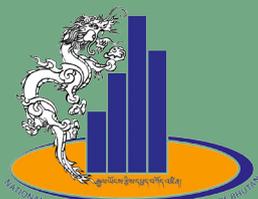




# Nation's waste on the scale

National Waste Inventory Survey (NWIS-2019) Bhutan



# **Nation's waste on the scale**

**NATIONAL WASTE INVENTORY SURVEY (NWIS-2019)**

**BHUTAN**

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National Statistics Bureau  
Royal Government of Bhutan  
PO Box No 338  
Thimphu, Bhutan  
Tel: +975 2 333296, +975 2 335848  
Fax: +975 2 323069  
[www.nsb.gov.bt](http://www.nsb.gov.bt)

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# FOREWORD

It is my pleasure to present the National Waste Inventory Survey of Bhutan 2019 (NWIS-19). I take this opportunity to congratulate the National Statistics Bureau (NSB) and National Environment Commission Secretariat (NECS) for successfully conducting the country's first national waste inventory survey.

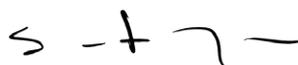
The NWIS-2019 has a wealth of information that will significantly enhance our general understanding of the country's waste management system and waste data. As such, the report and additional information from the survey data will provide evidence for sound policies related to waste management.

The topics the report covered include quantities of waste each sector produced daily and its composition. It also covers an analysis of public perception on awareness and knowledge of waste management, their current daily waste management practices and issues and challenges. It goes on to analyse public awareness on waste related rules and regulations, waste management by gender and employment opportunities waste management companies provide.

It is my sincere hope that the report will be useful and the information contained in it facilitates better policy making, planning and implementation of waste related plans and programmes

I would like to thank the officials of NSB, NECS, dzongkhag environment officers and enumerators involved in conducting the survey. By the same token, I also express my gratitude and appreciation to all survey respondents whose support and cooperation culminated in the successful completion of the survey.

Tashi Delek



(Sonam P. Wangdi)

Secretary

National Environment Commission  
Secretariat

# CONTENTS

FOREWORD .....	iii
PREFACE .....	v
LIST OF FIGURES .....	vi
LIST OF TABLES .....	vi
LIST OF ANNEX TABLES .....	vii
ABBREVIATIONS .....	viii
ACKNOWLEDGEMENT .....	ix
EXECUTIVE SUMMARY .....	x
1 INTRODUCTION .....	1
1.1 Background .....	1
1.2 Survey objectives .....	2
1.3 Scope and coverage .....	2
1.4 Concepts and definitions .....	2
2 METHODOLOGY AND OPERATIONS .....	5
2.1 Introduction .....	5
2.2 Preparation phase .....	5
2.3 Data capture methodology .....	6
2.4 Procedure for data collection .....	6
2.5 Sampling methodology .....	7
2.6 Enumeration .....	9
2.7 Analysis and dissemination .....	11
2.8 Limitations of the report .....	11
3 SOLID WASTE GENERATION, COMPOSITION, MANAGEMENT AND PERCEPTION ON WASTE .....	13
3.1 Household waste .....	14
3.2 Commercial waste .....	19
3.3 Institutional waste .....	22
3.4 Industrial waste .....	24
3.5 Health centres .....	25
3.6 Vegetable markets .....	27
3.7 Government offices .....	27
3.8 Private waste management companies .....	28

# PREFACE

The National Waste Inventory Survey 2019 (NWIS-2019) presents the results of the solid waste survey that National Statistics Bureau (NSB) conducted in collaboration with the National Environment Commission Secretariat (NECS). German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety and UNEP/IETC, through World Wildlife Fund (WWF) Bhutan, funded the project. It contains waste related statistics gathered from households, commercial units, health centres, institutes/offices and other relevant sectors.

NWIS-2019 presents information on total waste generated in quantities from different sectors, waste generation in per capita and composition of waste from different sectors. It also presents public perception of current daily waste management practices, awareness and knowledge, issues and challenges and suggestions and feedback to improve waste management services in the country.

Forty enumerators were engaged under supervision of the Dzongkhag Environmental Officers, National Statistics Bureau staff and National Environment Commission Secretariat (NECS) conducted the survey over 36 days (November- December 2019).

As in many other recent surveys, for this survey too the World Banks' Survey Solution was used to facilitate Computer Assisted Personal Interview (CAPI).

Despite numerous challenges and difficulties our survey team encountered, the information collected, processed and published in this report is robust. It can be used for making informed decisions with regard to formulation of policies and programmes for effective waste management in the country.

I extend my heartfelt appreciation to the staff of NECS and NSB, all the 40 enumerators and others, including respondents for their support and cooperation for the survey.

Our immense gratitude to funding agencies who made this survey possible in the first place.



Chhime Tshering

Director, National Bureau of Statistics

# LIST OF FIGURES

Figure 1	Proportion of wastes from different sectors in percentage .....	13
Figure 2	Waste composition in percentage.....	14
Figure 3	Composition of household waste in percentage .....	15
Figure 4	Proportion of households with access to waste collection services.....	16
Figure 5	Proportion of households using waste collection service .....	16
Figure 6	Reasons for not using available waste collection service.....	16
Figure 7	Reasons for dissatisfaction .....	17
Figure 8	Proportion of households segregating dry and wet wastes .....	17
Figure 9	Household waste disposal practices.....	17
Figure 10	Proportion of households with knowledge on 3Rs by area .....	18
Figure 11	Proportion of households practicing 3Rs by area .....	18
Figure 12	Proportion of households favouring waste management fee .....	18
Figure 13	Waste management in households by sex and area.....	19
Figure 14	Preferred waste management awareness programmes .....	19
Figure 15	Composition of waste generated from commercial establishments .....	20
Figure 16	Proportion of waste disposal practices commercial units used .....	21
Figure 17	Reasons for dissatisfaction over waste collection service in percentage .....	22
Figure 18	Proportion of commercial units aware of 3Rs of waste management .....	22
Figure 19	Proportion of commercial establishments practicing 3Rs .....	22
Figure 21	Problems related to waste management in institutes .....	23
Figure 20	Composition of the waste generated from institutes .....	23
Figure 22	Proportion of institutes segregating dry and wet wastes at source .....	24
Figure 23	Composition of waste from industries .....	25
Figure 24	Composition of general waste from health centres .....	26
Figure 25	Composition of waste from vegetable markets .....	27
Figure 26	Total number of employees in waste companies by sex and nationality ...	29

# LIST OF TABLES

Table 1	Quantity of solid waste generation per day by area by households.....	15
Table 2	Quantity of waste generation from commercial units per day.....	20

# LIST OF ANNEX TABLES

Table A1.1	Total waste generated from different sources in kilograms per day .....	29
Table A1.3	Proportion of household with access to waste collection service .....	29
Table A1.5	Proportion of household segregating different wastes.....	29
Table A1.2	Composition of waste generation in percentages .....	29
Table A1.4	Proportion of household using waste collection service .....	29
Table A1.6	Proportion of household with knowledge of 3Rs .....	30
Table A1.7	Proportion of household practicing 3Rs.....	30
Table A1.8	Proportion of household willing to pay for waste collection service.....	30
Table A1.9	Household awareness on waste management.....	30
Table A1.10	Most effective waste management awareness program (Households) .....	31
Table A1.11	Composition of household waste in percentage by area.....	31
Table A1.12	Composition of waste generated from commercial units in percentage.....	31
Table A1.13	Waste disposal practices among commercial units .....	32
Table A1.16	Waste management awareness (Tabular).....	32
Table A1.17	Most effective waste management awareness program (Commercial units) .....	32
Table A1.14	Proportion of commercial units segregating dry and wet wastes .....	32
Table A1.15	Proportion of commercial units with access to waste collection service in percentage.....	32
Table A1.18	Industries aware of relevant sections of environmental Act and regulation .....	33
Table A1.20	Policies industries adopted to minimise waste .....	33
Table A1.21	Composition of industrial waste in percentage.....	33
Table A1.19	Adequate for waste management (industries aware of relevant sections in environmental Act only) .....	33
Table A1.22	Medical facilities with waste storage facilities .....	33
Table A1.23	Management of infectious and pathological waste by health centers....	34
Table A1.24	Management of pharmaceutical waste by health centers .....	34
Table A1.26	Composition of waste generated from institutes in percentages .....	34
Table A1.25	General waste composition from health centers in percentage .....	34
Table A1.27	Waste issue in institutes.....	34

# ABBREVIATIONS

ECoB	Economic Census of Bhutan
HDPE	High Density Polyethylene
IKI	International Climate Initiatives
NECS	National Environment Commission Secretariat
NSB	National Statistics Bureau
NWIS	National Waste Inventory Survey of Bhutan
PET	Polyethylene Terephthalate
PHCB	Population and Housing Census of Bhutan
UNEP-IETC UN	Environment Programme International Environment Technology Center
WWF	World Wildlife Fund

# ACKNOWLEDGEMENT

The NSB expresses its sincere appreciation NECS team for their extensive support in designing and conducting the study and preparing the baseline report on Bhutan's waste management situation. The study received tremendous support from different government agencies and the society, for which we extend our sincere appreciation.

