National Waste Inventory Survey Report 2025

Department of Environment and Climate Change
Ministry of Energy and Natural Resources
Royal Government of Bhutan

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Preface

Acknowledgement

The National Waste Inventory Survey 2025 (NWIS-2025) represents a significant milestone in strengthening Bhutan's evidence-based approach to solid waste management. Conducted across six dzongkhags and multiple sectors, the survey provides a comprehensive update on waste generation, composition, management practices, and public perceptions, building on the 2019 baseline survey. The findings highlight the growing challenges associated with urbanization, economic development, and changing consumption patterns, while also reinforcing the importance of integrated and sustainable waste management systems. Importantly, the survey aligns with Bhutan's development philosophy of Gross National Happiness, the priorities of the 13th Five-Year Plan, and the country's commitments to the Sustainable Development Goals and international environmental conventions.

This is part of the *"Management of Plastic Waste and Circular Interventions on Plastics in South, Southeast Asia, and the Pacific"* project, a partnership between the United Nations Development Programme (UNDP) and the Department of Environment and Climate Change (DECC) with funding from The Coca-Cola Foundation (TCCF), and the Plastic Free Rivers and Seas for South Asia (PLEASE) Project, financed by the World Bank and implemented by the South Asia Co-operative Environment Programme (SACEP)

This report is the collective efforts and collaboration of numerous individuals and agencies. We extend our sincere appreciation to all those who contributed to the successful implementation of the survey, including field enumerators, data analyst, sectoral representatives, and reviewers who ensured the quality and credibility of the findings. We are particularly grateful for the guidance and technical support received from the National Statistics Bureau (NSB) throughout the process, which has enabled the development of robust and reliable national waste data to inform policy and planning.

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Glossary of Terms and Acronyms

Acronym	Full Form / Definition
AD	**Anaerobic Digestion** Is a biological process in which microorganisms break down organic (biodegradable) material in the absence of oxygen. It is widely used to treat wet and organic waste, such as food waste, animal manure, sewage sludge, and agricultural residues.
BES	**Bhutan Ecological Society** A civil society organization promoting sustainable development and environmental conservation in Bhutan.
BWB	**Bhutan Waste Bank** An initiative aimed at promoting waste segregation, recycling, and sustainable waste management practices.
CSO	**Civil Society Organizations** Non-governmental, non-profit organizations working on various development and advocacy activities in Bhutan.
DECC	**Department of Environment and Climate Change** Government agency responsible for implementing environmental policies and climate-related programs in Bhutan.
DEM	**Digital Elevation Model** A 3D representation of a terrain's surface, commonly used in GIS for topographic analysis.
DOC	**Drop-off Centres** Designated facilities where the public can dispose of segregated waste for further processing or recycling.
EPR	**Extended Producer Responsibility** A policy approach making producers responsible for the post-consumer stage of their products, especially packaging waste.
EU	**European Union** A political and economic union of 27 European countries, often a partner in development projects.
	Forest Management Units Demarcated forest areas under scientific management for sustainable use and conservation.
GIS	**Geographic Information System** A framework for capturing, managing, analyzing, and visualizing spatial and geographic data.
HDPE	**High-Density Polyethylene** A strong plastic polymer used in containers, piping, and plastic bottles; widely recycled.

Acronym	Full Form / Definition
LDPE	**Low-Density Polyethylene** A flexible plastic polymer used in packaging; less commonly recycled than HDPE.
MRF	**Material Recovery Facility** A specialized facility for sorting and processing recyclable materials.
NWIS	**National Waste Inventory Survey** A national-level survey to collect data on waste generation, types, and management practices.
NWMS	**National Waste Management Strategy** A guiding document for implementing integrated and sustainable waste management across Bhutan.
PE	**Polyethylene** A common plastic polymer used in packaging; includes variants like HDPE and LDPE.
PET / PETE	**Polyethylene Terephthalate** A widely used plastic in beverage bottles and food containers; recyclable.
PLEASE	**Plastic Free Rivers and Seas for South Asia** A regional initiative to reduce plastic pollution through systemic and collaborative efforts.
PP	**Polypropylene** A versatile plastic used in textiles, packaging, and automotive components.
PPPs	**Public-Private Partnerships** Collaborative agreements between government and private sector to deliver infrastructure or services.
PS	**Polystyrene** A plastic polymer used in disposable cutlery, packaging, and insulation; difficult to recycle.
RVM	**Reverse Vending Machine** A machine that accepts empty beverage containers and returns a monetary or token reward.
RDF	**Refuse Derived fuel** Is a solid waste processing technology that converts waste into fuel using its calorific value.
SACEP	**South Asia Co-operative Environment Programme** An inter-governmental organisation established in 1982 by the South Asian governments to promote and support the protection, management and enhancement of the environment in the region.
SOPs	**Standard Operating Procedures** Step-by-step instructions to ensure consistency and compliance in operations.
SDGs	**Sustainable Development Goals** The Sustainable Development Goals (SDGs), also known as the Global Goals,

Acronym	Full Form / Definition
	were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity.
TS	**Transfer Stations** Transfer Stations are intermediate waste handling facilities where waste is temporarily stored, sorted, or consolidated before being transported to a final disposal or treatment site.
WCF	**Waste Collection Facility** A facility designed to collect, store, and transfer waste for further processing.
WCP	**Waste Collection Points** Waste Collection Points are designated locations where waste is gathered from households, institutions, or businesses for routine collection by municipal or private waste service providers.
WPMA	**Waste Prevention and Management Act** A national legislation that governs waste management practices and responsibilities in Bhutan.

Executive Summary

Solid waste management in Bhutan is evolving due to urbanization, commercial growth, changing consumption patterns, and stronger policy frameworks. The National Waste Inventory Survey 2025 (NWIS-2025) updates national data on waste generation, composition, management practices, and public perception, building on National Waste Inventory Survey 2019 Report (NWIS-2019). The findings will inform national planning and programming, aligning with the principles of Gross National Happiness, 13th Five-Year Plan, and supports Bhutan's commitments under the SDGs and other international conventions. The survey covered six dzongkhags, across urban and rural areas, and five sectors of households, Industry, Commercial, Institution and Health facilities, using perception surveys and waste collection, weighing, and composition analysis.

Bhutan generates about 240,940 kilograms of waste daily and the per capita waste generation 0.31 kilograms a day, representing a 40 percent increase from the 172,161 kilograms reported in the NWIS 2019. On an average waste generation increased by about 6.6 percent annually for the six years. The commercial sector contributes over half (53.8 percent) of this amount, nearly doubling since 2019, while household waste accounts for 34.7 percent. Industrial waste is 5.9 percent, with institutes 4 percent (schools -1.7 percent, monasteries -1.5 percent, government offices-0.8 percent), and medical waste 1.6 percent. Of the total daily waste generated 50 percent is wet, followed by 32 percent dry, 17 percent plastic and about 1 percent medical waste.

Households

The household survey was stratified by urban and rural areas. Together, households from these two strata account for nearly one-third (83,634 kilograms per day) of the country's total daily waste generation. On an average, urban households generate 0.75 kilograms per household per day compared to 0.42 kilograms per household per day generated by rural areas. Increased waste production in urban areas can be attributed to higher incomes and increased dependence on packaged and processed goods. Household waste is primarily composed of wet waste 61 percent, dry waste 20 percent, and plastic waste 19 percent. Food waste, which falls under wet waste, accounts for two thirds of the total waste generated by households. Furthermore, urban households generate twice the amount of plastic waste, averaging 0.16 kilograms per day compared to 0.07 kilograms in rural households. Nearly 96 percent of the households are aware of the segregation of dry and wet waste. However, a significant gap exists between knowledge and practice, as majority of households that are aware do not implement waste segregation. Food waste is often disposed of together with general waste. A total of 86 percent of urban households reported disposing food waste together with general waste, whereas 47 percent of rural households indicated that they compost food waste or feed it to animals. Regarding plastic waste, 42 percent of urban households and 46 percent of rural households reported reuse of plastics for other purposes. About 59 percent of households reported disposing plastic waste with general waste.

Commercial Establishments

Commercial units include retail/wholesale shops, hotels, restaurant and bar, hardware and electronic shops, repair shops and small-scale manufacturing units among others. Commercial sector generates 129,582 kilograms of waste per day which represents 54 percent of the country's total daily waste generation. Wet and plastic waste together constitute approximately two-thirds (65 percent) of commercial waste, indicating a strong linkage to perishable food waste and single-use plastics. Approximately one-fourth of respondents reported that reusing plastic materials and packaging forms

is part of their practices, reflecting efforts to extend the lifespan of such products. In addition, 3 percent of establishments indicated selling plastic waste to scrap dealers. About 96 percent of establishments expressed the view that regulation is necessary to manage non-biodegradable plastic waste. Of these, 70 percent reported awareness of government-imposed penalties for the use of single-use plastic bags, while nearly one-fifth (20 percent) were not aware of such regulations.

Institutions

Under institutes it covers schools, government offices and monasteries. They collectively generate a total of 9,511 kilograms of waste per day, with schools contributing the largest share at 4,031 kilograms. Across all three institutional categories, wet waste constitutes the predominant fraction approximately 47%. The survey revealed that there exists a significant gap in waste management practices, as substantial quantities of recyclable materials continue to be disposed together with general waste.

1. Schools

This category includes Lower, Primary, Middle, and Higher Secondary Schools. In total, the sector generates approximately 4,031 kilograms of waste per day, comprising primarily wet waste (47%), followed by dry waste (36%) and plastic waste (17%). A further breakdown shows that food waste accounts for 30 percent of the total, making it the largest share, while paper waste contributes 18 percent. Plastic waste accounts for 17 percent. Most schools (70 percent) report segregating dry and wet waste; however, less than half (47 percent) undertake segregation specifically for recycling or reuse. The most commonly segregated materials are cardboard and paper, with 44 percent of schools targeting these for recycling. The most frequently reported waste-related challenge is the lack of garbage disposal facilities, affecting 34 percent of schools, followed by irregular collection timing (29 percent), highlighting gaps in waste management infrastructure and service efficiency.

