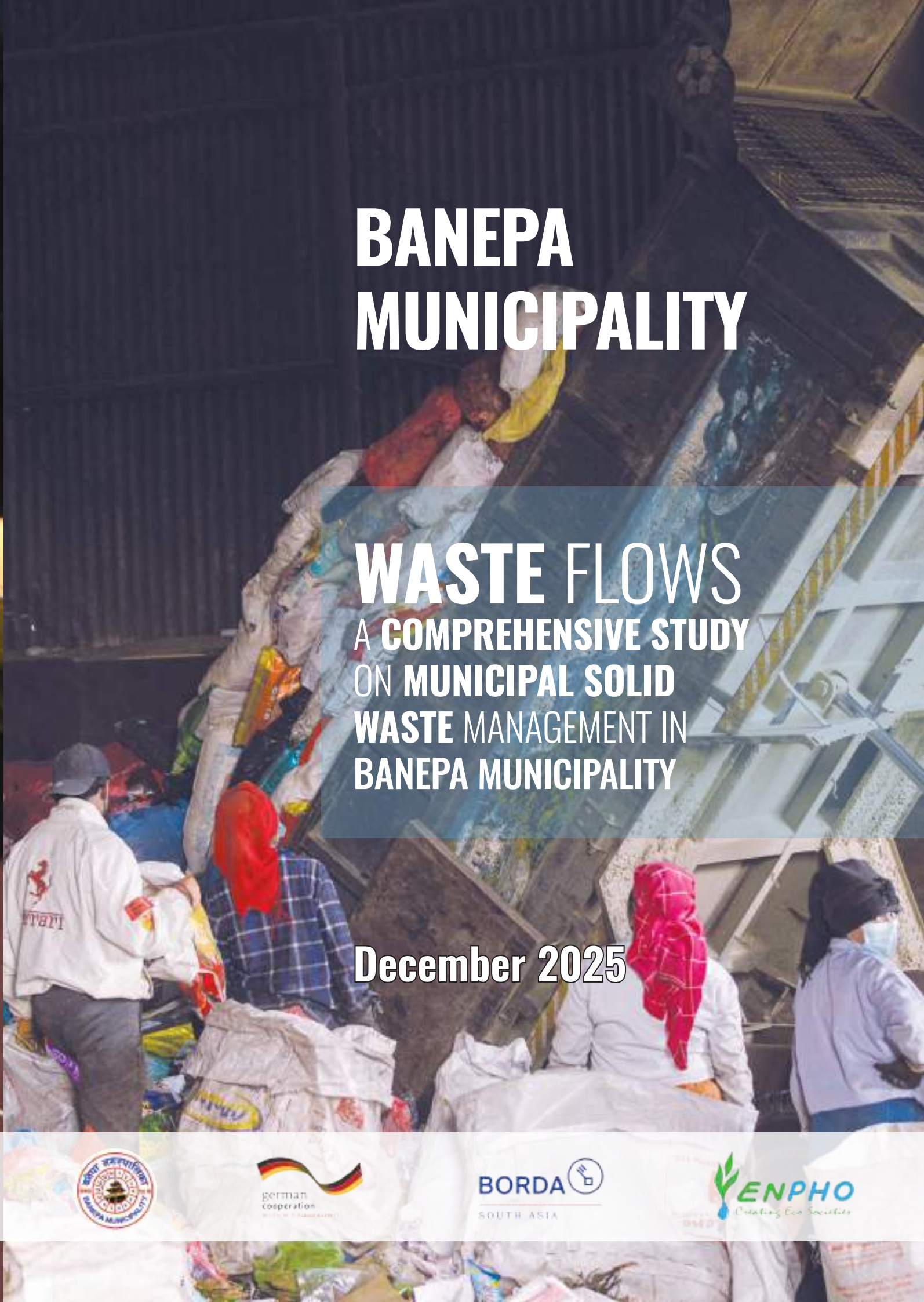

BANEPA MUNICIPALITY

WASTE FLOWS

A COMPREHENSIVE STUDY ON MUNICIPAL SOLID WASTE MANAGEMENT IN BANEPA MUNICIPALITY

December 2025

BANEPA MUNICIPALITY
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A COMPREHENSIVE STUDY ON MUNICIPAL SOLID WASTE MANAGEMENT IN BANEPA MUNICIPALITY

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December 2025


JCB

EXECUTIVE SUMMARY

This report presents a comprehensive analysis of Municipal Solid Waste (MSW) management in Banepa Municipality, addressing critical challenges posed by rapid urbanization and increasing waste generation. Utilizing the Waste Flow Diagram (WFD) framework, the study combined literature reviews, stakeholder consultations, and extensive field surveys of 213 households and 180 commercial establishments to map waste flows, quantify generation, identify systemic gaps, and propose evidence-based solutions for a sustainable waste management system.

The study reveals that Banepa generates approximately 34.72 tons of MSW daily, with commercial sources contributing 18.29 tons and households generating 16.43 tons at an average per capita rate of 0.211 kg/day. Waste composition analysis highlights a significant opportunity for resource recovery, as organic material constitutes the largest fraction (52.1% from households, 47.9% from commercial), followed by plastics (31% and 23.7%, respectively). A critical finding is the service gap in "Un-Collection Wards," where 3.38 tons of waste are generated daily without access to formal collection, leading to improper disposal methods like open dumping and burning.

While waste segregation practices are encouragingly high (92% in households), the overall system faces significant challenges. These include low public satisfaction with irregular collection services, a lack of local recycling or treatment facilities, and complete reliance on the distant Banchare Danda landfill, located 50 km away. The municipality also lacks a dedicated SWM unit, a formal management plan, and accurate, consistently updated waste data, which hinders strategic planning and effective governance. Although residents show a high willingness to pay for improved services, the current infrastructure is insufficient to meet their needs.

To create a sustainable and resilient waste management system, this report recommends several key interventions. First, the establishment of a dedicated SWM unit and the development of a comprehensive strategic plan are essential. Second, constructing a local Material Recovery Facility (MRF) will reduce landfill dependency and capture value from recyclables. Third, empowering communities through enhanced source segregation and decentralized composting programs will leverage existing positive behaviors. Finally, formalizing and integrating the informal waste sector (Kabadiwalas) will improve recovery rates and provide social security. Implementing these measures will enable Banepa to transition towards a circular economy, improve public health, and ensure long-term environmental sustainability.

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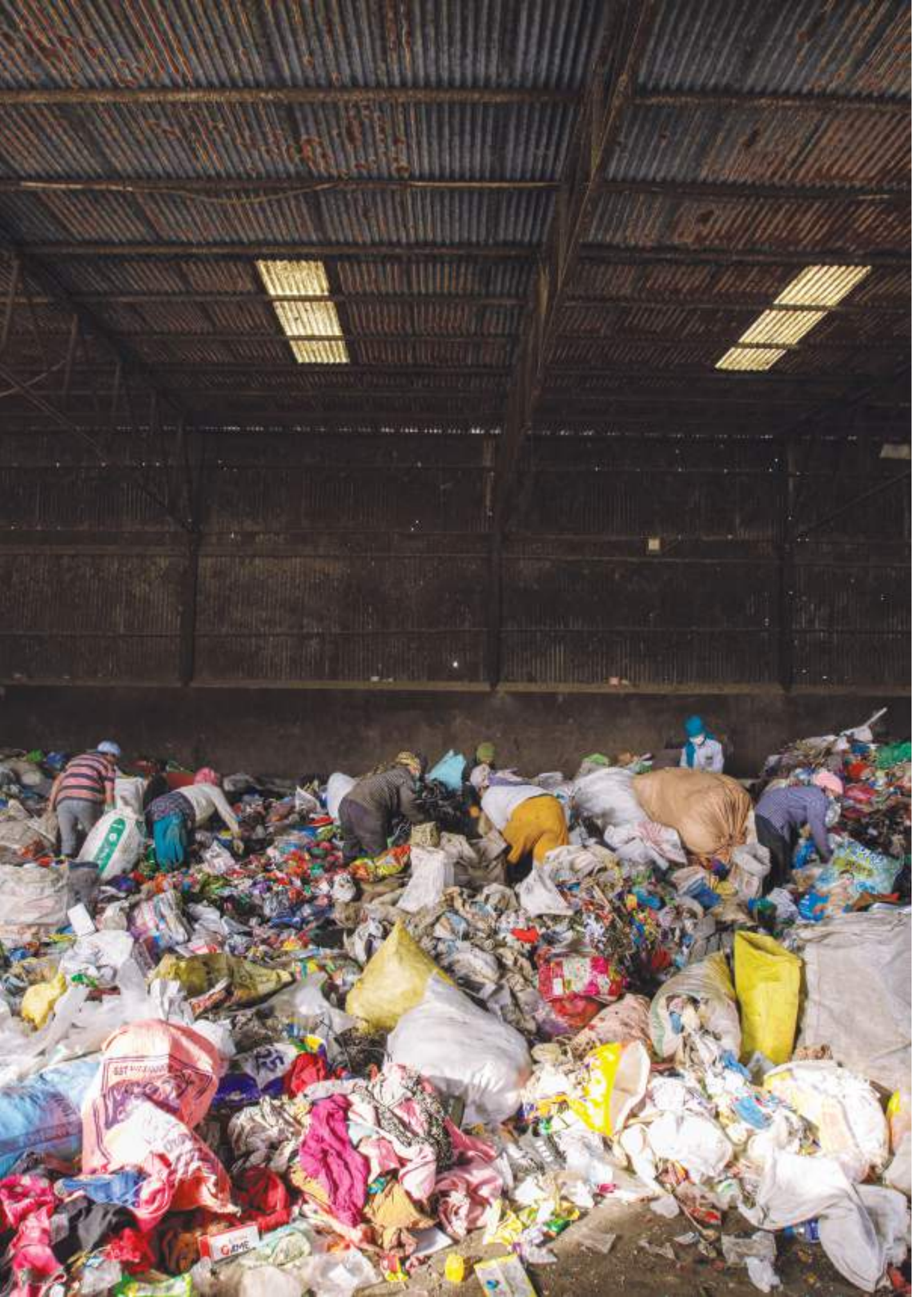
ABBREVIATION

ADB:	Asian Development Bank
BMZ:	Federal Ministry of Economic Cooperation and Development (Germany)
DHS:	Demographic and Health Survey
GIZ:	German Agency for International Cooperation
HDPE:	High-Density Polyethylene
IT:	Information Technology
IUWM:	Integrated Urban Water Management
LDPE:	Low-Density Polyethylene
MICS:	Multi Indicator Cluster Survey
MRF:	Materials Recovery Facility
MSW:	Municipal Solid Waste
NPR:	Nepalese Rupee
PET:	Polyethylene Terephthalate
PVC:	Polyvinyl Chloride
SDG:	Sustainable Development Goal
SWM:	Solid Waste Management
UNEP:	United Nations Environment Program
USD:	United States Dollar
WFD:	Waste Flow Diagram



1 CHAPTER 1: WASTE FLOW DIAGRAM

The proper collection and disposal of Municipal Solid Waste (MSW) remain a major global challenge, particularly for low- and middle-income countries. This issue is highlighted in the United Nations Sustainable Development Goals (SDG 11: "Sustainable Cities and Communities"), specifically through Indicator 11.6.1, which tracks the "proportion of municipal solid waste collected and managed in controlled facilities out of the total municipal solid waste generated by cities." Current estimates indicate that around 2 billion people worldwide lack access to waste collection services, while the waste of an additional 3 billion people is managed in environmentally harmful ways (Wilson, 2015). These shortcomings pose serious risks to human health and the environment, compounded by the rapidly growing problem of plastic pollution (Velis, 2020).

Plastic pollution is now pervasive across all ecosystems on Earth. It threatens wildlife, blocks drainage systems and waterways, and worsens flooding. It also degrades landscapes and has even infiltrated the food chain. Since the 1950s, over 6,300 million tons of plastic have been produced, with 360 million tons manufactured in 2018 alone. Yet, only about 9% of global plastic waste is recycled, while 12% is incinerated. The remaining 79% accumulates in landfills or leaks into the natural environment (Velis, 2020).

FIGURE 1:

ADEQUATE SOLID WASTE MANAGEMENT IS LINKED TO VARIOUS SDG INDICATORS AND TARGETS

Oceans are considered the ultimate sink for a significant portion of plastic waste. Studies suggest that nearly 80% of marine litter originates from land-based sources (Eunomia, 2016). For microplastics, this primarily results from inadequate waste collection systems and poor waste management practices. The challenges are further aggravated by population growth and increased resource consumption, underscoring the need to strengthen efforts in reduction, reuse, and recycling as outlined in SDG 12.5.

Once in the ocean, larger plastic debris gradually degrades into countless secondary microplastics, which are virtually impossible to control and pose severe threats to marine life and overall ocean health (SDG 14.1). Therefore, preventing microplastic pollution at its source is critical to avoiding uncontrolled environmental contamination and its potential entry into water bodies.

To curb pollution and prevent waste leakage into the environment, it is crucial to understand the entire waste flow from generation to final disposal or treatment. This understanding helps identify leakage points within the waste management system. Various methods and tools can be employed for this purpose, and one effective approach is the use of a Waste Flow Diagram.

1.1 What is a Waste Flow Diagram?

Understanding how waste leaks into the environment and the pathways it follows is essential for designing effective strategies to combat plastic pollution. The Waste Flow Diagram (WFD) is a tool that estimates the amount of solid waste escaping into natural environments and oceans at various points throughout the waste management cycle from generation to final disposal. Using its scenario function, the tool can also simulate the impact of improved waste management practices in reducing environmental pollution and preventing marine litter.

Developed on behalf of BMZ in collaboration with GIZ, the University of Leeds, Eawag-Sandec, and Waste Aware, the WFD provides a rapid assessment methodology for mapping the flow of macro-waste within a municipal solid waste management system at the city or municipal level. It also enables quantification of the sources and fate of plastics entering the waste stream. This purpose is achieved through the following key objectives (Velis C.A, 2020):

- To rapidly assess the municipal solid waste management system of cities or municipalities and visualize waste flows, while supporting the reporting of SDG 11.6.1 sub-indicators.
- To use observation-based assessments to measure sources of plastic leakage from the waste management system and track the eventual fate of uncontrolled waste.
- To identify major sources of plastic pollution, enabling targeted and informed interventions.
- To facilitate benchmarking and comparison across different cities.
- To model scenarios that provide approximate insights into how proposed interventions could affect waste management systems and reduce plastic pollution.
- To evaluate and quantify the effectiveness of implemented interventions.

1.2 Waste Flow Model

The WFD is an excel based model that comprises of 6 sheets –

1. Baseline data entry
2. Scenario data entry
3. Calculations
4. Flow diagrams
5. Results Summary
6. Settings

The Baseline data entry sheet provides the user interface for entering the data required to run baseline assessments. These baseline assessments aim to use primary data collection and local on-the-ground observations of the waste management system to map the current waste flows within the municipal solid waste management system. The "baseline data entry" sheet consists of 8-9 columns with each row indicating a separate data entry. In total, there are 5 main input sections as listed below.

a) Waste generation information.
b) Waste treatment and disposal.
c) Managed in controlled facilities.
d) Plastic leakage potential levels per leakage influence.
e) Plastic pollution levels per fate.

The "Scenario data entry" sheet follows the same logic and formatting as the "Baseline data entry" sheet but differs with respect to its purpose and the associated data inputs. The purpose of the "Scenario data entry" is to provide a means to allow users to estimate the potential impact of applying interventions within the waste management system.