The NSB is grateful to all sectors and private companies that have played an instrumental role in developing the baseline study approaches and providing their valuable input, both technical and in terms of coordination. We would like to

extend our deepest gratitude to members of the technical committee for reviewing the survey questionnaire and designing it, besides providing valuable comments for its improvement. We commend the commitment, dedication and diligence of all enumerators, who participated in the survey.

For facilitating and mobilising financial support from UNEP/ IETC and the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) the NSB would like to acknowledge and thank WWF Bhutan office.

# EXECUTIVE SUMMARY

The (NWIS-2019) was carried out to provide appropriate waste related data for planning and executing well informed waste management programmes and activities. The survey covered a sample of seven dzongkhags. The data was collected from households, commercial units, industries, institutes, health centres, government offices, private waste management companies and vegetable vendors, both in urban and rural areas. The survey adopted two-staged methods. In the first, the sampled units were administered the perception questionnaire and in the second, wastes from the sampled units were collected to be weighed and their composition studied.

The survey revealed that the country's total solid waste generation in a day was 172.16 metric tons and the per capita waste generation 0.23 kilogram a day. Of the total waste generation, almost 50 percent of it comes from households, followed by commercial units at 40 percent. In waste composition, nearly half the total waste, or 46 percent, comprises food waste, indicating the potential for composting. Plastic and paper wastes make up 33 percent of the total wastes, indicating potential for recycle or reuse.

## Household:

In total, solid waste generation from households was estimated at 81,000 kgs a day. On an average, each household in

urban area was generating 0.7 kgs of wastes a day, while in rural areas, each household was generating 0.4 kgs of waste a day. Half the total waste that households generated were food waste. Plastics and paper wastes constituted almost one-third of the total waste. At one percent, E-waste was the lowest households generated. Almost 65 percent of the households in the country do not have access to waste collection service. Only 15 percent of the households in rural areas had access to waste collection service. Eight in every 10 households reported they segregated dry and wet wastes. More than half the households either dump wastes in pit or burn them. Around 70 percent households reported willingness to pay certain fees if regular waste collection services were available. Almost 90 percent respondents reported that it was the female member of a household that managed wastes.

## Commercial units:

Commercial units include retail/wholesale shops, hotels, restaurant and bar, hardware and electronic shops, repair shops and small scale manufacturing units among others. On an average, each commercial unit generated 5.03 kgs of waste a day. The total waste commercial units generated a day was estimated at 67,299.67 kgs. More than one-third, about 35 percent, of that was food waste, followed by plastic at 17.7 percent and paper and card boards at 12.8 percent. More than 75 percent of the

commercial units reported knowledge of the 3Rs of waste management. Around 50 percent reported practicing it. Commercial units reported willingness to pay monthly fees of about Nu 230 for waste collection service.

## **Institutes**

Institutes include schools, colleges and training centres. In total, institutes generate around 5,400 kgs of wastes a day, of which, food waste constituted 38 percent. Paper and cardboards made up 25 percent and plastic, 21 percent of the total waste. The remaining institutional wastes were textiles, metals, glass and sanitary waste among others. Waste management issues the institutes faced were littering, lack of adequate garbage disposal area and municipal waste collection services.

## **Industries**

Solid general wastes the industries generated, excluding toxic and hazardous ones, were collected. Waste generation from industries was estimated at 5,719 kgs daily, or an average of 16.16 kgs of waste per industry a day. Around 40 percent of the industry waste comprises paper and cardboard products, followed by food waste at 23 percent and plastics at 13.5 percent. They also generate rubbers, glass, metals, woods and other wastes. Some of the issues the industries faced in waste management were the lack of waste storage facility, proper disposal sites and collection services. A majority of the industries reported lack of awareness of

relevant sections in the environmental Acts and regulations.

## **Health centres**

For health centres, only general wastes were collected and information on medical waste was obtained from administrative record. Health centres collectively generate 1,984.34 kgs of waste a day. One-third of that comprises food waste, followed by plastics at 27 percent, and paper and cardboards at 25 percent. Less than five percent make up the rest of the waste like textiles, sanitary waste, glass and rubber. Other wastes include metals, wood and e-waste. Health centres also generate nearly one tons of medical waste a day. Some of the methods health centres used to dispose waste include, open burning, dumping in pit and through collection services.

## **Vegetable vendors**

The total waste vegetable vendors across the country generated was estimated at 6,168.5 kgs a day. Of the total, more than 70 percent was food waste, followed by paper and cardboards at 12.7 percent and plastics at seven percent. Vegetable vendors also generate a small proportion of other wastes like textiles and sanitary pads.

## **Government offices**

On an average, civil servants generated around 0.19 kgs of waste a day at the offices. Excluding teaching and medical staff, 16,301 civil servants generated 3,097.19 kgs of waste a day.

## **Private waste management companies**

The total amount of wastes private waste companies collected in a week was 437.36 metric tons. Twenty-eight percent of that was wet waste, 31 percent were recyclable and 40 percent, non-recyclable. Lack of government support, labour shortage and lack of fund and awareness on waste management were some of the issues these companies faced to effectively deal with waste.

# 1 INTRODUCTION

## 1.1 Background

The Constitution of the Kingdom of Bhutan identifies every Bhutanese as a trustee of its natural resources and environment for the benefit of the present and future generations. Article 5.1 of the Constitution entrusts every citizen with the fundamental duty of protecting the natural environment, conserving the rich biodiversity and preventing all forms of ecological degradation including noise, visual and physical pollution. This is to be fulfilled through adoption and support of environment friendly practices and policies.

The importance of preserving and maintaining our environment was best articulated in His Majesty The King's words during the inauguration of the Royal Bhutan Flower Exhibition in April 2015. It stated: "Where we live must be clean, safe, organised and beautiful, for national integrity, national pride, and for our bright future. This too is nation building". In addition, a number of national policies and

requirements provide the rationale for the development of waste accounts.

Bhutan's 12<sup>th</sup> Five-Year Plan (2019-2023) emphasises effective waste management at the national level as one of the key performance indicators (KPI). It sets out clear performance indicators to be measured by the absolute amount of solid waste (in tons) recycled at the national level. It envisages measuring the efficiency of municipality services through the percentage of urban population satisfied with its waste collection facilities.

Waste management is one of the prevailing challenges in governance that have multi-fold implications on environmental, economic and social dimensions. Like most developing countries, there has been rapid population growth and urbanisation leading to growing waste generation. Providing adequate and efficient waste management services, therefore, was a challenge. Waste management, over the past year, has received impetus with the Zero Waste Hour initiative across the country, observed every

second day of every month. The idea is to trigger behavioural change towards proper waste management, besides practicing sustainable consumption lifestyle leading to a safe, healthy and clean environment.

While waste has been receiving increased attention and focus, information relating to waste was found wanting. Therefore, the NSB and NECS, with support from WWF, carried out the country's first waste inventory survey.

### 1.2 Survey objectives

National Waste Management Strategy 2019 identified 'informational barrier' as one of the obstacles for sound waste management. To provide appropriate data for planning and executing informed waste management programs and activities, the waste inventory survey was conducted with the following objectives:

- Identify the waste generation rate, of many, at households, institutions and commercial units;
- Identify the daily solid waste generation rates in kg/capita/day;
- Identify the composition of waste generated in percentage by weight;
- Identify potentials of solid waste recycling/resource recovery;
- To accurately calculate GHG emissions from waste.
- In addition, the inventory would help gather public perception on:
  - Current practices of waste management;

- Awareness and knowledge on waste management
- Issues and challenges in waste management
- Suggestions and feedback to improve waste management services

### 1.3 Scope and coverage

The survey covered the following sectors:

- Households (Residents)
- Commercial units
- Industries
- Health Centres
- Institutes/offices
- Vegetable markets
- Private waste management companies (perception only)

### 1.4 Concepts and definitions

For the survey, the concepts and definitions are as follows:

Sampling units, which were distinguished by following types:

- **Household:** A household is a person, or group of person, who usually live and eat together. The survey covers all sampled households from both rural and urban areas.
- **Commercial units:** The establishment is a physical entity, where mainly one entrepreneurial activity (or sometimes more than one, with no separate accounts) is carried out. Examples of commercial units include micro trade shops such as groceries, garments,

hardware, automobile workshops, hotels, bars, pharmaceuticals, electrical shops, etc.