2. Government offices

The survey covered government offices at various administrative levels, including central, regional, autonomous, and Dzongkhag-level institutions. On average, an employee in government offices generates 0.127 kilograms of waste per day, which is lower than the 0.19 kilograms reported in NWIS 2019. The composition of this waste consists of wet waste (46 percent), dry waste (28 percent), and plastic waste (26 percent). In aggregate, waste generated from government offices is estimated at 1,827 kilogram of waste per day. Nearly half of government offices (45 percent) report segregating paper, cardboard, and PET bottles from wet waste; however plastic waste is mixed with general waste. A majority of offices located in rural areas cited the lack of waste collection and disposal services as a major challenge, while one-third of offices (32 percent) with access to municipal services reported infrequent waste collection, highlighting gaps in service coverage.

3. Monasteries

The survey from monasteries includes Dratshang, Lobdra, Shedra, and Lhakhang. The monasteries generate approximately 3,653 kilograms of waste daily, which is about 0.457 per capita per day. The waste comprises of wet waste (47 percent), dry waste (36 percent), and plastic waste (17 percent). About 42 percent of respondents reported disposing of food waste either by feeding it to animals or through composting, while a similar proportion (42 percent) indicated that food waste is mixed with general waste. Regarding plastic waste, three-fourths (76 percent) of respondents stated that it is combined with general waste, whereas nearly 14 percent reported repurposing plastic for other

purposes.

Industries

Under the industry category, only medium and large industries are included to ensure comparability with the NWIS 2019. Industrial units in Bhutan generate 14,360 kilograms of waste per day, accounting for 6 percent of the nation's total solid waste stream. Dry waste constitutes the largest share at 77 percent, followed by plastic waste at 15 percent and wet waste at 8 percent. Within the dry waste category, recyclable materials such as paper (60 percent) and metal scraps (33 percent) are dominant. Plastic waste is primarily composed of Polypropylene (PP), which represents 52 percent and is widely used in packaging materials, food packaging, and household products. Waste collection and disposal are managed through services provided by informal private vendors and municipalities. Internal reuse (24 percent) and selling to recyclers (25 percent) are common practices, reflecting industries' efforts to promote circular economy approaches by reutilizing materials in operations or diverting them into recycling markets. Around 75 percent of respondents reported that they are aware of the polluter pay principle and penalties but lacked detailed understanding of it.

Medical (Healthcare facilities)

The survey included Primary Health Centre (PHC), Dzongkhag Hospital, Regional Referral and a National Referral Hospital. Bhutan's healthcare sector generates 3851 kilograms of waste per day. This waste stream comprises general waste, non-hazardous materials, medical waste (including infectious, sharps, pathological, pharmaceutical, and chemical categories), and plastic waste. On-site segregation and incineration are commonly practiced; however, the use of authorized biomedical waste vendors and proper recycling systems remains largely absent. In rural centers, waste is often managed through burning or disposal in pits.

1 Introduction

1.1 Background

Bhutan's Constitution enshrines the principle of environmental stewardship, which has been translated into progressive national strategies such as the Waste Prevention and Management Act 2009 and the subsequent Waste Prevention and Management Regulation 2012. These policy instruments are complemented by the vision for Zero Waste Bhutan by 2030, which institutionalises both behavioural change and system-level transformation toward sustainable waste management.

Since the release of the National Waste Inventory Survey (NWIS) Report in 2019, several significant and forward-looking developments have been initiated:

- The Waste Prevention and Management Regulation of 2012 introduced enhanced compliance mechanisms, incentives for recycling, mandatory source segregation, and provisions for Extended Producer Responsibility (EPR).
- Local Governments and Thromdes have improved waste management infrastructure by establishing Material Recovery Facilities (MRFs), transfer stations, and enhancing collection and transportation services.
- Citizen engagement initiatives, such as the Zero Waste Hour, nationwide awareness campaigns, and school-based education programs, have increased the reach and adoption of the 3Rs (Reduce, Reuse, Recycle) philosophy within communities.
- The 13th Five Year Plan (FYP) reinforces waste management as a critical development priority, connecting it to environmental sustainability, public health, youth engagement, and climate action.

Building on this foundation, the National Waste Inventory Survey 2025 (NWIS 2025) aims to update the 2019 baseline, evaluate sectoral progress, and provide evidence-based insights to inform strategic planning and programming in alignment with the principles of Gross National Happiness, Sustainable Development Goals (SDGs) and relevant global conventions.

1.1.1 Objective

The National Waste Inventory Survey 2025 intended to:

- Update the daily solid waste generation (dry, wet, and plastic), by households, health, institutions, industries, and commercial entities.
- Estimate the daily per capita waste generation in by households in both urban and rural areas.
- Understand and document the methods of waste segregation, collection, and disposal across sectors.
- Enable the estimation of GHG emissions from different waste streams for national reporting under climate agreements.
- Provide an update that is spatially disaggregated data to inform infrastructure investment, local government planning, and policy development.

1.1.2 Scope and coverage

The National Waste Inventory Survey (NWIS) 2025 provides nationally representative estimates of waste generation. The survey covered households, industries, commercial establishments,

institutions, health facilities, and the informal sector across selected Dzongkhags.

Daily waste generation was estimated by type (dry, wet, and plastic) for households, industries, institutions, commercial establishments, and health facilities. This represents an additional level of disaggregation compared to the 2019 survey, which classified waste only into solid and wet categories, with plastics included under solid waste.

1.2 NWIS 2019 and NWIS 2025

Over the past six years since the National Waste Inventory Survey (NWIS) 2019, significant progress has been made in waste management initiatives, policy development, and data availability. The NWIS 2025 provides three categories of waste plastic, dry, and wet waste, whereas in 2019, plastic waste was subsumed under the dry waste category.

The commercial establishment category in 2025 is consistent with 2019 classifications. For institutions, the 2025 survey includes samples from schools only whereas the 2019 survey included not only schools but also colleges and training institutes.

The Government Offices samples include central, regional, autonomous, and Dzongkhag-level offices. Waste generation was estimated using the daily per capita waste generation rate for civil servants, applying the same methodology as in 2019 (total waste divided by the number of civil servants).

The Annual Industrial Survey 2023–24 sample frame was used for the survey, while in NWIS 2019, the sample frames were derived from administrative offices/ministries. However, adjustments were made in the frame to make two surveys comparable. The hospital sample frame remains consistent between 2019 and 2025, and household samples in both rural and urban areas are also comparable.

In addition to the sectors covered under NWIS 2019, NWIS 2025 includes monasteries as an additional sector, recognizing that they generate a relatively high volume of waste.

2 Survey Methodology and Operations

2.1 Overview

The updating of the National Waste Inventory Survey employed a multi-dimensional methodological framework to ensure coverage of Bhutan's waste landscape. The approach combined quantitative measurements of waste generation and composition with qualitative insights drawn from structured perception surveys. This hybrid methodology enabled both empirical validation of waste data and deeper understanding of public behaviour, service access, and sectoral practices.

The methodology was designed to ensure comparability with the 2019 baseline, integrate updates aligned with international standards (e.g., UNEP Guidelines on Waste Statistics[1], SDG indicators), and capture spatial and sectoral variation across Bhutan.

2.2 Planning and Preparation phase

Desk Review and Methodological Refinement

Existing survey tools and field protocols from NWIS-2019 were reviewed to identify areas for improvement. Sector-specific questionnaires were designed and revised as per the inputs received from UNDP, NSB, DECC and other stakeholders. Six different questionnaires for households, industries, commercial establishments, institutions, health and the informal sector[2] were prepared in consultations. The necessary approvals from NSB for the survey were obtained. This followed pre-testing and Piloting: Tools were piloted in Thimphu to assess clarity, response time, and logistical challenges. Field manual and checklist were prepared to use as reference for selecting respondents and weighing waste in interpreting the questions.



Picture 1 Training on Sampling Methodology



Picture 2 Survey Enumerators with Resource Persons

2.3 Data Collection methodology

Updating of the NWIS 2019 involved a dual approach comprising waste quantification and perception surveys. The methodology adopted was aligned with the approach used in the NWIS 2019 to ensure comparability of findings over time.

[1] https://www.unep.org/resources/global-waste-management-outlook-2024

https://cwm.unitar.org/national-profiles/publications/cw/wm/UNEP_UNITAR_NWMS_English.pdf.

[2] For informal sectors from scrape dealers only perception was collected

For waste quantification, actual waste volume and composition were determined through the collection, segregation, and weighing of waste generated by households and commercial facilities using calibrated digital scales and spring balances. Selected households identified based on the approved sampling methodology were provided with biodegradable bags and instructed to segregate waste into three categories: wet waste, dry waste, and plastic waste. Trained enumerators subsequently collected and weighed the segregated waste to ensure consistency and precision in measurement.

For industrial, institutional, and healthcare sectors, waste quantification data were collected through consultations with facility managers, review of existing records, waste collection logs, and operational logbooks.

Field data collection was conducted over an extended period from May to June. The survey did not rely solely on short-duration measurement of waste generation. Instead, households and commercial establishments reported or presented accumulated waste generated over varying durations. In particular, dry waste, which is often stored for several days or weeks before disposal, was commonly measured as accumulated weekly or monthly waste. These quantities were subsequently standardized into estimated daily generation values (e.g., weekly quantities divided by seven days and monthly quantities divided by thirty days). This approach is consistent with the methodology adopted in the NWIS 2019, where accumulated waste quantities (collected for 7 days) were standardized into daily waste generation estimates, thereby ensuring comparability of findings over time.