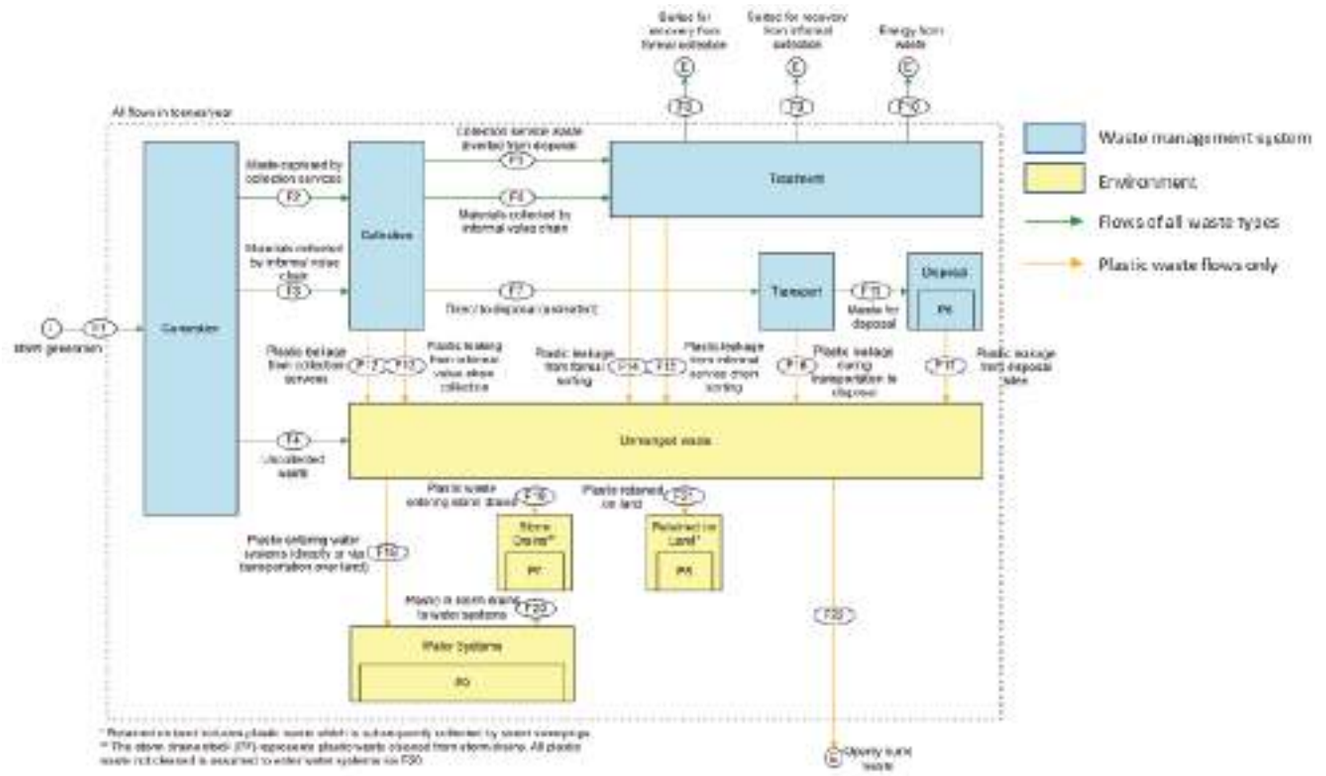
The "Calculations" sheet processes the data inputs to map the waste flow across the system. Although no data should be entered directly into this sheet, some important aspects remain to consider.

The "Flow Diagram" sheet is split into two sections:

a) Waste Flow Diagram

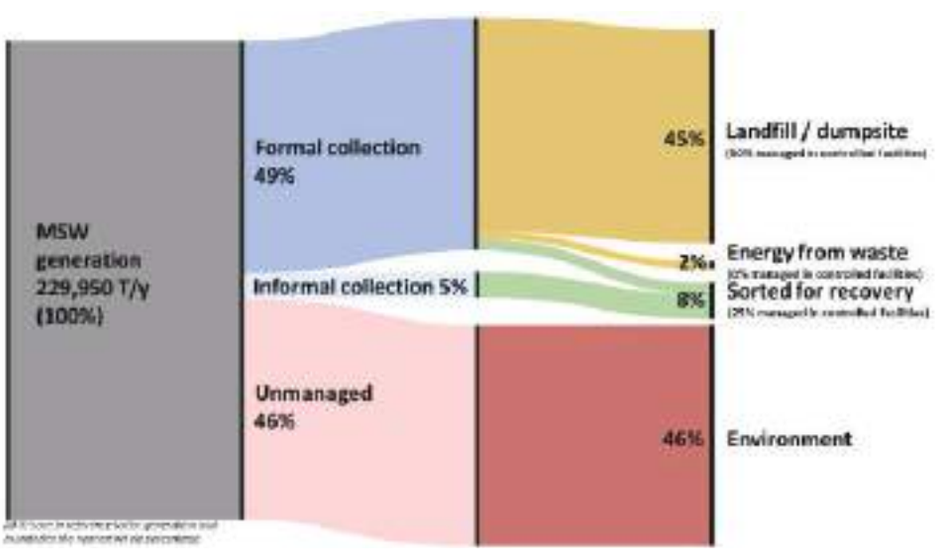
b) Sankey Diagram

FIGURE 2: WASTE FLOW DIAGRAM SYSTEM MAP



The Sankey Diagram is an alternative, more intuitive visualization output whereby the arrows are proportional to the mass. Depending on your needs, you can choose between a simpler and a more complex diagram. The code is designed to directly provide input into www.sankeymatic.com.

FIGURE 3: BASIC SANKEY DIAGRAM FOR ALL MSW



The "Results summary" sheet displays the most important information from each model run in an easy-to-compare and printer-friendly dashboard.

FIGURE 4: RESULT SUMMARY SHEET

	Plastic waste				Municipal Solid Waste				
	Baseline	Scenario 1	Scenario 2	Scenario 3	Baseline	Scenario 1	Scenario 2	Scenario 3	Unit
Municipal solid waste generation	20,696	20,696	20,696	20,696	229,950	229,950	229,950	229,950	Tonnes/year
Municipal solid waste generation	57	57	57	57	630	630	630	630	Tonnes/day
Collected waste	12,969	15,805	17,875	18,944	123,928	149,081	172,376	195,071	Tonnes/year
Collected waste	63%	76%	86%	92%	54%	65%	75%	85%	% of waste generation
Uncollected waste	7,727	4,890	2,821	751	106,021	80,869	57,574	34,879	Tonnes/year
Uncollected waste	37%	24%	14%	4%	46%	35%	25%	15%	% of waste generation
Waste sorted for recovery (excludes energy from waste)	5,116	5,352	5,680	6,008	17,520	18,172	19,350	20,527	Tonnes/year
Waste sorted for recovery (excludes energy from waste)	25%	26%	27%	29%	8%	8%	8%	9%	% of waste generation
Waste sorted for recovery by formal sector (excludes energy from waste)	1%	5%	10%	11%	2%	3%	5%	4%	% of waste generation
Waste sorted for recovery by informal sector (excludes energy from waste)	18%	17%	17%	18%	5%	5%	5%	5%	% of waste generation
Energy from waste	365	457	579	682	5,050	4,583	5,321	6,081	Tonnes/year
Energy from waste	1%	2%	3%	3%	2%	2%	2%	3%	% of waste generation
Disposal in disposal facilities	7,588	9,924	11,578	13,252	102,585	126,535	147,568	168,430	Tonnes/year
Disposal in disposal facilities	35%	48%	56%	64%	45%	55%	64%	73%	% of waste generation
Managed in controlled facilities	0	0	8,919	19,902	0	0	86,019	155,018	Tonnes/year
Managed in controlled facilities	0%	0%	43%	96%	0%	0%	37%	85%	% of waste generation

The "Settings" sheet contains the default non-user input data behind the model. Although this sheet is locked for editing, the transfer coefficients can still be viewed for transparency.

(Principal Investigator: Velis C.A. Research team: Cottom J., February 2020)


Sindhu Bikash Bank Ltd.

2 CHAPTER 2: ABOUT THE STUDY

2.1 Need for the Study

Banepa Municipality, like many rapidly urbanizing areas in Nepal, faces significant challenges in managing its municipal solid waste (MSW). The increasing population density and urbanization have led to a substantial rise in waste generation, placing immense pressure on existing waste management infrastructure and practices. While some efforts have been made in the past, such as the implementation of roadside pick-up and door-to-door collection systems, and the use of a crude dumping site, these methods are often insufficient to address the growing volume and change composition of waste.

Previous studies, such as the 2003 field survey, highlighted an average per capita household waste generation rate of 0.23 kg/person/day, with an estimated total municipal waste generation of 5.08 tons per day. More recent data indicates a daily solid waste generation of 0.32 kg/capita/day. The composition of this waste is predominantly organic (68.1%), followed by plastics (11.19%) and paper products (9.14%). This high organic content presents both an opportunity for composting and a challenge if not properly managed, as it contributes to greenhouse gas emissions. The continued reliance on open dumping practices, as observed in many municipalities, including Banepa, poses severe environmental and public health risks, including soil and water contamination, air pollution, and the spread of diseases.

Despite the allocation of municipal budgets towards waste management, with an average of 10% of the total budget spent on solid waste management in municipalities, a significant portion of these funds are often directed towards collection and transport rather than sustainable disposal or resource recovery initiatives. The lack of adequate financial resources and the absence of scientifically managed disposal sites further exacerbate the problem. The 2013 ADB report on Solid Waste Management in Nepal emphasized the critical need for clear policies, strategies, and guidelines, along with the promotion of the "3R" principle (reduce, reuse, recycle), strengthening local capacities, and fostering public-private partnerships.

Given these persistent challenges, a comprehensive study on waste flows in Banepa Municipality is imperative. Such a study will provide an updated and detailed understanding of current waste generation rates, characterization, collection efficiencies, and disposal practices. It will identify critical gaps in the existing system and assess the feasibility of implementing more sustainable and integrated waste management approaches, including advanced recycling, composting, and anaerobic digestion technologies. By analyzing the entire waste flow, from generation to final disposal, this study aims to offer actionable insights and recommendations for developing a more efficient, environmentally sound, and economically viable solid waste management system for Banepa Municipality, ultimately contributing to improved public health and environmental quality in the region.

2.2 Objective

The waste flow diagram tool is designed to quantify plastic leakage, but this study concentrates on analyzing the flow of municipal solid waste. Unlike the rapid assessment approach of the waste flow diagram, this study aims to conduct an in-depth analysis to accurately reflect real-world conditions. The objectives of this study are:

- To thoroughly evaluate the municipality's solid waste management system and visualize its waste flows.
- To quantify environmental leakage from the municipal solid waste management system using observational and empirical methods.
- To identify potential interventions for effective management and safe disposal of municipal solid waste.

2.3 Scope of the Study

This study was confined to the issue of municipal solid waste management within the administrative boundaries of Banepa Municipality, Kavrepalanchok District, Nepal. The geographical scope was extend across all wards of the municipality, thereby incorporating both urban and peri-urban/ rural settlements. This inclusive approach is necessary as the patterns of waste generation, collection, disposal, and recycling are often influenced by differences in population density, socio-economic status, land use, and access to municipal services. By covering the entire municipality, the study aimed to capture a holistic understanding of the variations in waste management across diverse contexts.

The study primarily focused on current waste management practices, including waste generation rates, segregation practices, collection efficiency, transportation methods, treatment options, and final disposal mechanisms. Both household and commercial waste streams were examined to capture the diversity of waste sources and their waste generation and waste management approaches.

In addition to documenting and assessing current practices, the study looked into future projections of waste generation. These projections were based on demographic trends, such as population growth, migration patterns, and urbanization, as well as on changing consumption behaviors and economic development within the municipality. Such forward-looking analysis is intended to support the municipality in anticipating future challenges and planning appropriate interventions for sustainable waste management.

Overall, the scope of the study was designed to provide a detailed, municipality-wide assessment of solid waste management practices and to generate evidence-based insights that can guide Banepa Municipality in enhancing its waste management strategies, policies, and service delivery in the short, medium, and long term.

2.4 Limitation

The study concluded with the creation of a Sankey diagram for municipal solid waste. A detailed category-wise waste flow diagram and scenario analysis of intervention effectiveness were not developed due to limited data. Overall, the study focused on general waste flow and does not specifically assess plastic leakage.

This study consists of several other limitations. Data collection was conducted during a single season, which may not reflect seasonal variations in waste generation and composition. The timing of the study during the rainy season had influenced results, as higher moisture content could artificially increase waste weight and alter composition. Additionally, certain waste streams such as healthcare waste and waste from open spaces were excluded, which may lead to an underestimation of total municipal waste.

Furthermore, there is a possibility of human error during waste sampling and measurement. This challenge was particularly pronounced during rainy conditions, when wet waste

was heavier and more difficult to handle, potentially affecting the accuracy of recorded data. Moisture content during the rainy season might also artificially inflate the measured weight of waste, leading to deviations in waste composition analysis.

2.5 Methodology

2.5.1 Literature Review

A comprehensive desk review was undertaken to examine existing studies, reports, and research papers on solid waste management (SWM) practices in Banepa Municipality as well as in comparable municipalities. The review incorporated analysis of national datasets such as the National Census, Municipality Profile, Demographic and Health Survey (DHS), and Multiple Indicator Cluster Surveys (MICS). In addition, relevant policy documents, strategies, guidelines, plans, and institutional frameworks related to SWM were studied to assess their implementation status and identify existing gaps. To complement this review, initial consultations with Banepa Municipality officials were conducted to obtain updated household data and gather context-specific insights.

2.5.2 Preliminary Field Visit

To gain a better understanding of the current waste management context in Banepa Municipality, a preliminary field visit was conducted. The visit allowed the team to observe the geographic conditions, household-level waste generation, collection systems, transportation, and disposal practices. Informal interactions were held with municipal officials, local communities, and waste collectors to gather preliminary insights into local needs, existing practices, and challenges in solid waste management. During the visits, the types and quality of waste were visually assessed to guide the sampling approach. Based on the observations and consultations, local volunteers were identified and oriented to support upcoming survey and data collection activities.

2.5.3 Survey and Sampling

To ensure that the data collected was representative of Banepa Municipality, a stratified sampling approach was adopted. The primary waste generators considered in the study were households and commercial establishments. Household units were further stratified by ward to reflect geographic distribution, while commercial units were categorized into multiple types based on their business nature.

The sample size for both categories of waste generators was calculated using Cochran's formula for determining the required sample size: $n_o = \frac{Z^2 pq}{e^2}$ and its finite Population Correction for the Proportion $n = \frac{n_0}{1+\frac{(n_0-1)}{N}}$.

Where:

- Z = 1.96, corresponding to a 95% confidence level
- p = 0.5, assuming maximum variability in household waste practices
- q = 1 - p
- e = 0.07, indicating a ±7% margin of error
- N = Total number of households in Banepa Municipality

It was followed by proportionate stratification random sampling such that each ward in the municipality is considered as one stratum. The sample size required in each ward is calculated as $\boldsymbol{n_h} = \frac{N_h}{N} \times \boldsymbol{n}$, where, N_h is a total population in each stratum.

For household units, a total of 16,698 households were considered. Using a 7% margin of error and a 95% confidence level, the required sample size was calculated to be 194 households. With a 10% contingency, the total sample size increased to 213 households. After data collection and cleaning, all 213 samples were valid and included in the analysis, which strengthened the robustness of the findings, improved accuracy, and ensured that no valuable data was unnecessarily discarded.

TABLE 1: WARD DETAILS WITH SAMPLE SIZE

Ward No.	No. of households	Proportion	Sample Size	Sample size with Contingency 10%
1	627	4%	7	8
2	548	3%	6	7
3	793	5%	9	10
4	1134	7%	13	14
5	1828	11%	21	23
6	1826	11%	21	23
7	1809	11%	21	23
8	1674	10%	19	21
9	1448	9%	17	19
10	1997	12%	23	26
11	553	3%	6	7
12	677	4%	8	9
13	1103	7%	13	14
14	681	4%	8	9
Total	**16698**	**194**	**194**	**213**

Source: Banepa Municipality Profile

For the commercial units, a sample size of 180 was calculated from a total population of 2,075 units in Banepa Municipality, based on the 95% of confidence level and 7% of margin of error. A contingency for non-response was considered unnecessary due to the nature of this population; as the commercial units are formally registered and readily accessible, a high rate of complete and reliable data was anticipated. Therefore, the final sample of 180 was deemed sufficient for reliable results and practical feasibility.

TABLE 2: COMMERCIAL DETAILS FOR SAMPLE SIZE

Commercial Units	Total Number	Sample Size
Beauty Parlor /Saloon	29	7
Boutique and Tailoring	30	8
Car Accessories/Service Center	30	2
Catering/Banquet/Party Palace	8	1
Church	1	1
Cinema Hall	3	1
Electronics/ Mobile Shop	21	2
Fancy Shop/Crockery	118	15
Financial Institutions/Banks/ Cooperatives/Saving Credits	285	22
Gas industries	12	1
General Shops	281	25
Homestay/Hotel/Guest House/ Lodge	15	1
Industries	508	13
Jewelry/Gold Smith	13	1
Meat Shop	20	2
Office	195	19
Optical/Chemist/Pharmacy	62	6
Resort	8	1
Restaurant/Bakery/Cafe	226	21
School/Training Institute	48	4
Small and Cottage Industries	132	24
Suppliers/Traders	30	3
Total	**2075**	**180**

Source: Banepa Municipality Data

2.5.4 Data Collection

Data for this study was collected using mixed methods, combining both quantitative and qualitative surveys to provide a comprehensive understanding of municipal solid waste

management (SWM) practices. Quantitative data were gathered through structured surveys and direct measurements, while qualitative insights were obtained through interviews, observations, and discussions with key stakeholders like municipal officials, formal waste collectors (private sectors), and waste collection truck drivers.