- **Industries:** This refers to all the manufacturing and mining companies incorporated under the Companies Act of Bhutan.
- **Institutional households/ offices:** Institutional households consist of group of persons living in an institution, like schools, colleges, training institutes, etc. This category also covers all government offices.
- **Health centres:** It covers all health centres, including hospitals and BHUs, in the country.
- **Private waste companies:** It refers to private enterprises and NGOs dealing with waste management.

### Solid waste:

- **Paper and its products:** This includes packaging materials, books, newspapers, cardboards, office papers and other paper products.
- **Plastics:** This consists of plastic bags and plastic wrappers.
- **Pet bottles:** Plastic containers, jars and bottles fall in this category.
- **Food waste:** In this category falls all kitchen wastes like left-over foods, vegetable peelings, rotten vegetables, meat items, egg shells, etc.
- **Textiles:** This category includes leather, threads, yarns, fabrics, cloths, etc.

- **Rubbers:** Rubber items like rubber footwear, vehicle tires, etc fall in the category.
- **Metals:** It includes tins, steel cans, iron rods and other ferrous metals.
- **E-waste:** All discarded, obsolete or recyclable electrical or electronic equipment including all components, subassemblies and consumables at the time of discarding make up such wastes.
- **Sanitary waste:** It includes sanitary pads, diapers, etc.
- **Batteries:** All forms of batteries such as car batteries, watch batteries, ordinary batteries for lighting/radios, etc. are included in this type.
- **Glass:** This consists of clear bottles, composite glasses and other glass.
- **Green plants:** It comprises all green plant materials such as leaves, grasses, etc.

**Medical waste:** Waste emerging from medical procedures and treatments in hospitals, BHUs, clinics, animal husbandries, veterinary hospitals and domestic households make up this category of wastes

**Liquid Waste:** It includes liquid waste such as engine oil, Mobil, etc. from automobile workshops and industries.

### 3Rs for waste management

- **Reduce:** It means the reduction of solid waste before it enters the solid waste stream by methods such as product

design, materials substitution, materials re-used and packaging restrictions.

- **Reuse:** It is the use of a material or product more than once before being recycled or discarded.
- **Recycling:** It is the treating of used or waste materials through a process to make them suitable for use and other purposes. It includes any process by which solid waste materials are transformed into new products in such a manner that the original products may lose their identity, and which may be used as raw materials to produce other goods or services.

**Autoclave:** It is a thermal process, where steam is brought into direct contact with waste in a controlled manner and for sufficient duration to disinfect the waste.

**Chemical waste:** It means a discarded material from a source that may be solid, semisolid, liquid or gaseous form designated as hazardous.

**Composting:** It is the decomposition of organic matters into a human-like product by natural process of micro-organisms.

**Incineration:** The controlled combustion of waste takes place, which is implemented as a final disposal of waste or part of material recovery technique.

**Landfill:** Final placement of waste into or onto the land in controlled or uncontrolled manner.

**Open burning:** It's the burning of solid waste in open space, releasing the by-product of

combustion directly into the atmosphere without adequate pollution control process.

**Waste:** It applies to any material or substance, in whatever form, solid, liquid, or gaseous, hazardous or non-hazardous, organic or inorganic, that has lost its primary value and is disposed of, intended to be disposed of or recycled.

**Waste management:** It is the control of waste generation and its adverse impacts through administrative, financial, legal, planning and engineering functions of storage, collection, transfer and transportation. Thereafter, its treatment and disposal in a manner consistent with the best principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations.

**Waste segregation:** It is a process of sorting different materials found in solid waste. This promotes recycling and re-use of resources and reduces the volume of waste for collection and disposal.

**Waste transfer:** A facility where solid waste materials, including yard waste, demolition materials and household refuse are transferred from small vehicles to large trucks to be transported to landfills, recycling centres and other disposal sites.

**Waste transfer station:** It refers to a facility for the segregation and intermediary collection point for waste before final disposal or recycling.

# 2 METHODOLOGY AND OPERATIONS

## 2.1 Introduction

Survey methodology and operation standards were strictly adhered to for assured quality of the results. Unlike other household surveys, the NWIS followed two-stage procedures. The first stage entailed administering the sample units with perception questionnaire. The same units were requested to store their waste for measurement and composition study in the second stage.

## 2.2 Preparation phase

Survey preparation entailed designing questionnaire, consulting stakeholders, developing survey module with the Survey Solution system and selecting and training field enumerators. The field enumeration was conducted in November and December 2019.

### 2.2.1 Stakeholder participation

Being the first nation-wide waste survey by the NSB, several rounds of workshops

were conducted at various stages of the survey preparatory phase. The perception questionnaires and survey methodologies were discussed with relevant stakeholders at different levels. Annex II provides the list of agencies that were consulted.

### 2.2.2 Questionnaire design and field staff manual

In the absence of a national experience to draw on, several survey questions of other countries that conducted similar surveys were reviewed while drafting the perception questionnaire. Based on recommendations and feedback from the stakeholders' workshops six different perception questionnaires were developed for different sectors like household, commercial units, industries, health centres, institutes, offices and private waste management companies. A waste quantification format was developed to capture the quantity of waste. After finalising the different questionnaires, field manuals were developed to guide

enumerators and supervisors for the enumeration, just as it served as the basis for their training.

The questionnaires and manuals were tested during the pilot survey and revised based on feedback.

### 2.3 Data capture methodology

For this survey, two different data capturing methods were used. Survey Solution was used for the perception questionnaire to create the interface for data capture. Survey Solutions is a free software package the World Bank developed to assist governments, national statistics offices and non-governmental organisations in implementing advanced surveys using mobile devices. The software is then loaded into a tablet to guide enumerators through the questionnaire. This method of data capture is called "Computer-Assisted Personal Interviewing" (CAPI).

A number of consistency checks was incorporated, the automatic skip patterns, for instance, so when specific questions had to be skipped - depending on information already provided by answers to previous questions - the program automatically guide denumerators to the next question. Specific instructions were provided against each question to help enumerators and respondents deal with them. In addition, a large number of validation checks was also incorporated to assure data quality. Following completion of data collection, they were exported from survey solutions to

STATA for analysis.

For waste quantification, the waste quantity data, generated from what enumerators collected and measured from different sectors, were recorded in the excel (hardcopy). The waste quantity recorded in excel format was later entered in CSPRO software before being exported to STATA for analysis.

### 2.4 Procedure for data collection

The guidelines for solid waste management assessment (baseline survey) produced by UNESCAP was adopted to collect and measure the wastes from sampling units and study the waste composition by different waste contributing sectors. The process involved are as follows:

- Enumerators first administered the perception questionnaires for the selected sampling units (households, commercial units, institutes, health centres, industries and private waste companies);
- The units were provided plastic bags to store wastes they generated;
- Households were asked to store the waste they generated daily for a week (seven days), while establishments/ units were asked to store their two-day wastes, considering they generated substantial amounts of waste;
- The collection days were agreed on with respondents and their waste was collected based on the agreed schedule;

- The above processes were repeated for each sample area;
- This was followed by weighing of wastes and recording them in the data sheets developed for waste quantification;
- Collected wastes were taken to the drop off centre and segregated to determine their composition by types in keeping with the standard procedures prescribed in the guidelines; and
- The waste was weighed by type and recorded in the data sheet;

### Types of waste

- Organic - food waste
- Green plant material
- Wood
- Plastic, hard - PET and HDPE
- Plastic, soft - packaging, etc.
- Paper and cardboard
- Glass
- Metals
- Textiles
- Electronic waste
- Sanitary Pads
- Rubbers
- Others

## 2.5 Sampling methodology

### Sampling frame

Multiple sampling frames were used since the survey collected different units. The sampling frame for households was prepared from the Population and Housing



Field supervisor and enumerators measuring and recording the waste collected from households

Census of Bhutan 2017 and for commercial units from Economics Census of Bhutan 2018-2019. The frame for industries, medical facilities, schools, colleges and training institutes (TTI) were prepared based on the administrative information received from relevant ministries and agencies.

### Sample design

The sample is designed to provide national level indicators. However, the household sample was designed to provide indicators at urban and rural areas. Different sampling techniques were applied for different sampling units because a uniform one would not fit all sampling types.