A perception survey was conducted through structured interviews using Epicollect5 digital forms to collect data on public awareness, behaviour, and overall satisfaction with existing waste management services. The survey covered areas such as the availability and utilisation of waste management services, awareness and practice of the Reduce, Reuse, and Recycle (3R) principles, current waste segregation practices, and the role of gender in household waste management.

Throughout the survey process, strict ethical safeguards were observed, including obtaining informed verbal consent from all participants, ensuring the confidentiality of responses, and clearly communicating that participation in the survey was entirely voluntary.

2.4 Procedure for data collection

Field data collection was conducted from May to June. 11 trained enumerators and 4 supervisors were deployed to administer the extensive data collection. The field team was supported by Dzongkhag Environment Officers, who served as local liaisons, facilitating in smooth execution during survey.



Picture 3 Training on how to use Epicollect App



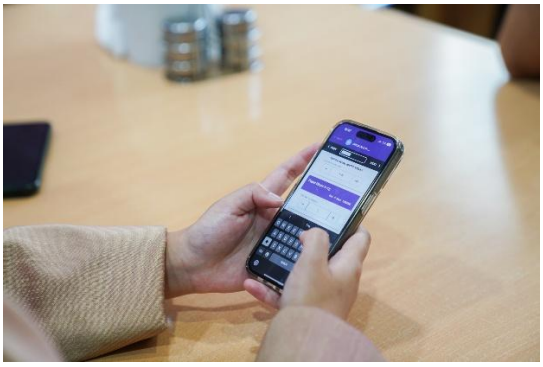
Picture 4 Fresher training to the Enumerators

Within each selected Enumeration Area (EA), a complete listing of households was first conducted. Households were then selected using systematic random sampling prior to the administration of the questionnaire. Before interviews commenced, enumerators used standardised scripts to brief respondents and obtain informed participation. In cases where selected households were not reachable, a minimum of three revisit attempts was made at different times before considering non-response. Systematic visits were also carried out to all selected sample units for accurate waste quantification, in line with the survey methodology.

Data flow and quality assurance:

To guarantee data flow and quality assurance, all data collected via Epicollect5 was uploaded daily to a central system for immediate review. Supervisors played a critical role in maintaining data integrity by conducting checks on each of the samples, verifying the accuracy and completeness of the collected information at the end of daily survey.

Additionally, health and safety were prioritised, with all enumerators consistently using gloves and masks, and adhering to necessary safety protocols wherever applicable during their field activities.





Picture 5 & 6 Enumerator conducting a survey at a commercial sector

2.5 Sampling methodology

Sampling frame

Multiple sampling frames were used, as the survey covered different types of units. The sampling frame for households was prepared using the Population and Housing Census and and for commercial units from Economics Census of Bhutan 2018-2019. The Annual Industrial Report 2023-24, published by the Ministry of Industries, Commerce, and Employment, provided the frame for industrial sampling. Additionally, the Annual Health Bulletin 2024, which offers a detailed account of health facilities in Bhutan, was used as the sampling frame for health-related data. The school frame was based on administrative data from the Department of School Education. The frame for monasteries was prepared based on the administrative information from Dratshang Lhentshog and relevant local monastic authorities.

Sample design

The sample was designed to generate national-level indicators. In addition, the household sample was structured to produce separate indicators for urban and rural areas. Given the diversity of sampling units covered by the survey, different sampling techniques were applied, as a single uniform approach would not be suitable for all unit types.

(i) Sampling of Households

A stratified three-stage sampling design was adopted to collect data on household waste generation and perceptions. Dzongkhags were selected using Probability Proportional to Size With Replacement (PPSWR), with the number of households used as the measure of size. Within selected Dzongkhags, Enumeration Areas (EAs) and Chiwogs were also selected using PPSWR. At the final stage, households were selected using Circular Systematic Sampling (CSS).

This design ensures representativeness at both national and urban–rural levels.

(ii) Sampling of Commercial Units, Industries, Health Facilities, and Institutions

For commercial units, industries, health facilities, and educational institutions, a quota sampling approach a non-probabilistic form of stratified sampling was applied. Sampling units were allocated across strata within the selected Dzongkhags.

Commercial units were stratified into wholesale/retail and other service categories, including construction, manufacturing, repair services, tailoring, grocery stores, restaurants, and hotels. Industries were stratified into medium and large enterprises. Health facilities were stratified into national and regional referral hospitals, Dzongkhag headquarters hospitals, Primary Health Centres (PHCs), and Sub-Posts. Schools were stratified into primary, lower secondary, middle secondary, and higher secondary levels.

Sample sizes were allocated to each stratum across the selected Dzongkhags to ensure balanced coverage of unit types.

Assigning Weights

Sampling weights were computed to allow the survey findings to be generalised to the national level. For households, sampling weights were derived based on the probabilities of selection at each stage of sampling, including Dzongkhags, Enumeration Areas (EAs), Chiwogs, and households. For other sampling units, the sampled units from the selected Dzongkhags were assumed to be representative of the corresponding populations at the national level.

The selected Enumeration Units (EUs) for households were assigned to sampling weights as different units have unequal probabilities of selection under PPS. Z is the population size, n; number of units selected. P is the probability and sample weight in inverse of the probability of selection.

$$P_{i=}\frac{Z_i}{\sum_j^i Z} \text{ and weight is } W_e = \frac{1}{P_1}$$

Households' weight within the selected EA. Each household has equal probability of selection. $P_{h=}\frac{y}{Z_I}$ and weights assigned to households $w_{h=\frac{1}{P_h}}$

The Dzongkhag probability was calculated by the PPS method P_d. And the inverse of the weight of probability $w_{d.}$ The cumulative weight was assigned to each case

$$W_{i=} W_e \times W_i \times W_d$$

Sample size

The sample size was carefully determined and distributed across key sectors to ensure comprehensive coverage. It included distinct sample sizes for urban and rural households from six Dzongkhags across three regions, accounting for their differing waste-generation patterns and management practices.

The number of sample units enumerated for different types of sampling units are presented as follows:

Sampling Units	Numbers
Household	1060
Industrial Establishments	4
Institutes	52
Monasteries	20
Government Offices	12
Schools	20
Commercial	126
Medical Facilities	17
Total Sampling Units	**1,259**

2.6 Analysis and dissemination

Data processing and analysis

Initially, raw survey data, collected through questionnaires, is validated to check for completeness, accuracy, and any logical inconsistencies. This includes identifying missing values, detecting outliers, and correcting errors, which might involve cross-referencing with other data points or revisiting the source if possible. Following validation, the data were typically cleaned, coded, and transformed into a structured format suitable for statistical software, often involving the standardisation of categories and units, like converting all waste weights to kilograms per day. Data analysis involved Descriptive statistics to summarize the main features of the data. For instance, this included calculating percentages, averages (like the average weight of waste generated per household), and frequencies (like the percentage of households using a particular disposal method). This was followed by generating cross tabulations and statistical analysis to estimate the waste generated by various sectors.

Limitations of the report

Non-domestic waste from households and commercial establishments was directly weighed, while waste data for industries, medical facilities, and institutions were obtained from existing records.

The survey did not estimate or analyze non-domestic waste observed or dumped in open areas such as riverbanks, roads, and drains. This was beyond the scope of the study due to the extensive spatial coverage required and limitations in time and resources.

While the survey is broadly comparable with the NWIS 2019 assessment, differences in institutional coverage should be noted. In the current survey, the institutional category included schools, monasteries, and government offices, whereas the NWIS 2019 survey included schools, colleges, and training centres, while government offices were presented as a separate category and monasteries were not included.

For comparability with the NWIS 2019 findings, waste generation and composition data for government offices and monasteries have been separately presented in the current report. The main difference in institutional coverage relates to schools, as the current survey included only schools, whereas the NWIS 2019 survey also included colleges and training institutes under the institutional category. Therefore, comparisons related to institutional waste generation should be interpreted with caution.

Solid waste management in Bhutan is undergoing a significant transformation, driven by commercial expansion, rapid urbanization, shifting consumption patterns, and the strengthening of policy and institutional frameworks. In this context, the National Waste Inventory Survey 2025 (NWIS-2025) updates the country's current patterns of waste generation, waste composition, disposal practices, and public perception. This survey builds on the first National Waste Inventory Survey (NWIS-2019) with the key objective of expanding and refining the characterisation of waste. The findings from NWIS-2025 will serve as crucial input for national strategic planning and programming, and aligning with the principles of Gross National Happiness, Bhutan's commitments under the Sustainable Development Goals (SDGs), international conventions and the priorities outlined in the 13th Five-Year Plan. The survey was conducted across six Dzongkhags, covering households, commercial establishments, industries, institutions (schools, government offices and monasteries) and healthcare facilities.

Bhutan generates an estimated 240,940 kilograms of waste per day which is 40 percent higher than the 172,161 kilograms per day reported in the National Waste Inventory Survey (NWIS) 2019. On an average waste generation increased by about 6.6 percent annually for the six years. The increase in waste is primarily contributed by the commercial sector, with more than half (54 percent) of the total waste generated. This figure has doubled since NWIS 2019, with the commercial sector generating a total of 129,582 kilograms of waste per day in 2025. Household waste is the second-largest contributor, accounting for 35 percent of total waste, representing an increase of 5percent since NWIS 2019. Industrial waste contributes 6 percent, while institutions, monasteries, and healthcare facilities each account for approximately 2 percent. Government offices generate about 1percent of total waste. Overall, the findings indicate that commercial and household activities together constitute most of the waste generation in Bhutan.

