC project activities. 10 samples for each village were taken for household waste data. The sampling included areas of high, medium and low-income levels.

The majority of the villages are in the North of the regency, therefore a further 60 samples were taken from locations in the South, East and West in order to obtain a regency-wide understanding. The waste composition categories for household and non-household waste are in Annex 1.

Non-domestic waste sampling: For WaCT Step 3, from each village, 37 samples of non-household waste were taken, from shops, religious sites, offices, hotels, restaurants and health facilities. In addition 77 non-household samples were taken from across the regency, with locations including markets, streets and tourists sites.

Figure 4 Waste sampling and data collection

Sampling methodology: The WaCT sample selection approach is tailored towards cities therefore the National Indonesia Standard (SNI) 19-3964-1994 was followed to determine the number of samples. A sampling box with standard approach to compaction (dropping the box three times) was applied. The WaCT waste composition analysis was followed (for WaCT step 2) using 12 waste types, from high, middle and low income areas. An eight day sampling period was used, following both SNI and WaCT.

Recovery facility sampling: WaCT Step 4, a combination of field visits and detailed questionnaires obtained waste data from the facilities identified in the eight project villages and regency-wide. The approach is shown below.

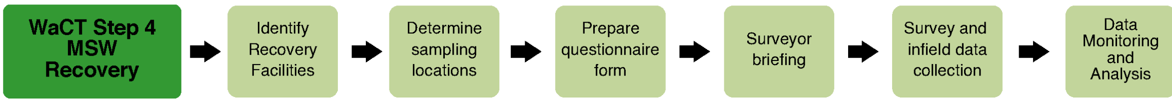


Figure 5 Recovery facility assessment approach

Disposal facilities sampling: For WaCT Step 5 and 6, interviews were undertaken with operators and informal waste pickers at the site to assess the recyclables removed from the waste. A waste composition analysis was undertaken by sampling for eight consecutive days.

Figure 6 Recovery facility data collection visit

Figure 7 Disposal facility informal sector survey

Sampling methodology: The WaCT sample selection approach is tailored towards cities therefore the National Indonesia Standard (SNI) 19-3964-1994 was followed to determine the number of samples. A sampling box with standard approach to compaction (dropping the box three times) was applied. The WaCT waste composition analysis was followed (for WaCT step 2) using 12 waste types, from high, middle and low income areas. An eight day sampling period was used, following both SNI and WaCT.

2.2.3 Assumptions and challenges

A number of assumptions were made by the survey team as summarised below:

- For income levels, data are not readily available. Within the sampling area, it was assumed that 30% of the area is considered high income, 30% is medium income 40% and the remainder is low income, based on observations such as physical building conditions, domestic facilities and size of the house area.
- For non-household waste assumptions were made based on local experience, such as number of employees in a shop and land area of a religious site in order to gauge waste arisings.
- For non-household areas the area (m2) was used as a tool to estimate waste generation in locations such as markets or public spaces.
- For the informal sector, the WaCT tool identifies three types: Materials Recovery (MRF) Facilities, Apex Trader and End of Chain. The team considered TPS3R and waste banks as ‘MRF’, Waste pickers and junkshop (pelapak and bandar) as Apex traders and recycling industry facilities as the end of chain.
- School and tourism waste, closures of schools and reduction in tourist numbers due to COVID-19 means that the data collection was not conducted under normal conditions; however, data for these facilities are not available for ‘pre-COVID-19’ conditions for comparison therefore the data has not been amended as the adjusted data may not be meaningful and it is understood that this is a relatively small source of waste arisings.

The main challenge for the data collection was the COVID-19 restrictions which presented a challenge to the team overseeing the local data collectors’ work because movements were restricted. This was overcome by online training using bespoke videos for sampling techniques, mentoring and monitoring in-field work via video calls, and investigating any data fluctuations or anomalies. In addition, the survey team followed health protection guidance, using masks and hand sanitizer during the field work.

3. Banyuwangi Regency Project Area

3.1 Introduction

Figure 8 Banyuwangi Regency subdistricts and target project villages

Banyuwangi Regency in East Java, Indonesia is located on eastern tip of Java Island. The Regency is approximately 5,700 km2 and is bounded to the East by Bali Strait, the South by the Indonesian Ocean and has land borders with three Regencies to the West and North.

Administratively, Banyuwangi Regency is divided into four Regions: North, South, Mid East and Mid West[18] which are further sub-divided into 25 kecamatan (subdistricts), 189 desa (villages), 28 kelurahan (urban villages) with an approximate population of 1.7 million people[19], see Annex 2.

Eight project target villages for waste baseline data collection are located in seven subdistricts within the Regency, with a population of approximately 98,000.

3.2 Legal and institutional framework

3.2.1 Legal framework

The legal framework for SWM is established by a number of National, regional and local legislative instruments (see Annex 3). Nationally, waste management is regulated under National Waste Management Law (No. 18/2008) which enables derivative regulations on waste management to be initiated and sets out requirements for environmental standards and stakeholder support for waste management activities. The Presidential Decree on National Strategy Policy on Waste Management (No. 97/2017) called Jakstranas, influences the execution of waste management in cities and regencies nationally. Jakstranas pledges to collection of 100% of MSW through a combination of 30% waste reduction and 70% handled by municipalities by 2025. The 30% waste disposal reduction target is to be achieved by programmes on waste prevention, reuse and recycling. Local Governments are required to integrate the decree into local policies and strategies. It also coordinates stakeholder roles and responsibilities to achieve the target. In Banyuwangi, Jakstranas is implemented through the Banyuwangi Regent Decree (No. 54/2018), known as Jakstrada.

[18] Penyusunan Revisi Rencana Tata Ruang Wilayah (RTRW) Kabupaten Banyuwangi Tahun 2012 - 2032

[19] Kabupaten Banyuwangi Dalam Angka, 2021

3.2.2 Institutional responsibilities for waste management

Under National Waste Management Law (No. 18/2008) the key institutional responsibilities for SWM are delegated by the national government to local government with cities and regencies being responsible for waste management. In Banyuwangi Regency, the SWM regulator is the Banyuwangi Dinas Lingkungan Hidup (Environmental Agency) under the Cleanliness Division. The Environmental Agency's function is to develop waste management policies and standards and regulate their implementation. Waste management operators are responsible for operating waste management infrastructure and facilities in accordance with the Environmental Agency requirements.

Kelurahan (urban areas) depend on regency authority for regulations, institutions, and planning, whereas in desa (villages) local institutions are given the authority to plan, create and implement their own regulations.

3.3 Solid waste management practices

3.3.1 Household solid waste management

Under National Waste Management Law (No. 18/2008) the key institutional responsibilities for SWM are delegated by the national government to local government with cities and regencies being responsible for waste management. In Banyuwangi Regency, the SWM regulator is the Banyuwangi Dinas Lingkungan Hidup (Environmental Agency) under the Cleanliness Division. The Environmental Agency's function is to develop waste management policies and standards and regulate their implementation. Waste management operators are responsible for operating waste management infrastructure and facilities in accordance with the Environmental Agency requirements.

Kelurahan (urban areas) depend on regency authority for regulations, institutions, and planning, whereas in desa (villages) local institutions are given the authority to plan, create and implement their own regulations.

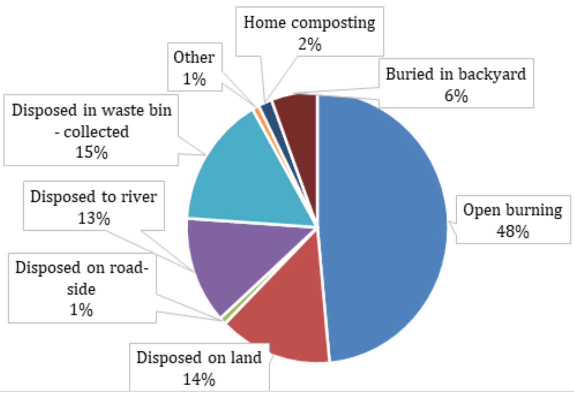


Figure 9 Village survey waste behaviour

The survey asked for a maximum of three options for disposal of residual solid waste. The survey results (Figure 9) show that the most common waste disposal practice is burning (48% of responses) with disposal on vacant land and in rivers being the second and third most common practices (14% and 13% of responses respectively). 15% of people consider their waste behaviours as 'good'. These waste practices reflect that only 54 villages (29%) have a formal SWM system and of these only 37 levy a waste collection fee from service users. The fee levied ranges from Rp. 5000 to Rp. 30,000 per household per month, depending on the economic situation of the village and the householders ability and willingness to pay.

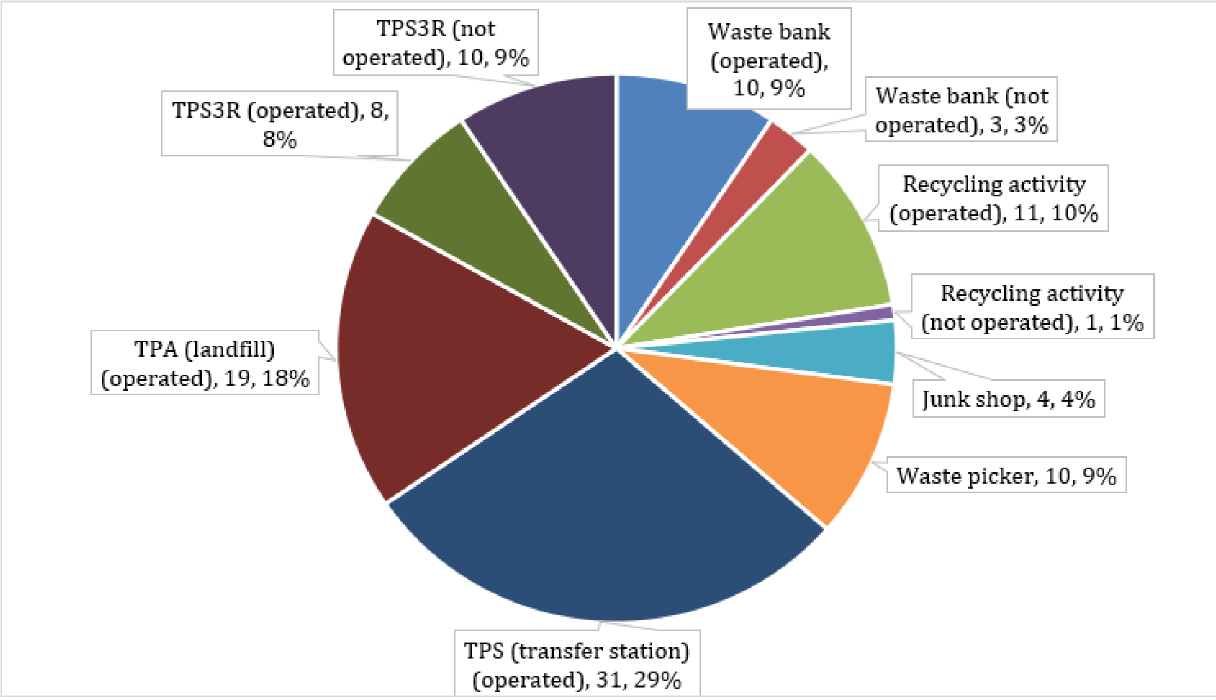


Figure 10 Village survey waste infrastructure

Regarding waste management infrastructure, most villages with a waste collection system also had a TPS; 18 villages had a TPS3R of which only 8 were operational. Figure 10 shows the respondents' understanding of waste management options and the operational status within their villages.

Women's survey results. The survey asked 10 questions related to waste management practices covering topics including difficulties with waste, waste segregation practices, managing difficult wastes and suggestions for improvements. The results are grouped into themed responses in Figure 11:

Daily waste challenges	•Poor waste and sanitation practices cause odor, mosquitoes and injuries to children •Waste causes flooding when it is dumped in rivers •Lack of staff and resources stopped a composting project •Single use facemasks are burned at home or mixed into plastic waste deposits at waste banks •COVID-19 has caused waste collection delays
Domestic waste practices	•Waste bins used include buckets, baskets, rice sacks, trash bags, large paint cans •Bin is stored in the kitchen or yard to front of the house for collection every 1-2 days if there is a collection •Neighbours are observed disposing of waste into rivers from bridges at dawn
Waste segregation	•Waste segregation is for recyclables that can be sold to waste banks or itinerant buyers •Food waste is separated for the householder or neighbouring animals for feed •Solid plastic, carton, paper, cans, glass are most commonly separated for waste banks •Not everyone realises there is value in segregated recyclable waste
Urban /rural differences	•Some rural areas have no waste collection so householders do what they can with their own resources •In villages without a collection service, waste can be taken to the village dumpsite if the household has no space to burn or bury it •Waste collection in villages with a service is undertaken by collectors mandated by the village •Village waste collection is approximately twice per week •Urban waste collection is door to door, with collectors using a hand or motorised cart
Other wastes	•Diapers and sanitary napkins are washed and the plastic elements treated with other waste, including burning and burial •Unwanted clothing is given to friends of family, or buried, not burned due to local beliefs which prohibit burning clothing •Unwanted furniture is given away for free or to waste pickers or waste banks.
Suggested improvements	•Support for markets including sales outlets for women's crafts made from waste •Finance and infrastructure support for home composting on small scale (10 houses) or large scale (100 houses) •Specific training for women on treatment of organic waste and managing waste during religious / large family events •Specific education for children on waste issues •All villages require a dumpsite, waste banks and waste collection for every house, to improve waste behaviours

Figure 11 Women's survey summary on waste practices

The women's survey and the village survey support the findings of the waste data baseline sampling and field work. The surveys consistently show coherent waste challenges such as a lack of operational infrastructure, and common informal disposal practices. The surveys and further research also input into the following sections, which provide further detail on waste management separation, transport treatment and disposal.