- i) Sampling for household perception on waste

A stratified two-stage sampling design was adopted to gather information on households perception of waste. The Primary Sampling Units (PSU) were Enumeration Areas (EA) and chiwogs in urban and rural areas respectively.

The Probability Proportional to Size with Replacement (PPSWR) was used to select PSUs with number of households as size of variable. Households, which were Secondary Sampling Unit (SSU) were selected using Circular Systematic Sampling (CSS) in each selected PSU. The perception questionnaires were added to the Labour Force Survey and enumerated in all dzongkhags.

- ii) Sampling for household waste generation

A stratified three-stage sampling design was adopted to collect information on households waste generation. Seven dzongkhags, two each from eastern and central regions and three from western region were selected, applying the PPSWR with number of households as size of variable, method. The PPSWR was also adopted to select EA and chiwog in the selected dzongkhags. The households were then selected applying Circular Systematic Sampling (CSS).

- iii) Sampling for commercial units, industries, health centres and institutions

The quota sampling technique, a non-probabilistic version of stratified

sampling, was adopted to select sampling units for commercial units, industries, medical facilities, schools, colleges and training institutes. The commercial units were stratified into wholesale, retail, beverage serving activities, construction, manufacturing, repair services, restaurant and hotel and others. Industries were stratified into large, medium and small. Likewise, medical facilities were stratified into hospital, BHU I and BHU II and schools into primary, lower secondary, middle secondary and higher secondary. They were then allotted sample size for each stratum in all selected dzongkhags.

### Weights

Sampling weights were determined to generalise the survey findings for the country's entire population. For households, the probability for selection of dzongkhags, EAs and chiwogs and households were used to determine the sampling weights. For other sampling units, the units sampled in the seven selected dzongkhags were assumed to represent the whole population. For example, out of the 319 primary schools in the country, 22 primary schools were used for sampling. The sampling weight is calculated by dividing the total number of primary schools by the total number of those sampled,  $(319/22=14.5)$ . In other words, it implies that on an average one sampled primary school represents 15.

### Sample size

The number of sample units enumerated

for different types of sampling units are presented as follows;

## 2.6 Enumeration

### 2.6.1 Pilot census

A week-long pilot survey was conducted in October 2019 to check the structure, flow of the questionnaire and to estimate the average time required for enumeration. In addition, it provided the opportunity to test procedures, train enumerators and supervisors and in data processing. Six NSB officials conducted the pilot survey.

Findings from the pilot census were used to:

- make necessary corrections in the structure and flow of the census questionnaire;
- plan the number of supervisors and enumerators required to complete the

field enumeration within stipulated time; and revise the tasks of field supervisors to review contents of the field staff training for the survey.

### 2.6.2 Selection and training of census staff

For the main survey, 10 supervisors, 40 enumerators and three regional supervisors were engaged for 36 days (18<sup>th</sup> November 2019- 23<sup>rd</sup> December 2019). Dzongkhag Environmental Officers and NECS officials supervised a group of university graduates selected and recruited as temporary survey enumerators.

Training for supervisors and enumerators were conducted for a week, from 13<sup>th</sup> November to 17<sup>th</sup> November 2019. They were introduced to the survey’s general background, including the concepts and definitions of the terms contained in the

Sampling units	Numbers
Household-Perception	3,262
Household-Waste generation	1,584
School-Perception	70
School-Waste generation	67
College and Training institute-Perception	10
College and Training institute-Waste generation	8
Medical facility-Perception	26
Medical facility-Waste generation	26
Industry-Perception	40
Industry-Waste generation	36
Commercial-Perception	677
Commercial-Waste generation	402
Private waste company-Perception	9
Government office-Perception	47
Government office-Waste generation	47
Sunday vegetable market-Waste generation	7

questionnaire. They were also trained on various enumeration procedures and to capture responses electronically in the tablets.

Mock interviews in different dialects were conducted among the enumerators to equip them with interviewing skills and techniques during the training. It concluded with enumerators conducting field tests to acquire hands-on training and familiarize with the use of the tablet.

Thimphu Thromde officials were engaged in educating enumerators on waste composition, segregation and measurement for waste quantification and composition study.

### 2.6.3 Enumeration

The census was conducted over a period of 36 days from November 2019 to December 2019. The enumerators were split into 10 teams comprising four enumerators and a supervisor each. The teams were assigned to specific dzongkhags and depending on the size of samples, two teams were assigned for Thimphu, Chhukha and Samdrup jongkhar. Three regional supervisors and a dash board manager at NSB headquarters checked the quality of the field survey.

### 2.6.4 Data checking and editing

The main task of field supervisors was to assign questionnaires regularly to enumerators in the field and to verify the quality and consistency of each completed questionnaire. To ensure data quality,

regional supervisors and dashboard managers further checked and verified the completed questionnaires that supervisors submitted. Missing, incomplete and inconsistent responses were rejected with comments for correction as soon as it was received from supervisors. Enumerators revisited enumerated areas to correct data for resubmission to dashboard managers through their supervisors. This process was repeated until dashboard managers accepted the data .

After data collection was completed, the consolidated dataset underwent a thorough

Check to identify missing values, errors and inconsistencies, including responses that did not meet established criteria for plausibility. Data checking and editing was conducted from December 2019 to January 2020. In many cases, issues were followed up through telephone calls with respondents to resolve them. Remaining issues were addressed through following editing procedures:

- Deterministic editing of individual data issues based on available information in the dataset;
- Imputation of sets of data issues based on logical inference; and
- Assigning codes for 'missing values' if data issues could not be adequately addressed.

## 2.7 Analysis and dissemination

### 2.7.1 Analysis and report writing

During the census preparation, a detailed report outline and tabulation plan was developed to produce the tables during analysis. This was the basis for presentation and analysis of results in the survey report. The NSB and NECS teams were involved in analysing and report writing. The NWIS-2019 team was split up into three groups, assigned with the responsibility of drafting the respective sections and chapters of the report. The team received full-time support from NSB's senior IT officer for production of additional analysis tables and general data management.

The analysis results and report chapters the team produced underwent several rounds of internal review.

## 2.8 Limitations of the report

The NWIS-2019 did not cover the entire waste generating sectors. Since the survey duration coincided with academic year ending, some schools although open, had no students, with the vacation having already started. This resulted in slight downward bias in the quantity of waste collected from those schools.

The survey had not estimated and analysed the non-domestic waste that were seen or dumped in open areas, river banks, roads/drains, etc. as it was not planned, given its extensive area and limited resources and time.

This survey report did not make any adjustment for seasonal variation of waste generation.



A field supervisor measures and records waste collected from commercial units



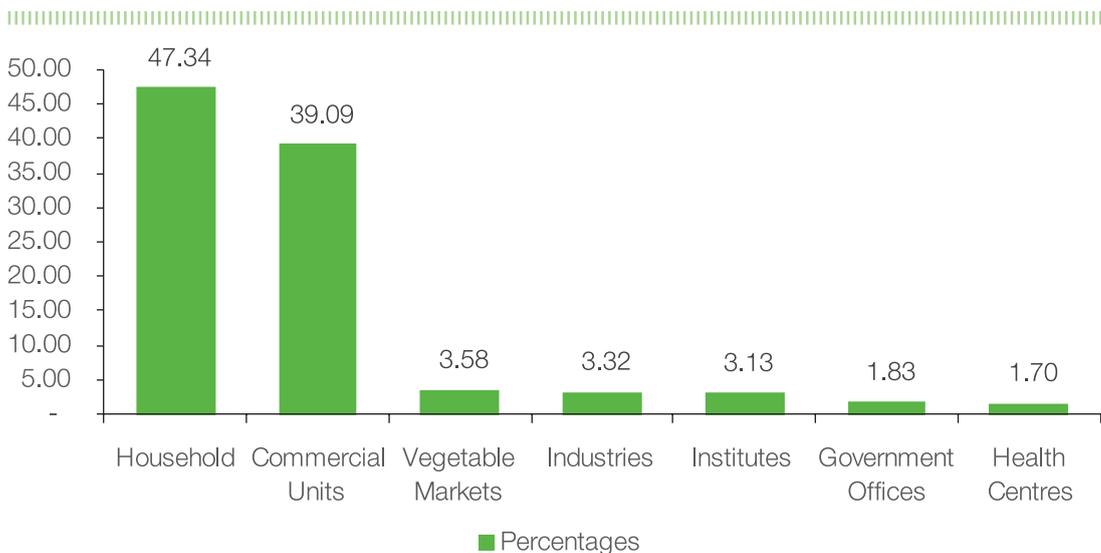
## 3 Solid Waste Generation, Composition, Management and Perception on Waste.