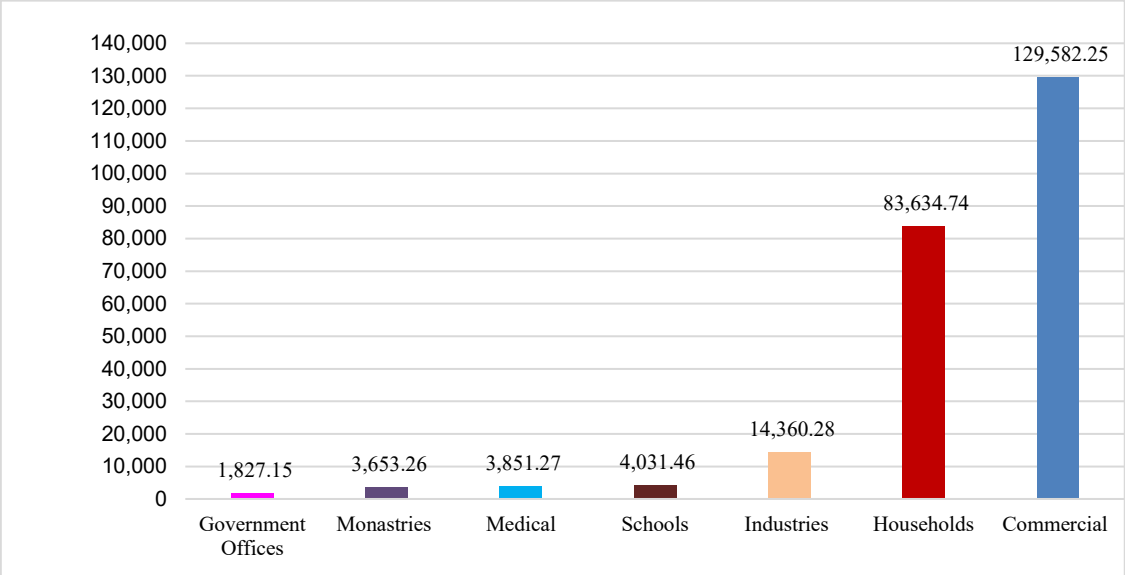


Figure 5: Waste generated across different sector in kg per day

Note: *Institutions include monasteries, government offices, schools, colleges, and training institutes.*

Table 1 Waste Composition & generation per day (in kg)

Waste Category	Dry	Wet	Plastic	Medical	Total (in kg)
Household	16,579.16	51,163.98	15,891.61	-	**83,634.74**
Commercial	46,017.61	64,567.83	18,996.81		**129,582.25**
Industries	10,981.58	1,182.20	2,196.50		**14,360.28**
Medical	904.17	378.29	957.25	1,611.56	**3,851.27**
Institutes	3,406.24	4,318.11	1,787.86		**9,512.20**
Total (in kg)	**77,888.76**	**121,610.40**	**39,830.02**	**1,611.56**	**240,940.74**

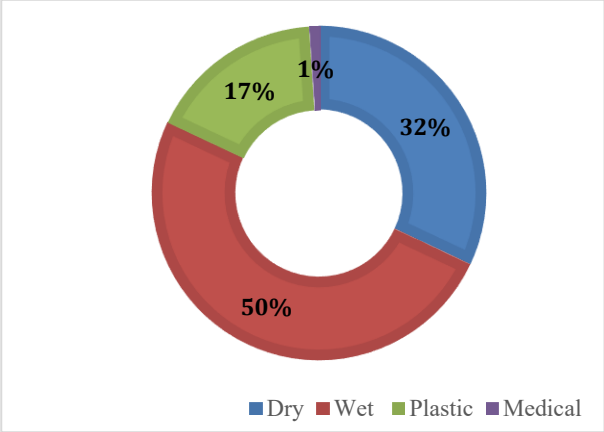


Figure 6 Waste Composition by Type (in percent)

Area	Total waste per day (kg)	Mean Waste (kg)
Rural	41,570.25	0.4
Urban	42,064.49	0.8
Total	**83,634.74**	**0.5**

Table 2 Quantity of solid waste generation per day by area by households

In terms of waste type, wet waste accounts for 50 percent, plastics for 17 percent, dry waste for 32 percent and medical waste for 1 percent.

3.1 Household

3.1.1 Waste Generation and Composition

Households contribute approximately 35percent of the total daily waste generated. Urban households represent around 36 percent of the total households and generate approximately 42,064.49 kilograms of waste in a day. The waste generated by urban households exceeds that of rural households, which produce about 41,570.25 kilograms and account for 64 percent of Bhutan's population. On average, an urban households generate 0.75 kilograms of waste per day, which is more than 1.7 times the average waste generated by rural households, estimated at 0.42 kilograms. The National Waste Inventory Survey (NWIS) 2019 reported waste generation of 0.7 kilograms per household in urban areas and 0.4 kilograms per household in rural areas respectively.

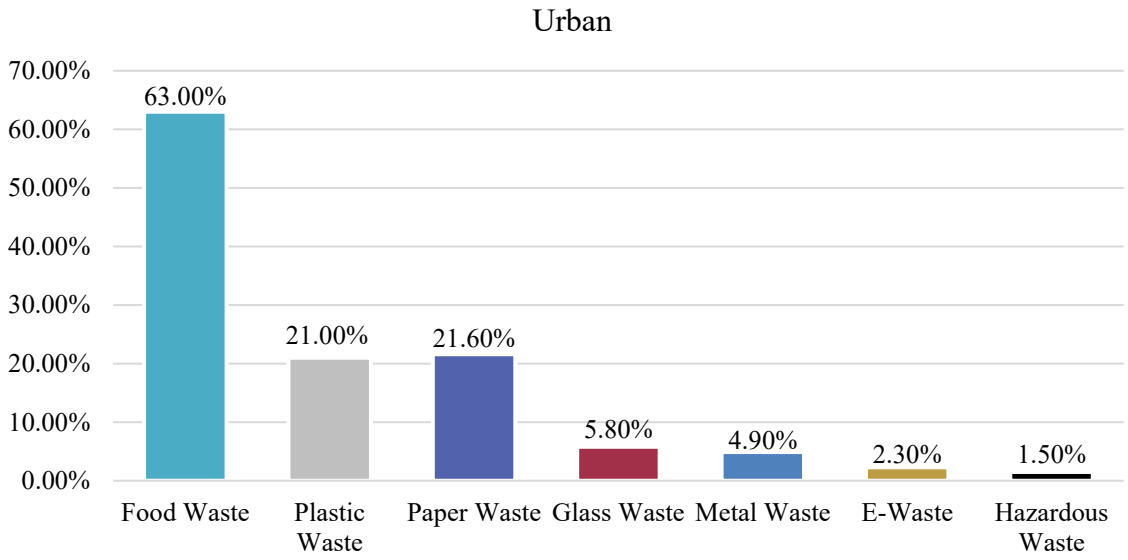
The increased waste production in urban households can be attributed to higher income levels and

greater access and increased dependence on packaged and processed goods. In urban areas, the average daily wet waste generated is 0.48 kilograms, while in rural areas, it is only 0.25 kilograms. Additionally, average urban households generate double the plastic waste, at 0.16 kilograms per day, compared to rural households at 0.07 kilograms per day.

Table 3. Waste generated by Urban and Rural Households (kilograms/day)

Sl. No	Estimate total waste generated	Solid Waste Type			
					**Total**
1	Urban	6,508.95	26,670.02	8,885.52	**42,064.49**
2	Rural	10,070.20	24,493.96	7,006.09	**41,570.25**
Total waste		**16,579.16**	**51,163.98**	**15,891.61**	**83,634.74**

Household waste is primarily composed of wet waste (61percent), dry waste (20 percent), and plastic waste (19 percent). Food waste, which falls under wet waste, accounts for 63 percent of the total waste generated by households. Perception based reporting indicates that plastic waste primarily packaging materials and bottles is perceived to account for approximately 21percent of waste generated by urban households. Paper waste, including newspapers and packaging materials, is similarly perceived to be widely generated by households, comprising about 19 percent of the total waste. In contrast, glass, metal, and other waste types are perceived to represent only a minor share of overall household waste.