3.3.2. Waste container and separation

Householders generally provide their own waste container where a waste collection service is provided, e.g. plastic or bamboo waste bin, or used tires, outside their property for doorstep collection. Accessible communal waste containers for households are provided independently by relevant groups.

In urban commercial and public areas such as markets, schools and hospitals, waste containers are provided by Banyuwangi Regency Environmental Agency. For commercial operations e.g. restaurants, shops and offices, the waste containers are provided by the commercial waste producer.

Little waste source segregation is practiced; householders generally use one mixed waste container, however in some public areas, two or three types of bins for residual waste and recyclables may be provided by the Environmental Agency.

3.3.3 Waste collection and transport

Figure 12 Waste collection tricycles TPS3R Tembokrejor

In urban areas, household waste containers are transported to bring sites or transfer stations (Tempat Pengolahan Sampah TPS3R /Tempat Penampungan Sementara TPS) by neighbourhood/community associations (Rukun Tetangga/Warga) using waste cart or tricycles. Onward transport to the landfill site (Tempat Pemrosesan Akhir TPA) is undertaken by the Regency using a truck.

In villages, total waste management is primarily a village responsibility; the CLOCC village survey identified only 54 villages in have a waste collection . The neighbourhood/ community associations or village authority collects waste from households by waste cart or tricycle for transfer to a TPS3R/TPS, where one is present. Villages without a TPS3R manage waste through informal disposal. Villages with a TPS3R extract recyclables, disposing of the residue at the TPA or more often informally; two villages currently dispose of their residual waste in the Regency TPA.

Traditional market waste is delivered by market workers to a TPS and commercial waste is delivered by waste collectors to a TPS or sent directly to the TPA in commercial waste vehicles. Waste in the TPS is transferred to the TPA by Regency waste vehicles. Waste collectors also transfer waste from public areas to a TPS via a waste cart, for onward transfer to the TPA.

3.3.4 Waste treatment and infrastructure

Waste treatment in Banyuwangi focuses on diversion from landfill using TPS, TPS3R, and waste banks; there are 31 TPS, 18 TPS3R, 16 active waste banks plus 10 transfer depots (see Annex 4 for details). In a TPS, materials such as rigid plastic and cardboard are separated by informal waste pickers for recycling. In a TPS3R, both recyclables and organic materials are separated, with the latter usually composted. Finally waste banks encourage the community to separate waste at source through exchanging recyclables for money or goods.

3.3.6 Informal waste disposal practices

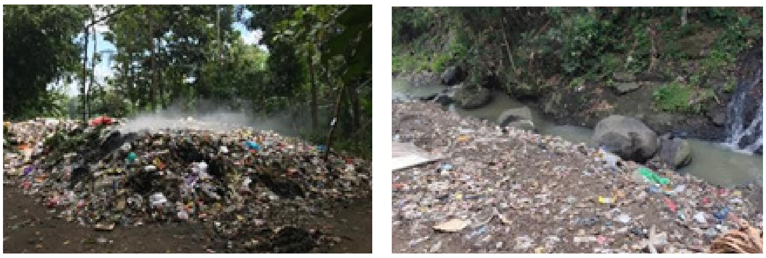


Figure 14 Informal disposal in villages

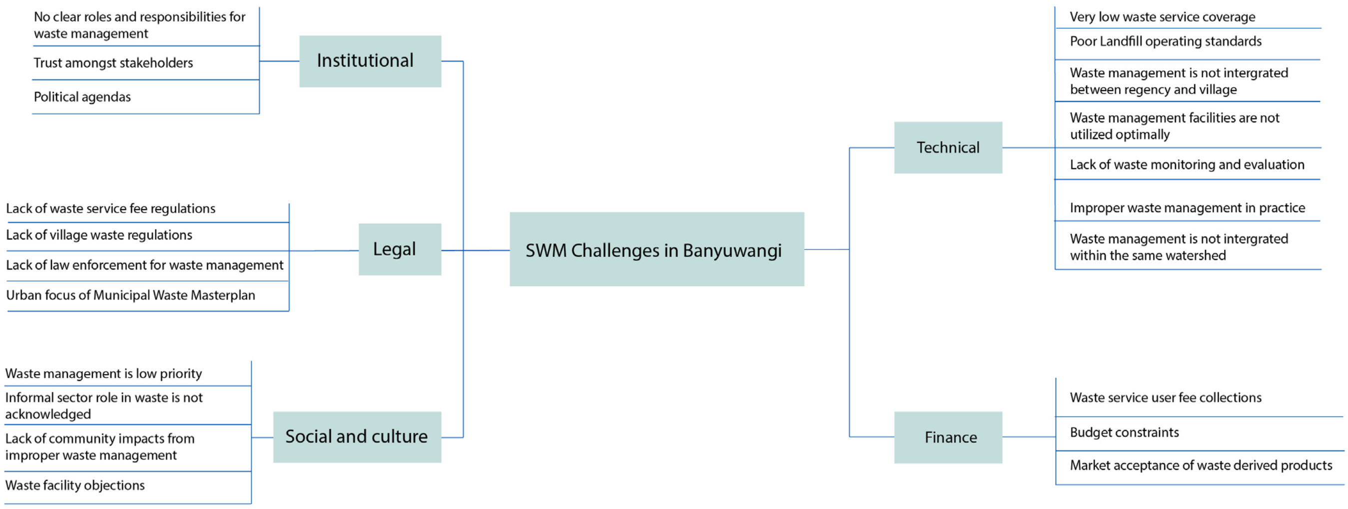
Waste management in Banyuwangi is focused on urban areas meaning waste from villages is informally managed. This results in many uncontrolled dumpsites within the regency. Besides uncontrolled open dumping, collected waste in villages is also burned; a quick and economically acceptable method of disposal.

3.3.7 Muncar's waste management

Waste behaviours in Muncar can be considered separately; Muncar on the regency's east coast has been in partnership with Project STOP[20] since 2017. The city was selected due to recognition of the serious waste issues, the coastal location and the leadership and environmental commitment at national, regency and local levels. Impacts of Project STOP have included improved waste management collections for 89,655 people, 133 full time jobs created and reduced plastic leakage.

3.4 Summary of waste management challenges in Banyuwangi

The CLOCC project conducted a Stakeholder Meeting and consultation with villages on waste management; Figure 15 summarises the SWM challenges in Banyuwangi identified in the stakeholder meeting, grouped according to the cause of each.



[20] https://www.stopoceanplastics.com/en_gb/muncar/

Annex 5 provides details on stakeholder's views and a brief outline is provided below.

Challenge 1: Technical aspects

There is very low waste service coverage, with many regions without effective waste management systems, therefore improper waste management practices are used, e.g. open burning and disposal in water bodies are common. Poor landfill operating standards means the formal landfill site has limited environmental controls. Waste management is not integrated between regency and villages with villages needing to manage waste independently. Waste management facilities are not utilized to their maximum as many are non-functioning due to lack of resources, budget and community objections. Finally, there is a lack of waste data monitoring and evaluation.

Challenge 2: Financial aspects

Waste service user fee collections are often unaffordable and many people are unwilling to pay the fees. Regency waste management is hampered by budget constraints, exacerbated by COVID-19 as waste budgets were diverted to other issues. In addition, there is little market acceptance of waste-derived products such as compost.

Challenge 3: Institutional aspects

The unclear responsibilities for waste management between regulators and operators leads to limited implementation. Stakeholder concerns over limited capacity and financial issues can cause stakeholder trust issues within waste management, stakeholders also consider the political cycle and commitments at the regency and village levels can influence decision making. Further collaboration, and commitment from local government structures is needed for waste management improvements.

Challenge 4: Legal aspects

Waste service fee regulations across the regency and in villages are not in place, and most villages have yet to establish a waste regulation, meaning a lack of clarity on waste management operators, waste service fees and waste management rewards and penalties. Enforcement for waste management is limited, even where village waste regulations are established. Furthermore, the urban focus of Municipal Waste Masterplan (2016) does not integrate village waste management needs into the formal approach.

Challenge 5: Social and cultural aspects

It is recognised that waste management is a low priority for many stakeholders across government, business and the community. This is possibly because improper waste management does not directly impact enough on communities to ensure they realize it is an issue. However, waste facility development is often hindered by community objections to potential nuisance issues. Finally, the beneficial informal sector not recognized within the formal waste management system roles.

4. Results

4.1 Introduction

The waste data baseline survey results are presented in line with the WaCT steps, calculating the waste generation (domestic and non-domestic), waste recovery (informal and formal) and disposal. The survey results demonstrate the differences between urban and rural locations, and different income levels for domestic waste.

Waste data from the survey are aggregated using district, sub-district and population data across the regency. This results in a regency-wide final mass balance, which shows the ‘leakage’ of waste into the environment from the waste management system.

4.2. Waste composition

This shows a waste composition for the household and non-household waste stream, including rural and urban areas, and housing of all income levels. The combined waste composition shows a significant organic waste fraction (nearly 75%) comprising food and garden waste, with a plastics fraction including solid and film plastics of over 15%.

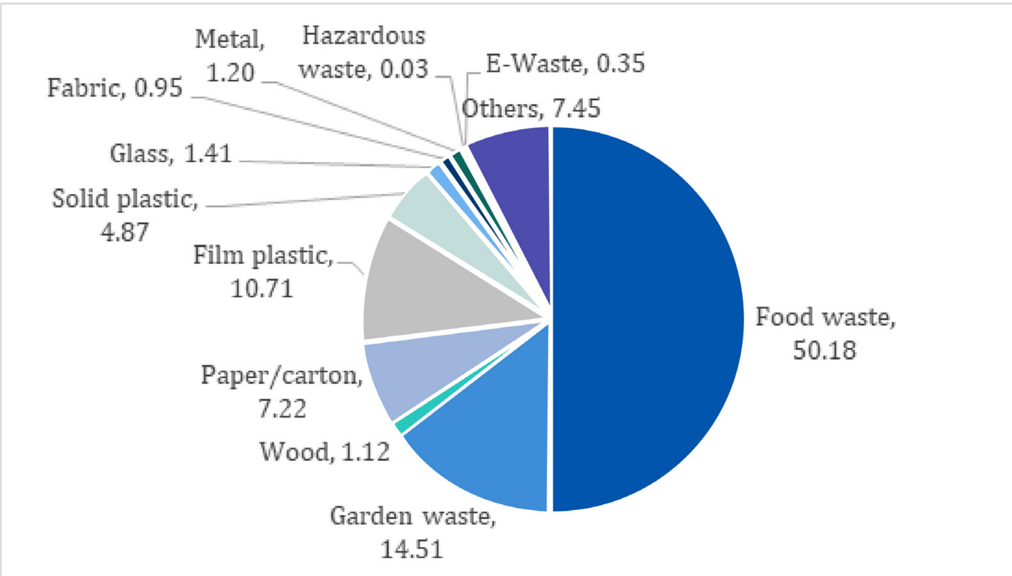


Figure 21 Waste composition all MSW, household and non-household combined

The composition is further analyzed in the following sections.

4.2.1 Domestic waste composition

Waste composition analyses for domestic rural and urban locations in the survey show that the composition is broadly comparable across all income levels; the main fraction for all is organic waste (food/kitchen waste). Based on income levels and urban/rural split, the composition of domestic waste is shown in the table below:

Table 2 Domestic waste composition analysis

No	Waste Composition	% by weight						Average
		High Income		Middle Income		Low Income		
		Rural	Urban	Rural	Urban	Rural	Urban	
1	Kitchen / food waste	58.37	52.94	56.67	50.48	66.72	52.54	56.29
2	Garden waste	9.62	9.31	13.26	7.28	5.23	7.38	8.68
3	Wood	0.45	1.73	1.16	0.98	1.35	1.18	1.14
4	Paper / Carton	5.94	7.21	5.30	7.13	6.08	6.62	6.38
5	Film Plastic	9.93	11.87	9.68	10.26	9.81	13.66	10.87
6	Solid Plastic	5.69	3.47	4.56	5.02	4.55	3.91	4.54
7	Glass	0.78	1.56	2.41	2.08	0.37	1.83	1.51
8	Fabric	0.61	0.96	0.19	3.30	0.50	1.36	1.15
9	Metal	0.93	2.27	0.63	1.83	0.04	1.62	1.22
10	Hazardous waste	0.00	0.04	0.00	0.09	0.00	0.00	0.02
11	E-waste	0.19	0.01	0.00	0.00	0.00	2.30	0.42
12	Others	7.47	8.62	6.14	11.55	5.35	7.6	7.79

Aggregating the data between all income levels, shows a broadly comparable urban/rural composition analysis (Figure 16 and Figure 17).