For the purpose of waste inventory, the survey adopted two-stage methods. In the first stage, enumerators administered the perception questionnaires for the sampling units. The perception questionnaires comprised of the current daily practices of waste management, awareness and knowledge in waste management, issues

and challenges faced while managing waste. It also encouraged suggestions and feedback to improve the nation's waste management system.

Enumerators collected wastes from the sampling units to study the total waste generation and composition in the second

**Figure 1** Proportion of wastes from different sectors in percentage



stage. For households, the survey collected wastes generated over seven days while for other sectors, it was for two days.

The survey result showed that the country generated a total of 172,161.09 kg of solid waste a day. The per capita solid waste generation was estimated at 0.23 kg a day. Of the total, more than 85 percent of the waste was from households and commercial units.

Figure 2 illustrates the composition of wastes from various sources in percentage. Of the total waste generation at 172.16 metric tons, approximately 50 percent comprises food waste. It includes all waste generated from kitchen, such as

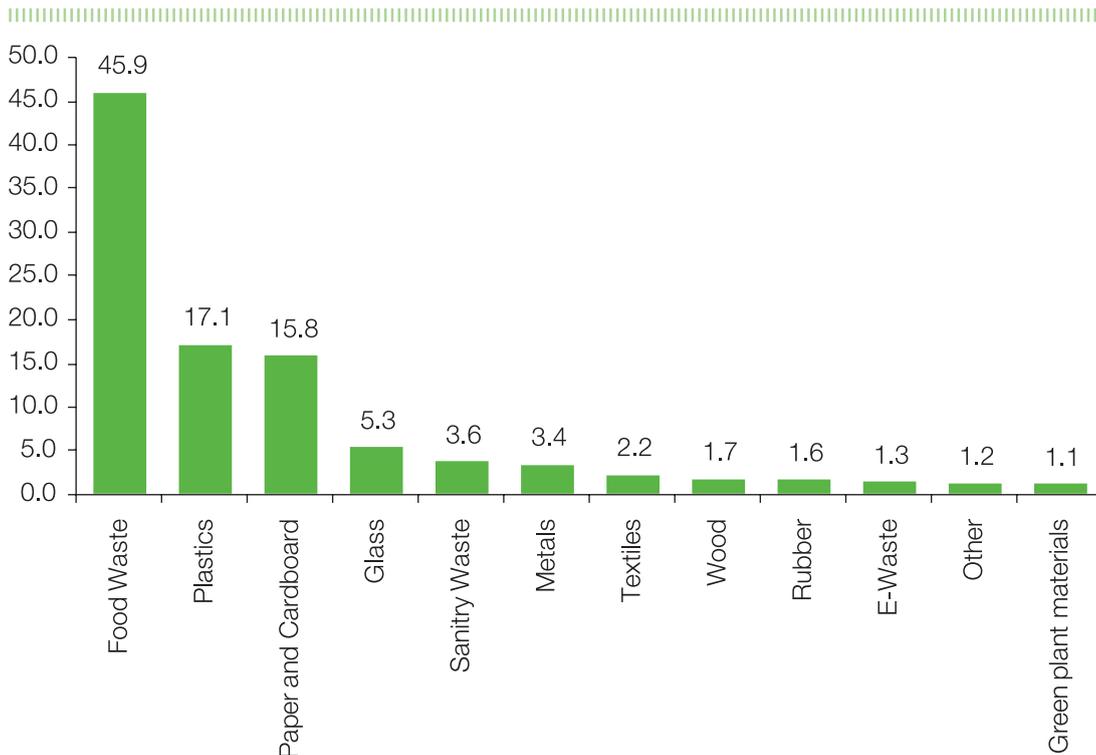
vegetables, fruits, food remains, etc. Plastics (soft plastics, pet bottles & HDPE) comes in second to make up 17.1 percent followed by paper and card boards at 15.8 percent.

### 3.1 Household waste

#### 3.1.1 Waste generation and composition

The survey gathered waste from households over seven days. The sample households were provided plastic bags and asked to accumulate waste generated for seven days from their household, while they were interviewed on the general perception questionnaire.

**Figure 2** Waste composition in percentage



Field enumerators collected wastes from the households after a week and segregated them into different compositions.

The survey result showed that households generated more than 80,000 kg of solid waste every day. On an average, each household generated around 0.5 kg of solid waste a day. Waste the urban households generated 0.7 kg a day per household is almost double the amount of waste rural households generated at 0.4 kg a day per household.

Figure 3 presents the composition of solid waste the households generated. Overall, half or 50 percent of the solid waste households generated constituted food waste. One-fifth or 20 percent were plastics followed by paper and card boards at 10 percent.

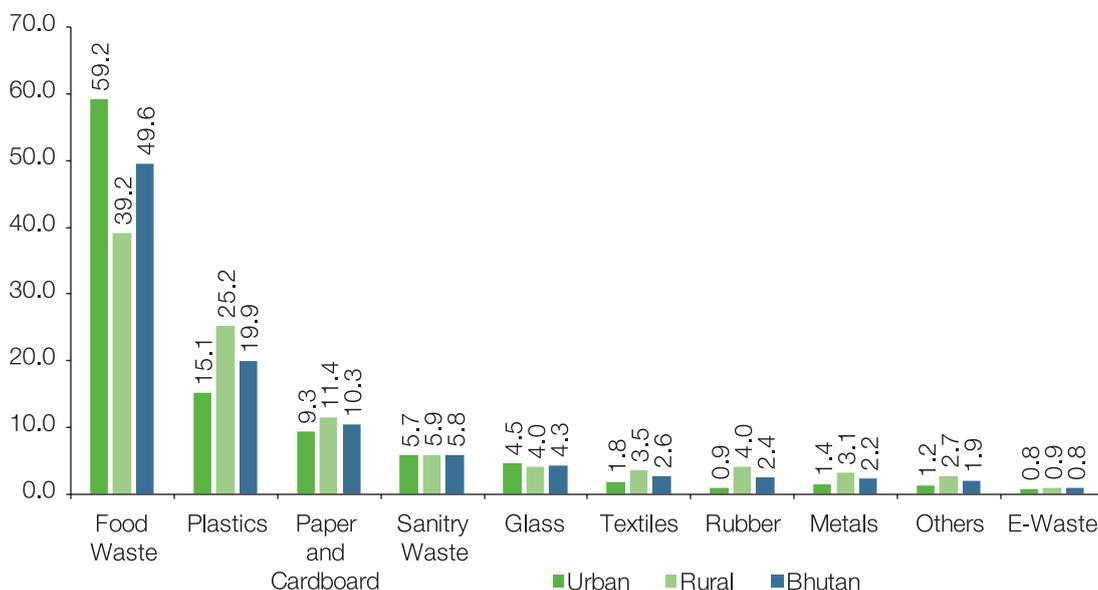
In urban households, food waste constitutes almost 60 percent of the total waste, while in rural households, the proportion of food waste is comparably lower at 40 percent. In both urban and rural households, plastics, paper and paper boards make up the next big waste after food waste.

Almost six percent of the total wastes comprises sanitary pads both in urban and rural households. Electronic waste is the lowest, at less than one percent, of the total household wastes.

**Table 1** Quantity of solid waste generation per day by area by households

Area	Total Waste (kg)	Mean Waste (kg)
Urban	42,274.5	0.7
Rural	39,226.1	0.4
Bhutan	81,500.5	0.5

**Figure 3** Composition of household waste in percentage

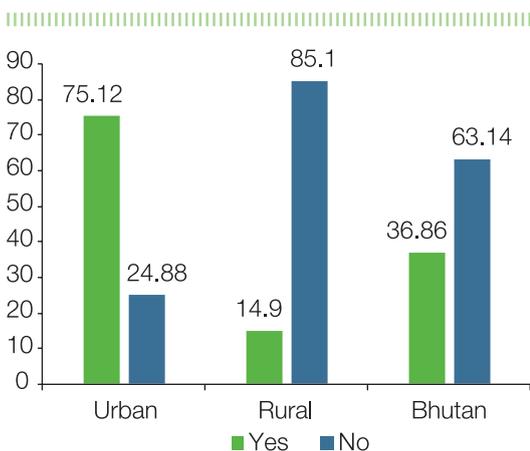


### 3.1.2 Waste management practices and general perception

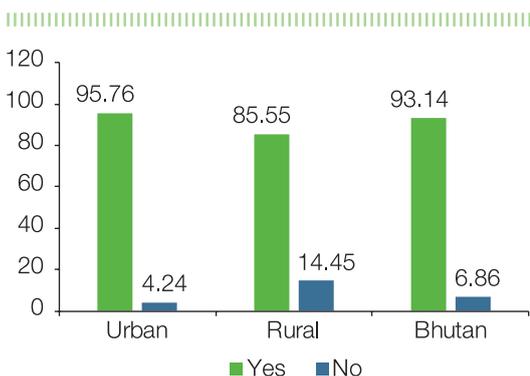
Of the total households, more than 60 percent lacked access to waste collection services in the country. However, more than 75 percent of the urban households had access to waste collection service against the 15 percent of the rural households.