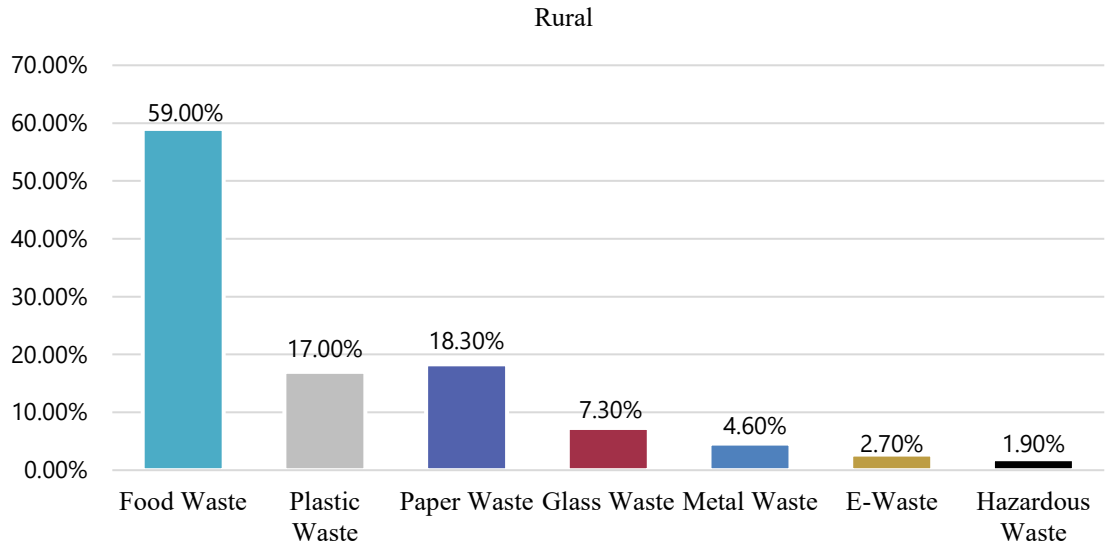
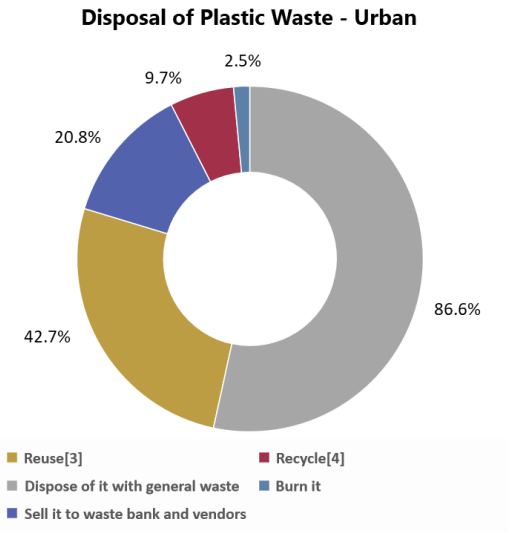
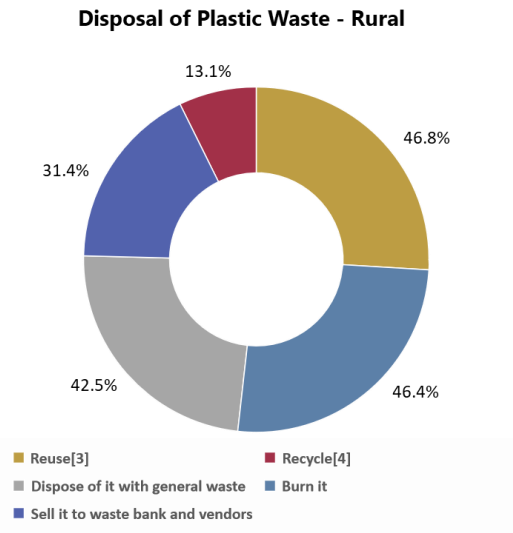


Figure 7: Types of solid waste generated by households (Urban and Rural) (values percent)[3]

3.1.2 Waste Disposal

Nearly 97 percent of households are aware of the importance of segregating dry and wet waste, however, among those aware only small proportion of households do practice waste segregation. A significant gap is evident between knowledge and practice in food waste management. In urban areas, 86 percent of households reported disposing of food waste together with general waste. In contrast, in rural areas, 47percent of households reported managing food waste through composting or by feeding it to animals. Almost 42 percent and 46 percent of urban and rural households reported reusing of plastics for other purposes. The most commonly reported practice for plastic waste disposal is mixing it with general waste, as cited by 58.42 percent of households. In addition, 27.60 percent of households reported selling plastic waste to waste banks or other recycling facilities. In rural areas, open burning of plastic remains a prevalent disposal method, practiced by 46.40 percent of households.





[3] Since the survey allowed respondents to select multiple types of waste, the total percentage exceeds 100%. This reflects the fact that households often generate more than one type of waste simultaneously. The same approach has been applied consistently across all analyses in the report where the survey questions allowed multiple responses.

Figure 8: Disposal of plastic waste by household (percent)

3.1.3 Waste Management Practices

Urban areas are primarily served by established formal municipal house-to-house waste collection services. In contrast, rural areas face considerable challenges, relying largely on community bins (centralized waste collection points) and informal disposal practices such as open burning and pit disposal. This disparity reflects the limited availability and coverage of waste management infrastructure in rural settings.

House-to-house waste collection provided by municipal services is the dominant disposal method in urban areas, with 82 percent of urban households availing this service. Other disposal channels include private collectors (4.8 percent), drop-off centers (3.4 percent), and specialized collection trucks (0.7 percent). In rural areas, only 13.7 percent of households reported access to household waste collection services. Consequently, alternative practices are more prevalent, including the use of community bins (20.8 percent), open dumping (0.7percent), and feeding waste to animals (1.4 percent).

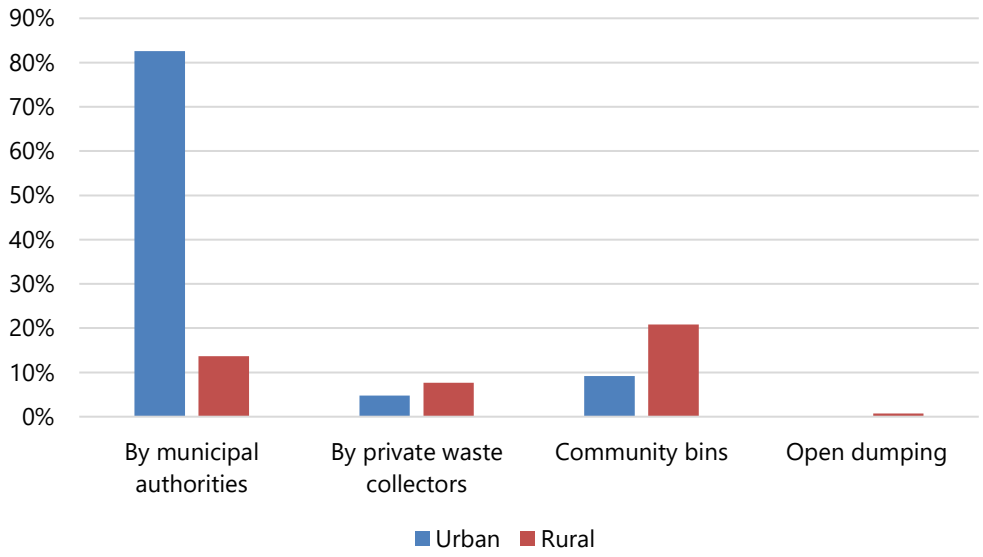


Figure 9: Waste Collection and Disposal Practise (Urban and Rural)

Barrier to the segregation of waste

Approximately 64 percent of urban households reported the absence of waste collection services that support segregation at source. The lack of daily waste collection contributes to the accumulation of waste, and respondents indicated that improved segregation practices could help optimize storage space for separated waste streams. Furthermore, the time required to segregate waste remains a notable constraint, with 18 percent of households identifying it as a key challenge.

For rural households, multiple factors contribute to waste management challenges. A lack of awareness and inadequate waste infrastructure were reported by 41.24 percent of respondents, while 34.83 percent identified the time-intensive nature of waste segregation as a challenge.

Frequency of Waste Collection

Waste collection services are generally limited in frequency. About one-third of urban households (34 percent) reported that waste is collected twice a week. Once-a-week collection was reported by

18 percent of urban households and 23 percent of rural households, indicating that many households receive only a basic level of service.

In rural areas, 60 percent of households reported that no waste collection service is available at all, highlighting a significant service gap in remote and hard-to-reach locations. Only a small proportion of households (around 5 percent) receive waste collection daily or more than three times a week, indicating that high-frequency collection services are not common.





Picture 7 & 8 Weighing of the segregated waste

Post Waste collection

More than half of the respondents (52 percent) perceive that the collected waste is sent to landfill, and a good proportion are unaware of the final disposal of the waste. A very small proportion is informed of recycling and reuse. Accurate information about the waste management cycle can enhance household participation in proper waste management. The limited awareness of post-collection processes, particularly beyond landfills, highlights the need for improved public advocacy and communication.

Common Waste Disposal issue

About 35 percent of urban households and 40 percent of the rural households reported that scattered plastic waste is a common issue affecting urban and rural areas. This highlights the lack of collection services and limited efforts to contain plastic waste. Street littering and improper waste dumping are widespread issues, affecting 38 percent of urban areas and 60 percent of rural areas. In urban settings, overflowing bins are frequently cited as a concern. Although reported in only about 10 percent of cases, practices such as burning waste and waste obstructing drains pose serious environmental and public health risks, requiring targeted local interventions.

Perception on Waste Management

In response to the question about the effectiveness of waste management systems about 55 percent from urban and 60 percent from rural areas rated that the systems as "somewhat effective" indicating a moderate level of satisfaction with service delivery. About one-third of urban respondents (35 percent) rated the service as effective, reflecting greater reliability and infrastructure in urban areas as compared to rural. Around 8.5 percent of rural respondents reported having "no system in place", slightly lower than the approximately 4.5 percent in urban areas. This highlights the existence of service access gaps in rural areas.

Community Waste Management System Rating

Rating	Very Effective	Somewhat Effective	No System in Place
Urban	35.0%	61.0%	4.5%
Rural	30.0%	54.2%	8.5%

The respondents were also asked whether waste segregation should be made mandatory. More than 90 percent expressed support for mandatory waste segregation; however, they emphasized that this must be supported by adequate infrastructure, improved reliability of waste collection services, and appropriate incentives to sustain long-term behavioural change. About 60 percent of both urban and rural respondents prefer the basic dry and wet segregation indicating familiarity with the two-bin waste segregation. About 40 percent of respondents in rural and urban opt for more further segregation of dry recyclables (e.g. paper, plastic, glass, metal), reflecting an emerging awareness of material-specific waste management.

3.2 Commercial Establishments

As Bhutan transitions toward a more service-oriented economy, particularly in urban centres, commercial waste is becoming an increasingly significant component of the country's solid waste stream. These findings will help shape Bhutan's waste minimisation efforts by improving regulation and strengthening resource recovery systems. The commercial establishment has retail/wholesale and other business. The retail/wholesale category includes hardware, building materials, sanitary equipment, general stores, garments, footwear, etc. Commission agents and other categories include restaurants, hotels and bars.