Questionnaire Survey

A structured questionnaire survey (household and commercial) was conducted across Banepa Municipality using the digital platform called "Kobo Toolbox". The questionnaire collected detailed information on general information, current solid waste management (SWM) practices and the challenges faced by residents. Local enumerators conducted the survey after receiving a thorough orientation covering the survey objectives, the importance of accurate data collection, and a step-by-step explanation of each question to ensure proper understanding.

Waste Calculation Survey

The waste generation and composition survey was conducted across all wards of Banepa Municipality to ensure geographic representation. Wards 5, 6, 7, 8, 9, 10, 13, and 14 were identified as key commercial zones due to higher population density and business activity.

Waste from households and commercial units was collected over five consecutive days (four weekdays and one weekend day) to capture daily variations. Waste was segregated at the source into wet and dry using color-coded polybags, then transported to the waste collection center at Radhe Radhe, Bhaktapur for waste analysis including calculation and characterization.

The survey was conducted in two phases due to limited volunteers: Week 1 for households and Week 2 for commercial units. On the first day of each phase, enumerators conducted a structured questionnaire using Kobo Toolbox and distributed polybags for Days 1 and 2.

Waste from Day 1 was discarded to allow participants to adapt to the segregation process. Actual data collection began on Day 3, with volunteers rotating between distributing polybags and collecting waste daily within a 24-hour period to maintain accuracy.

TABLE 3: SURVEY SCHEDULE

Day	Activity	Polybags Distributed for	Remarks
Day 1	Survey initiation; Structured questionnaire conducted	Day 1 & 2	Adaptation: waste discarded
Day 2	No visit	None	Waste stored
Day 3	Collected Day 1 & 2 waste	Day 3	Start of actual data collection
Day 4	Collected Day 3 waste	Day 4	Midway collection
Day 5	Collected Day 4 waste	Day 5	Waste stored 24 hours
Day 6	Collected Day 5 waste	None	End of sampling

2.5.5 Data Analysis

The recorded data were first entered and organized in Microsoft Excel, where raw entries from surveys, waste measurements, and field observations were systematically tabulated. Excel was used to perform preliminary checks, data cleaning, coding of responses, and computation of basic descriptive statistics, such as averages, percentages, and frequency distributions.

In addition, the waste flow along the entire value chain from generation to segregation, collection, transportation, treatment, and final disposal was visualized using a Sankey diagram. This graphical representation highlighted the proportions of different waste streams and their pathways, making it easier to understand inefficiencies, leakages, and potential opportunities for resource recovery.

3 CHAPTER 3: TOWN PROFILE

3.1 Location and Geography

Banepa Municipality lies in Kavrepalanchok District of Bagmati Province, Nepal, about 25 kilometers east of Kathmandu. The municipality is located in a valley at an average elevation of 1,500 meters (4,900 feet) above sea level, with terrain typical of Nepal's mid-hill region, consisting of rolling hills and valleys ranging between 1,400 and 2,000 meters.

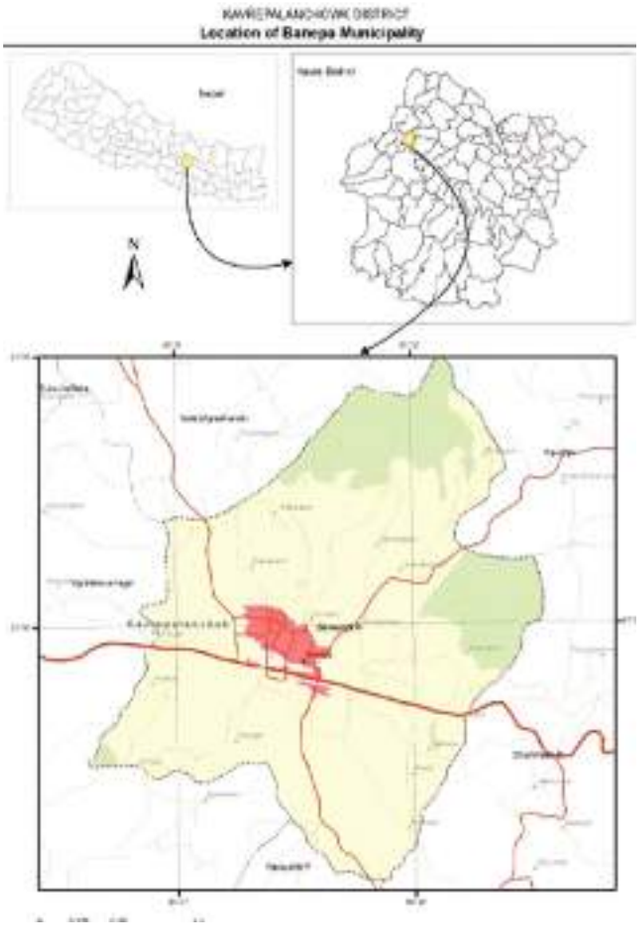
Covering a total area of 54.59 square kilometers, Banepa is geographically positioned at 27.6332252° N latitude and 85.5277488° E longitude. It is bounded by Panauti Municipality to the south, Mandandeupur Municipality to the east, Dhulikhel Municipality to the southeast, and several rural municipalities in the remaining directions. This strategic location makes Banepa an important urban center in Kavrepalanchok District.

TABLE 4: TOWN PROFILE

NAME	BANEPA MUNICIPALITY
District	Kavrepalanchowk
Year of Establishment	2038 B.S.
No. of Administrative Division (Wards)	14
No. of Urban Wards	11
No. of Rural Wards	3
Total Area	54.59 sq. km
Total Population (2021 census)	67690
	Male: 33172
	Female: 34518
Floating Population	20%
Population Growth rate	1.50%
Population Density	1240 per Sq
Literacy rate	84.80%

Source: Banepa Municipality Profile

FIGURE 5: ADMINISTRATIVE MAP



3.2 Administration Division and Demography

Banepa Municipality is administratively divided into 14 wards, each functioning as the smallest local government unit. According to the 2021 Nepal Census, Banepa Municipality has a total population of 67,690, comprising 33,172 males (49.0%) and 34,518 females (51.0%), distributed across 16,698 households. With an area of 54.59 square kilometers, the municipality has a population density of 1,240 persons per square

kilometer. The annual population growth rate between 2011 and 2021 was recorded at 1.5%. The municipality is home to a diverse population, with Nepali speakers, Newar, Tamang, and other ethnic and linguistic groups forming the major communities.

The population distribution across wards is uneven. Ward 7 has the largest population with 7,755 residents, closely followed by Wards 5 (7,444) and 10 (7,515), reflecting their urbanized and commercially active nature. In contrast, Ward 11 has the lowest population with only 2,268 residents, highlighting the demographic variations between densely populated urban wards and relatively smaller residential wards.

TABLE 5: WARD WISE DEMOGRAPHIC DETAILS

Ward No.	Male	Female	Total Population	Total Households
1	1,220	1,309	2,529	627
2	1,082	1,212	2,294	548
3	1,671	1,707	3,378	793
4	2,231	2,313	4,544	1,134
5	3,667	3,777	7,444	1,828
6	3,539	3,615	7,154	1,826
7	3,809	3,946	7,755	1,809
8	3,365	3,516	6,881	1,674
9	2,965	3,092	6,057	1,448
10	3,796	3,719	7,515	1,997
11	1,113	1,155	2,268	553
12	1,354	1,464	2,818	677
13	2,042	2,243	4,285	1,103
14	1,318	1,450	2,768	681
Total	**33,172**	**34,518**	**67,690**	**16,698**

Source: Banepa Municipality Profile

3.3 Economy

Banepa serves as a key economic hub of Kavrepalanchok District, with a diverse mix of trade, services, industries, and agriculture. Historically, Banepa has been recognized as a traditional trading center, particularly for the distribution of food grains and textiles across the district. Its location along the Arniko Highway, which links Kathmandu with the Chinese border, further strengthens its position as a gateway for regional trade and commerce.

In recent years, Banepa has also been emerging as a center for information technology and innovation. An IT Park is being developed with an estimated investment of NPR 270 million (USD 2.7 million), and the Government of Nepal has designated Banepa as a Special Economic Zone (SEZ) for the promotion of IT and IT-enabled services, underscoring its growing importance in the digital economy. According to the 2018 Economic Census, Banepa Municipality is home to 4,329 establishments engaged in a variety of economic activities. Many of these involve small-scale industries and manufacturing units, which provide significant local employment and support the municipality's economic base.

Despite increasing urbanization, agriculture remains a vital livelihood source for many households. Local farmers are gradually adapting to changing climatic conditions by adopting climate-smart practices. Studies show that 64% of farmers practice crop rotation and intercropping, ensuring both sustainability and productivity.

Banepa also plays a central role in the service sector, hosting numerous educational institutions, healthcare facilities, financial services, and government offices. These not only serve residents of Banepa but also attract people from surrounding municipalities and rural areas. Employment data indicates that about 50% of workers in industries and institutions are local residents, reflecting the municipality's role in generating jobs and sustaining livelihoods.

3.4 Land Use Patterns

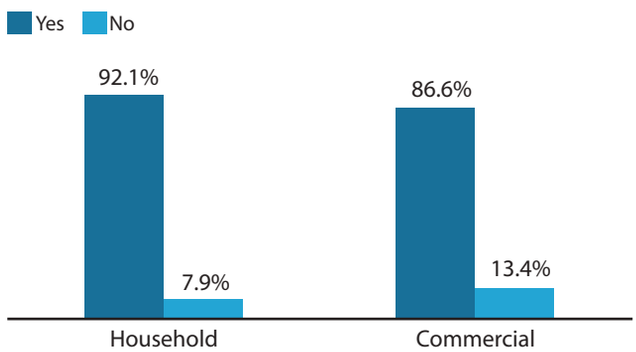
Land use in Banepa Municipality has undergone significant changes over recent decades. There has been a major increase in settlement areas, particularly between 2013 and 2020. Urban development has led to continuous conversion of agricultural land to built-up areas. Despite urbanization, agriculture remains a significant land use category, though declining in proportion. The agricultural landscape includes terraced fields typical of Nepal's mid-hills. The Arniko Highway and other road networks have influenced settlement patterns and land use changes along transportation corridors. Remote sensing studies between 1992-2020 show a significant increase in built-up areas at the expense of agricultural land. This urban growth pattern is driven by migration from rural areas of Kavrepalanchok district to Banepa.

4 CHAPTER 4: SOLID WASTE MANAGEMENT PRACTICES IN TOWN

4.1 Waste Segregation Practices

The analysis of waste segregation practices indicates a high level of environmental awareness in both the commercial and household sectors. The household sector demonstrates a strong commitment to waste segregation, with 92.1% of residents reporting that they separate their waste. In comparison, 86.6% of commercial establishments practice segregation. While slightly lower than households, this still represents a significant majority, indicating that commercials also recognize the importance of waste segregation.

FIGURE 6: WASTE SEGREGATION PRACTICES

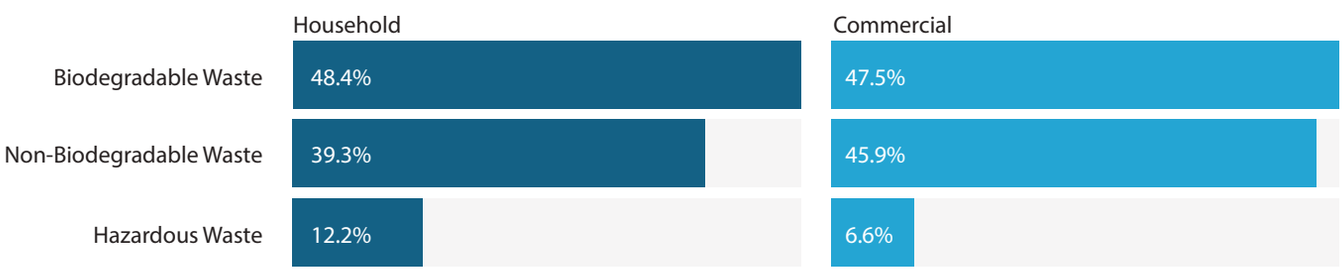


4.2 Types of Waste Segregated

Both sectors primarily separate waste into organic (biodegradable) and inorganic (non-biodegradable) categories. In households, biodegradable waste such as food scraps, peels, and agricultural residues is the most segregated category (48.4%), followed by non-biodegradable waste (39.3%) which is likely to be paper, plastic bottles, metals, cloth, wood, plastic bags, etc. and hazardous waste (12.2%) such as batteries, bulbs, etc.

Commercial establishments show a similar distribution for biodegradable (47.5%) and non-biodegradable waste (45.9%), but a notably smaller proportion (6.6%) report separating hazardous materials.

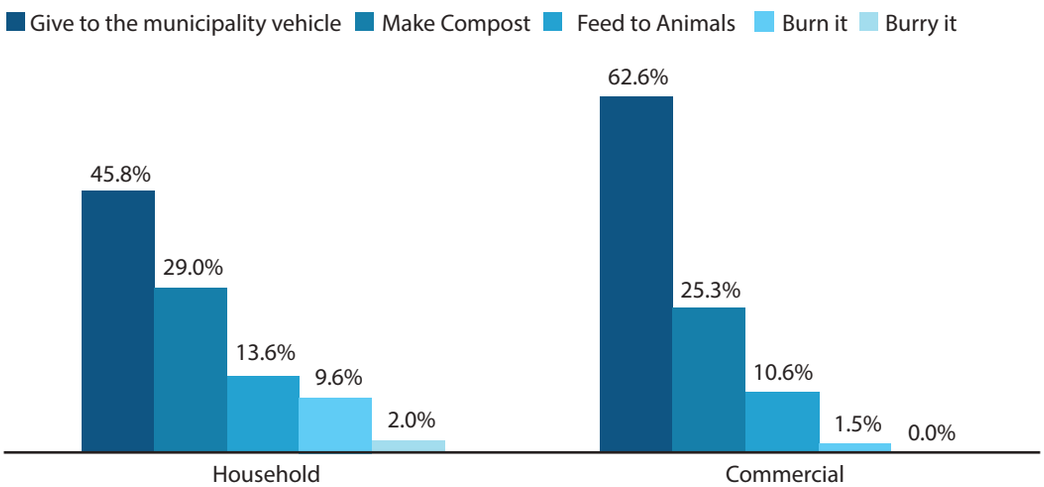
FIGURE 7: TYPES OF WASTE SEGREGATED



4.3 Management of Biodegradable (Wet) Waste

In households, biodegradable waste is managed in a variety of ways: 45.8% give it to municipal collection vehicles, 29.0% compost it at home, and 13.6% feed it to animals. Some households bury organic waste (9.6%), while very small percentages use community dustbins (0.3%) or dispose of rivers and canals (1.7%). These figures show that a significant portion of households use self-management methods, reducing the amount of organic waste entering the municipal system.

FIGURE 8: MANAGEMENT OF WET WASTE



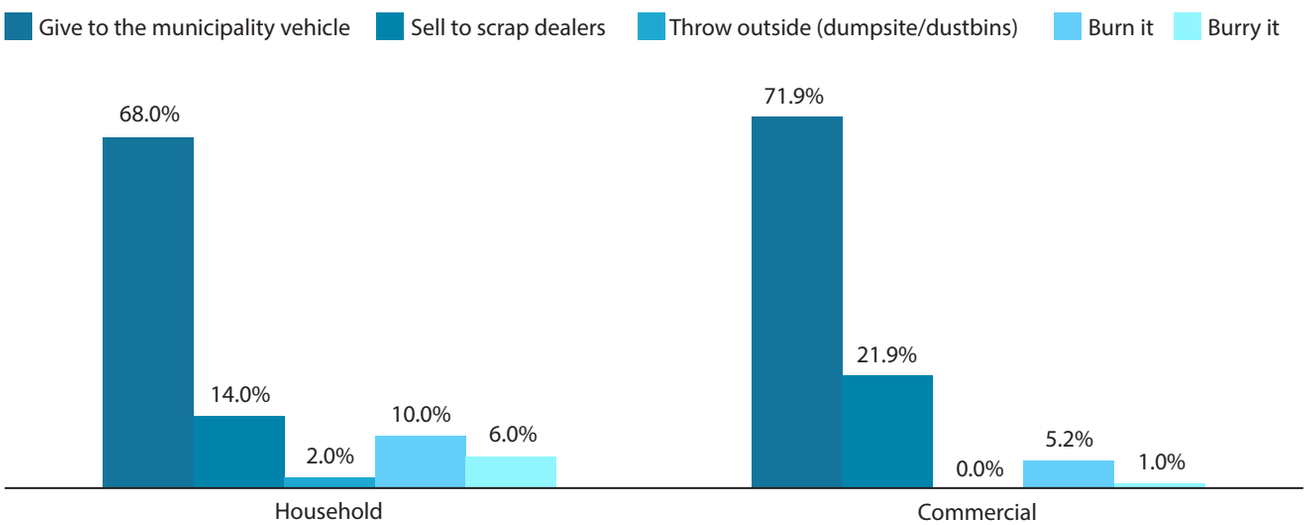
Commercial establishments rely more heavily on municipal vehicles (62.6%) for biodegradable waste disposal, with smaller shares composting (25.3%), feeding animals (10.6%), or burying (1.5%). This reliance likely reflects higher waste volumes and operational constraints in business environments.