Of the total households with access to waste collection services, only 95.76 percent of

**Figure 4** Proportion of households with access to waste collection services



**Figure 5** Proportion of households using waste collection service



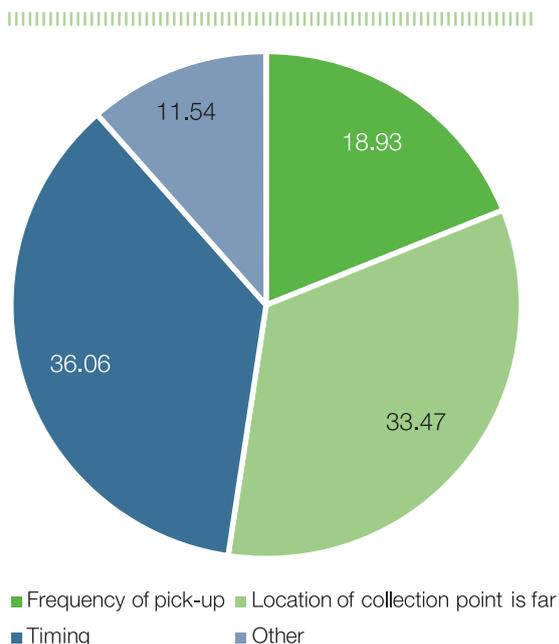
the urban households and 85.55 percent of the rural households used the services as depicted in Figure 5. Overall, of the total households with access to waste collection services, more than 93 percent used the service.

Inappropriate timing and location of waste collection point being far or inconvenient were the two main reasons for not using waste collection services.

Around 80 percent of the total households reported they were satisfied with the waste collection service, while almost one-fifth of the households reported they were dissatisfied with the service.

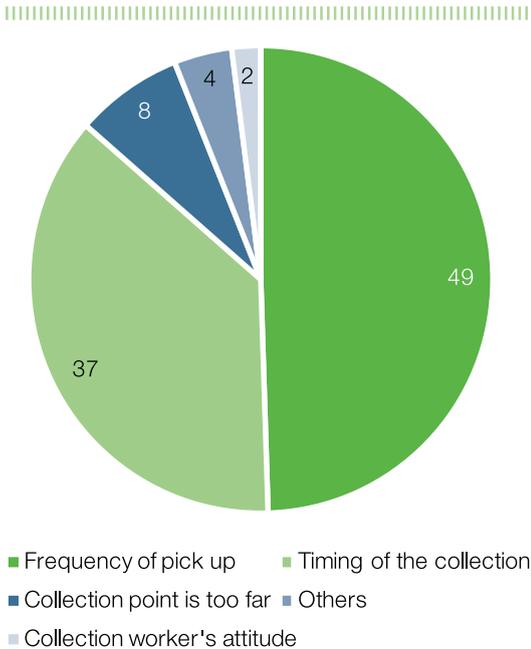
Reasons for dissatisfaction over waste collection services include inadequate

**Figure 6** Reasons for not using available waste collection service

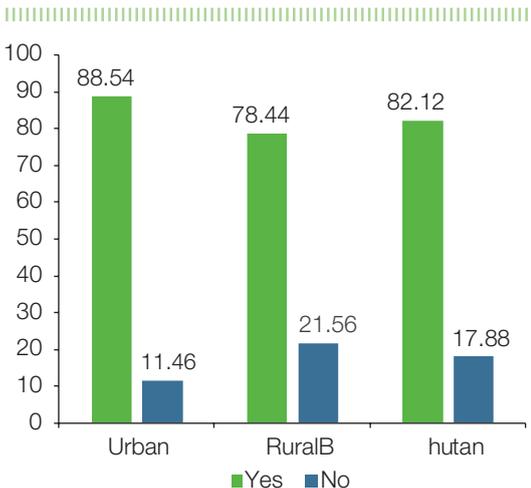


frequency of collection that makes up 49.2 percent of the respondents, 37 percent that reported inappropriate timing, 7.5 percent that said the collection points were too far, two percent who were displeased by

**Figure 7 Reasons for dissatisfaction**



**Figure 8 Proportion of households segregating dry and wet wastes**

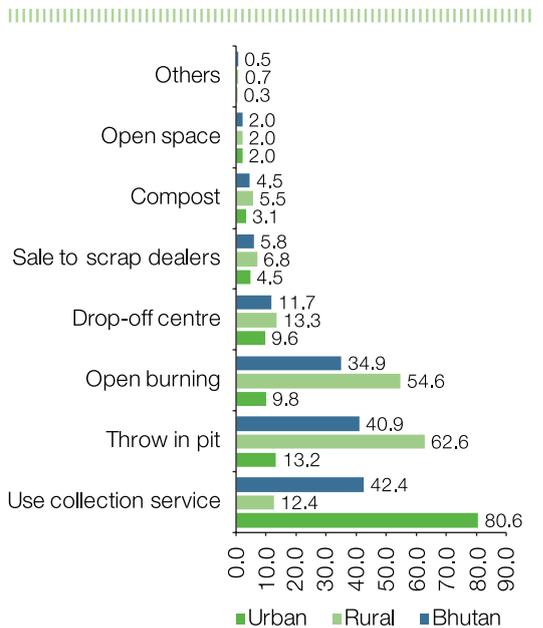


collection worker's attitude and four percent that made up for other reasons.

As presented in Figure 8, more than 80 percent of the households reported segregating dry and wet wastes at home. There was almost equal proportion of households in urban (88%) and rural (78%) areas that segregated dry and wet wastes.

Figure 9 presents the different waste disposal practices followed by the households. The total percentages are more than 100 because of the multiple responses households provided. In rural areas, more than 55 percent of the households still resort to disposing their household waste in the pit or practice open burning due to lack of collection service in the area.

**Figure 9 Household waste disposal practices**

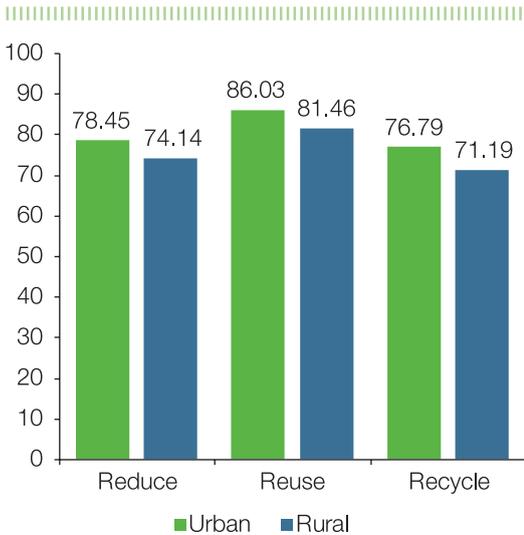


## NATION'S WASTE ON THE SCALE

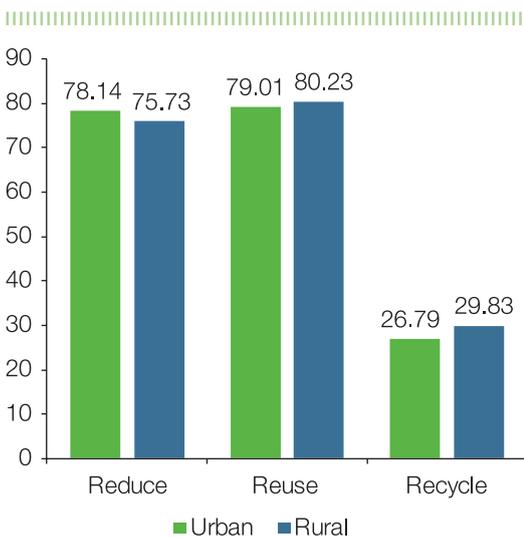
Almost 80 percent of the households in rural areas and 60 percent in urban areas reported to having participated in the community clean-up campaigns/activities in one year before the survey.