3.2.1 Waste Generation and Composition

The survey focused on retail, wholesale, and other business to assess the daily waste generation. These commercial units generate a total of 129,582 kilograms of waste per day, accounting for 54 percent of the country's total waste generation. On average, each commercial unit generates approximately 12 kilograms of waste per day. Commercial waste is dominated by wet and plastic waste, which together account for two-thirds (65 percent) of commercial waste, indicating a strong link with perishable food waste and single-use plastic, commonly used in bottles and containers. Other waste includes grocery bags and plastic wraps, highlighting the widespread use of flexible and film-based packaging materials across commercial units.

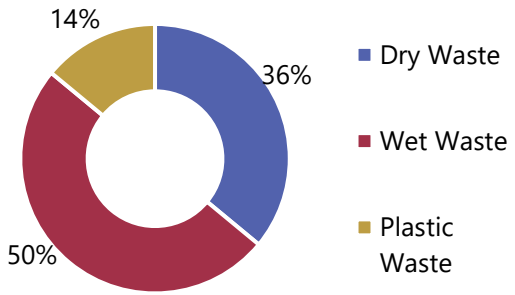


Figure 10 Commercial waste composition

Table 4: Waste Compositions generated by commercial sectors (kilograms/day)

Sl. NO	Description	Waste Composition			
					Total
1	Retailers / wholesalers	24,607.91	43,783.60	10,892.25	**79,283.76**
2	Other	21,409.70	20,784.22	8,104.56	**50,298.48**
Total Commercial Waste		**46,017.61**	**64,567.83**	**18,996.81**	**129,582.25**

3.2.2 Waste Disposal

A majority of establishments with access to a garbage collection service report that they avail this service. About one-fourth of the respondents indicated that reusing plastic materials and packaging is part of their practices, which reflects efforts to extend the utility life of these materials. Additionally, about 3 percent of the establishments reported selling plastic waste to scrap dealers.

The survey indicates that the primary challenges in managing plastic waste at these establishments include limited awareness of different types of plastics and insufficient space for waste segregation. The lack of segregation space is often associated with less frequent waste collection, which creates physical constraints and hampers proper sorting. Additional challenges include limited recycling options, many of which are not financially viable, suggesting that both infrastructure and economic factors significantly constrain effective plastic waste management.

Knowledge and Awareness

The increase in population and common use of packaging materials has led to a rise in waste generation. About 96 percent of respondents believes that regulation is necessary to manage non-biodegradable plastic waste. Among them, 70 percent reported being aware of penalties levied for using single-use plastic bags, while nearly one-fifth (20 percent) are not aware of the penalties. Respondents emphasised that substantial behaviour change is needed at all levels to control and reduce plastic waste. They identified various initiatives to raise awareness and implement waste management practices, including mass campaigns such as cleanup drives (22 percent), social media awareness (20 percent), door-to-door campaigns (25 percent), and regular dissemination through radio and TV (17 percent).

3.3 Institutional Waste Generation and Composition

Lower, Primary, Middle, and Higher Secondary Schools, Monasteries and Government offices are categorized under the institutional sector.

Despite persistent challenges related to waste segregation, handling, and disposal, the volume of waste generated by these institutions is lower than that of commercial and household. This can be attributed to increased knowledge and understanding of waste management practices, further complemented by waste reduction initiatives.

3.3.1 School

Waste Generation and Composition

Schools generate approximately 4,031 kilograms of waste per day, primarily comprising wet waste (47 percent), dry waste (36 percent), and plastic waste (17 percent). On average, each school generates about 7 kilograms of waste per day.

Sector	Waste generation per day (kg)
Schools	4031

Table 5 Comparison of waste generation from Commercial and School units in a day.

Perception-based findings indicate that food waste constitutes the largest share (30 percent) of the total waste generated. Garden waste and paper waste each contribute approximately 18 percent, while glass and metal waste account for about 2 percent each. E-waste represents 6 percent, and hazardous waste accounts for 4 percent of the total waste. The remaining 3 percent is categorized as miscellaneous waste.

Table 6: Waste Compositions generated by the Institutional sector sectors (kilograms/day)

Sl. NO	Type				Total Waste
1	Schools	1,431.91	1,910.14	689.41	**4,031.46**

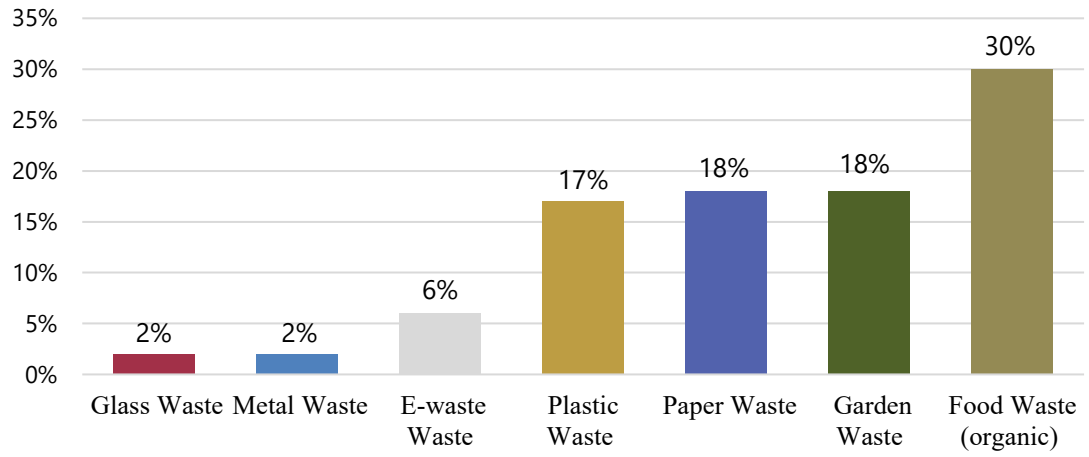


Figure 11: Composition of Waste (in percentage)[4]

Among the various categories of plastic waste generated by schools, mixed and unsegregated plastics constitute 30 percent of the total waste. PET bottles account for 22 percent, while LDPE plastics comprise 18 percent of the total plastic waste stream. The relatively higher proportions of these materials are likely attributable to higher consumption levels and prevailing operational practices within school premises.

[4] Since this a multiple choice questions, total will not add up to 100%

Waste Management

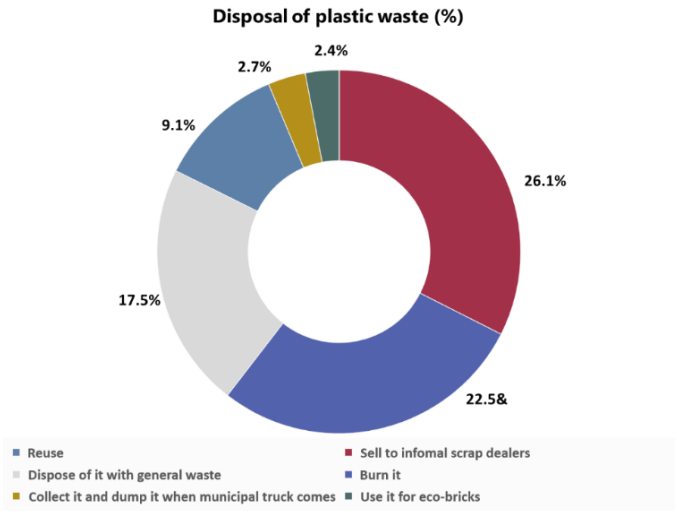


Figure 12 Disposal of plastic waste (percent)

Schools reported multiple methods for managing food waste, including feeding it to animals, using it for composting, and disposing of it together with general waste.

Regarding plastic waste management, 17 percent of schools reported disposing of plastics together with general waste, while 22.5 percent indicated that plastic waste is burned, reflecting a limited understanding and adoption of environmentally friendly waste management practices. The use of plastic waste for eco-bricks, although limited, represents an innovative approach and was reported by 2.4 percent of schools. In contrast, 26.1 percent of schools reported selling plastic waste to recycling entities, indicating some level of engagement with formal recycling mechanisms.

Waste Segregation

Most schools (70 percent) reported that they segregate dry and wet waste and about less than half (47 percent) specifically do so for recycling or reuse. The most commonly segregated materials are cardboard and paper, with 44.9 percent of schools targeting them for recycling. This is followed by PET bottles, which are segregated by 42.2 percent of schools. Other materials, such as metals (5.8 percent) and e-waste (1.5 percent), are segregated by a significantly smaller proportion of schools.

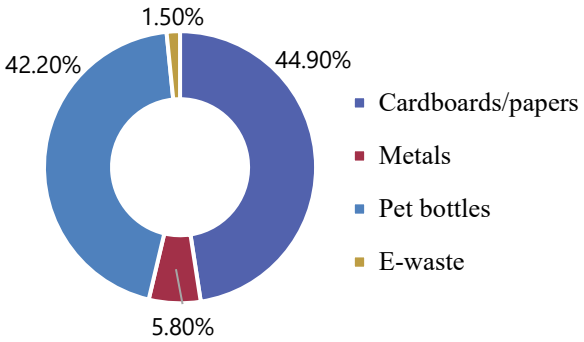


Figure 13 Categories of Waste Segregation Practised by Institution (percent)

The most reported waste-related challenge is due to lack of garbage disposal affecting 34.1 percent of schools and irregular collection timing (29.6 percent) are also significant concerns, indicating gaps in waste management infrastructure and service efficiency. Additionally, lack of municipal services (17.9 percent) poses a challenge for a notable number of schools. In comparison, issues such as difficulties with waste segregation and the absence of accountability are reported by a smaller fraction (2.2 percent).