4.4 Management of Non-Biodegradable (Dry) Waste

For households, the main method of managing non-biodegradable waste such as paper, plastic, and cardboard is handing it over to municipal collection vehicles (68.0%). Some households sell recyclable materials to scrap dealers (14.0%), while others burn (10.0%) or bury (6.0%) the waste. A small fraction takes it directly to dumpsites (1.3%) or uses community dustbins (0.7%).

In commercial establishments, municipal vehicle collection is slightly more common (71.9%), with a larger share (21.9%) selling to scrap dealers. Burning (5.2%) and burying (1.0%) occur at lower rates, and no reports were made of direct dumping or use of community dustbins. The higher sales to scrap dealers in commercial areas are likely due to the greater quantity and value of recyclable materials produced by businesses.

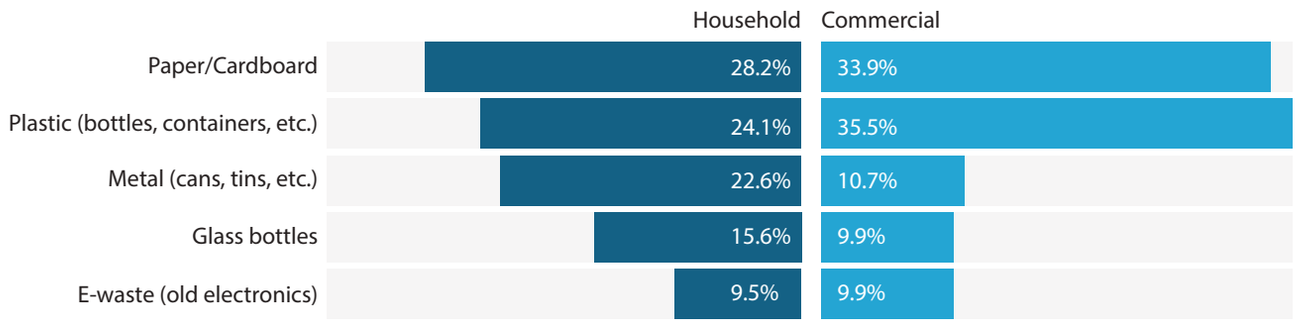
FIGURE 9: MANAGEMENT OF DRY WASTE



4.5 Types of Waste Sold: Non-Biodegradable

Households most often sell paper and cardboard (28.2%), followed by plastics (24.1%), metals (22.6%), glass bottles (15.6%), and e-waste such as old electronics (9.5%).Commercial establishments also prioritize selling paper/cardboard (33.9%) and plastics (35.5%) but sell metals (10.7%) and glass bottles (9.9%) less often than households. E-waste sales are similar between the two sectors (around 9–10%).

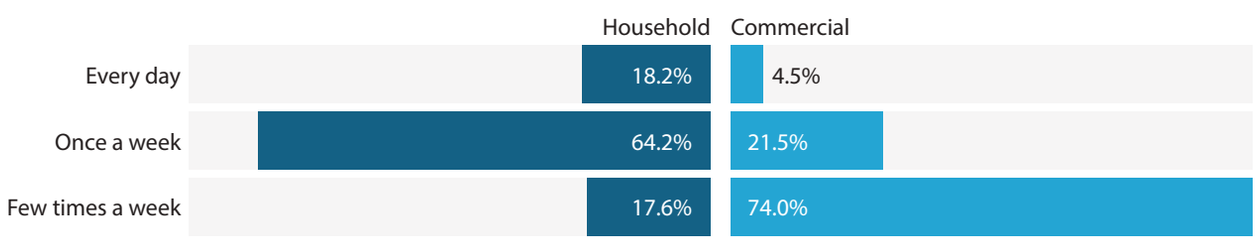
FIGURE 10: DRY WASTE SOLD



4.6 Frequency of Waste Collection

In households, waste collection is most often conducted once a week (64.2%), followed by daily collection (18.2%) and collection a few times a week (17.6%).

FIGURE 11: FREQUENCY OF WASTE COLLECTION

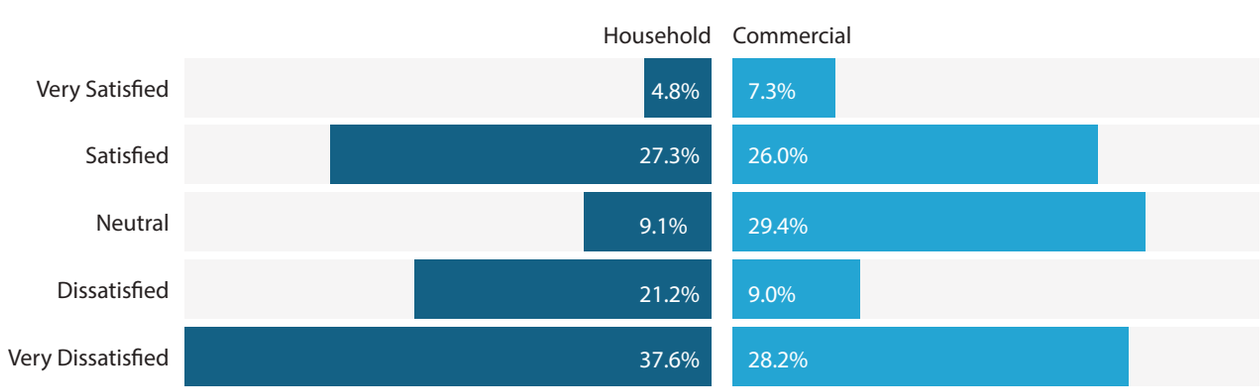


In contrast, most commercial establishments (74.0%) receive collection a few times a week, with fewer receiving it once a week (21.5%) or daily (4.5%). This pattern indicates that businesses generally have more frequent collection services, possibly reflecting the larger waste volumes they generate.

4.7 Satisfaction with Current Waste Collection Service

Household satisfaction levels are generally low. Only 4.8% are very satisfied and 27.3% satisfied, while 21.2% are dissatisfied and 37.6% are very dissatisfied. The high dissatisfaction rates suggest that factors such as reliability, timing, and service quality may be key issues.

FIGURE 12: SATISFACTION WITH CURRENT WASTE COLLECTION SERVICE



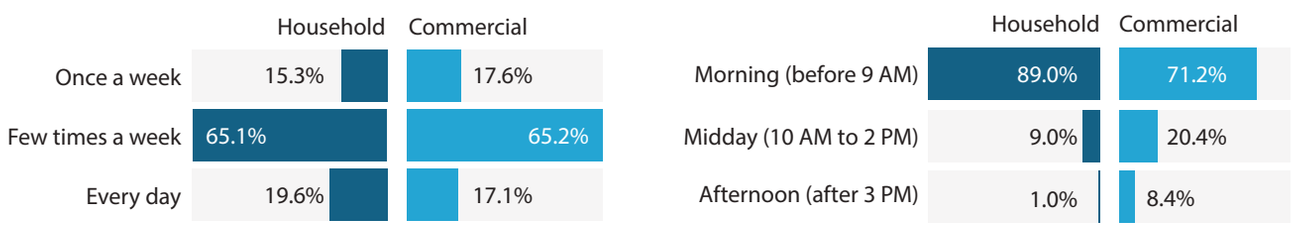
In commercial establishments, satisfaction is slightly higher, with 7.3% very satisfied and 26.0% satisfied. However, 28.2% are very dissatisfied and 9.0% dissatisfied, showing that dissatisfaction is also a significant concern for businesses.

However, nearly all households (97.7%) pay for waste collection services, with only 2.3% not paying. In commercial establishments, 95.5% pay for waste collection, and 4.5% do not.

4.8 Preferred Frequency for Improved Service

When asked about improvements, 65.1% of households and 65.2% of commercial establishments preferred collection a few times a week. Among households, 19.6% preferred daily collection and 15.3% preferred once a week. In commercial areas, 17.1% preferred daily collection and 17.6% preferred once a week. The similarity in preferences suggests a strong alignment in desired service frequency across both sectors.

FIGURE 13: PREFERRED FREQUENCY FOR IMPROVED SERVICE



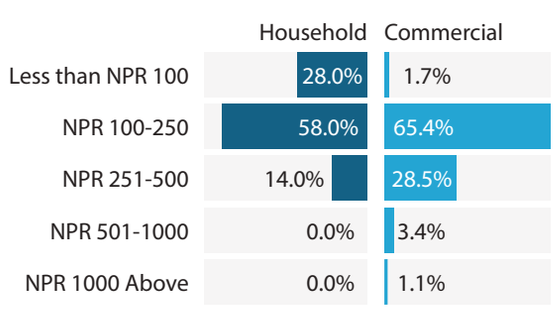
Households show a clear preference for morning collection before 9 AM (89%), with only small percentages preferring midday (9%) or afternoon (1%). Commercial establishments also prefer mornings (71.2%), but a higher share is open to midday (20.4%) and afternoon (8.4%) collections, indicating greater flexibility in timing.

4.9 Willingness to Pay

There is strong willingness to pay for improved waste collection, with 97.1% of households and 95.7% of commercial establishments agreeing to contribute to a reliable, well-managed daily collection service.

Households most commonly prefer to pay NPR 100–250 (58%), followed by less than NPR 100 (28%), and NPR 251–500 (14%). No households indicated willingness to pay above NPR 500.

FIGURE 14: WILLINGNESS TO PAY



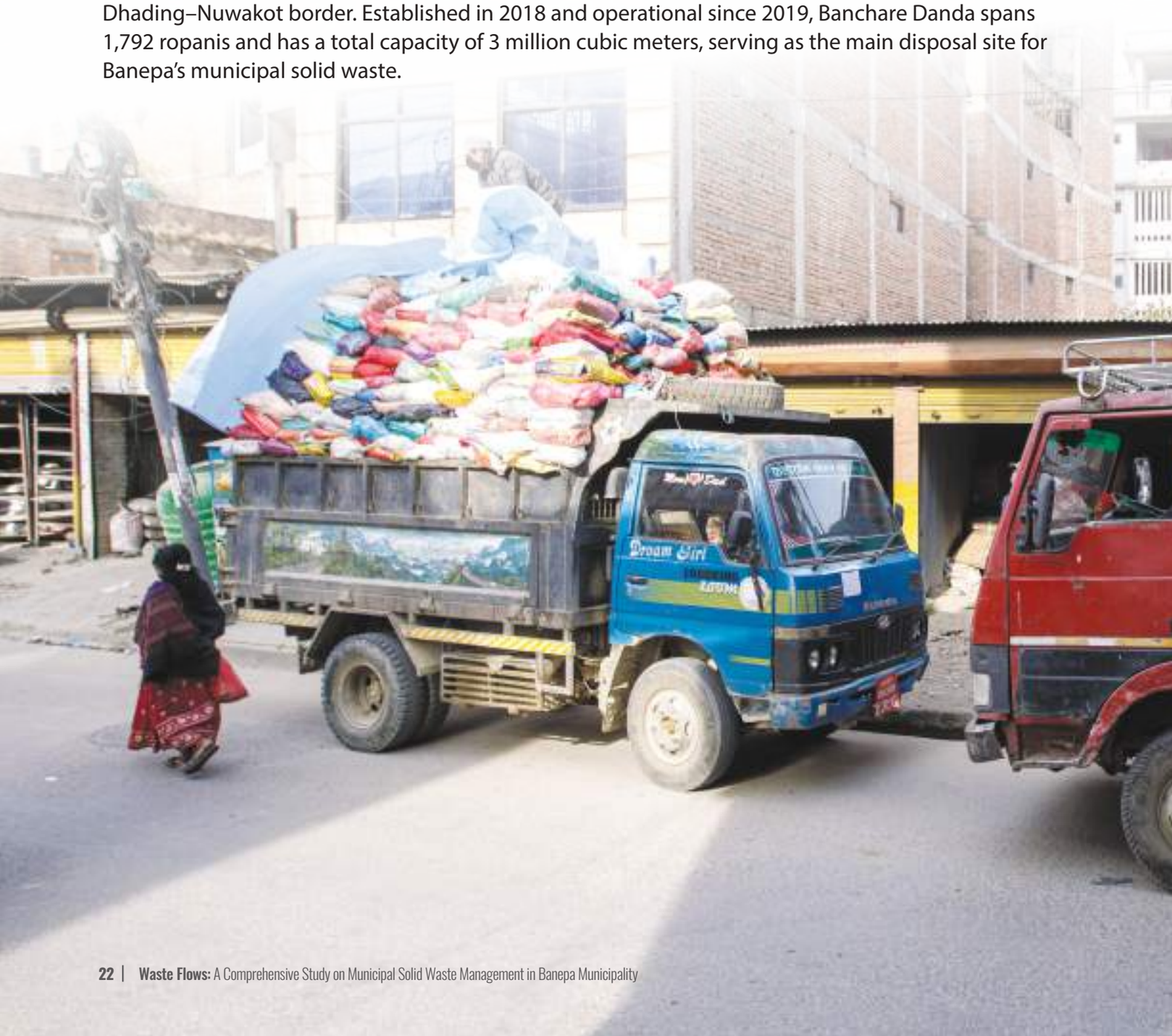
Commercial establishments also prefer NPR 100–250 (65.4%), but a larger proportion are willing to pay higher amounts 28.5% for NPR 251–500, 3.4% for NPR 501–1000, and 1.1% for more than NPR 1000. Only 1.7% prefer less than NPR 100.

4.10 Waste Collection and Transportation System

Banepa Municipality manages its waste through two private companies: Parivartan Sewa Pvt. Ltd and Nepsemyak Sewa Pvt. Ltd. Together, they collect waste daily using a total of three vehicles: one owned by the municipality and two from the private sector (Tata 909, Mahindra/Nissan, and Eicher models). These vehicles make two trips each day, one in the morning from 6:00 to 10:00 a.m. and another in the afternoon from 12:00 to 3:00 p.m. providing roadside pickup and door-to-door waste collection services in urban areas.

A total of 48 people is involved in solid waste management, including 20 municipal staff, 19 from Parivartan Sewa Pvt. Ltd., and 9 from Nepsemyak Sewa Pvt. Ltd. The team consists of drivers, sweepers, helpers, and office staff.

Currently, Banepa lacks its own recycling or reuse facility. Collected waste is transported to a segregation center in Radhe Radhe, Thimi Municipality–4, Bhaktapur, where recyclable materials are separated and sold to scrap contractors. The municipality also does not have a local landfill site and relies on the regional Banchare Danda landfill, located about 50 kilometers away on the Dhading–Nuwakot border. Established in 2018 and operational since 2019, Banchare Danda spans 1,792 ropanis and has a total capacity of 3 million cubic meters, serving as the main disposal site for Banepa's municipal solid waste.

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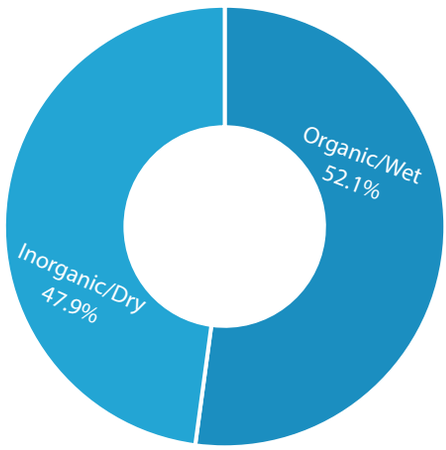
5 CHAPTER 5: DATA COLLECTION AND ANALYSIS

5.1 Waste Calculation and Analysis

5.1.1 Household Waste Generation Calculation

The study's aggregate data provides a clear snapshot of average daily waste generation. An average household produces a total of 0.955 kg of solid waste each day. Analyzing the composition of this waste reveals a relatively balanced mix, with a slight predominance of organic material. Specifically, wet waste, which typically includes food scraps and other biodegradables, accounts for 0.499 kg, making up approximately 52.1% of the household total. The remaining 0.456 kg (or 47.9%) consists of dry waste, such as paper, plastics, and other recyclables.