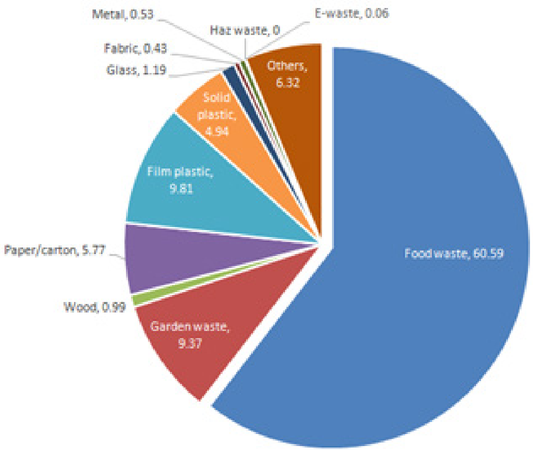


Figure16 Rural domestic waste composition (% weight)

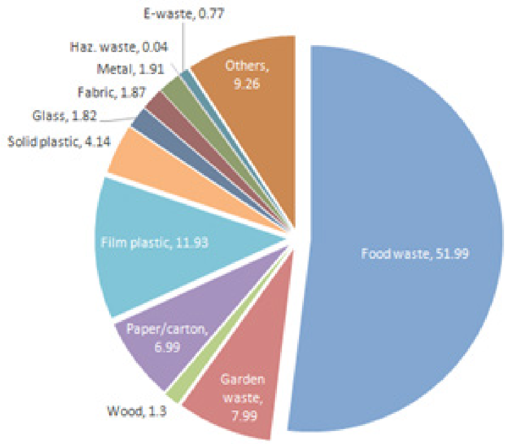


Figure17 Urban domestic waste composition (% weight)

The waste composition divides plastic into two types; film and solid plastic. Averaging the total plastic in the waste stream across all areas and income levels shows that Banyuwangi regency's domestic plastic waste generation is approximately 15% by weight (Figure 16). Plastic waste including both hard and film plastics, shows a slight increase in low income urban areas.

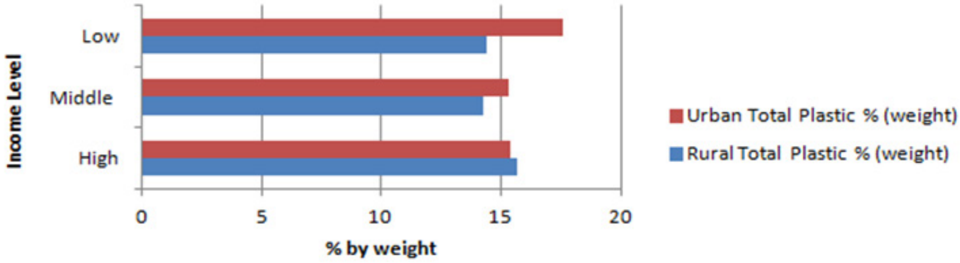


Figure 18 Total plastic waste in composition

The waste composition includes two organic waste streams; food/kitchen waste and garden waste. These are key waste streams in terms of greenhouse gas emissions and are therefore often specifically targeted for recovery by municipalities. The data show near identical total percentages (60%) in both rural and urban areas, combining food and garden waste (Figure 19); the organic fraction of the waste stream is significant throughout the regency.

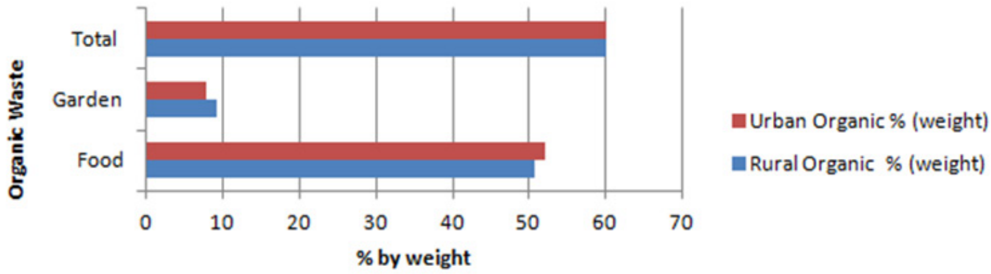
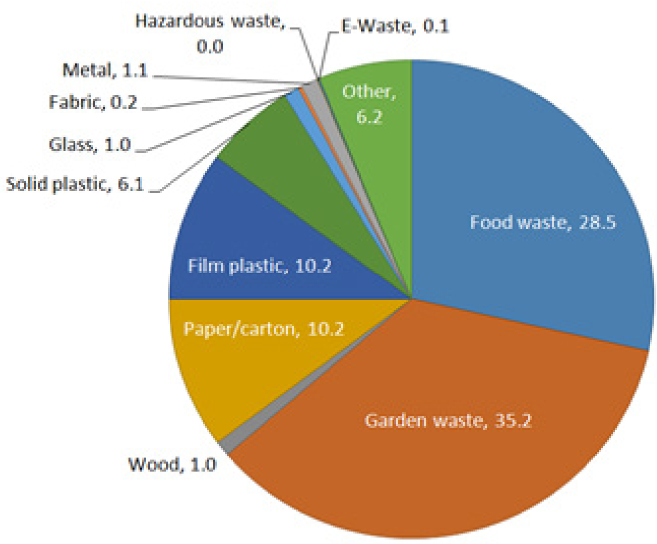


Figure 19 Total organic waste in composition

4.2.2 Non-domestic waste composition



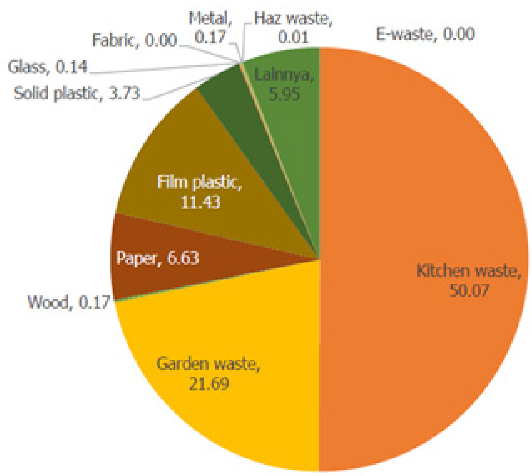
The composition of non-domestic waste was obtained through sampling in the rural village locations and in the urban locations across the regency. Annex 6 shows the composition for individual types of waste producer sampled; Figure 20 shows a combined composition for all non-domestic waste:

Comparable to domestic waste, plastic is approximately 16% (film and solid plastic) of the non-domestic waste stream. Organic waste (food and garden) is the major fraction at 63% in total.

Figure 20 Non-domestic waste composition (% weight)

4.2.3 Combined domestic and non-domestic waste composition

4.2.4 Landfill waste composition



Comparable to the domestic and non-domestic waste compositions i.e. waste at source, the majority of landfilled waste is organic at 72%, comprising 50% kitchen waste and 22% garden waste.

Plastic waste is 15% in total, including 11% film plastics. This waste is sampled at the point of arrival at the landfill, after which informal recovery takes place by waste pickers; plastic removal by the transport crew is also usual during transport.

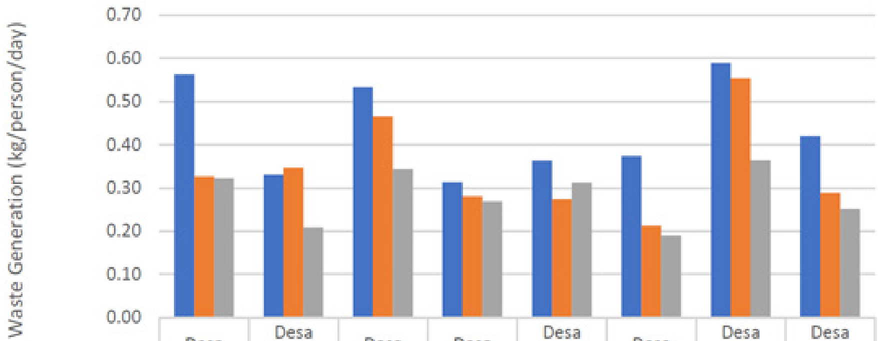
This shows that the removal of recyclable and compostable waste is limited as the composition from sources to landfill changes minimally.

Figure 22 Landfill waste composition (% weight)

4.3. Waste generation

4.3.1 Domestic waste generation

Domestic waste generation is divided into urban and rural locations. The rural locations are based on detailed field surveys in each village. The results show that income levels are directly proportional to waste generation per capita. In each village surveyed, except Desa Segobang, high income areas produced the most waste per capita.



	Desa Gelagah	Desa Segobang	Desa Pakis	Desa Sidodadi	Desa Kebondalem	Desa Curing	Desa Tembokrejo	Desa Kedungrejo
High Income	0.56	0.33	0.53	0.31	0.36	0.37	0.59	0.42
Middle Income	0.33	0.35	0.47	0.28	0.27	0.21	0.55	0.29
Low Income	0.32	0.21	0.34	0.27	0.31	0.19	0.36	0.25

Figure 23 Waste generation (kg/capita) in rural villages surveyed

The table below gives the per capita average waste generation in urban and rural areas, across income levels. Standard deviations were compared in the analysis and the selected value for calculating domestic waste generation across the regency combines the average samples of both rural and urban locations across the income levels i.e. 0.37 kg/person/day. The data for this calculation is in Annex 7.

Table 3 Domestic waste generation per capitain rural and urban areas

Type	Rural areas Kg/person/day	Urban areas Kg/person/day	Combined Average Kg/person/day	Combined Average Litre/person/day
High Income	0.44	0.49	0.45	2.87
Middle Income	0.34	0.39	0.36	2.64
Low Income	0.28	0.38	0.31	2.38
Average			**0.37**	**2.63**

Secondary data sources, e.g. Badan Pusat Statistik (BPS)[21] were used to identify the population in each subdistrict across the regency. The figure of 0.37 kg/person/day[22] was applied to the population data. A summary for the regency is in the table below, and detail is provided in Annex 7.

Table 4 Total domestic waste generation regency-wide

Regency Population (Total 25 subdistricts)	Waste generation			
	kg/person/day	l/person/day	tonne/day	m^3/day
1,788,112	0.37	2.63	665.56	4,705

4.3.2 Non-domestic waste generation

Non-domestic waste was sampled in the eight surveyed villages (rural areas) and in the wider urban areas. All schools and most tourist sites were closed during the survey due to COVID-19 therefore schools could not be separately reported and tourist site samples were limited.

In village and urban areas surveyed, waste generation data was collected by directly sampling accessible non-domestic waste sources. The unit measure for each type of non-domestic site is selected to be appropriate to the specific waste source, as derived through field assessments.

[21] Badan Pusat Statistik (Statistics of Banyuwangi Regency) available at: https://banyuwangikab.bps.go.id/

[22] Note that due to rounding up/down, the direct calculation of waste generation x population will not match the table. The raw data uses 0.3722 kg/person/day and 2 .63116 l/person/day

For both urban and rural locations, the challenges of accessibility to non-domestic sites posed by COVID-19 restrictions meant data collection for some sites was limited, therefore for rural areas, averages across all villages are used, not disaggregated according to village. The table below gives the averages calculated for non-domestic waste generation in rural and urban areas.

Table 5 Average non-domestic waste generation by source

Non-domestic source [unit measure]	Rural Areas (Kg/Unit/Day)	Urban Areas (Kg/Unit/Day)
Shops [kg/worker/day]	0.49	0.46
Religious site [kg/m²/day]	0.0029	0.01
Office [kg/worker/day]	0.17	0.27
Market [kg/m²/day]	No data	0.01
Restaurant [kg/seat/day]	1.04	1.19
Street [kg/m/day]	No data	0.05
Hotel [kg/room/day]	1.25	0.24
Health Facility [kg/bed/day]	1.24	0.59

The urban and rural non-domestic waste generation averages are combined, and applied to the numbers of non-domestic sites in the regency as a whole. Information on the number of shops, markets or hotels across the regency was obtained from secondary data sources and publicly available statistics, such as Banyuwangi Regency in Figures, and Sub-districts in Figures. This gives a total of 187 tonnes per day (tpd).

Table 6 Total non-domestic waste generation regency-wide

No	Non-domestic source	Unit measure	Waste generation (kg)	No. of Sites	Waste generation (tonne/day)
1	Shop	per worker/day	0.48	16,452	77.63
2	Religious Site	per m²/day	0.01	7,010	77.28
3	Office	per worker/day	0.20	298	1.35
4	Market	per m²/day	0.01	74	11.42
5	Street	per m/day	0.05	2,298	0.12
6	Restaurant	per seat/day	1.09	476	5.36
7	Hotel	per room/day	0.74	1,031	8.04
8	Health Facility	per bed/day	0.95	202	3.55
9	Tourism Site	per person/day	0.79	20	2.56
Total					**187.31**

4.4. Waste recovery

4.4.1 Recycling industry

13 recycling businesses in Banyuwangi regency were identified, which shred, grind, wash, dry, mould or form recovered materials. From interviews with the businesses, 60% of the materials come from junk shops, with the remainder (10% each) from waste banks, waste pickers, community or 'other' sources. The table below shows that approximately 19 tpd of waste materials are processed daily.