More than 70 percent of the households,

**Figure 10** Proportion of households with knowledge on 3Rs by area



**Figure 11** Proportion of households practicing 3Rs by area



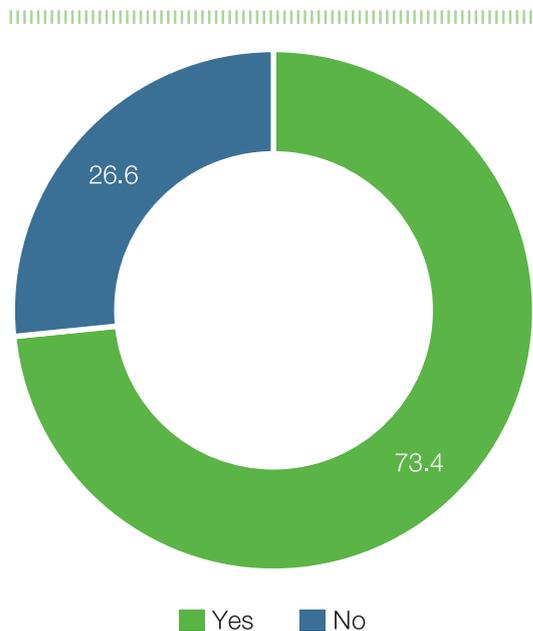
both in urban and rural areas, reported of their knowledge on 3Rs (Reduce, Reuse, Recycle) of the waste management.

Of the total households with knowledge on the 3Rs, more than 70 percent reported of having reduced and reused waste, whereas, only around 30 percent of the households recycled their waste.

Figure 12 shows the proportion of household willingness to pay for waste collection services if regularly provided. More than 70 percent of the households, both in urban and rural areas, are willing to pay a certain fee for regular waste collection services. On an average, households are willing to pay around Nu150 in a month for such a service.

When households were administered the

**Figure 12** Proportion of households favouring waste management fee

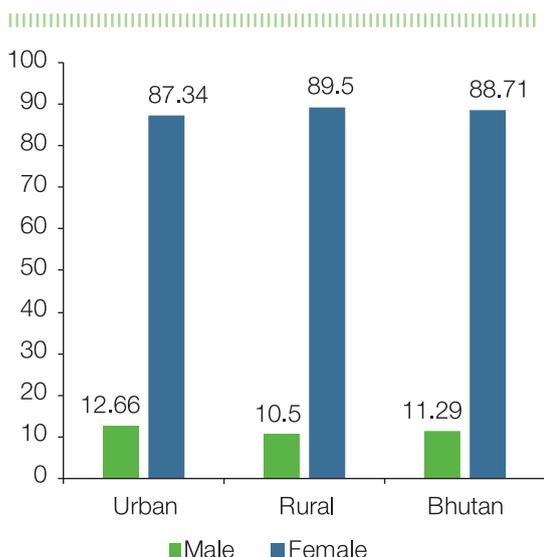


question on sex of the person who usually manages waste in their household, more than 85 percent, both in urban and rural areas, reported that it was usually the female that managed the waste.

A little more than one-third of the households felt that conducting clean-up

campaigns, including the door-to-door ones were most effective in terms of creating awareness on waste management. On the other hand, few (less than one percent) of the households preferred conducting waste management awareness through print media. Comparably, around six percent of the households preferred social media for conduct of such awareness.

**Figure 13** Waste management in households by sex and area

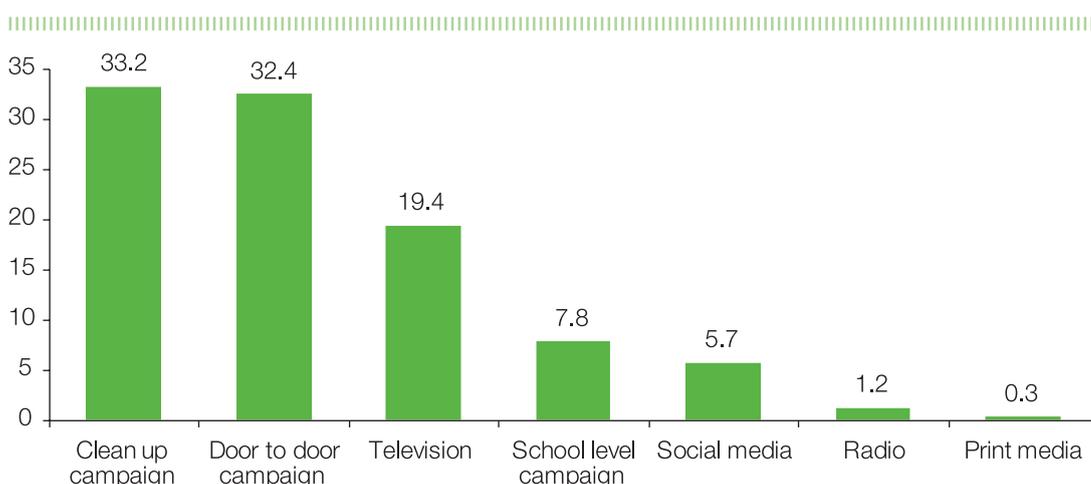


### 3.2 Commercial waste

#### 3.2.1 Waste generation and composition

The commercial units here include retail/wholesale shops, restaurant and bars, hardware and electronic shops, repair shops, manufacturing, etc. To have a representative sample, the survey ensured inclusion of all types of commercial units involved in different activities. The sampling frame for commercial units is used from the recent Economic Census (ECoB-2018-19) NSB conducted in 2018-19.

**Figure 14** Preferred waste management awareness programmes



## NATION'S WASTE ON THE SCALE

Table 2 shows the waste generation from commercial units. Wastes from commercial units were collected for two days for the survey. Like for the households, commercial units were first selected for the sample and were administered the perception questionnaire. They were then asked to accumulate waste for 48 hours (two days) in plastic bags they were provided. The survey team, after two days, collected the wastes from the commercial units to be weighed and for composition study.

The total commercial waste generated was

**Table 2** Quantity of waste generation from commercial units per day

Total Waste (kg)	Mean Waste (kg)
67,299.67	5.03 kg

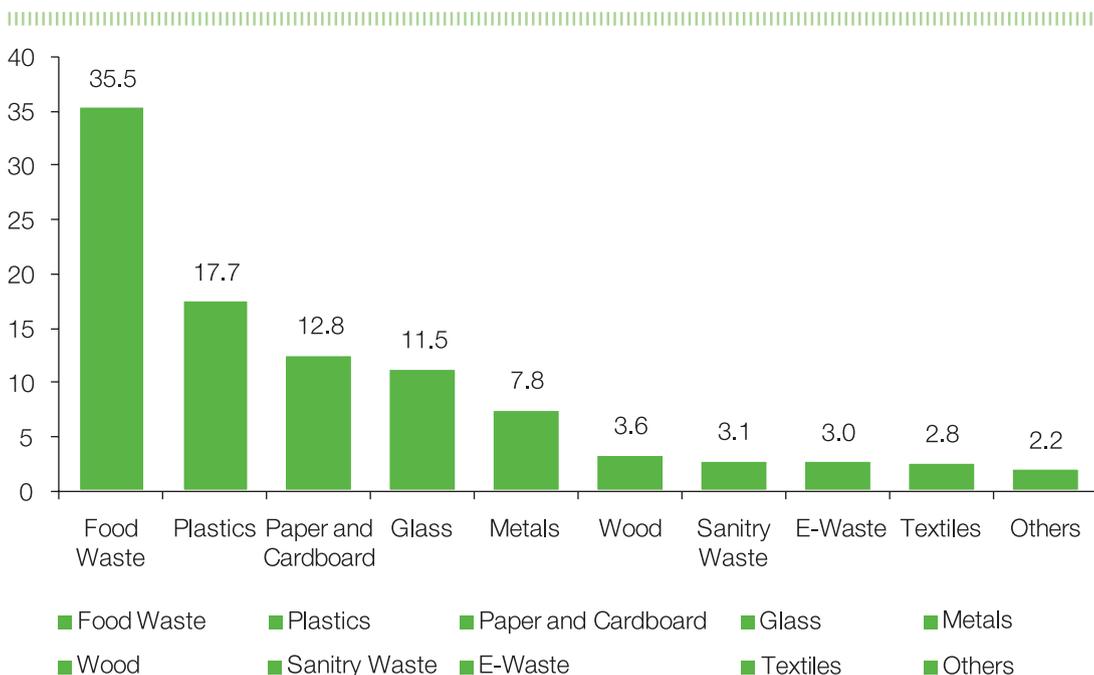
estimated at 67,299.67kg a day. The average commercial waste generation was 5.03kg a day per commercial unit.