FIGURE 15: HOUSEHOLD WASTE CALCULATION

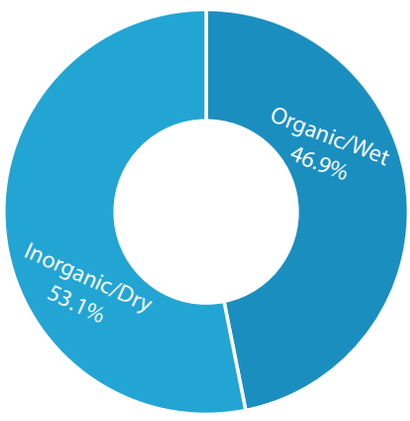


When this data is scaled down to an individual level, the average per capita waste generation rate is 0.211 kg (210.7 grams) per day. This individual contribution reflects the same compositional balance seen at the household level. Each person is generating approximately 0.110 kg of wet waste and 0.101 kg of dry waste daily, highlighting the nearly even split between the two main waste streams.

5.1.2 Commercial Waste Generation Calculation

The analysis of commercial waste from 180 samples across various establishment types reveals a total estimated daily generation of 18,288.85 kg (18.29 tons). A breakdown of the waste composition shows that dry materials, such as packaging, paper, and plastics, are the primary components, constituting 53.1% of the total stream. Wet waste, largely organic matter from kitchens and production processes, makes up the other 46.9%.

FIGURE 16: COMMERCIAL WASTE CALCULATION



The overall composition of this commercial waste stream is slightly dominated by dry materials. In terms of average daily weight,

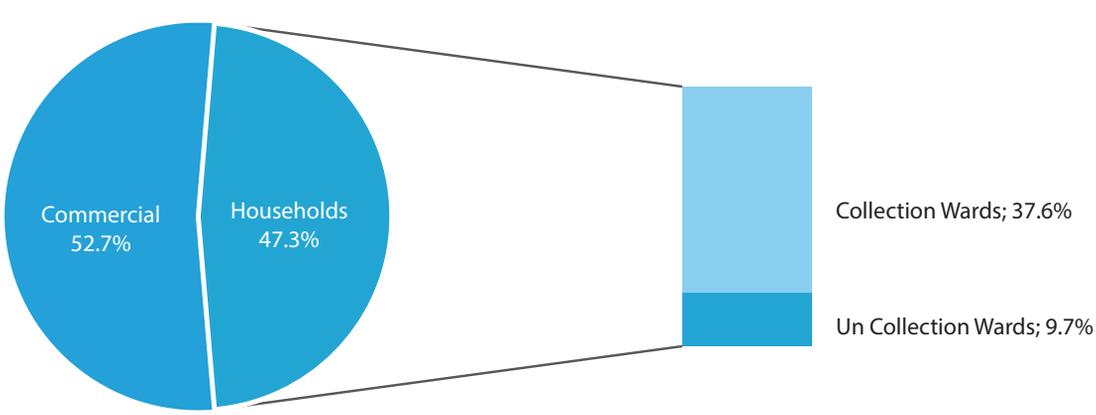
dry waste contributes 477.70 kg, while wet waste amounts to 421.41 kg. While these figures provide a broad overview, the data clearly shows that waste generation is highly concentrated within a few specific sectors. The industrial sector is overwhelmingly the largest contributor, single-handedly responsible for 13,668.26 kg, or nearly 75% of all commercial waste recorded. Other significant sources of waste include Resorts (1,440.00 kg), Restaurant/ Bakery/Cafe establishments (1,095.91 kg), and Small and Cottage Industries (1,081.99 kg). Together, these four categories account for most of the commercial waste, suggesting that targeted management strategies focused on these key sectors would yield the most significant impact on overall waste reduction and handling.

5.2 Total Waste Calculation Analysis

Based on demographic data for a total population of 77,944 (including a floating population of 20% additional), the total municipal solid waste generated daily is 34.72 tons. The waste stream is nearly evenly divided between commercial and household sources, though the commercial sector is the larger contributor, accounting for 18.29 tons (approximately 52.7% of the total). The remaining 16.43 tons (47.3%) originate from households, where the per capita generation rate is calculated at 210.75 grams per person per day. This total household weighssst is derived by multiplying the per capita generation rate (210.75 gm) by the total population (77,944). This household waste is composed of a nearly equal split of wet (0.1099 kg/person) and dry (0.1009 kg/person) materials.

While 13.04 tons (37.6%) of household waste are collected from Collection Wards, an estimated 3.38 tons (9.7%) of waste generated daily in "Un-Collection Wards" are not managed by the formal system. This highlights a critical service gap affecting a population of 16,055 residents and indicates a substantial amount of waste that may be disposed of improperly within the municipality each day.

FIGURE 17: TOTAL WASTE CALCULATION



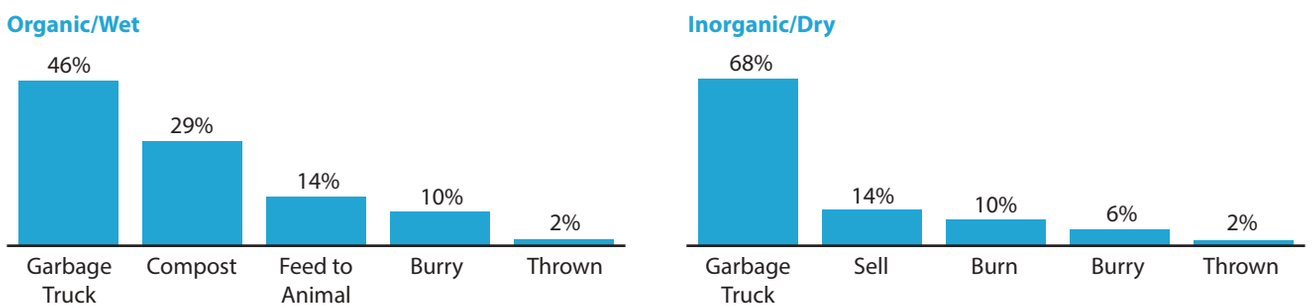
5.3 Detailed Analysis of Waste Management Practices

A detailed analysis of waste disposal practices reveals a multi-layered approach, dominated by the formal collection system. This section provides a granular breakdown of how a total municipal solid waste is managed and disposed of, separating practices by household vs. commercial sectors and by areas with and without formal waste collection services. The total daily municipal solid waste generation for the area is 34.72 tons. This waste is generated by two primary sectors, with the commercial sector producing a slightly larger share at 18.29 tons per day, compared to 16.43 tons per day from households. The average daily waste generation for an individual resident is 210.75 grams. Notably, there is a significant service gap, as 3.38 tons of the total household waste is generated in wards where waste is not formally collected, indicating a daily volume of unmanaged waste.

5.3.1 Household Waste Management in Collection Wards

In wards with access to formal waste collection i.e. waste collection by vehicle, households generate a total of 13.04 tons of waste daily, which is managed through a combination of formal collection and various informal practices. Of the 6.80 tons of wet waste, the primary disposal method is formal collection, with 3.11 tons (46%) given to garbage trucks/ waste collection vehicles. A significant portion is also managed sustainably at the source through composting by 29% (1.97 tons) and use as animal feed (0.92 tons). The remaining wet waste is handled through on-site burial (0.65 tons) and improper throwing (0.14 tons).

FIGURE 18: HOUSEHOLD WASTE MANAGEMENT IN COLLECTION WARDS

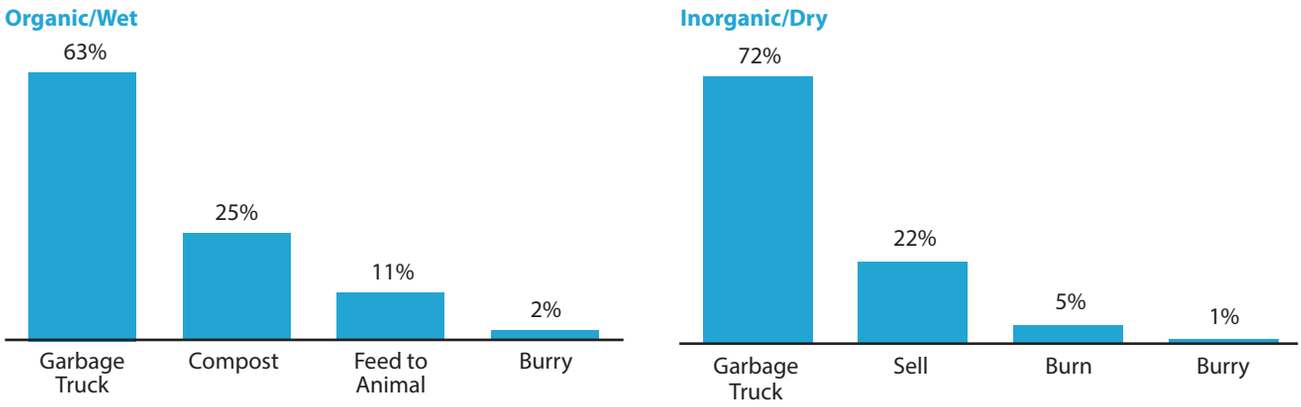


For the 6.24 tons of dry waste, management is even more reliant on the formal system, with a substantial 4.24 tons (68%) collected by the garbage trucks. Resource recovery is also practiced through the selling of recyclables, which accounts for 0.87 tons (14%), while improper disposal methods include burning (0.62 tons), burial (0.37 tons), and throwing (0.12 tons).

5.3.2 Commercial Waste Management

Commercial establishments generate a total of 18.29 tons of waste daily, and their management relies heavily on formal collection and resource recovery, with minimal reliance on improper disposal. 8.57 tons of wet waste is primarily managed through the formal system, with 5.37 tons (63%) being collected by garbage trucks. Furthermore, a substantial portion is diverted from the main waste stream through sustainable practices, including the composting of 2.17 tons and the use of 0.91 tons as animal feed, leaving only a small fraction to be buried. A similar pattern is observed for the 9.72 tons of dry waste, where the dominant channel is formal collection, accounting for 6.99 tons (72%). Significant economic value is also recovered through the sale of recyclables, which amounts to 2.13 tons. The remaining small portion is handled through less desirable methods, with 0.51 tons being burned and a negligible amount 0.10 tons (1%), is buried.

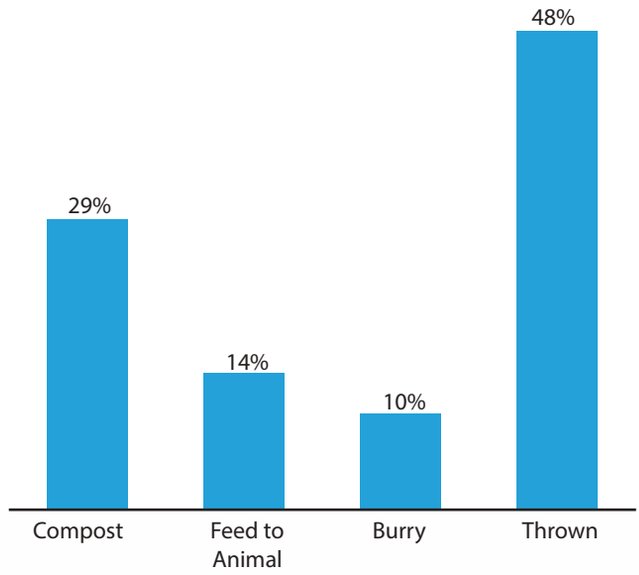
FIGURE 19: COMMERCIAL WASTE MANAGEMENT



5.3.3 Waste Management in Un-Collection Wards

In areas without formal collection services, the 3.38 tons of daily household waste is managed entirely through informal and often inadequate methods. While residents actively manage a portion of this waste through practices such as composting (0.98 tons), using organic waste as animal feed (0.46 tons), and on-site burial (0.32 tons). The data reveals that a significant total of 1.62 tons is disposed of improperly by being thrown away. This figure is composed of 0.07 tons explicitly reported as "thrown" and an additional 1.55 tons which is unaccounted for and assumed to be discarded in the same manner.

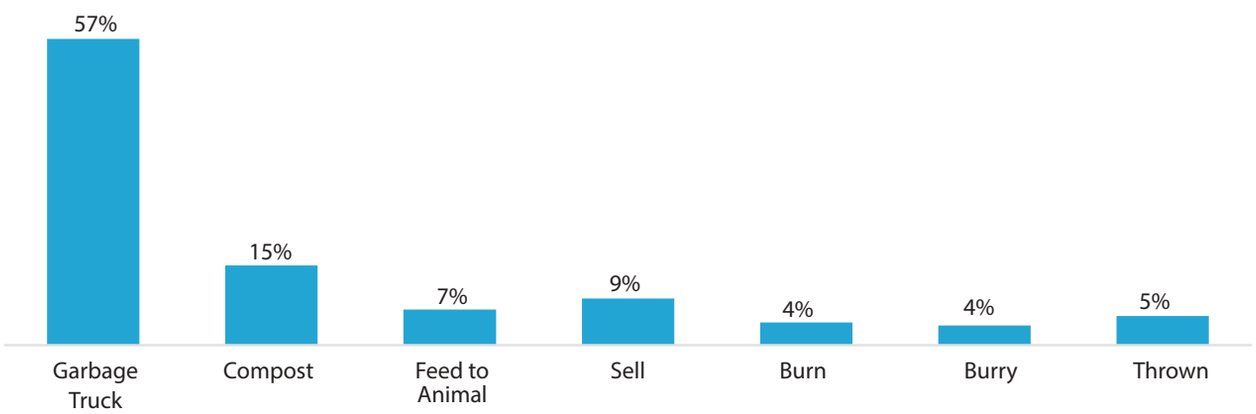
FIGURE 20: WASTE MANAGEMENT IN UN-COLLECTION WARDS



5.3.4 Summary of Municipal Disposal Methods

The primary method for municipal waste disposal is formal collection, with 19.71 tons managed daily by garbage trucks. In addition to this, significant waste is managed combining 10.41 tons through composting (5.12 tons), selling recyclables (3.00 tons), and using organic waste as animal feed (2.29 tons). However, improper disposal methods are also prevalent, including the burning of 1.13 tons and burial of 1.57 tons. The most critical issue is the 1.88 tons of waste thrown away daily, with the vast majority of this (1.62 tons) originating from households in unserved wards.

FIGURE 21: SUMMARY OF MUNICIPAL DISPOSAL METHODS



5.4 Waste Composition

For the determination of waste composition, the quartile and coning method was applied separately for both days of 2 different sources, i.e. households and commercials as illustrated in Figure 22. The diagram illustrates the Quartile Method (also known as the Quartering Method) for determining the composition of solid waste. The process begins with Sampling and Mixing a large representative batch (e.g., 100–200 kg). This bulk sample is then systematically reduced through Dividing and Reducing (Quartering): the pile is flattened, divided into four quadrants, and two diagonally opposite quadrants are discarded, with the remainder re-mixed. This reduction process is repeated until a manageable working sample (e.g., 20–30 kg) is achieved, ensuring the smaller sample retains the exact material proportions of the original waste stream.

The final reduced sample is then subjected to Sorting by Physical Composition to quantify the material breakdown. This analysis reveals the human and natural flow of materials: Organic Waste represents the biodegradable waste (food, plant residue); Plastic Waste and Others (metals, paper, textiles, e-waste) represent the human/industrial, synthetic flow, which is targeted for recycling or specialized recovery. The remaining non-recoverable material is designated as Landfill Waste.