Table 7 Recycling industry inputs and outputs regency-wide

Unit	Material Inputs and source*		Total inputs	Product	Residue disposal		
	Internal	External			Environment	Landfill	Other business
tonne/ month	514.6	56.0	570.6	423.3	12.8	0.8	133.8
tonne/day	17.2	1.9	19	14.1	0.4	0.03	4.5
*source: internal is material sourced within Banyuwangi regency and external is from outside the regency.							

Approximately 25% of the material inputs become residue, of this, interviews indicate that nearly 9% is disposed of (burning and burial) in the environment. The majority (91%) is moved to other businesses and less than 1% is landfilled.

Under WaCT, different 'control levels' are used to describe the standard of operations at a recovery (recycling) facility. These are detailed in Annex 8. Of the 13 recycling businesses identified, three were classified as 'full control' and the remainder as 'limited control'.

4.4.2 Junk shop collections

Based on secondary data, 47 junk shops were identified for sampling and interview; of these, the majority (55%) are not yet legal entities. Under the WaCT classification (Annex 8) all of the 47 junk shops were classified as 'limited control'.

The junk shops are businesses which actively receive waste from other sources. Junk shops receive a variety of materials including all types of plastic, glass, paper/card and metals. No organic waste was shown to be collected by junk shops. Informal waste pickers are the main source of waste supplied to the junk shops, as shown in Figure 24.

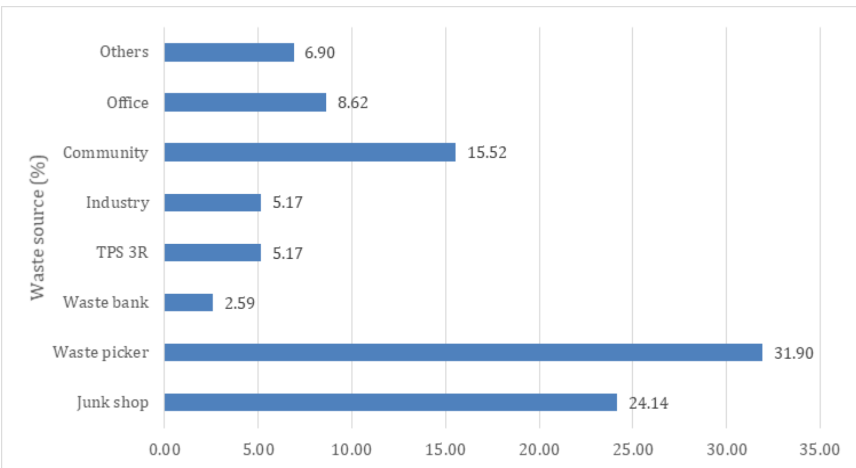


Figure 24 Junk shop sources of waste (% by weight)

As shown in the table below, the junk shop residue is approximately 3.7% of inputs indicating that the materials are well sorted with relatively low contamination on receipt. Of the residual waste disposed, 54% enters the environment, and nearly 14% landfilled.

Table 8 Junk shop recovery inputs and outputs regency-wide

Unit	Material Inputs and source*		Total inputs	Product	Residue disposal		
	Internal	External			Environment	Landfill	Other business
tonne/ month	933.5	212.0	1145.5	1214.1	23.2	5.9	13.3
tonne/ day	31.1	7.1	38.2	40.5	0.8	0.2	0.4

*source: internal is material sourced within Banyuwangi regency and external is from outside the regency.

4.4.3 TPS3R recovery

18 TPS3R were located within the regency. Their operational status is shown below; of the seven operational sites, under the WaCT classification (Annex 8) four were classified as ‘limited control’ and three as ‘full control’.

Table 9 TPS3R operational status regency-wide

Number of TPS3R	Status
3	Never operational
4	Previously operating, currently not functioning
7	Operating
1	Limited operation (not 3R)
3	Not operated (no records)

As with junk shops, TPS3Rs accept a wide range of materials, including organics. The main treatment activity is sorting, however the sites also store materials for onward transport and mould, dry, wash and shred materials. The throughputs for the operational TPS3Rs are as follows:

Table 10 TPS3R recovery inputs and outputs regency-wide

	Material Inputs and source*		Total inputs	Product	Residue disposal		
	Internal	External			Environment	Landfill	Other business
tonne/ month	771.85	0.00	771.85	89.6	5.07	677.2	0
tonne/ day	25.73	0.00	25.73	3.0	0.17	22.57	0

*source: internal is material sourced within Banyuwangi regency and external is from outside the regency.

The TPS3Rs accepted 25.7 tpd of recyclable material, but of this, a considerable proportion becomes residual waste, representing 88% of the inputs. Of the residual waste disposed, 99% is landfilled with the remainder entering the environment.

4.4.4 Waste bank

Waste banks are community based waste operations with a goal of educating the public on improved waste management. The regency records having 57 waste banks, 16 of which were located for the WaCT survey, contributing to the results in this report. In addition to simple waste banks, the Central Waste Banks includes more complex sorting activities and therefore receives 'product' for further sorting, from simpler waste banks. The inputs and outputs for waste banks are shown in the table below.

Table 11 Waste bank recovery inputs and outputs regency-wide

	Material Inputs*	Product	Residue
Total (tonne/month)	6.2	6.2	0
Total (tonne/day)	0.2	0.2	0
*All inputs are sourced within Banyuwangi regency			

The waste banks do not have residual waste residues; all materials received are sorted and transferred into the next stage of recovery processing. This indicates low contamination levels and high awareness of waste acceptance criteria.

4.5. Waste disposal

The TPA (landfill) does not have a weighbridge therefore a conversion factor is used on its estimated received waste volumes in order to obtain a mass estimate. Based on data from Banyuwangi Environmental Agency (2021) the average quantity of waste landfilled in the last 12 months is 133 tpd. This figure is based on a density of 465 kg/m3. This is low compared to the WaCT suggested 750 kg/m3 and the WaCT sampling data obtained on site over seven days, of 326 kg/m3. Given that the DLH Banyuwangi data was provided for one year and is in the middle of the three potential densities, the figure of **133 tpd** is used in this report.

4.5.1 Landfill site informal waste recovery

The survey team identified 10 informal waste pickers at the landfill site. As anticipated, there is no formal recording system for wastes recovered. Interviews show that the pickers collect all materials apart from organics, with an equal focus on metal, glass, paper and all types of plastic, noting expandable polystyrene and PVC are minor elements of the collected waste composition. The materials are generally sold to junk shops and on average, the survey identified that each person collects 48 kg/day indicating that the landfill waste pickers extract approximately **0.048 tpd** between them.

4.6. Waste mass balance

Following the WaCT and completion of detailed surveys, interviews and sampling, the mass balance showing waste flows within the regency per day is shown in Figure 25.

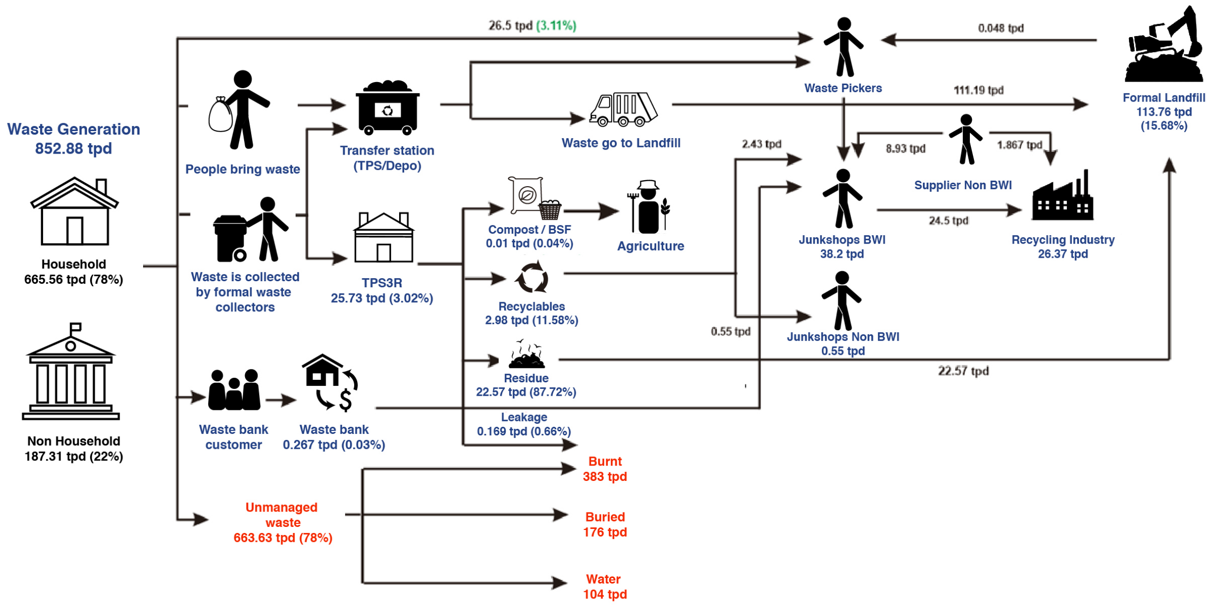


Figure 25 Banyuwangi regency waste mass balance (tonne per day)

The data and mass flow balance presented as a Sankey diagramme, with the use of the WFD toolkit [23] :

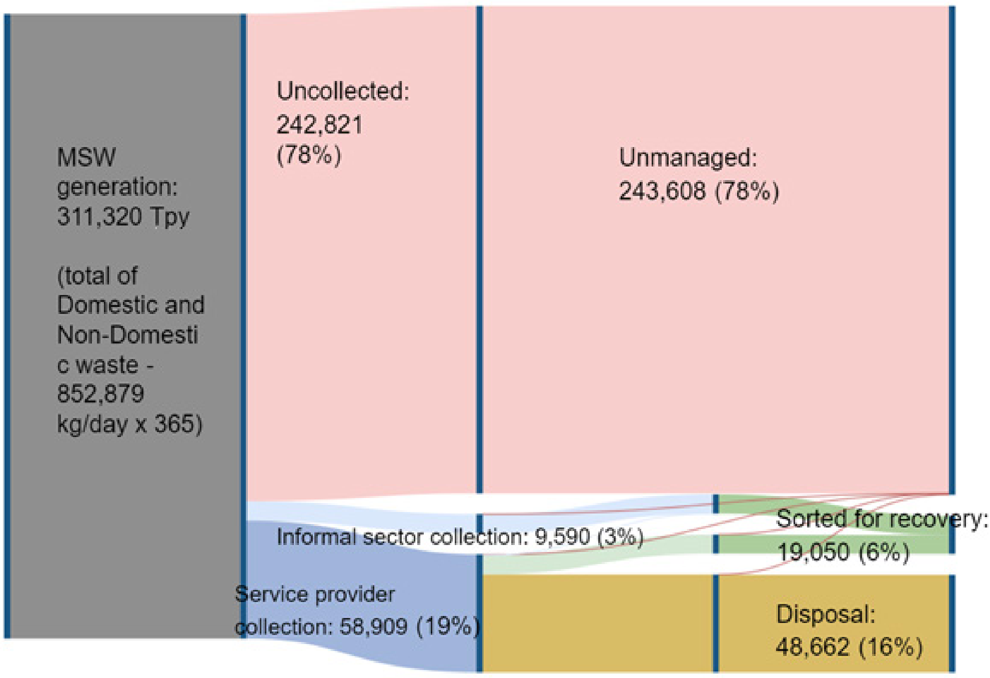


Figure 26 All MSW flow overview, tonnes per year

[23] GIZ, University of Leeds, Eawag-Sandec, Wasteaware (2020). Toolkit: Waste Flow Diagram (WFD): A rapid assessment tool for mapping waste flows and quantifying plastic leakage. Version 1.0. February 2020. Principal Investigator: Velis C.A. Research team: Cottom J., Zabaleta I., Zurbruegg C., Stretz J. and Blume S. Zurich, Switzerland and Leeds, UK. Obtain from: plasticpollution.leeds.ac.uk

Total waste generation. The mass balance shows a total of 853 tonnes of waste is generated daily in Banyuwangi regency, of which 666 tpd (78%) is from domestic waste sources and 187 tpd (22%) is from non-domestic waste sources. This indicates where the potential focus for waste prevention and recovery activities and resources could be directed for maximum effect, recognising that the majority of waste generated in the regency is from domestic waste producers.

Waste leakage into the environment. The mass balance calculations indicate that over 78% or **666 tpd of waste is leaking into the environment,** through various means including burial, burning, dumping on ground or into water bodies. This finding is supported by community surveys and discussions, which show a lack of formal waste management practices. This means approximately **243,000 tonnes of waste** annually is not managed and requires further controls.

The waste composition analysis for landfilled waste, domestic waste and non-domestic waste indicates approximately 15% of waste is plastic, from all waste sources. This corresponds to 48,500 tonnes per year, or 132.876 tonnes per day.

The WaCT survey step 5 and 6 found that a total of 25.729 tpd of waste is handled by the formal recycling sector (TPS3R), 26.500 tpd by the informal sector and 133.760 tpd to final disposal, of which 20.3 tons is plastics. The survey does not include exact data for waste composition of the waste handled by formal and informal recycling sector, but based on information about which materials each actor is handling we estimate 20.22 and 15.6 tpd of plastic sorted for recycling by the formal and informal sectors respectively.