Waste Disposal

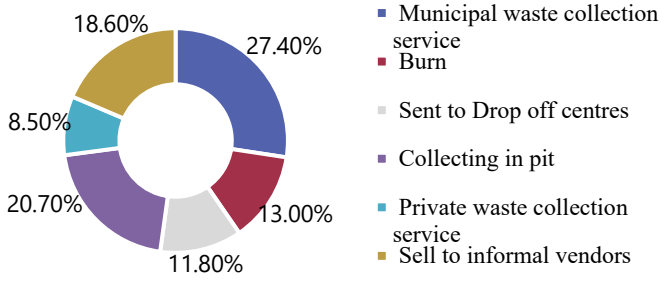


Figure 14 Waste disposal practices by schools (percent)

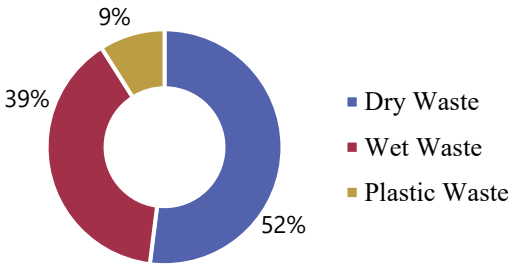
Nearly 27 percent of schools rely on municipal waste services for disposal. Occasional burning of waste is practiced by 13 percent of schools, posing potential air pollution and health risks. Dumping waste at drop-off centres accounts for 11.8 percent, indicating a preference for centralized collection in some areas. Other disposal methods include pit disposal (20.7 percent), private collection services (8.5 percent), and selling waste (18.6 percent), reflecting the wide variation in waste management practices across schools.

3.3.2 Government offices

The survey encompassed government offices at central, regional, autonomous, and Dzongkhag levels. The government offices generate approximately 1,827 kilograms of waste per day. Waste composition shows that wet waste constitutes 46 percent, dry waste - 28 percent, and plastic waste - 26 percent.

The per capita waste generation is estimated at 0.13 kilograms per day. The estimates were calculated on a per capita basis, using data from the Royal Civil Service Commission's Annual Report 2024-25, which reports a total of 30,025 civil service employees. For waste calculations, only 14,387 employees were considered, after excluding civil servants working in schools and health facilities, as their waste generation has already been accounted for under the education and health sectors. To ensure consistency with the 2019 NWIS, per capita waste generation was calculated using the same definition.

Compared to NWIS 2019, where per capita waste was 0.19 kilograms per day, NWIS 2025 shows a slightly lower figure of 0.13 kilograms per day. This reduction can be attributed to government initiatives to reduce paper use and other cost rationalization measures. The eDATS and e-GP systems have significantly reduced paper consumption by replacing manual processes with fully digital workflows, as part of a broader e-Governance policy promoting efficiency, transparency, and a paperless environment. Additional measures include eliminating paper publications and encouraging official correspondence via email.



About half of government offices (45 percent) segregates paper, cardboard and PET bottles from the wet waste, while other plastic waste is disposed together with general waste. About 32 percent of offices in rural areas reported the lack of waste collection, disposal facilities and limited collection services.

Figure 15 Waste Compositions for Government Offices

3.3.3 Monasteries

This sector was not covered in the 2019 survey and has been included in the current round to capture waste generated in monasteries and Dratshangs, thereby providing a more comprehensive assessment of waste composition. The survey covered 20 Dratshangs, Shedras, Lobdras, and Lhakhangs across six Dzongkhags. It is estimated that monasteries generate approximately 3,653 kilograms of waste per day, comprising 46 percent wet waste, 28 percent dry waste, and 26 percent plastic waste. The survey further indicates that per capita waste generation is 0.457 kilograms per day, based on 7,944 learners enrolled in monastic education, as reported in the National Statistical Yearbook 2025.

Approximately 42 percent of respondents reported that food waste is managed through feeding to animals or composting, while an equal proportion (42 percent) indicated that food waste is mixed with general waste for disposal. In the case of plastic waste, 76 percent of respondents reported disposing of plastics together with general waste, whereas nearly 14 percent indicated that plastics are reused for other purposes.

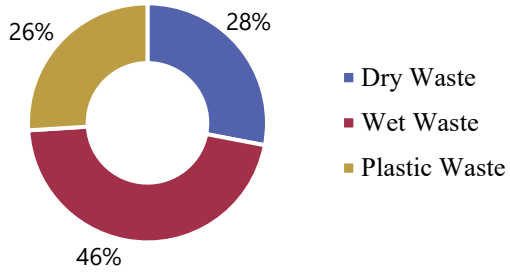


Figure 16 Waste composition for Monasteries

Monasteries located in urban areas generally avail municipal waste collection services, while those in other locations dispose of waste through pit disposal or community drop-off bins. For monasteries using municipal services, waste collection is generally conducted twice per week. Respondents highlighted the need to increase the frequency of collection, noting that temporary storage of waste poses a significant operational challenge.

3.4 Industries

As Bhutan undergoes gradual industrialisation, understanding the volume, types, and distribution of industrial waste is critical for policy formulation, regulatory planning, and the development of sector-specific waste-treatment infrastructure. The industrial survey covers medium and large manufacturing industries, based on the Annual Industrial Survey 2023–24, to ensure comparability with the 2019 NWIS, which also included only medium and large industries.

3.4.1 Waste Generation and Composition

As per the survey the Industrial sector generates 14,360 kilograms of waste in a day, accounting for 6 percent of the country's total solid waste generation. On an average, each industrial unit generates approximately 156 kilograms of waste per day. Dry waste accounts for three-fourths (76 percent) of the waste composition, plastic waste 15 percent and wet waste 8 percent.

Further desegregation of the waste as per the perception revealed that among the dry waste, recyclable materials such as paper constitutes 60 percent, followed by metal scraps at 33 percent. The remaining 7 percent waste comprises of E-waste, glass and hazardous waste.

Table 7: Estimated Waste Generated from Industries per day (Value (Kilograms/day)

Sl. No	Description				Total Waste
1	Industrial waste	10,981.58	1,182.2	2,196.5	**14,360.28**

The composition of plastic waste consists of 52 percent Polypropylene (PP), which is widely used in packaging materials, food packaging, and household products. Low-Density Polyethene (LDPE) accounts for 14 percent, while High-Density Polyethene (HDPE) makes up 12 percent. LDPE is primarily found in plastic carry bags and packaging films, whereas HDPE is used for containers, pipes, and other durable items. This highlights the significant presence of both flexible and rigid packaging materials in the waste stream. Polyethene Terephthalate (PET) comprises 9 percent of plastic waste, mainly sourced from beverage bottles and food containers. Polyvinyl Chloride (PVC) contributes a small 1percent. Additionally, mixed plastic waste, which refers to unsegregated constitutes 12 percent of the total.

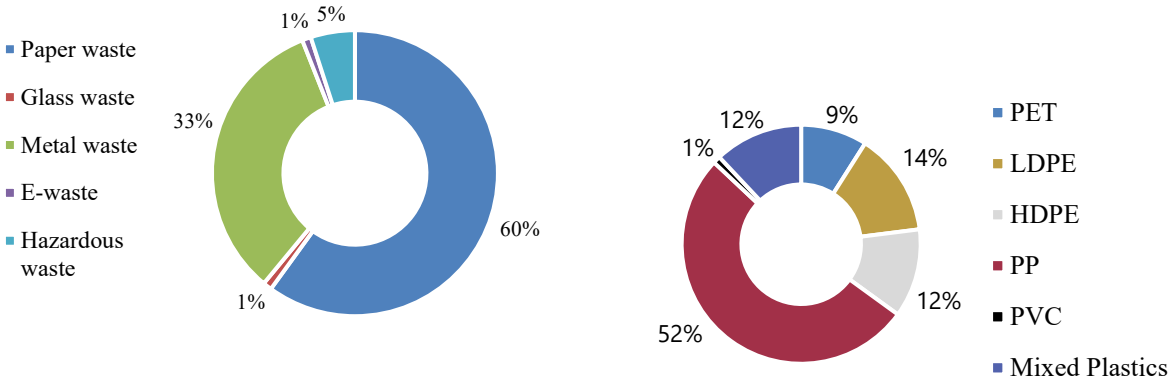


Figure 17 Dry waste composition and plastic waste composition (in percent)

3.4.2 Waste Segregation and Disposal

The industries segregate waste by material type: paper, metal scraps, plastics and hazardous waste. The waste is collected and disposed of by private vendors and municipalities. Private vendors handle scrap, paper, and plastic waste, while other waste, such as mixed waste, is disposed of through municipal services. Internal reuse (24 percent) and selling to recyclers (25 percent) are also prevalent, reflecting industries' efforts to promote circular economy practices by either reutilising plastics in operations or diverting them to the recycling market. Material type and recyclability remain the predominant focus of industrial waste segregation efforts.

3.4.3 Waste Management Practices

As majority of industrial sector, 75 percent, report that they do not have a dedicated waste storage house or facility. The storage of segregated waste poses a challenge for industries due to limited space.

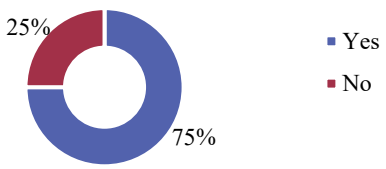


Figure 18 Availability of Waste Storage Facility

Awareness of Waste Management

The industries were asked about the polluter pays principle and the penalties under the Waste Prevention and Management Act 2009 and Regulation

2012. Around 75 percent of respondents have reported that they are aware of these concepts but does not know its details. Similarly, the industries were unfamiliar with the concept of Public-Private Partnerships (PPPs) for waste management.

The change in consumption patterns, combined with population growth, is a significant factor contributing to the rise in waste generation in the country. The management of plastic waste has emerged as a major issue, with non-biodegradable plastic waste posing the greatest challenge. Industries argue that behaviour change communications (75 percent), alongside the promotion of biodegradable materials and recycling efforts (50 percent), have been identified as key to effectively managing waste. Additionally, a strong awareness program through regular cleanup campaigns needs to be promoted to enhance waste management efforts.