FIGURE 22: VISUAL REPRESENTATION OF QUARTILE MENTHOD

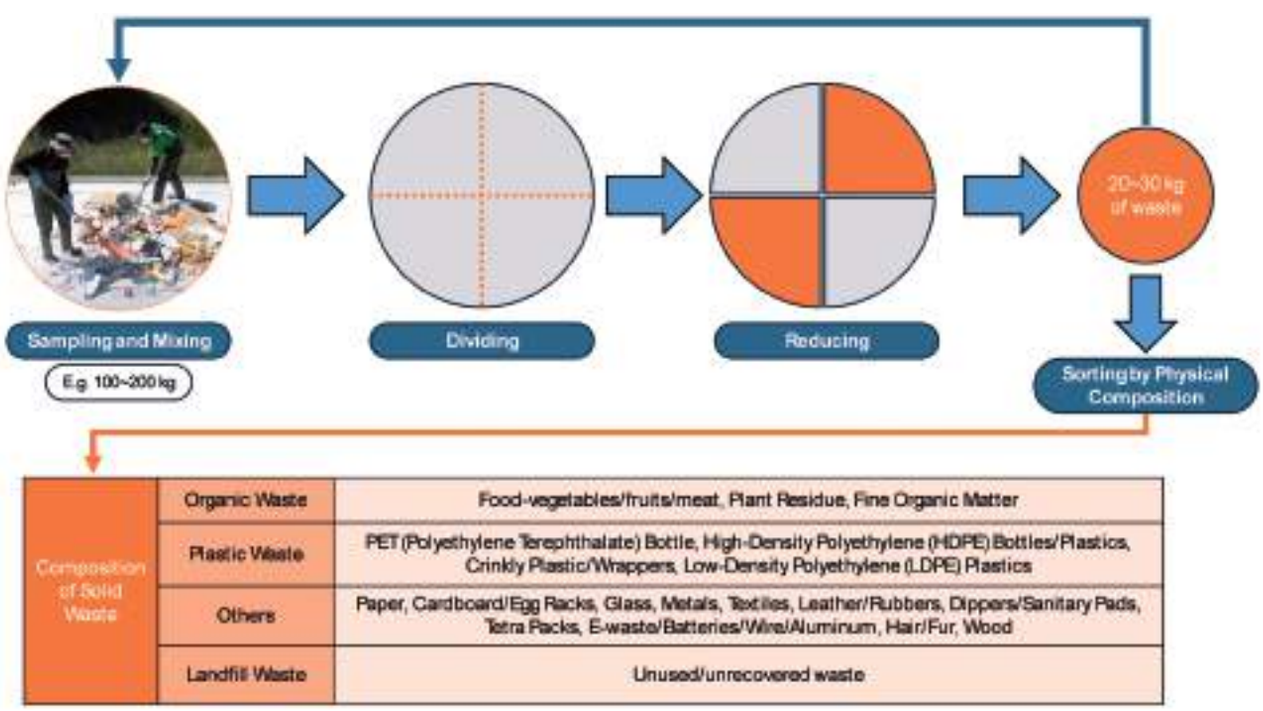
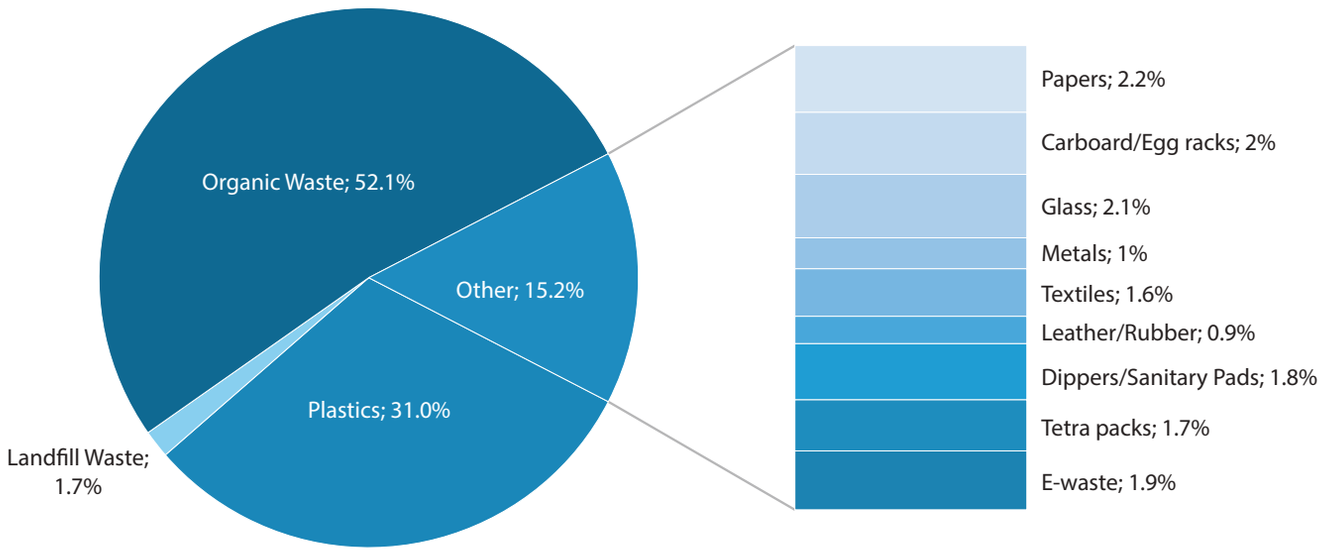


FIGURE 23: WASTE COMPOSTITON IN HOUSEHOLD



The waste characterization of households shows that more than half of the total waste generated (52.1%) is organic, which means there is a high potential for composting production if managed properly. Plastics waste makes up the second-largest portion at 31%, indicating a heavy use of plastic materials and the need for better reduction, recycling, and reuse systems. The remaining 15.2% includes various other materials such as paper, cardboard, glass, metals, textiles, rubber, diapers, tetra packs, and e-waste, most of which can be recycled if properly segregated. Only a small fraction (1.7%) ends up as landfill waste, showing that most of the waste could be diverted from dumpsites through better waste separation and resource recovery practices.

FIGURE 24: PLASTIC WASTE COMPOSITION

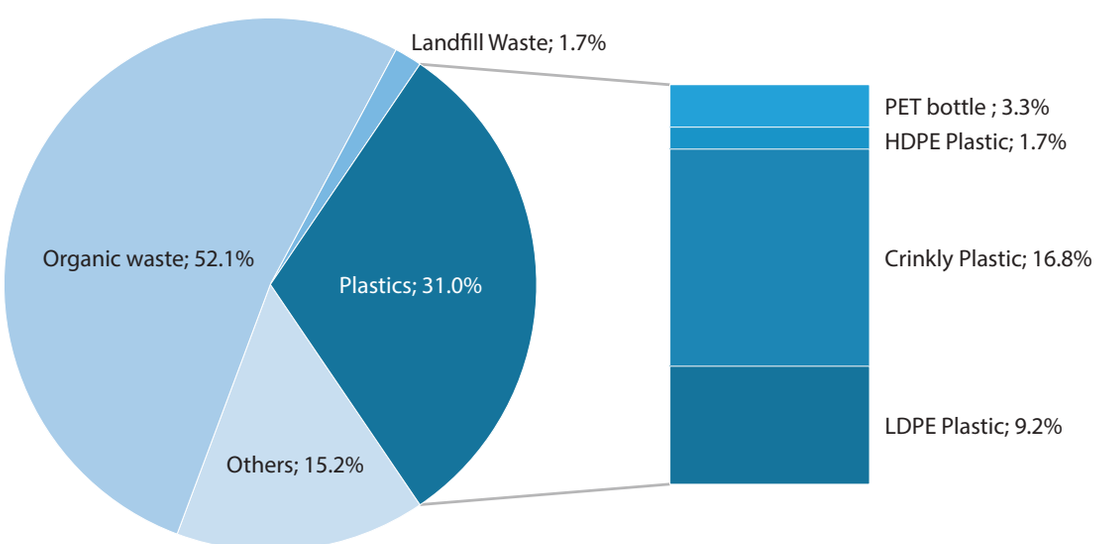
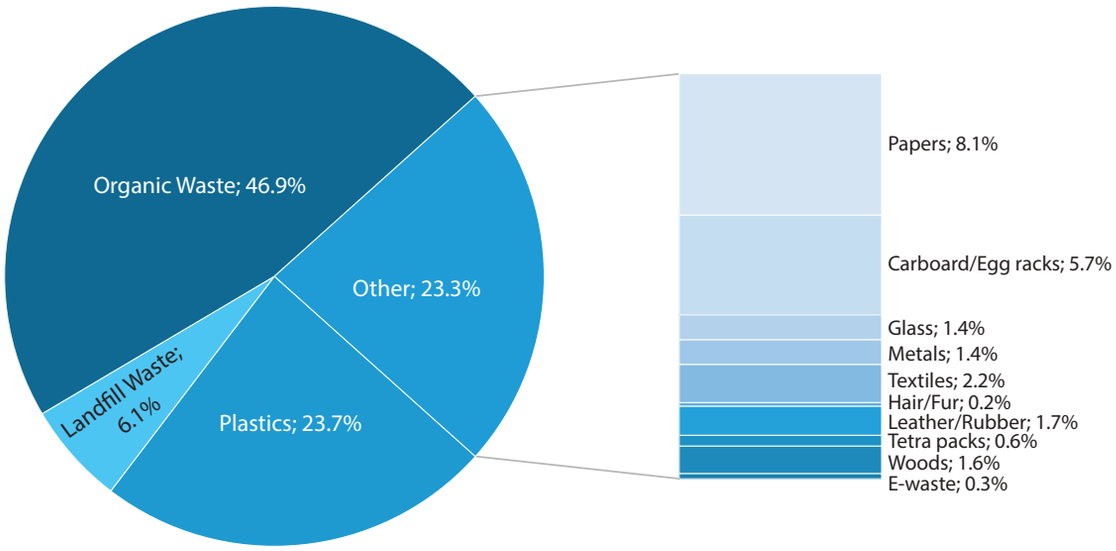
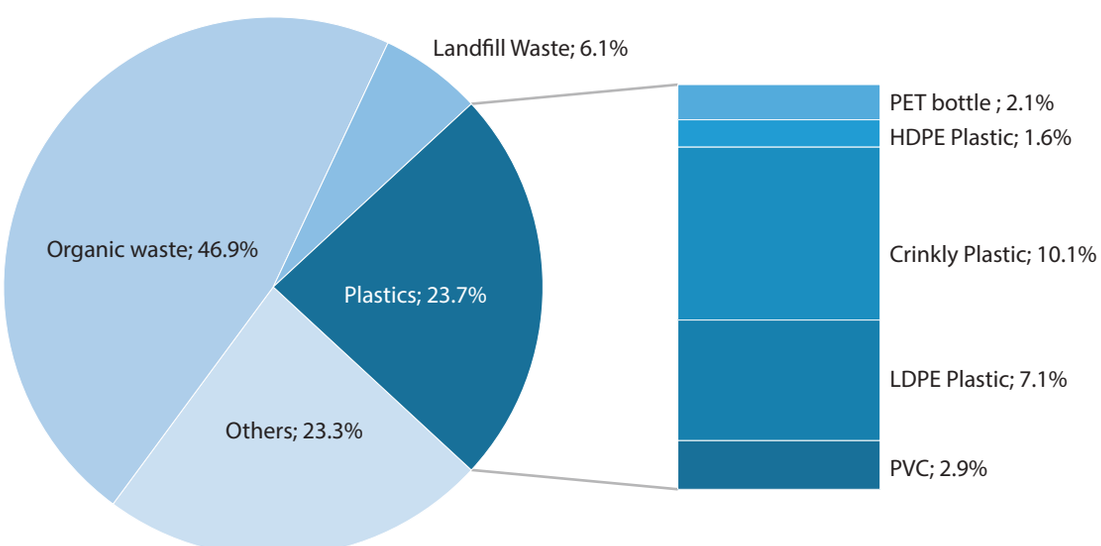


FIGURE 25: WASTE COMPOSITION IN COMMERCIAL



This chart highlights the types of waste produced by a commercial establishment, showing that most of it originates from food-related activities and packaging materials. Nearly half of the total waste (46.9%) is organic, which indicates that the establishment likely deals with food preparation or service, such as a restaurant, cafeteria, or grocery store. Plastics make up 23.7% of the waste, showing heavy use of single-use containers and disposable packaging, while the "Other" category (23.3%) mainly paper (8.1%) and cardboard or egg racks (5.7%) reflects the significant use of packaging and office materials in operations. Textiles (2.2%), leather or rubber (1.7%) and wood (1.6%) likely come from uniforms, furnishings, or maintenance tools, while recyclable metals (1.4%) and glass (1.4%) are still being discarded. E-waste (0.3%) indicates disposal of small electronics that require special handling, and landfill waste (6.1%) represents the truly non-recoverable portion.

FIGURE 26: PLASTIC WASTE COMPOSITION IN COMMERCIAL




SAMSUNG
COMMANDO

6 CHAPTER 6: RESULTS AND DISCUSSION

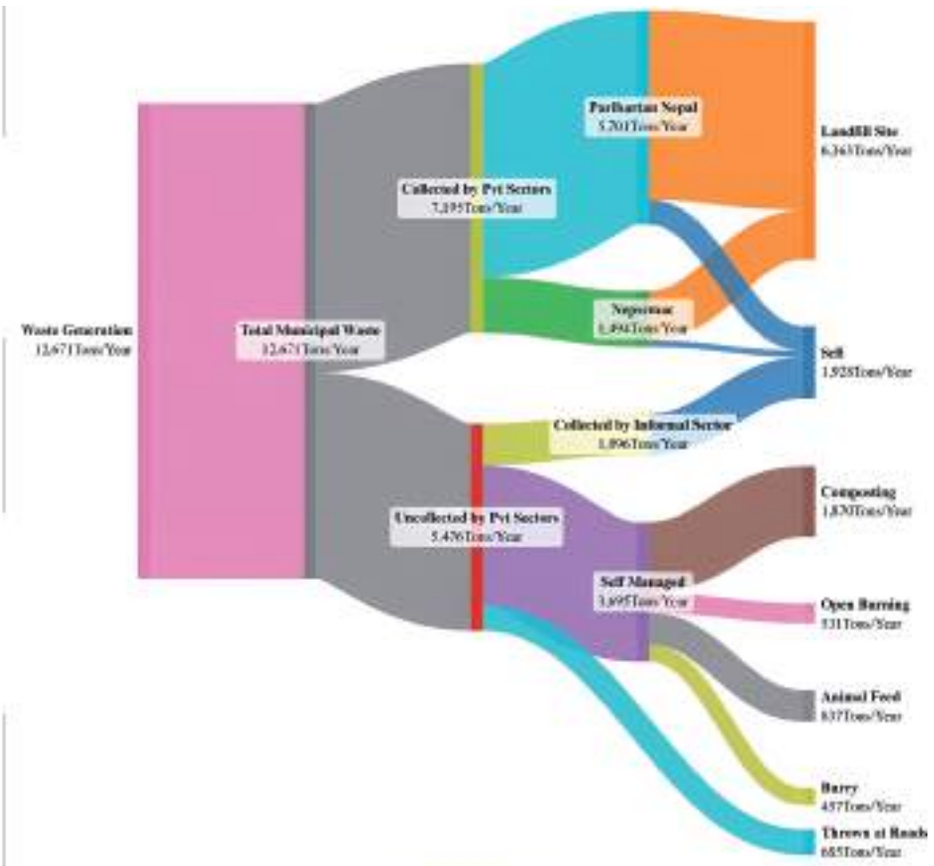
6.1 SANKEY Diagram

Banepa Municipality generates a total of 12,671 tons of waste each year. Of this, about 7,195 tons are collected by private contractors hired by the municipality, 1,096 tons are collected by the informal sector, and 5,476 tons remain uncollected. Around 88% (6,363 tons) of the collected waste is sent to the Okharpauwa landfill, while about 16% (1,928 tons) is recovered and sold through material recovery facilities and informal waste collectors (Kabadiwalas).

To reduce environmental impacts, the municipality should aim to bring uncollected waste into the formal system. This can be done by increasing segregated waste collection through more trucks and bins, and by strategically placing recycling facilities to reduce landfill dependency.