To sum up this we find that 58%, equivalent to 28,192 tonnes per year of plastics is unmanaged, while 30% or 14,618 tpy is collected by the formal sector and 12% or 5,694 tpy collected by the informal sector.

Based on the responses from the survey about most common waste practices we estimate that of the unmanaged plastics approximately 7,000 tpy is buried or dumped on land, 4,500 tpy is dumped in water and 16,500 tpy is undergoing open burning.

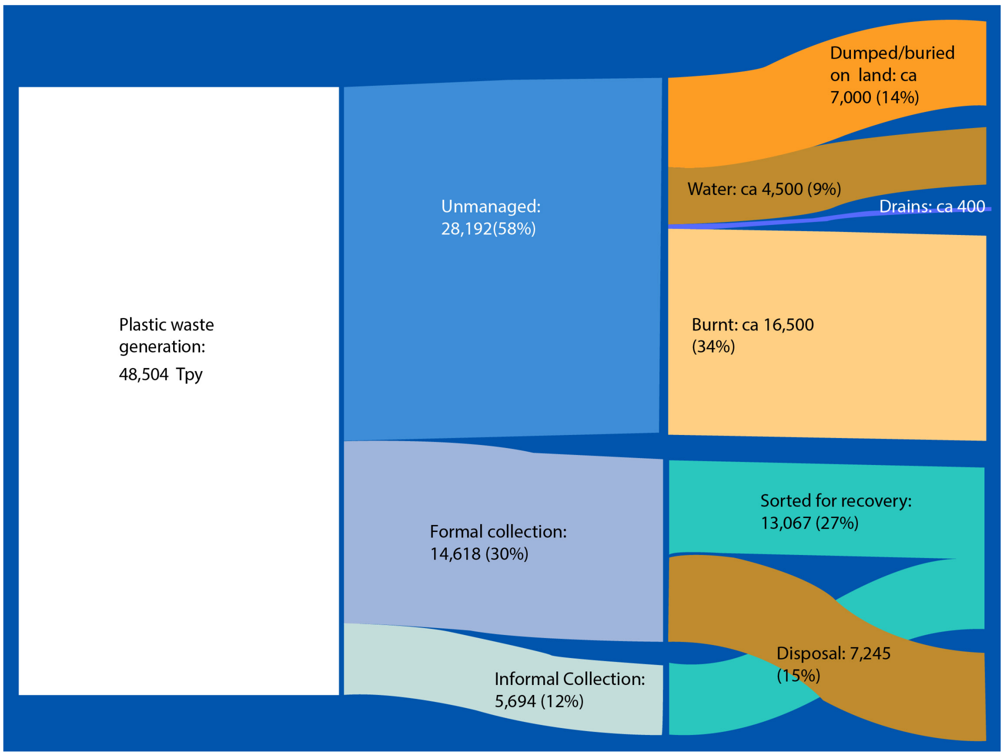


Figure 27 Plastic waste overview, tonnes per year

The World Economic Forum's Multistakeholder Action Plan for plastic in Indonesia[24] , estimate that 9% of mismanaged waste is directly disposed of in water; this is the national average figure with rural areas increasing to 12%. Using the average 9-12% estimation, this indicates that from 4,365 to 5,820 tonnes of plastic waste per year could enter the freshwater and marine environment from Banyuwangi regency. Our estimate based on the data and survey falls within the lower end of this range, and there is a possibility that the real figure is even higher.

This estimate of plastic leaking into the marine environment represents a significant loss of valuable resources and environmental risk; between 12 to 16 tonnes of plastic per day are being dumped in water from land within the regency. The surveys and interviews informing this report show a clear link between poor waste management behaviours and a waste management system which does not meet the needs of the domestic and non-domestic waste producers.

4.7. Impact on Green House Gas (GHG) emissions

Approximately 16,500 tonnes of plastic is being burnt without energy recovery, if that amount of plastics had been recycled instead it could have saved more than 58,000 tonnes of CO2eq. emissions per year[25] . Even a 50% diversion from burning to recycling would save almost 30,000 tonnes of CO2eq. each year, which corresponds to the annual emissions from at least 10,000 cars[26] .

In addition to this comes the potential reduction of methane emissions from landfilling of organic waste. Methane is formed when the organic waste is compressed and decompose without oxygen, and it is more than 20% more potent as a climate gas than the CO2. The annual emissions can be from 0.3 and up to 1 tonne CO2eq. per tonne of mixed waste landfilled, depending on several factors such as depth and compression of waste, climate and operational factors. It has not been within the scope of this baseline survey to gather data to calculate these emissions accurately, but given that almost 50,000 tonnes of mixed waste with more than 50% organic content is landfilled every year the emissions are likely to be considerable. It should however also be noted that increased collection rate may cause these emissions to increase, if the additional collected waste goes from currently aerobic to anaerobic decomposition in landfills with no gas collection. Waste modelling projections

Waste generation is a function of economic activity, for which a proxy of Gross Domestic Product (GDP) is used, and population growth. This assumes that the current correlation between GDP and waste is not broken, e.g. through waste prevention; instead, increasing GDP growth translates into increased consumer purchasing and waste generation. Therefore, a modest increase in waste generation is expected, correlating with an increase in GDP, although the exact relationship depends on the nature of the economic growth e.g. service sector, heavy industry or manufacturing.

According to World Bank data, in the past 10 years, Indonesia's GDP growth rate has been fairly steady, around 5% with a significant decline in 2020 (-2%).[27] Within Banyuwangi regency, the 2020 decline is even more marked (-3.6%).[28] The following assumptions are made to predict future domestic and non-domestic waste growth rates:

- **Domestic waste:** 1) Per capita waste increase based on modest rises up to 0.5 kg. 2) population increase[29] of 0.94%.

- **Non-Domestic waste:** 1) Modest rise, up to 3% from 2036 as high waste producing developments such as heavy industries are not anticipated to be the focus of economic development in the regency. 2) Slower start for first few years to reflect COVID-19 recovery.

[24] World Economic Forum (2020) Radically Reducing Plastic Pollution in Indonesia: A multistakeholder action plan. National Plastic Action Partnership.

[25] The Circulate Initiative GHG calculator for Indonesia, https://www.thecirculateinitiative.org/ghg-calculator

[26] 200 gCO2/km x 15000 km/year

[27] https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?end=2020&locations=ID&start=2003

[28] https://banyuwangikab.go.id/profil/ekonomi.html

[29] Based on Banyuwangi Regency Statistics Document [2021]

Figure 28 shows the total waste generation based on these assumptions and the detail is provided in Annex 9. This shows that by 2040, Banyuwangi regency will generate over 500,000 tons of waste requiring collection, recovery and disposal.

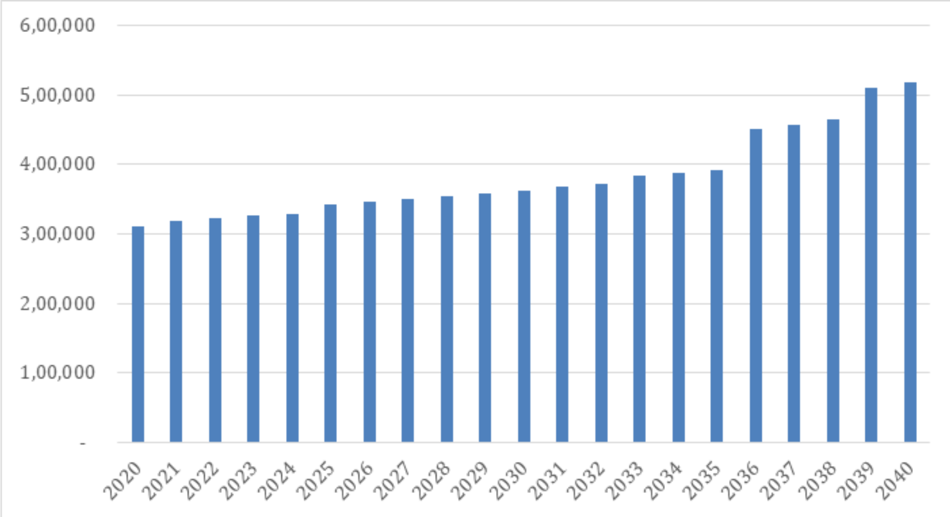


Figure 28 Total waste generation regency-wide up to 2040 (baseline)

The 2017 National Strategy Policy on Waste Management sets a target of a 30% reduction in MSW disposal. This target is based on a combination of waste prevention at source, and recycling and composting programmes such as improved performance at wastebanks and TPS3Rs to divert waste from disposal. The figure below shows how this could impact on waste disposal requirements for planning purposes. The projection is based on the predicted cumulative waste arisings from all sources, in Figure 28, i.e. does not adjust the waste arisings for waste prevention at source as it is more reasonable to anticipate that in the short term, the target will be achieved primarily through recycling and composting.

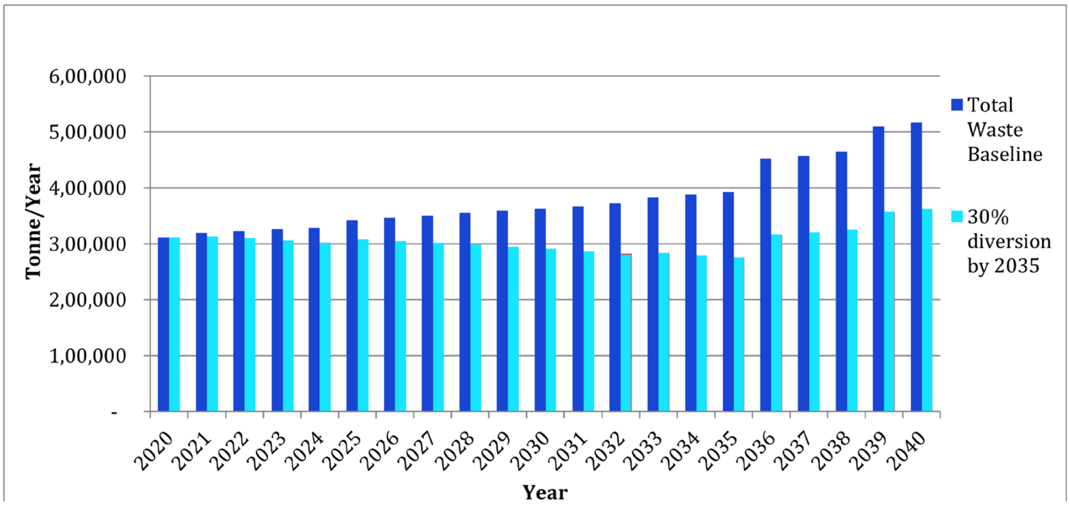


Figure 29 Total waste generation baseline with high diversion

If a 30% reduction in MSW disposal is obtained in 2035 through a modest 2% annual increase, and then maintained until 2040, Figure 29 shows the benefit; the gap between the baseline and the increasing diversion from disposal, quantifies the difference in waste which would need disposal sites or infrastructure in the regency.

In 2035, meeting the 30% diversion target would mean over 100,000 tonnes of residual waste would be avoided, compared to the baseline. This means the budget and infrastructure required for disposal of 100,000 tonnes of waste would not be needed and the resources from the diverted waste would be recovered. Improving diversion from disposal, through waste prevention at source, recycling or composting will need implementation of new infrastructure or diversion programmes; the practicalities of this and establishing meaningful targets for waste diversion will be part of the ISWMP development process.

4.8. Sensitivity analysis and comparison data set comparisons

4.8.1. Data sensitivities and scenarios

Waste generation predictions are subject to assumptions, the sensitivity of which can be assessed by showing how the data varies if assumptions are changed. For example, using the data from the WaCT survey, a value of 0.37 kg/capita is used in this report, however a Banyuwangi waste related Feasibility Study (in draft) uses 0.47 kg/capita, increasing to 0.48 by 2043 and a population growth rate of 0.39%. These figures use different base data sources and assumptions therefore would provide different waste generation results.

The sensitivity analysis in Figure 30 for domestic waste shows the following scenarios:

- Baseline, with lower population growth, 0.4%
- Baseline with higher population growth, 1.1%
- Baseline with higher waste generation per capita, increasing to a maximum of 0.55kg/capita/day from 2038.