3.5 Healthcare Facilities

The medical waste survey provides critical insights into the volume, composition, and disposal practices associated with healthcare facilities across Bhutan. The health facilities samples are representing from Primary Health Centre (PHC), Dzongkhag Hospital, Regional Referral and a National Referral Hospital. Information on medical waste was obtained from records maintained ny the respective health centres.

Waste Generation and Composition

Bhutan's healthcare sector generates 3851 kilograms of waste per day, up from 1.98 metric tons in 2019. This waste stream includes general waste, non-hazardous materials, medical waste (including infectious, sharps, pathological, pharmaceutical, chemical, and radioactive waste), and plastic waste.

Table 8: Composition of Waste Generated by Health Facilities (in Kilograms.)

Sl. No	Description					Total
1	Healthcare Facility	904	378	957	1,612	**3,851**

The survey indicates the average daily medical waste generated by different healthcare facilities. The National Referral generates the highest volume, averaging 931.37 kilograms per day, composed of dry waste (401.36 kilograms) and medical waste (318.62 kilograms) reflecting its patient load and complex range of services.

Regional Hospitals generate comparatively lower quantities (20.88 kilograms per day), with plastic waste (10.38 kilograms) as the predominant component. General Hospitals and Primary Health Centers (PHCs) generate waste ranging from 9 to 16 kilograms per day, with variable proportions of dry, wet, plastic, and medical waste.

Medical Waste by Healthcare facilities

Medical waste generation varies widely across healthcare facilities, reflecting differences in services and patient load. Infectious waste is particularly high in National Referral hospital (81percent) and PHCs (35 percent). Plastic medical waste including IV tubes, gloves, PPE, and syringes dominates in Hospitals (43 percent) and Regional Hospitals (50 percent), showing extensive reliance on disposable medical supplies.

Sharps waste is notable in Hospitals (23 percent) and PHCs (20 percent), while pathological, pharmaceutical, and chemical wastes appear in smaller proportions. Radioactive waste is minimal, limited to Hospitals (2 percent), and other medical waste is significant in Regional Hospitals (34 percent). Overall, larger urban facilities generate a higher share of infectious and plastic waste, whereas smaller or rural centers produce relatively lower volumes but still require careful management.

3.5.1 Waste Management Practices

Description	PHC	Hospital
Segregation and incineration on-site	100.0%	100.0%
Sent to authorised biomedical waste vendors	–	20.0%
Burned	–	10.0%
Collected in a pit	30.0%	10.0%
Thromdes garbage truck	20.0%	–

On-site segregation and incineration are commonly practised; however, facilities still rely on unsafe methods, and reuse after sterilisation occurs in some PHCs but authorised biomedical waste vendors and proper recycling are largely absent. Burning and disposal in pits are observed, particularly in rural centres, whereas some urban facilities depend on dustbins. Advanced treatment methods like autoclaving are not systematically used. Regional Referral Hospital and National Referral Hospital practise 100 percent segregation and incineration on-site. Data for PHC and Hospitals are presented in infographic.

3.6 Scrap Dealers

The scrap dealer, comprising individual collectors, small-scale enterprises, and local traders, play a critical role in recycling materials from the waste stream, supporting both livelihoods and environmental sustainability. Informal waste operators often serve as the first point of contact in waste management, collecting materials from households, markets, construction sites, and other sources, and channelling them into recycling networks. To avoid double-counting, estimates from scrap dealers are not accounted in the national waste estimate.

Despite their contribution, these actors face challenges such as limited storage facilities, fluctuating market prices, financial constraints, and inconsistent access to buyers, particularly in rural areas. Understanding the practices, capacities, and needs of the informal sector is therefore essential for designing interventions that enhance efficiency, promote circular economy principles, and strengthen nationwide waste management systems.

3.6.1 Waste Generation and Composition

To understand the composition of waste collected, scrap dealers were asked to estimate the average amount of different types of waste they collect per month. This provides insights into the dominant waste streams and highlights the materials that require the most attention for management and recycling.

The bulk of waste collected are metal (29 percent), glass (29 percent), which together account for the majority of the material flow. Paper waste (19 percent) is substantial, pointing to a steady stream of newspapers, packaging, and cardboard. Plastic waste (11percent) is slightly lower in volume compared to these categories but still forms a significant and consistent stream.



Within the plastic waste streams PET bottles (45 percent) are the most collected plastic waste. Nearly one fourth are mixed plastic waste (unsegregated items) collected are HDPE bottles and other plastic waste. At the lower end, e-waste (1percent) contributes very little in terms of mass, although its environmental impact is disproportionate to its size.

3.6.2 Waste Disposal

Disposal Practices for Non-Recyclable Waste

One of the important questions in the survey looked at how waste collectors deal with materials that cannot be sold or recycled. This gives insight into the "end of the line" in waste management and helps us understand whether such materials are being disposed of safely or through unsustainable practices.

The responses were very consistent across the board. Every respondent (100 percent) reported that unsellable or non-recyclable waste is sent to landfill. None reported burning the waste, disposing it in open areas, or using other disposal methods.

Awareness of Environmental Policies and Regulations on Waste Management

All respondents in the survey reported that they are aware of environmental policies and regulations related to waste management. This indicates a high level of awareness among stakeholders, suggesting that key messages about environmental protection and legal requirements are reaching the community effectively.

3.6.3 Waste Collection Sources



Respondents were asked about the main sources from which they usually collect waste. Their answers highlight the diversity of collection points, ranging from households and markets to industries, construction sites, and landfills. At the national level, the main sources of waste collection are shops and markets (75 percent), followed by households (62.5 percent) and construction sites (62.5 percent). This indicates that a large portion of waste comes from commercial and domestic activity, with markets and households forming the backbone of the waste stream. Industries are also significant, contributing 50 percent of the collection points. Landfills and dump sites account for 15 percent, suggesting that direct collection from disposal sites by informal scrap dealers.

The daily waste collection is the most common practice, with 50 percent of respondents reporting that they collect waste every day. A significant portion (25 percent) collects on call or as needed, which allows flexibility for times when waste generation is irregular, or volumes are low. Smaller shares report collecting every 2–3 days (12.5 percent) or weekly (12.5 percent), showing that some operators follow more periodic schedules rather than a fixed daily routine.

To understand how collected waste is managed before it reaches buyers or recycling facilities, respondents were asked where they store the waste prior to selling. Most respondents store collected waste either in scrap yards or recycling facilities (62.5 percent) or in rented storage spaces (50 percent). The respondents reported that waste is stored for varying periods before sale. Around 42 percent store waste for 1–2 weeks and a similar proportion (42.9 percent) store it for more than 2 weeks, indicating that most collectors hold waste for at least a week.

Buyers of Waste Collected

The majority of waste (75 percent) is sold to large-scale recycling industries, making them the dominant buyers nationwide. About 50 percent also reported selling waste to buyers outside their region or country, suggesting a strong export component in the waste trade.

Across all respondents, metal commands the highest average price (41.3 Nu/kilograms), followed closely by plastic (32.5 Nu/kilograms) and e-waste (31.9 Nu/kilograms). Paper and glass fetch much lower returns at 11.8 Nu/kilograms and 4.8 Nu/kilograms respectively. “Other” waste materials average 18.2 Nu/kilograms, sitting in the middle range. This pattern highlights the stronger market value of recyclable metals and plastics compared to bulkier, lower-value waste streams like glass and paper.

Conclusion

Bhutan generated 240,940 kilograms of waste per day, with the commercial and household sectors being the primary contributors. Wet waste accounts for 54 percent of total waste, followed by dry waste (27 percent) and plastic waste (19 percent). As wet waste is predominantly generated by households, effective source segregation and proper decomposition offer significant potential to reduce overall waste volumes and pressure on collection and disposal systems.

In the short term, priority interventions should focus on addressing critical service delivery gaps, strengthening enforcement of waste segregation at source, and increasing the frequency of waste collection, including the introduction of designated collection days for segregated waste streams. Parallel investments are required to enhance waste collection infrastructure, expand localized composting facilities, and strengthen Drop-Off Centres (DOCs). Scaling up private sector participation in waste management both in infrastructure operations and in developing markets for recyclable materials should be actively pursued. This may include leasing and managing DOCs, Bhutan Waste Banks (BWBs), mini-Material Recovery Facilities (mini-MRFs), and collection fleets through design–build–operate or concession models, thereby improving operational efficiency and extending service coverage.

With an enabling regulatory framework and appropriate incentives like corporate social responsibility (CSR), buy back policy, public private partnership (PPP), with exploration of Extended Producer Responsibility (EPR) can drive innovation and improve service delivery, particularly within industrial and commercial clusters, thereby reducing the burden on municipal waste management systems.

Over the medium to long term, sustained investment in standardized waste management infrastructure particularly composting facilities, anaerobic digestion (AD) and biogas plants, refuse-derived fuel (RDF) production, and appropriate waste-to-energy solutions will be critical, as organic (wet) waste accounts for 50 percent of Bhutan's total waste generation. Strengthening these treatment pathways will reduce reliance on landfilling, enable recovery of organic nutrients and energy, and support the gradual transition toward a more circular, resource-efficient, and low-emission waste management system.

Bridging the gap between awareness, knowledge, and practice will require a targeted and effective communication strategy, supported by efficient service delivery systems, to translate awareness into sustained behavioral change. Such strategies should engage households, industries, and commercial establishments, with clear and consistent messaging on waste segregation and responsible disposal.

The systematic promotion of the 4Rs: Refuse, Reduce, Reuse, and Recycle should form the cornerstone of Bhutan's future waste management strategy, guiding policy development, infrastructure investments, and community engagement. In addition, incentive or performance-based mechanisms for Dzongkhags demonstrating high standards of cleanliness and waste management could further motivate local communities and strengthen ownership and accountability in solid waste management.

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