A household survey showed that a large share (around 2,707 tons/year) of uncollected waste is managed on-site. 15% is used as animal feed and 34% is composted at home, easing pressure on the municipal system. However, about 10% of uncollected waste is still burned or dumped openly. (IUWM, 2025)

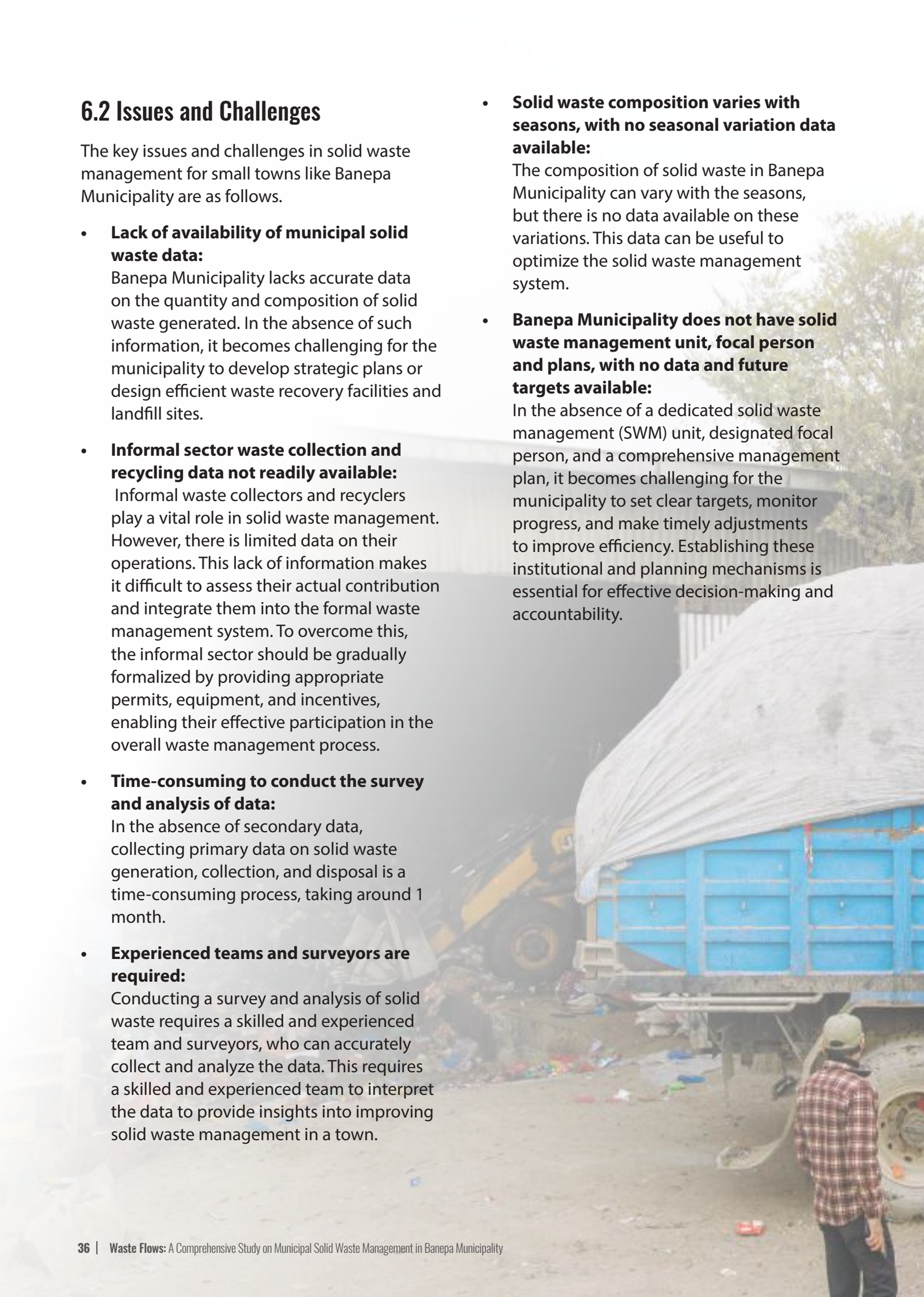
FIGURE 27: SANKEY DIAGRAM OF WASTE FLOW OF BANEPA MUNICIPALITY



6.2 Issues and Challenges

The key issues and challenges in solid waste management for small towns like Banepa Municipality are as follows.

- **Lack of availability of municipal solid waste data:**
  Banepa Municipality lacks accurate data on the quantity and composition of solid waste generated. In the absence of such information, it becomes challenging for the municipality to develop strategic plans or design efficient waste recovery facilities and landfill sites.
- **Informal sector waste collection and recycling data not readily available:**
  Informal waste collectors and recyclers play a vital role in solid waste management. However, there is limited data on their operations. This lack of information makes it difficult to assess their actual contribution and integrate them into the formal waste management system. To overcome this, the informal sector should be gradually formalized by providing appropriate permits, equipment, and incentives, enabling their effective participation in the overall waste management process.
- **Time-consuming to conduct the survey and analysis of data:**
  In the absence of secondary data, collecting primary data on solid waste generation, collection, and disposal is a time-consuming process, taking around 1 month.
- **Experienced teams and surveyors are required:**
  Conducting a survey and analysis of solid waste requires a skilled and experienced team and surveyors, who can accurately collect and analyze the data. This requires a skilled and experienced team to interpret the data to provide insights into improving solid waste management in a town.
- **Solid waste composition varies with seasons, with no seasonal variation data available:**
  The composition of solid waste in Banepa Municipality can vary with the seasons, but there is no data available on these variations. This data can be useful to optimize the solid waste management system.
- **Banepa Municipality does not have solid waste management unit, focal person and plans, with no data and future targets available:**
  In the absence of a dedicated solid waste management (SWM) unit, designated focal person, and a comprehensive management plan, it becomes challenging for the municipality to set clear targets, monitor progress, and make timely adjustments to improve efficiency. Establishing these institutional and planning mechanisms is essential for effective decision-making and accountability.



7 CHAPTER 7: WAY FORWARD

A potential way forward to improve the waste management situation in Banepa Municipality is to prioritize the recovery and recycling of waste materials. This goal can be achieved through the implementation of the following strategies:

Dedicated Solid Waste Management Unit and Designated Focal Person: Banepa Municipality continues to experience rapid urbanization; the volume and complexity of waste generation are increasing significantly. To meet these growing demands, the municipality must prioritize forward-looking planning, including investment in infrastructure, system development, and human resources. Proactive planning will ensure the municipality can deliver efficient, sustainable, and environmentally sound waste management services that support urban resilience and public health.

To mitigate those issues, dedicated Solid waste Management unit with designated focal person should have comprehensive solid waste management strategic plan. Banepa Municipality should develop its own solid waste management act, regulation and guidelines.

Establishment of Material Recovery Facility (MRF): Banepa Municipality should establish its own Material Recovery Facility (MRF) within the municipal area, supported by adequately trained human resources and efficient operational mechanisms. Developing such a facility would enable the municipality to recover a substantial volume of recyclable materials, reduce landfill dependency, and generate revenue from waste, ultimately promoting a more sustainable and circular waste management system.

Empowering Communities to Manage Waste at the Source: The Waste Flow Diagram (WFD) survey revealed that a substantial portion of wet waste is already being managed at the household level. This positive practice should be further encouraged and incentivized by promoting home composting and establishing community-level composting systems, supported with necessary infrastructure and services. Along with this, they should also reuse and recycle dry waste. Such initiatives would significantly reduce the volume of waste reaching central processing units, which are often found to be overburdened.

Formalizing Informal Waste Collectors such as Kabadiwalas and Ragpickers: Informal waste collectors, including kabadiwalas and ragpickers, play a crucial role in Banepa's waste management system by recovering recyclable materials and reducing the overall waste that ends up in landfills. However, their work often goes unrecognized, unregulated, and unsupported, leaving them without social protection, safety measures, or access to formal waste value chains.

To enhance the efficiency and inclusiveness of the waste management system, Banepa Municipality should take steps to formally integrate these workers into the municipal framework. This can be achieved by providing them with legal recognition, identity cards,

training in occupational health and safety, and access to protective equipment. In addition, the municipality can establish partnerships with cooperatives or private recycling enterprises to ensure fair pricing, consistent waste collection, and improved working conditions.

Formalizing this sector not only strengthens recycling and recovery rates but also promotes social inclusion, livelihood security, and environmental sustainability within the municipality.

Regular Monitoring and Evaluation of the Waste Management System: Establishing a consistent monitoring and evaluation (M&E) mechanism is essential to ensure the effectiveness, transparency, and sustainability of Banepa Municipality's waste management system. Regular assessment helps identify gaps in collection, segregation, transportation, treatment, and disposal processes, enabling timely interventions and continuous improvement.

Moreover, community feedback and stakeholder consultations should be incorporated into the evaluation process to reflect ground realities and improve service delivery. Periodic reviews and audits can also guide resource allocation, strengthen accountability, and inform policy adjustments.

A robust M&E framework not only enhances operational efficiency but also builds public trust, ensures environmental compliance, and supports evidence-based decision-making for a cleaner and more sustainable Banepa Municipality.

Data and insights obtained from the Waste Flow Diagram (WFD) can guide the development of a comprehensive and evidence-based waste management strategy. By leveraging this information, the municipality can make informed investments in appropriate technologies and infrastructure to enhance efficiency across the waste management chain.

Such strategic interventions would significantly reduce the volume of waste directed to landfills, while increasing material recovery and recycling rates. In doing so, the municipality can move towards a more sustainable, resource-efficient, and circular waste management system ultimately improving overall environmental health and urban livability in Banepa Municipality.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REFERENCES

Asian Development Bank. (2013). Solid waste management in Nepal : Current status and policy recommendations. https://www.adb.org/sites/default/files/publication/30366/solid-waste-management-nepal.pdf

Bajracharya, S., Adhikari, A., Shrestha, P. P., & Ghimire, A. (2022). Life-cycle assessment of solid waste management in Dhulikhel Municipality, Nepal. Journal of Environmental Engineering Science, 17(4), 147–154. https://doi.org/10.1680/jenes.21.00045

Bhattarai, K. (2015). Households' willingness to pay for improved solid waste management in Banepa Municipality, Nepal. Environment and Natural Resources Journal, 13(2), 14–25. https://www.thaiscience.info/journals/Article/ENRJ/10976742.pdf

Clean Energy Nepal & Environment and Public Health Organization. (2003). A report on solid waste management in Banepa Municipality.

Eunomia. (2016). Plastics in the marine environment. Bristol, UK.

Pokhrel, D., & Viraraghavan, T. (2005). Municipal solid waste management in Nepal: Practices and challenges. Waste Management, 25(5), 555–562. [https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=4319cc4fdb8a8b9dc1f92217fe2314125c49b08b]

Research Gate. (2022). Knowledge and practice regarding household waste management among middle aged adult people of Banepa Municipality. https://www.researchgate.net/publication/366547581_Knowledge_and_Practice_Regarding_Household_Waste_Management_among_Middle_Aged_Adult_People_of_Banepa_Municipality.

Shrestha, P. P., Ghimire, A., Dangi, M. B., & Uche, M. A. (2023). Development of a municipal solid waste management life cycle assessment tool for Banepa Municipality, Nepal. Sustainability, 15(13), 9954. https://doi.org/10.3390/su15139954

Velis, C. A., Zwirner, C. J., Iacovidou, E., Zaman, I. Z., Coker, S. J., & Brunner, S. (2020). User manual: Waste flow diagram (WFD): A rapid assessment tool for mapping waste flows and quantifying plastic leakage (Version 1.0). Eschborn: GIZ, University of Leeds, Eawag-Sandec, Wasteaware.

Wilson, D. C., Rodic, L., Modak, P., Soos, R., Carpintero, A., Velis, C., Iyer, M., & Simonett, O. (2015). Global waste management outlook. Nairobi: UNEP.

ANNEXES

Annex 1: WFD data collection format

Integrated Urban Water Management (IUWM/BORDA)
Household Survey Form on Municipal Solid Waste Management in Banepa Municipality
Ward 1

Surveyor Name		Day 1			Day 2			Day 3			Day 4			Day 5		
		Date:			Date:			Date:			Date:			Date:		
Code	House Owner	HH Size	Wet Waste	Dry Waste	HH Size	Wet Waste	Dry Waste	HH Size	Wet Waste	Dry Waste	HH Size	Wet Waste	Dry Waste	HH Size	Wet Waste	Dry Waste
1-1																
1-2																
1-3																
1-4																
1-5																

Integrated Urban Water Management (IUWM/BORDA)
Commercial Survey Form on Municipal Solid Waste Management in Banepa Municipality

Commercial Type: Car Accessories/Service Center

Name of Surveyor	Day 1		Day 2		Day 3		Day 4		Day 5	
	Date:		Date:		Date:		Date:		Date:	
Name of Car Accessories	Wet Waste	Dry Waste	Wet Waste	Dry Waste	Wet Waste	Dry Waste	Wet Waste	Dry Waste	Wet Waste	Dry Waste

Commercial Type: Electronics/ Mobile Shop

Name of Surveyor	Day 1		Day 2		Day 3		Day 4		Day 5	
	Date:		Date:		Date:		Date:		Date:	
Name of Vehicle Service Center	Wet Waste	Dry Waste	Wet Waste	Dry Waste	Wet Waste	Dry Waste	Wet Waste	Dry Waste	Wet Waste	Dry Waste

Annex 2: Data Collection sheet filled by enumerators

Integrated Urban Water Management (IUWM/BORDA)
Commercial Survey Form on Municipal Solid Waste Management in Banepa Municipality

Commercial Type: Financial Institutions/Banks/Cooperatives/Saving Credits

Name of Surveyor	Day 1		Day 2		Day 3		Day 4		Day 5	
Januka Suruwa	Date: 2082/3/29		Date: 2082/3/30		Date: 2082/3/31		Date: 2082/3/32		Date: 2082/3/33	
Name of Financial Institutions	Wet Waste	Dry Waste	Wet Waste	Dry Waste	Wet Waste	Dry Waste	Wet Waste	Dry Waste	Wet Waste	Dry Waste
1. 93 दुरुगाउँ सहकारी	0.000	0.160	0.175	0.060	0.045	0.170	0.200	0.065	0.260	0.000
2. 93 नारी चेतना	0.000	0.249	0.115	0230	0.100	0070	0075	0.070	0.065	0.260
3. 93 कृषा सहकारी	0.160	0.825	0.095	0.060	0060	0.060	0290	0.310	0.240	10160
4. 93 विजन सहकारी	0255	0065	0.075	0.060	0.050	0.065	0.355	0.100	0.385	0.120
5. 98 महिला विकास	0.430	0.090	0.100	0.110	0.000	0065	0.230	0.100	0.000	0.180
6. 98 लघुवित्त तथा विकास बैंक	1.095	1.260	2.955	0.195	0.335	0095	0.415	0770	1.975	0.285
7. 98 राष्ट्रीय सहकारी	0.000	0.090	0.000	0.045	0000	0.050	0.000	0.090	0000	0.1000
8. 98 कृषि सहकारी संस्था	0460	1.350	0.155	0155	0.255	0.075	0.150	0.200	0.100	0.000

Integrated Urban Water Management (IUWM/BORDA)
Household Survey Form on Municipal Solid Waste Management in Banepa Municipality
Ward 7

Surveyor Name		Day 1			Day 2			Day 3			Day 4			Day 5		
Gyanu Shrestha		Date: 2082/03/11			Date: 2082/03/12			Date: 2082/03/13			Date: 2082/03/14			Date: 2082/03/15		
Code	House Owner	HH Size	Wet Waste	Dry Waste	HH Size	Wet Waste	Dry Waste	HH Size	Wet Waste	Dry Waste	HH Size	Wet Waste	Dry Waste	HH Size	Wet Waste	Dry Waste
7-1	Arjun kayastha	5	0.700	0.225	5	0.750	0.245	5	1.290	0.100	4	0.45	0.779	4	0.220	0.15
7-2	Nhuche Shrestha	6	0.670	0.155	5	0.565	0.120	4	0.710	0.165	4	1.89	0.57	4	0.105	0.25
7-3	Krishna Gopal karanjit	5	0.480	0.185	4	0.220	0.085	5	0.475	0.105	2	0.70	0.22	2	0.72	0.16
7-4	Bhabindar Shrestha	4	0.580	0.60	4	0.385	0.095	3	0.570	0.45	4	1.26	0.25	2	0.59	0.42
7-5	Bijaunath Tamrakar	4	0.925	0.160	4	0.525	0.515	4	1.365	0.115	2	0.62	0.95	2	0.187	0.81
7-6	Jagadevi Shrestha	5	0.085	0.350	5	0.815	0.385	4	1.675	0.80	3	0.100	0.51	3	0.161	0.17
7-7	Bijaya kawar Shrestha	3	0.595	0.085	2	0.510	0.145	2	0.350	0.145	1	0.100	0.21	2	0.165	0.24
7-8	Narayan pd Nyaupane	3	0.650	0.265	2	0.140	0.140	3	0.555	0.150	1	0.65	0.15	3	2.02	0.78
7-9	Balaram Manandhar	5	0.800	0.065	4	0.600	0.275	4	0.625	0.50	2	0.77	0.30	2	0.150	0.26
7-10	Sonam chuhandhan	4	1.90	0.160	4	0.500	0.320	4	1.350	0.750	3	0.185	0.45	4	4.52	0.17

Annex 3: Questionnaire for household survey

1. General Information

Q. No.	Question	Response Field
1.1	Household Code	_____
1.2	Date	_____
1.3	Ward No.	Choose One: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
1.4	Name of Household Head	_____
1.5	Family Size (Number of members)	_____

2. Current Waste Management Practice

2.1 Do you separate your waste into different types (e.g., wet and dry)?

- ☐ Yes
- ☐ No

2.2 What types of waste do you separate? (If Q2.1 is Yes)

- ☐ Wet Waste (food scraps, peels, animal waste, agricultural residue, etc.)
- ☐ Dry Waste (paper, plastic bottles, metal, clothes, wood, plastic bags, etc.)
- ☐ Hazardous Waste (batteries, bulbs, etc.)
- ☐ Others (Please specify: _____)

2.3 How do you dispose of your DRY WASTE?

- ☐ Give it to the door-to-door or collection vehicle
- ☐ Sell to a scrap dealer (Kabadi)
- ☐ Take it directly to the dumpsite
- ☐ Take it to a community dustbin
- ☐ Burn it
- ☐ Bury it
- ☐ Throw it in the street or an open space
- ☐ Throw it in a stream or waterway
- ☐ Other (Please specify: _____)

2.4 (If you sell your waste) Which DRY waste do you sell?