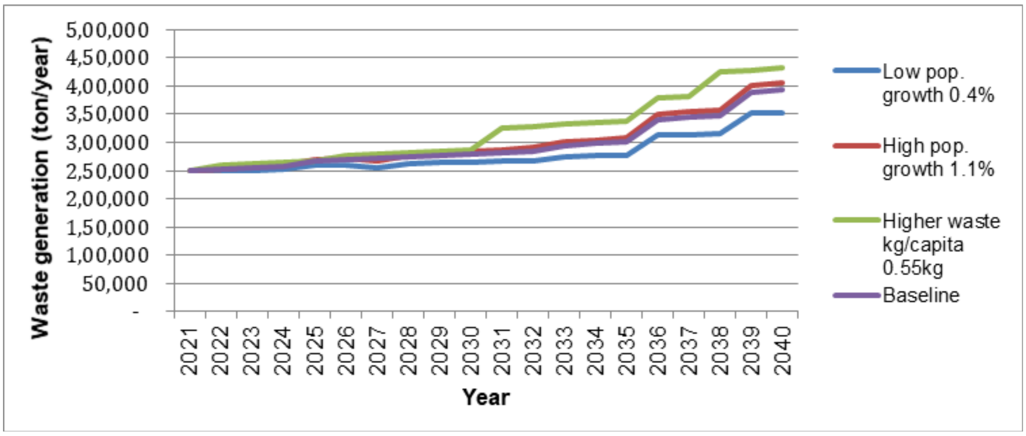


Figure 30 Domestic waste generation sensitivity analysis

Figure 30 shows that the relatively cautious population increase shows a minimal change from baseline, however the influence of a higher per capita waste generation and a lower population growth can be seen to more significantly influence the waste arising predictions.

For non-domestic waste, the variable influencing waste growth rates is economic development. The scenarios in Figure 31 show the impact of higher and lower growth rates, as compared to the baseline rate:

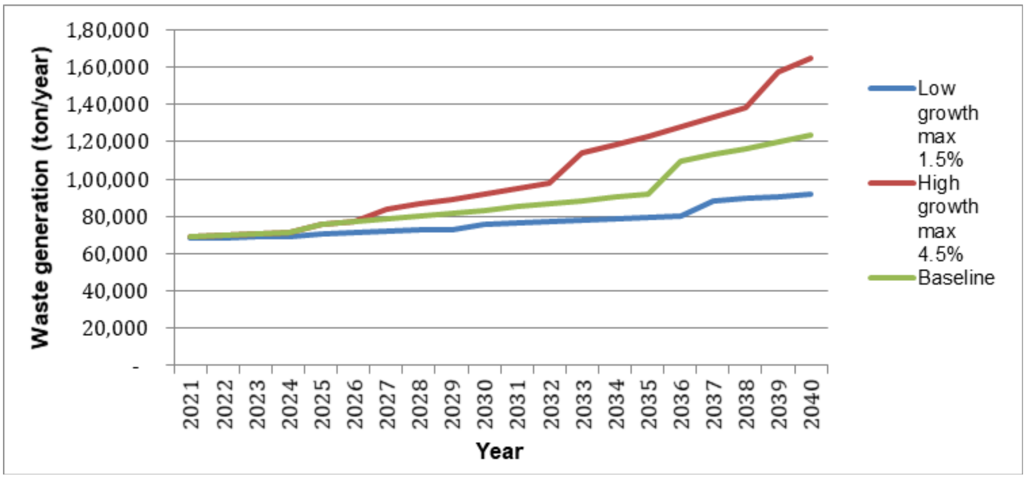


Figure 31 Non-domestic waste generation sensitivity analysis

In terms of planning for waste management services delivery and infrastructure, these sensitivities should be considered to an extent, with some flexibility built into the system. This would allow the future uncertainties to be accommodated as far as is practicable when the SWM approach is being designed.

4.8.2. Secondary data versus survey data, non-domestic waste

Throughout the waste data baseline collection process, the survey team identified non-domestic waste sources through being on the ground in the sampling locations. Throughout the regency as a whole, secondary data (BPS) was used to provide information on the number of non-domestic sources of waste; these figures show a marked difference, as shown below:

Table 12 Non-domestic waste sources comparison of secondary data and survey data

Area	Shop		Religious Site		Office		Restaurant	
	BPS	Survey	BPS	Survey	BPS	Survey	BPS	Survey
Desa Glagah	38	33	9	13	2	4	4	7
Desa Segobang	9	65	57	25	1	1	5	5
Desa Pakis	55	90	23	27	3	2	4	24
Desa Sidodadi	13	109	6	48	1	1	7	57
Desa Bangorejo	119	113	66	82	5	5	6	18
Desa Cluring	101	118	61	36	3	5	4	10
Desa Tembokrejo	109	417	87	92	1	10	1	109
Desa Kedungrejo	107	172	63	97	1	50	6	62
Total	551	1117	372	420	17	78	37	292

The table above shows that the official BPS data differs from survey data in the villages sampled. In terms of waste generation calculations, the surveyed non-domestic waste sources generate an estimated 7.4 tpd in the sampled villages, compared to 3.1 tpd using BPS data. These differences may be due to varying classifications of a shop or restaurant, informal businesses not counted in BPS calculations but considered in the survey, or data update intervals mean representation on BPS is not as up to date as the survey.

4.8.3. Existing planning data sources

Perencanaan Teknis Manajemen Persampahan (PTMP) is Banyuwangi's waste masterplan from 2015. A comparison can be made between elements of the PTMP and survey team's data sets, considering their different approaches and geographic scope.

PTMP sampling identifies a waste composition for non-domestic waste. The sampling locations are not directly comparable to the survey team, as PTMP separates transport hubs and industry; these locations are not surveyed for this report. However, as a broad comparison averaging the non-domestic waste compositions, PTMP notes that 32% of waste is organic; this excludes rice, reported separately as 3%. 21% of the waste stream is plastic. Compared to the survey team's results, the non-domestic organic waste content according to PTMP is significantly lower than the 63% identified in this report and the plastic content is higher.

PTMP sampling identified a waste generation per capita per day of 2.08 litre based on 2015 data and 2.1 litre in 2016; this is broadly comparable with the 2.63 litre (0.37kg) / capita identified by the survey team in 2021, considering that sampling methods will have varied and the samples are 6 years apart. It is not possible to directly compare was generation data as the geographic scope of PTMP is different to the survey for this report.

5. Conclusions,Next Steps, and Recommendations

5.1. Conclusions

5.1.1. Data collection approach

The WaCT was developed for use across a city area. Its application across a region meant that some of the data collected through the tool could not easily be used regency-wide. For example, for non-domestic waste, the survey team noted the numbers of commercial activities in the areas surveyed, but these could not be used for the regency wide aggregated data, as it was not possible to exclude these eight specific villages from the regency-wide statistics; this means some level of data collection and on the ground accuracy is lost. However, for high level planning purposes, it is not anticipated that this would have significant impacts on the final results.

The data collection methodology, including integration of the Indonesian standards for waste data collection, has resulted in robust data that will satisfactorily serve the planning process. It is recognised that the survey team faced considerable challenges with COVID-19 restrictions but due diligence was undertaken, including comprehensively training the survey team and verifying the results with the surveyors as the data collection was being undertaken. This gives confidence in the data which produced a mass balance for the regency as a whole, importantly showing the leakage of waste to the environment.

5.1.2. SWM challenges

The challenges outlined in the report and detailed in Annex 5 indicate that there are a range of causes for the waste management system to be performing as it currently is. The causes are diverse, ranging from legal issues to a lack of social awareness on the impacts of poor waste management, as waste is typically seen as someone else's issue. Through analysis of these challenges, and with a data driven waste baseline, Banyuwangi regency is in a very strong position to move forward with ISWM and ensure that resource management will contribute positively to the regency economy, both directly in terms of resources recovered and indirectly through improving the environment for residents, visitors and tourists.

5.1.3. Waste recovery

The survey showed that throughout the regency, the recovery network of junk shops, waste banks, waste pickers, TPS3Rs and the recycling industries play a role in recovering resources. However, in total they handle only approximately 12% of the waste generated. The composition of domestic and non-domestic waste at source indicates that 90% of waste is considered recoverable either through recycling or composting. This includes all plastics, paper, glass, metal and organic wastes. Therefore, there is considerable feedstock available for the recovery sector which is currently not being utilised. This may be due to several reasons as described in the SWM challenges section of this report, such as technical issues, a lack of resources and a skills gap.

In terms of the quality of material inputs to the recovery sector, the junk shops in particular showed low levels of residual waste arising from their operations (under 4%) compared to 88% at the TPS3Rs; an optimally operated TPS3R would expect 20-30% residual waste. This indicates that improvements could be made in the quality of inputs at the TPS3R, through actions such as improving waste separation at source, adherence to waste acceptance criteria and communications on accepted materials. In general, the TPS3Rs indicate they are subject to considerable challenges, leading to only eight operating at the time of the survey. Their improvement and establishment of additional sorting facilities, leading to a fully operational network of sites, should lead to higher recovery rates and improved control over waste.

5.1.4. Mass balance and waste flows

The waste flows within the regency are the critical result of the waste data baseline survey. The mass balance shows a clear and significant leakage of waste from within the waste management system. Leaked waste means that control over the waste has been lost. This can result in atmospheric emissions which contribute to global environmental issues, such as methane from organic waste decomposition, as well as local environmental issues including reduced air quality and health risks from burning waste. It will also impact on the efficacy of other urban and rural infrastructure such as sewers and drainage.

The GHG emissions from burning of plastics and landfilling of organic waste are also substantial, and budgeting for GHG emissions should be included the planning process.

In general, the mass balance is a valuable tool for Banyuwangi regency's ISWMP. It gives a quantifiable baseline, identifying where improvements can be made and where gaps exist, such as increasing the recovery sector's contribution to waste management, and improving control over wastes, from their generation source to their final disposal.

5.1.5. Future waste generation

The modelling estimates future waste generation based on a number of assumptions. It is recognised that these assumptions are to an extent subjective, and as seen with COVID-19, larger global issues may change the actual waste generation in the future. However, the modelling and sensitivity analysis shows that, as a function of population increase and economic growth, waste generation will continue to increase. Using the assumptions on the current waste data baseline, it shows over 850 tpd of waste is generated in the regency, which will increase to over 1,400 tpd by 2040. If a higher than expected figure of waste per capita is used, plus a high economic growth rate, the model shows a potential 1,637 tpd or over 597,000 tonnes of waste generated per year.

This shows how important it is to put in place systems, infrastructure, human resources and skills capable of handling the current and future waste streams, in a way which benefits the regency and the wider regional and global environment.

5.2. Next Steps and Recommendations

The waste data baseline should be used as a tool in the practical implementation of ISWM improvements; it is not an end point, but instead is a sound basis for progressing waste management in the regency. The CLOCC project aims to promote and support integrated sustainable waste management (ISWM) planning and the waste data baseline forms one of the steps in ISWM planning.

The next steps will involve further engagement and participation in order to ensure that any waste management solutions fit with the needs of the local communities. This will feed into the ISWMP which is a key CLOCC project output. This plan will define the way forward and aspirations of the regency for its waste management future.

The following recommendations are made, following the waste data baseline:

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

- When any further engagement or surveys are undertaken, all necessary COVID-19 protection measures required nationally should be followed. It is also recommended that when the impacts from COVID-19 subside, further waste sampling could be undertaken to further verify the results from this first survey, in particular in the sectors affected by the pandemic including tourist and visitor related businesses.

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

- The participatory processes used in conjunction with the waste survey showed considerable momentum for change within the Banyuwangi regency community and institutions. This should be capitalised on and the process moved forward. This can involve sharing the waste data baseline, ensuring residents, business and institutions understand the future waste challenges in terms of waste generation and also the role they can play in defining and implementing its solutions.

Annex 1 Waste Categories for Composition Analysis

The following categories were used for household and non-household waste composition analysis in this report:

No	Category	Example of Waste
1	Kitchen/Food Waste	Leftover bread, rice, fruit/fruit peel, vegetables, meat, fish, coffee grounds, tea bags, and pet food
2	Garden Waste	Flowers, leaves, grass, and similar waste generated in the garden/yard
3	Wood	Twigs, tree branches, furniture, wooden toys, wooden pallets, and similar waste
4	Paper / Carton	Newspapers, magazines, cardboard boxes, books, tissues, brochures, notes, cards and similar waste
5	Plastic Film	Plastic packaging for food/beverage/other products, single use plastic, and tarpaulins
6	Solid Plastic	All kinds of plastic bottles/containers, bottle caps, toothpaste packs, toys and similar waste
7	Glass	Glass bottles such as syrup, soy sauce, sauce, broken glass/glass/plate and similar waste
8	Fabric	Clothes, towels, rags, bundles of threads, patchwork, carpets and similar waste
9	Metal	Soft drink cans, canned food, aluminum foil, other cans/aluminum products
10	Hazardous Waste	Batteries, bulbs
11	E-waste	Remotes, headsets, chargers, and other electronic items
12	Others	Outside categories 1-11, including very small waste (ash, dust/impurities), ceramic shards, styrofoam, and diapers/women sanitary pad

Annex 2 Banyuwangi Administrative Divisions and Population

Banyuwangi regional division and subdistricts

Region	Sub-Districts
North	Banyuwangi, Wongsorejo, Blimbingsari, Kalipuro, Giri, Licin, Glagah
Mid East	Rogojampi, Muncar, Songgon, Kabat, Singojuruh, Srono, Cluring
Mid West	Genteng, Kalibaru, Glenmore, Tegalsari, Sempu, Gambiran
South	Bangorejo, Siliragung, Purwoharjo, Pesanggaran, Tegaldimo

Banyuwangi demography

No	Sub-Districts	Area (km^2)	Population	Density (person / km^2)
1	Pesanggaran	802.5	53,373	67
2	Siliragung	95.15	48,678	512
3	Bangorejo	137.43	65,709	478
4	Purwoharjo	200.30	69,471	347
5	Tegaldimo	1,341.12	66,737	50
6	Muncar	146.07	136,425	934
7	Cluring	97.44	77,417	795
8	Gambiran	66.77	66,187	991
9	Tegalsari	65.23	52,361	803
10	Glenmore	421.98	75,365	179
11	Kalibaru	406.76	65,142	160
12	Genteng	82.34	92,448	1123
13	Srono	100.77	96,914	962
14	Rogojampi	48.51	57,217	1179
15	Blimbingsari	67.13	54,341	809
16	Kabat	94.17	63,413	673
17	Singojuruh	59.89	50,463	843
18	Sempu	174.83	83,100	475
19	Songgon	301.84	57,077	189
20	Glagah	76.75	36,532	476
21	Licin	169.25	29,460	174

22	Banyuwangi	30.13	117,558	3,902
23	Giri	21.31	31,621	1,484
24	Kalipuro	310.03	83,685	270
25	Wongsorejo	464.80	77,420	167
	Total	5782.50	1,708,114	

Annex 3 Local and National Waste Management Regulations

1. National Law No. 18 / 2008 about Waste Management
2. Government Regulation No. 81 / 2012 about Household and Similar Household Waste Management
3. Presidential Decree No. 97 / 2017 about National Strategy Policy to Handle Household and Similar Household Waste
4. Ministry of Public Works Regulation No. 03/PRT/M/2013 about Implementation of Solid Waste Infrastructure and Facilities in Handling Household and Similar Household Waste
5. Banyuwangi Local Regulation No. 9 / 2013 about Household and Similar Household Waste Management
6. Banyuwangi Regent Decree No. 54 / 2018 about Banyuwangi Strategy Policy to Handle Household and Similar Household Waste
7. Banyuwangi Regent Decree No. 12 / 2021 about Revision of Banyuwangi Regent Decree No. 49 / 2019 about Position, Organization Structure, Functions and Work Procedures of Banyuwangi Environmental Agency

Annex 4 SWM Infrastructure in Banyuwangi Regency

a. **TPS**

No	Name	Subdistrict
1	TPS Perum Kalirejo – Jurang Jero (Pakis)	Kabat
2	TPS Selatan RS Fatimah – Jl. Anggur Perum Kalirejo	Kabat
3	TPS Sumberrejo - Pakis	Banyuwangi
4	TPS Perum Jalio - Pakis	Banyuwangi
5	TPS Terminal Karangente	Banyuwangi
6	TPS Pasar Sobo	Banyuwangi
7	TPS DPRD Banyuwangi	Banyuwangi
8	TPS Klatak Perum GGM	Kalipuro
9	TPS Boyolangu	Giri
10	TPS Banjarsari	Glagah
11	TPS Sukorojo	Glagah
12	TPS Buyut Cungking	Giri
13	TPS Gapangan	Giri
14	TPS Polres Banyuwangi	Banyuwangi
15	TPS BKD Banyuwangi	Banyuwangi
16	TPS Pengadilan Negeri Banyuwangi	Banyuwangi
17	TPS Pasar Banyuwangi (armroll)	Banyuwangi
18	TPS Terminal Sritanjung (armroll)	Banyuwangi
19	TPS Pasar Blambangan (armroll)	Banyuwangi
20	TPS RSUD Blambangan (armroll)	Banyuwangi
21	TPS Pemda Banyuwangi (armroll)	Banyuwangi
22	TPS Lapas Banyuwangi (armroll)	Giri
23	TPS Dusun Stembel Desa Gambiran	Gambiran
24	TPS Dusun Lidah Desa Gambiran	Gambiran
25	TPS Dusun Sumbermulyo Desa Gambiran	Gambiran
26	TPS Sumberberas Pasar Muncar	Muncar
27	TPS Sumberberas Depan SD Negeri 6 Muncar	Muncar
28	TPS Badewang Songgon	Songgon
29	TPS Bakungan	Glagah
30	TPS Benculuk	Cluring
31	TPS Sempu	Sempu

b. **Transfer Depot**

No	Name	Subdistrict
1	Depo Pasar Jajag	Gambiran
2	Depo Sobo	Banyuwangi
3	Depo Karangrejo	Banyuwangi
4	Depo Kepatihan	Banyuwangi
5	Depo Kebalenan (armroll)	Banyuwangi
6	Depo Singotrunan	Banyuwangi
7	Depo Ketapang	Kalipuro
8	Depo Penataban	Giri
9	Depo Gor Tawang Alun	Giri
10	Depo Stadion	Banyuwangi

c. **TPS3R**

No	Name	Subdistrict	Status
1	TPS3R Badean	Blimbingsari	Not operated
2	TPS3R Bajulmati	Wongsorejo	Not operated
3	TPS3R Balak	Songgon	Not operated
4	TPS3R Bangorejo	Bangorejo	Not operated
5	TPS3R Cluring	Cluring	Not operated
6	TPS3R Purwodadi	Purwodadi	Not operated
7	TPS3R Glagah	Glagah	Operated
8	TPS3R Mangir	Rogojampi	Not operated
9	TPS3R Pakis	Banyuwangi	Not operated
10	TPS3R Purwoharjo	Purwoharjo	Operated
11	TPS3R Segobang	Licin	Operated
12	TPS3R Tegalsari	Tegalsari	Not operated
13	TPS3R Tegalsari 2	Tegalsari	Not operated
14	TPS3R Tembokrejo	Muncar	Operated
15	TPS3R Sidoayu	Muncar	Operated
16	BPS Gobas Kedungrejo	Muncar	Operated
17	TPS3R Sumberejo	Banyuwangi	Operated
18	TPS3R Kabat	Kabat	Operated

d. **Waste Bank**

No	Name	Subdistrict
1	Cacalan Beach Waste Bank	Kalipuro
2	Cemara Beach Waste Bank	Banyuwangi

3	Banyuwangi Waste Bank	Banyuwangi
4	SD Kepatihan Waste Bank	Banyuwangi
5	SDN 1 Lateng Waste Bank	Banyuwangi
6	SDN 1 Singotruna Waste Bank	Banyuwangi
7	SDN 5 Lateng Waste Bank	Banyuwangi
8	SDK Santa Maria	Giri
9	SDN 3 Mojopanggung Waste Bank	Giri
10	SDN Kebalenan Waste Bank	Banyuwangi
11	SMAK Hikmah Mandala Waste Bank	Banyuwangi
12	SMK Pradana	Giri
13	SMP PGRI Banyuwangi	Banyuwangi
14	Kompas Waste Bank	Muncar
15	SMKN 1 Glagah	Glagah
16	SMAN 1 Glagah	Glagah

The SWM challenges in Banyuwangi are divided into five categories according to the research undertaken for the CLOCC project (Stakeholder Meeting 1):

1.Technical challenges

a. Very low waste service coverage According to the data from the sampling survey, only 28% of waste is managed properly in Banyuwangi. It is caused by not all regions in Banyuwangi have and implement effective waste management systems.

b. Poor landfill operating standards Currently, Banyuwangi has one recognized landfill. The site is still operated using very limited controls, meaning limited if any environmental protection is in place.

c. Waste management is not integrated between regency and village Regency responsibilities for waste management only focuses on urban areas. For village areas, the waste is managed independently by the village or community

d. Waste management facilities are not utilized optimally In 2020, there were 18 TPS3Rs in several villages in Banyuwangi Regency. These TPS3R were built with support from the government, private parties and communities. However, only eight are operating. The remaining 10 TPS3Rs are non-functioning due to lack of resources, budget and community rejection of their operations.

e. Lack of waste data monitoring and evaluation Indonesia, both national and city/regency level, waste management monitoring data is inadequate and difficult to obtain even within commercial operations such as hotels and restaurants.

f. Improper waste management in practice Open burning and waste disposal in water bodies e.g. rivers are common waste practices in Banyuwangi. It is caused by a number of wider issues including lack of resources, budget, and capacity (knowledge).

g. Waste management is not integrated within the same watershed Improper waste management from upstream villages is observed to pollute downstream villages within the same watershed, due to a lack of waste management systems.

2. Financial challenges

a. Waste service user fee collections In villages, many people cannot afford to pay the waste service fees, or they consider that waste should instead be managed free of charge, by being burned or buried within their property/compound. This results in the poor collection of user fees.

b. Budget constraints Lack of budget is the most common issue arising issue in the Regency regarding managing waste. This was exacerbated during the COVID-19 pandemic, which has seen proposed budgets for waste management being switched to COVID-19 issues.

c. Market acceptance of waste derived products After the waste has been processed and products such as compost are manufactured, there are challenges with finding markets for the products meaning market development is lacking.

3. Institutional challenges

a. Unclear roles and responsibilities for waste management The role of regulators and operators within the waste management sector are not always clear and are often overlapping which leads to confusion during implementation.

b. Trust amongst stakeholders Concerns over limited capacity and transparency can cause trust issues within waste management; many stakeholders have concerns regarding whether the authorities have the knowledge and skills to implement waste management systems, and also are concerned with financial transparency.

c. Political agendas Waste management issues are recognised as a political concern and therefore influenced by the political cycle and commitments at the local government level, including both the regency and villages). Waste management systems in the Regency will run optimally if there is collaboration, support and strong commitment from local government structures.

4. Legal challenges

a. Lack of waste service fee regulations Banyuwangi regency is developing a regulation regarding standard waste service fees for household and similar waste. In villages, the waste service fee regulation can be integrated into a village regulation, however in practice, few villages that already have a village regulation regarding waste management include waste service fee.

b. Lack of village waste regulations Most villages have yet to establish a waste regulation. Therefore, there is no clear reference to waste management systems including waste management operators, waste service fees and waste management rewards and offences e.g. for non-payment of fees.

c. Lack of law enforcement for waste management Even within villages that have established a waste regulation, enforcement of the regulation is limited for example penalties are not generally issued to those who violate the regulations.

d. Urban focus of Municipal Waste Masterplan The Municipal Waste Masterplan is required by every city / regency as the technical guidance document for planning waste management. The latest Municipal Waste Masterplan in Banyuwangi (2016) only covers planning, programs and targets in urban areas not the villages (desas). Therefore, a new Municipal Waste Masterplan is necessary to integrate village waste management into the planning.

5. Social and cultural challenges

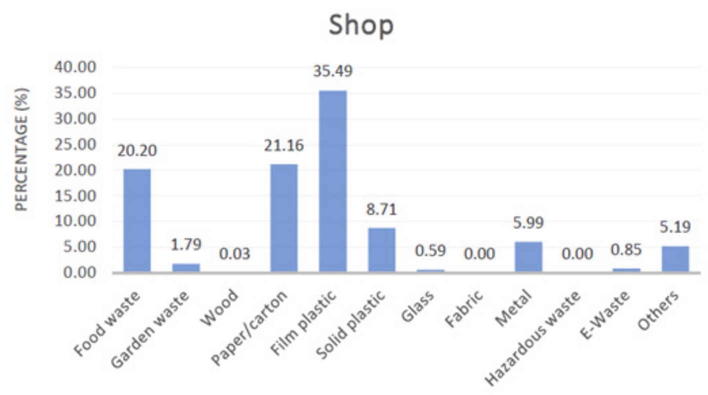
a. Waste management is low priority Many stakeholders across government, business and the community considers waste to be an environment agency issue only. This means stakeholders do not consider waste issues in their programs and activities.

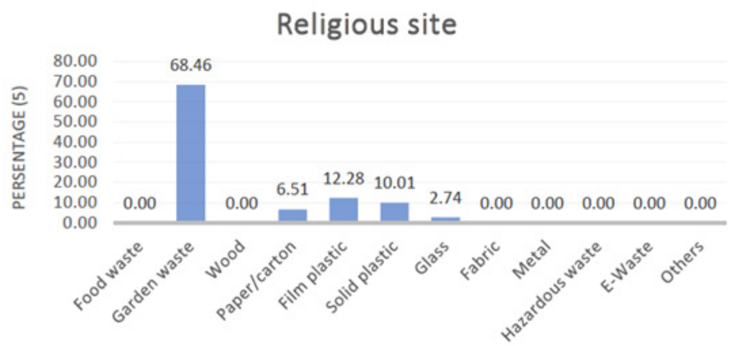
b. Informal sector role in waste is not acknowledged The existence of informal sectors e.g waste pickers, junkshops (pelapak and bandar) and other informal workers are not included within the scope of the formal waste management system. Their beneficial contribution to waste management including waste collection, sorting and recovery is not recognized.

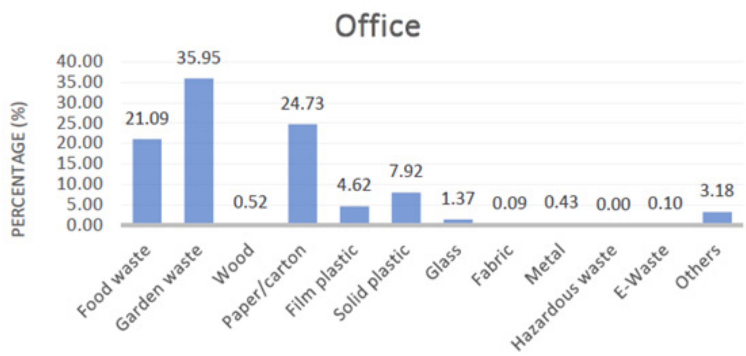
c. Lack of community impacts from improper waste management The impact of improper waste management such as environment pollution and public health has not been realized directly by people.

d. Waste facility objections Waste facility development is often hindered by objections from the community, especially when the sites or facilities are located in residential areas. The community rejects the facilities due to nuisance-related concerns, such as noise, dust and odour.