- ☐ Paper / Cardboard
- ☐ Plastic (bottles, containers, etc.)
- ☐ Metal (cans, tins, etc.)
- ☐ Glass bottles
- ☐ E-waste (old electronics)
- ☐ Other (Please specify: _____)

2.5 How do you dispose of your WET WASTE?

- ☐ Compost it at home
- ☐ Feed it to animals
- ☐ Give it to the door-to-door or collection vehicle
- ☐ Take it to a community dustbin
- ☐ Bury it
- ☐ Throw it in the street or an open space
- ☐ Throw it in a stream or waterway
- ☐ Other (Please specify: _____)

2.6 How do you dispose of your HAZARDOUS WASTE (e.g., batteries, light bulbs)?

- ☐ Give it to the door-to-door or collection vehicle
- ☐ Mix it with our dry or wet waste
- ☐ Take it to a designated collection point
- ☐ Sell to a scrap dealer (Kabadi)
- ☐ Store it at home indefinitely
- ☐ Other (Please specify: _____)

2.7 How do you dispose of your mixed household waste? (If you answered "No" to Q2.1)

- ☐ Give it to the door-to-door/collection vehicle
- ☐ Take it to a community dustbin
- ☐ Take it directly to the dumpsite
- ☐ Burn it
- ☐ Bury it
- ☐ Throw it in the street or an open space
- ☐ Throw it in a stream or waterway
- ☐ Other (Please specify: _____)

2.8 Do you reuse any of the following items?

- ☐ Bottles, jars, or plastic bags
- ☐ Packaging materials (boxes, cartons, etc.)
- ☐ We do not reuse waste items
- ☐ Others (Please specify: _____)

3. Information about Collection Service

3.1 Which service do you currently use for waste collection?

- ☐ Municipal truck collection
- ☐ Door-to-door collection
- ☐ No service

3.2 How often does the municipal collection truck/door-to-door collection come to your area?

- ☐ Everyday
- ☐ Twice a week
- ☐ Once a week
- ☐ Irregularly / Don't know

3.3 Satisfaction: Overall, how satisfied are you with the current waste collection service?

- ☐ Very dissatisfied
- ☐ Dissatisfied
- ☐ Neutral
- ☐ Satisfied
- ☐ Very satisfied

4. Waste Management Improvement in Banepa Municipality

4.1 In your opinion, what is the main reason for waste on the streets and in waterways?

- ☐ Littering by residents
- ☐ No dustbin / not enough dustbins available
- ☐ Collection service is not regular or reliable
- ☐ Animals scattering waste from open dustbins
- ☐ Other (Please specify: _____)

4.2 Do you like to continue having the waste collection service?

- ☐ Yes
- ☐ No

4.3 To improve the service, how often would you like the waste to be collected? (If Yes to Q4.2)

- ☐ Everyday
- ☐ A few times a week
- ☐ Once a week

4.4 What time of day do you think is suitable for waste collection? (If Yes to Q4.2)

- ☐ Morning (before 9 am)
- ☐ Late Morning/Daytime (10 am - 2 pm)
- ☐ Afternoon/Evening (after 2 pm)

4.5 Would you be willing to pay a monthly fee for a reliable, daily door-to-door waste collection service?

- ☐ Yes
- ☐ No

4.6 If Yes to Q4.5, how much are you willing to pay per month for this service?

- _____ (Amount in Rupees)

4.7 GPS Location (For Surveyor Use)

- _____ (Geopoint)

Annex 4: Questionnaire for Commercial survey

1. General Information

Q. No. Question Response Type/Options

1.1 Date _____ (Date Field)

1.2 Ward No.

Choose One: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14

1.3 Type of Commercial Establishment

Choose One:

- ☐ Fancy Shop/Crockery Store
- ☐ Beauty Parlor/Salon
- ☐ Restaurant/Bakery/Cafe
- ☐ General Shop/Cold Store
- ☐ Electronics/Mobile
- ☐ Car Accessories/Service Center
- ☐ Jewelry/Goldsmith
- ☐ Hotel/Guest House
- ☐ Educational Institutions
- ☐ Office
- ☐ Pharmacy/Chemist
- ☐ Other (Please specify: _____)

1.4 Name of Business _____ (Text Field)

1.5 Owner's Name _____ (Text Field)

1.6 On average, how many employees work in this business daily? _____ _____ (Number Field)

2. Current Waste Management Practice

2.1 Do you separate your waste into different types (e.g., wet, dry)?

- ☐ Yes
- ☐ No

2.2 What types of waste do you separate? (Relevant if Q2.1 is Yes)

- ☐ Wet Waste (food scraps, peels, etc.)
- ☐ Dry Waste (paper, plastic, metal, clothes, wood, etc.)
- ☐ Hazardous Waste (batteries, bulbs, etc.)
- ☐ Other (Please specify: _____)

2.3 How do you dispose of your DRY WASTE (paper, plastic, packaging, cardboard)?

- ☐ Give it to the door-to-door collector / Municipal vehicle
- ☐ Sell to a scrap dealer (Kabadi)
- ☐ Take it directly to the dumpsite
- ☐ Burn it
- ☐ Bury it
- ☐ Throw it in the street or an open space
- ☐ Throw it in a stream or waterway
- ☐ Other (Please specify: _____)

2.4 (If you sell your waste) Which dry waste do you sell? (Relevant if 'Sell to a scrap dealer' is selected in Q2.3)

- ☐ Paper / Cardboard
- ☐ Plastic (bottles, containers, etc.)
- ☐ Metal (cans, tins, etc.)
- ☐ Glass bottles
- ☐ E-waste (old electronics)
- ☐ Other (Please specify: _____)

2.5 How do you dispose of your WET WASTE? (Relevant if Q2.1 is Yes)

- ☐ Give it to the door-to-door collector / Municipal vehicle
- ☐ Compost it
- ☐ Give it to a piggery or for animal feed
- ☐ Take it to the dumpsite
- ☐ Bury
- ☐ Throw it in the street or an open space
- ☐ Throw it in a stream or waterway
- ☐ Other (Please specify: _____)

2.6 How do you dispose of your HAZARDOUS WASTE (bulbs, batteries, chemicals)? (Relevant if Q2.1 is Yes)

- ☐ Give it to a designated collector / collection point
- ☐ Store it on site
- ☐ Mix it in with our other waste
- ☐ Not applicable / We don't generate any
- ☐ Other (Please specify: _____)

2.7 How do you dispose of your mixed commercial waste? (Relevant if Q2.1 is No)

- ☐ Give it to the door-to-door collection vehicle
- ☐ Take it directly to the dumpsite
- ☐ Burn or bury it
- ☐ Throw it in a public bin, street or stream
- ☐ Other (Please specify: _____)

3. Collection Service and Fee

3.1 Do you reuse any of the following items in your business?

- ☐ Bottles/jars or plastic bags
- ☐ Packing materials (boxes, cartons, etc.)
- ☐ We do not reuse waste items
- ☐ Others (Please specify: _____)

3.2 Which service do you currently use for waste collection?

- ☐ Municipal truck collection
- ☐ Door-to-door collection
- ☐ No service

3.3 How often is there municipal truck/door-to-door waste collection in your area? (Relevant if service is used)

- ☐ Everyday
- ☐ A few times a week
- ☐ Once a week
- ☐ Irregularly or never

3.4 Satisfaction: Overall, how satisfied are you with the current waste collection service? (Relevant if service is used)

- ☐ Very dissatisfied
- ☐ Dissatisfied
- ☐ Neutral
- ☐ Satisfied
- ☐ Very satisfied

3.5 Do you currently pay a user fee for waste collection? (Relevant if service is used)

- ☐ Yes
- ☐ No

3.6 If Yes to Q3.5, how much do you pay per month?
_____ (Amount in Rupees - Number Field)

4. Service Improvement

4.1 In your opinion, what is the biggest cause of the waste problem in public places?

- ☐ Littering by public/tourists
- ☐ Businesses not managing waste properly
- ☐ Collection service is not regular or reliable
- ☐ Not enough public dustbins
- ☐ Others (Please specify: _____)

4.2 To improve the service, how often would you like the waste to be collected?

- ☐ Everyday
- ☐ A few times a week
- ☐ Once a week

4.3 What time of day do you consider suitable for waste collection?

- ☐ Morning (before 9 am)
- ☐ Mid-day (10 am - 2 pm)
- ☐ Afternoon (after 3 pm)

4.4 Would you be willing to pay a monthly fee for a reliable, daily waste collection service that manages waste correctly?

- ☐ Yes
- ☐ No

4.5 If Yes to Q4.4, what monthly fee would be appropriate for such a service for your business?
_____ (Amount in Rupees - Number Field)

4.6 GPS Location (For Surveyor Use)
_____ (Geopoint Field)

Annex 5: Summary sheet of household waste calculation

N=213	Ward 1	Ward 2	Ward 3	Ward 4	Ward 5	Ward 6	Ward 7	Ward 8	Ward 9	Ward 10	Ward 11	Ward 12	Ward 13	Ward 14	TOTAL (KG)	TOTAL (gm)
HHs Size	4.5	5.4	5.3	4.1	4.7	4.0	3.5	5.0	4.6	3.5	4.3	6.0	4.8	5.6	*4.7*	
Wet Waste Per Day (kg)	0.389	0.604	0.407	0.402	0.475	0.522	0.504	0.569	0.573	0.513	0.568	0.616	0.455	0.420	***0.501***	***501.100***
Wet Waste Per Day Per Person (Per Capita in kg) [B/A]	0.086	0.113	0.077	0.097	0.100	0.130	0.145	0.115	0.124	0.146	0.132	0.103	0.095	0.074	***0.110***	***109.883***
Dry Waste Per Day (kg)	0.408	0.481	0.343	0.408	0.465	0.404	0.428	0.459	0.698	0.566	0.422	0.436	0.441	0.439	***0.457***	***457.008***
Dry Waste Per Day Per Person (Per Capita in kg) [D/A]	0.091	0.090	0.065	0.098	0.098	0.101	0.123	0.092	0.151	0.161	0.099	0.073	0.092	0.078	***0.101***	***100.867***
Total Waste Per Day (kg) [B+D]	0.797	1.085	0.750	0.809	0.940	0.925	0.932	1.029	1.272	1.079	0.990	1.052	0.896	0.859	***0.958***	***958.1***
Total Waste Per Capita (kg) [F/A]	0.177	0.203	0.142	0.195	0.198	0.231	0.268	0.207	0.275	0.307	0.231	0.176	0.187	0.152	***0.211***	***210.7***
Total Waste Per Capita (gm)	177.06	202.50	141.51	195.34	198.36	231.31	267.83	207.21	275.39	307.42	230.96	176.16	187.15	152.30	***210.7***	***TRUE***

Annex 6: Summary sheet of commercial waste calculation

Type	Sum of Wet Day 2	Sum of Wet Day 3	Sum of Wet Day 4	Sum of Wet Day 5	Total Average Wet	Sum of Dry Day 2	Sum of Dry Day 3	Sum of Dry Day 4	Sum of Dry Day 5	Total Average Dry	Total Average Waste	No of Sample	Total Type	Per Sample	Total Waste Generation Per Type
Beauty Parlour/Saloon	1.45	0.27	0.00	0.00	0.43	4.03	3.38	3.64	2.86	3.48	3.91	7	29	0.56	16.19
Boutique and Tailoring	3.99	4.04	4.50	5.00	4.38	7.72	10.56	8.90	14.73	10.48	14.86	8	0	1.86	0.00
Car Accessories/Service Center	0.00	0.00	0.00	0.00	0.00	3.10	2.23	0.68	0.00	1.50	1.50	2	30	0.75	22.52
Catering/Banquet/Party Palace	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1	8	0.00	0.00
Church	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.03	0.03	1	1	0.03	0.03
Cinema hall	0.00	0.00	0.00	0.00	0.00	0.21	0.66	0.36	0.30	0.38	0.38	1	3	0.38	1.14
Electronics/ Mobile Shop	0.00	0.00	0.00	0.00	0.00	1.38	0.70	0.53	0.14	0.69	0.69	2	21	0.34	7.23
Fancy Shop/Crockery	5.77	3.45	3.43	0.73	3.34	10.06	13.39	7.17	7.73	9.59	12.93	15	118	0.86	101.72
Financial Institutions	12.40	2.40	13.21	13.06	10.27	7.02	4.06	10.92	9.91	7.98	18.24	22	285	0.83	236.34
Gas industries	0.00	0.00	0.00	0.00	0.00	4.75	1.21	1.20	0.00	1.79	1.79	1	12	1.79	21.48
General Shops	28.36	18.60	10.53	17.28	18.69	8.17	7.99	12.48	6.49	8.78	27.48	25	281	1.10	311.40
Homestay/Hotel/Guest House/Lodge	0.00	0.00	0.00	0.00	0.00	0.26	0.41	0.90	0.88	0.61	0.61	1	15	0.61	9.13
Industries	155.45	206.88	206.90	109.97	169.80	173.09	183.13	182.42	181.28	179.98	349.78	13	508	26.91	13668.26
Jewelry/Gold Smith	0.15	0.20	0.10	0.20	0.16	0.56	1.00	0.50	1.44	0.87	1.04	1	13	1.04	13.46
Meat Shop	1.20	1.00	0.80	1.00	1.00	0.27	0.00	0.49	1.17	0.48	1.48	2	20	0.74	14.82
Office	0.87	0.00	2.04	1.78	1.17	7.60	3.96	3.75	4.48	4.95	6.12	19	195	0.32	62.77
Optical/Chemist/Pharmacy	0.00	0.00	0.00	0.00	0.00	1.87	1.97	1.25	1.33	1.60	1.60	6	62	0.27	16.57
Resort	35.00	35.00	35.00	35.00	35.00	145.00	145.00	145.00	145.00	145.00	180.00	1	8	180.00	1440.00
Restaurant/Bakery/Cafe	25.82	30.41	17.39	123.03	49.16	23.07	26.27	13.12	148.22	52.67	101.83	21	226	4.85	1095.91
School/Training Institute	11.92	0.00	13.04	13.93	9.72	2.83	0.00	0.81	2.27	1.48	11.20	4	48	2.80	134.40
Small and Cottage Industries	163.60	91.82	104.72	106.10	116.56	43.41	43.71	46.69	41.14	43.74	160.29	24	162	6.68	1081.99
Suppliers/Traders	6.75	0.00	0.11	0.00	1.72	1.93	0.00	3.63	0.98	1.64	3.35	3	30	1.12	33.50
Grand Total	**452.73**	**394.07**	**411.77**	**427.07**	**421.41**	**446.31**	**449.74**	**444.43**	**570.33**	**477.70**	**899.11**	**180**	**2075**	**233.83**	**18288.85**
					46.9"					53.1"					1 8.29

Annex 7: Summary sheet of total waste calculation

Demographic Data			
	Total	Waste Collection Wards	Waste Uncollection Wards
Total Households	13915	10036	3879
Total Population	67629	51574	16055
Floating Population		20%	0
Total Population including Floating Population	77944	61889	16055
Total Registered Commercial	2075		

Waste Generation Household			
Waste Generation Household Data	Generation	Waste Collection Wards	Waste Uncollection Wards
Total Waste Generation Per Capita (gm)	210.75	210.75	210.75
Total Waste Generation (gm)	16426655.20	13043064.08	3383591.116
Total Waste Generation (kg)	16426.66	13043.06	3383.59
Total Waste Generation (ton)	16.43	13.04	3.38

Waste Generation Sector Wise						
Waste Generation Household Data		Generation from Total Municipality Population	Collection from Served Wards		Waste Generation Commercial Data	
Total Wet Waste Per Day Per Person (kg)	0.1099	8564.69	6800.52	U	Total Wet Waste Per Day (Average) kg	4.13
Total Dry Waste Per Day Per Person (kg)	0.1009	7861.97	6242.55	V	Total Dry Waste Per Day (Average) kg	4.68
Total Household Waste Generation Per Day Per Person (kg)	0.2107	16426.66		W	Total Waste Generation (Average) kg	8.81
Total Household Waste Generation per Person (kg)	16426.66	16426.66	13043.06	X	Total Waste Generation in Commercial (kg)	18288.85
Total Houehold Waste Generation per Person (Ton)	16.43	16.43	13.04	V	Total Waste Generation in Commercial (Ton)	18.29
	47.3%					52.7%

Total Municipal Waste Generation (Sector Wise)	
Total Waste Generation (ton) [N+V]	34.72


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BANEPA MUNICIPALITY

WASTE FLOWS
A COMPREHENSIVE STUDY ON MUNICIPAL SOLID WASTE MANAGEMENT IN BANEPA MUNICIPALITY

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