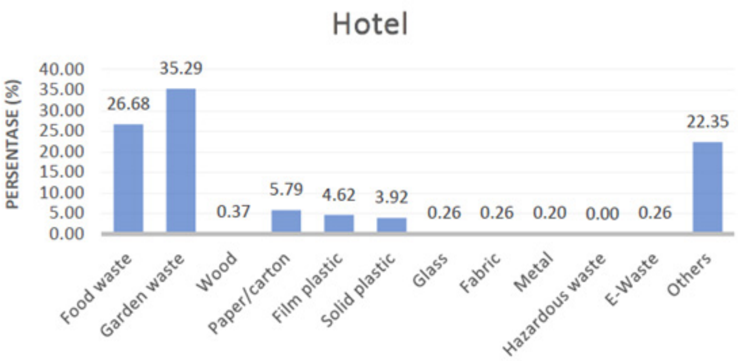
Annex 6 Non-Domestic Waste Composition Sample Results

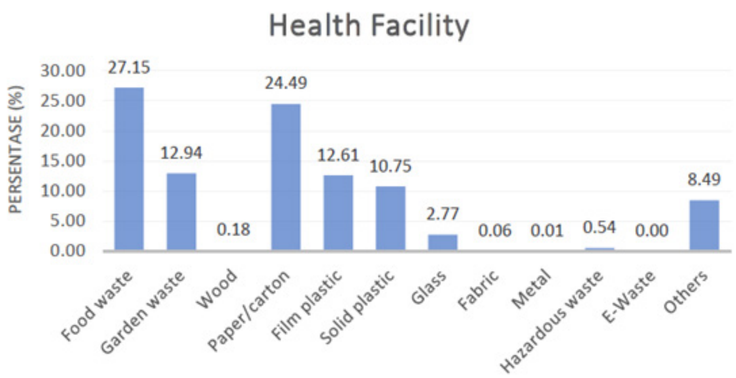







Restaurant
PERCENTAGE (%)
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
64.85
1.03
0.01
5.75
11.62
9.20
2.61
0.90
1.99
0.00
0.00
2.05
Food waste
Garden waste
Wood
Paper/carton
Film plastic
Solid plastic
Glass
Fabric
Metal
Hazardous waste
E-Waste
Others


Hotel
PERSENTASE (%)
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
26.68
35.29
0.37
5.79
4.62
3.92
0.26
0.26
0.20
0.00
0.26
22.35
Food waste
Garden waste
Wood
Paper/carton
Film plastic
Solid plastic
Glass
Fabric
Metal
Hazardous waste
E-Waste
Others

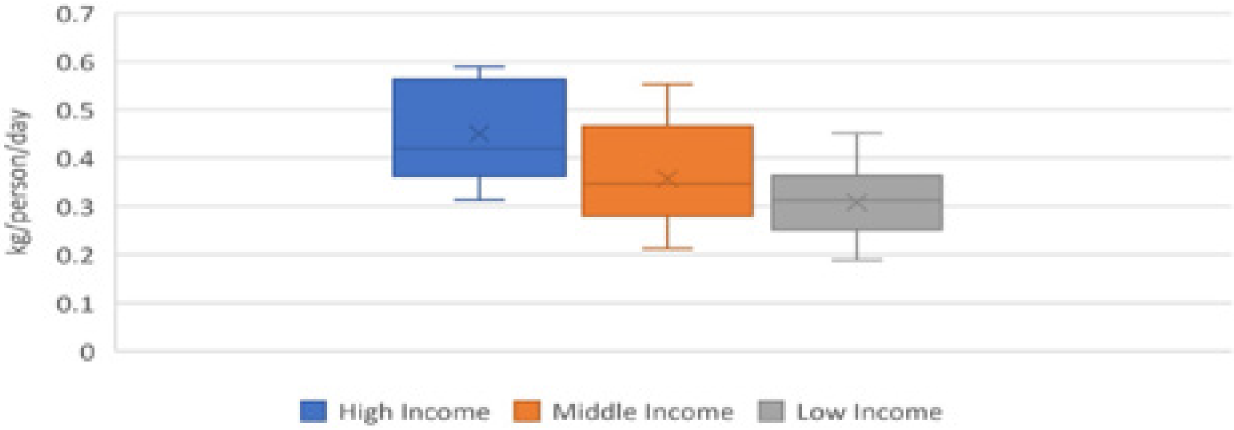

Health Facility
PERSENTASE (%)
30.00
25.00
20.00
15.00
10.00
5.00
0.00
27.15
12.94
0.18
24.49
12.61
10.75
2.77
0.06
0.01
0.54
0.00
8.49
Food waste
Garden waste
Wood
Paper/carton
Film plastic
Solid plastic
Glass
Fabric
Metal
Hazardous waste
E-Waste
Others

Annex 7 Domestic Waste Generation Calculation

Domestic Waste Generation Based on Income Level in Banyuwangi Regency

Income Level	Type	Survey Area	Waste Generation		Waste Generation per Area	
			Kg/prs/day	L/ors/day	Kg/prs/day	L/prs/day
High Income	Rural	Desa Gelagah	0,563	2,173	0,44	2,69
		Desa Segobang	0,331	1,450		
		Desa Pakis	0,533	3,033		
		Desa Sidodadi	0,313	2,466		
		Desa Kebondalem	0,363	3,506		
		Desa Cluring	0,373	2,847		
		Desa Tembokrejo	0,589	3,729		
		Desa Kedungrejo	0,420	2,281		
	Urban	South	0,525	4,685	0,49	3,35
		Middle West	0,365	2,218		
		Middle East	0,584	3,133		
	Standard Deviation		**0,10**	**0,85**		
	Average		**0,45**	**2,87**		
Middle Income	Rural	Desa Gelagah	0,326	1,687	0,34	2,49
		Desa Segobang	0,347	2,139		
		Desa Pakis	0,466	2,647		
		Desa Sidodadi	0,281	2,786		
		Desa Kebondalem	0,274	2,474		
		Desa Cluring	0,213	2,133		
		Desa Tembokrejo	0,553	3,312		
		Desa Kedungrejo	0,289	2,713		
	Urban	South	0,471	4,075	0,39	3,07
		Middle West	0,358	1,952		
		Middle East	0,355	3,172		
	Standard Deviation		**0,10**	**0,66**		
	Average		**0,36**	**2,64**		
Low Income	Rural	Desa Gelagah	0,322	1,523	0,28	2,15
		Desa Segobang	0,209	1,051		
		Desa Pakis	0,344	2,974		
		Desa Sidodadi	0,269	2,674		
		Desa Kebondalem	0,312	2,326		
		Desa Cluring	0,189	2,078		
		Desa Tembokrejo	0,364	2,383		
		Desa Kedungrejo	0,251	2,174		
	Urban	South	0,451	4,153	0,38	3,01
		Middle West	0,381	2,968		
		Middle East	0,299	1,913		
	Standard Deviation		**0,07**	**0,79**		
	Average		**0,31**	**2,38**		

Regency wide distribution of waste generation (kg/person/day)



No	Sub-District (Kecamatan)	Populatio n	Waste Generation		Waste Generation	
			kg/person/da y	L/person/da y	tonne/da y	m3/day
1	PESANGGAARA N	54,293	0.37	2.63	20.21	142.85
2	SILIRAGUNG	49,882	0.37	2.63	18.57	131.25
3	BANGOREJO	67,582	0.37	2.63	25.16	177.82
4	PURWOHARJO	71,213	0.37	2.63	26.51	187.37
5	TEGALDIMO	69,014	0.37	2.63	25.69	181.59
6	GAMBIRAN	67,276	0.37	2.63	25.04	177.01
7	TEGALSARI	52,215	0.37	2.63	19.44	137.39
8	GLENMORE	77,434	0.37	2.63	28.82	203.74
9	KALIBARU	65,621	0.37	2.63	24.43	172.66
10	GENTENG	94,759	0.37	2.63	35.27	249.33
11	SEMPU	86,050	0.37	2.63	32.03	226.41
12	MUNCAR	137,720	0.37	2.63	51.26	362.36
13	CLURING	80,099	0.37	2.63	29.81	210.75
14	SRONO	99,317	0.37	2.63	36.97	261.32
15	ROGOJAMPI	57,756	0.37	2.63	21.50	151.97
16	SINGOJURUH	53,672	0.37	2.63	19.98	141.22
17	SONGGON	56,903	0.37	2.63	21.18	149.72
18	KABAT	112,408	0.37	2.63	41.84	295.76
19	BLIMBINGSARI	56,490	0.37	2.63	21.03	148.63
20	GLAGAH	37,138	0.37	2.63	13.82	97.72
21	LICIN	29,791	0.37	2.63	11.09	78.38
22	BANYUWANGI	120,007	0.37	2.63	44.67	315.76
23	GIRI	31,184	0.37	2.63	11.61	82.05
24	KALIPURO	83,647	0.37	2.63	31.13	220.09
25	WONGSOREJO	76,641	0.37	2.63	28.53	201.65
	Total	**1,788,112**			**665.56**	**4704.80**

Annex 8 WaCT Levels of Control for Recovery Facilities

Categories	Description
Full Control	Built to and and operating in compliance with current national laws and standards
	Pollution control compliant to environmental standards
	Protection of workers' health and safety
	Terdapat pengolahan sampah organik
	Materials are extracted, processed according to market specifications, and sold to recycling markets
	Weighing and recording of incoming loads conducted
	Weighing and recording of outgoing loads conducted
	Recording of destination for the outgoing loads
Improved Control	Engineered facilities with effective process control
	Pollution control compliant to environmental standards
	Protection of workers' health and safety
	Evidence of materials extracted being delivered into recycling or recovery markets
	Weighing and recording of incoming loads conducted
	Weighing and recording of outgoing loads conducted
Basic Control	Registered facilities with marked boundaries
	Some environmental pollution control
	Provisions made for workers' health and safety
	Weighing and recording of incoming loads conducted
	Weighing and recording of outgoing loads conducted
Limited Control	Unregistered facilities with distinguishable boundaries
	No environmental pollution control
	No provisions made for workers' health and safety
	Weighing and recording conducted but not detail
No Control	Unregistered locations with no distinguishable boundaries
	No provisions made for workers' health and safety
	No environmental pollution control

Annex 9 Future Waste Generation Modelling

DOMESTIC	Year (t)	Population	Kg/capita increase	tpd	tpy
2020 (t0)	0	1,788,112	0.3722	665.54	242,920.38
2021	1	1,804,920.25	0.38	685.87	250,342.44
2022	2	1,821,886.50	0.38	692.32	252,695.66
2023	3	1,839,012.24	0.38	698.82	255,071.00
2024	4	1,856,298.95	0.38	705.39	257,468.66
2025	5	1,873,748.16	0.39	730.76	266,728.05
2026	6	1,891,361.39	0.39	737.63	269,235.29
2027	7	1,909,140.19	0.39	744.56	271,766.11
2028	8	1,927,086.11	0.39	751.56	274,320.71
2029	9	1,945,200.72	0.39	758.63	276,899.32
2030	10	1,963,485.61	0.39	765.76	279,502.18
2031	11	1,981,942.37	0.39	772.96	282,129.50
2032	12	2,000,572.63	0.39	780.22	284,781.51
2033	13	2,019,378.01	0.4	807.75	294,829.19
2034	14	2,038,360.16	0.4	815.34	297,600.58
2035	15	2,057,520.75	0.4	823.01	300,398.03
2036	16	2,076,861.44	0.45	934.59	341,124.49
2037	17	2,096,383.94	0.45	943.37	344,331.06
2038	18	2,116,089.95	0.45	952.24	347,567.77
2039	19	2,135,981.20	0.5	1,067.99	389,816.57
2040	20	2,156,059.42	0.5	1,078.03	393,480.84

NON-DOMESTIC	Year (t)	Non-Domestic Waste Increase (r)	Growth Rate Factor (1+r)	tpd	tpy
2020 (t0)	0			187.31	68,368
2021	1	1%	1.01	189.18	69,052
2022	2	1%	1.01	191.07	69,742
2023	3	1%	1.01	192.99	70,440
2024	4	1%	1.01	194.92	71,144
2025	5	2%	1.02	206.81	75,484
2026	6	2%	1.02	210.94	76,994
2027	7	2%	1.02	215.16	78,534
2028	8	2%	1.02	219.46	80,104
2029	9	2%	1.02	223.85	81,706
2030	10	2%	1.02	228.33	83,340
2031	11	2%	1.02	232.90	85,007
2032	12	2%	1.02	237.55	86,707
2033	13	2%	1.02	242.31	88,441
2034	14	2%	1.02	247.15	90,210
2035	15	2%	1.02	252.09	92,015
2036	16	3%	1.03	300.58	109,711
2037	17	3%	1.03	309.59	113,002
2038	18	3%	1.03	318.88	116,392

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