Figure 15 depicts the composition of waste generated by commercial units in percentage. It was observed that a majority of the waste the commercial units generated comprised of food waste at 35.53 percent, followed by plastics at 17.7 percent and paper and cardboards making up 12.8 percent

### 3.2.2 Waste management practices and general perception

Collection services the municipal office provided was the most preferred disposal practice with 82.27 percent hailing it followed by sale to scrap dealers at 19.65 percent. Open space dumping and composting

**Figure 15** Composition of waste generated from commercial establishments



practices were the least preferred and practiced methods for commercial units at 1.48 and 1.77 percent respectively. The total percentage can be more than 100 percent since each commercial unit was allowed more than one option (multiple answers) to choose.

Nearly half, or 47.23 percent of the commercial units surveyed, reported segregating wastes into dry and wet categories. While six percent do not segregate waste, 45.78 percent reported generating only the dry wastes.

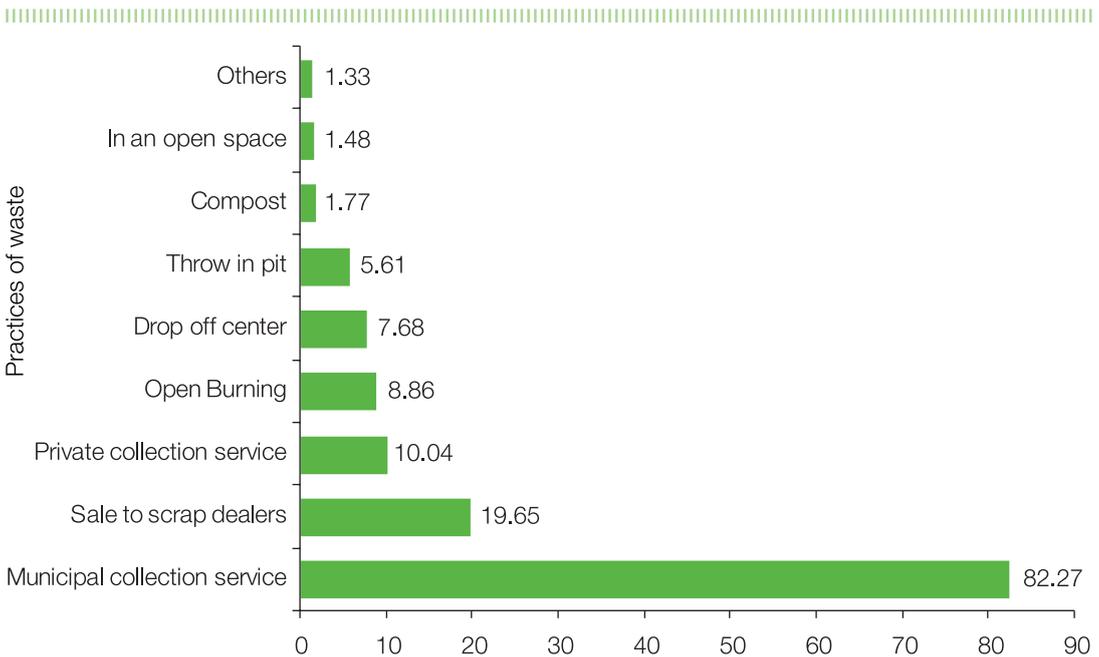
Lack of adequate time to segregate waste, according to 19.53 percent of the respondents, was the major reason for

non-segregation, followed by the lack of disposal facility/service at 17.1 percent. One out of 10 commercial units cited lack of awareness as the reason for not segregating waste.

Of the total commercial units surveyed, 78.3 percent had access to waste collection service, of which, 98.17 percent availed of it. A little less than two percent of commercial units do not use the available service because of its ill-timing according to 22.51 percent of the respondents and collection point being far for 16.23 percent.

Almost ninety percent of the commercial units were satisfied with the waste collection services, while 11.62 percent reported

**Figure 16 Proportion of waste disposal practices commercial units used**



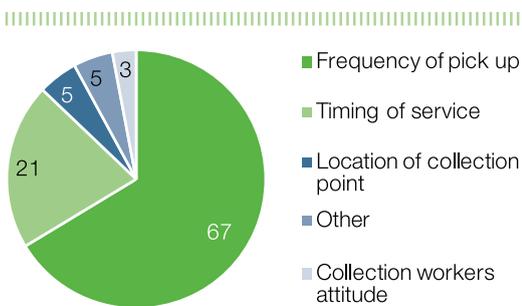
## NATION'S WASTE ON THE SCALE

dissatisfied. Inadequate frequency of collection at 66.67 percent and inappropriate timing of the services at 21.21 percent were two of the major reasons.

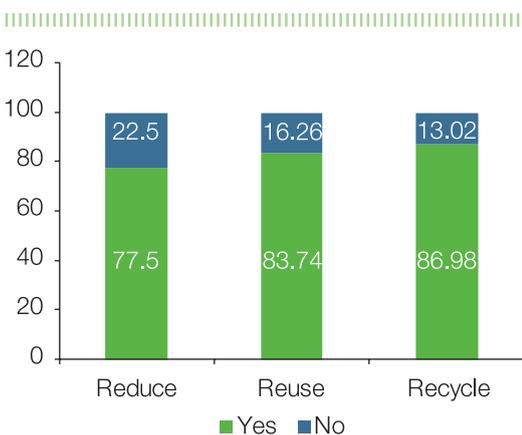
Although a majority of the commercial units know the 3R concept, only about a half of them practice it.

More than 70 percent of the commercial units were willing to pay a monthly mean fee of Nu 232.25 for regular waste collection service. It was also encouraging to learn

**Figure 17** Reasons for dissatisfaction over waste collection service in percentage



**Figure 18** Proportion of commercial units aware of 3Rs of waste management



that a majority of the commercial units were aware of the causes of increasing waste generation, the nature of wastes, available tools for waste management and the ill effects of improper waste management.

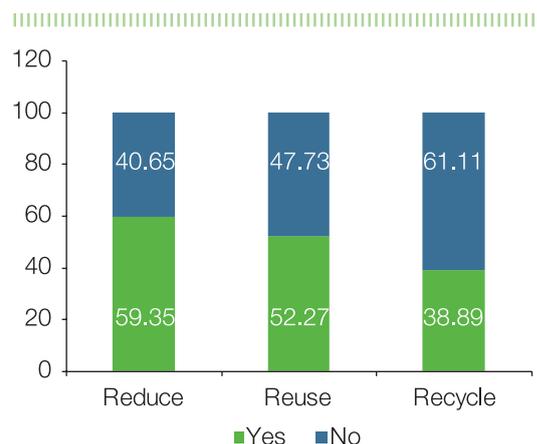
### 3.3 Institutional waste

#### 3.3.1 Waste generation and composition

Institutes include schools, colleges and training centres. The total waste institutes produced was estimated around 5,400 kg a day, which works out to almost 10 kg a day per institute in terms of waste generation.

Figure 20 depicts the composition of waste generated by institutes. A majority, at 38 percent, of the total wastes comprises food waste and almost one-fourth or 24.25 percent paper and card boards. Other wastes, which include wood, green grasses, E-waste, etc. make up seven percent of the total waste.

**Figure 19** Proportion of commercial establishments practicing 3Rs

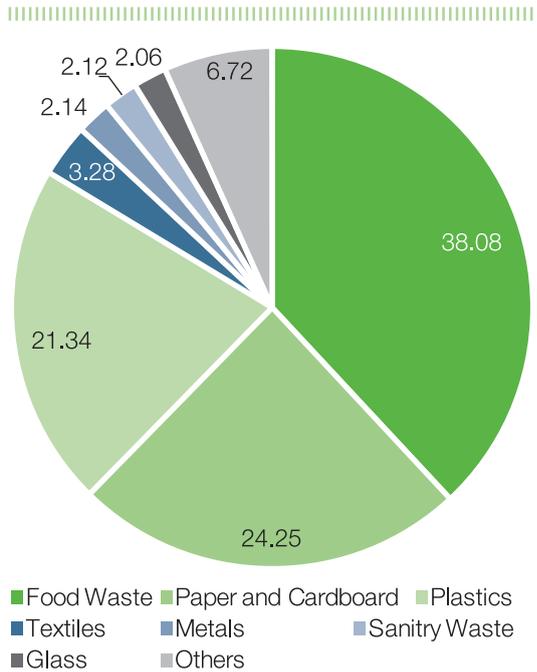


### 3.3.2 Waste management practices and perception

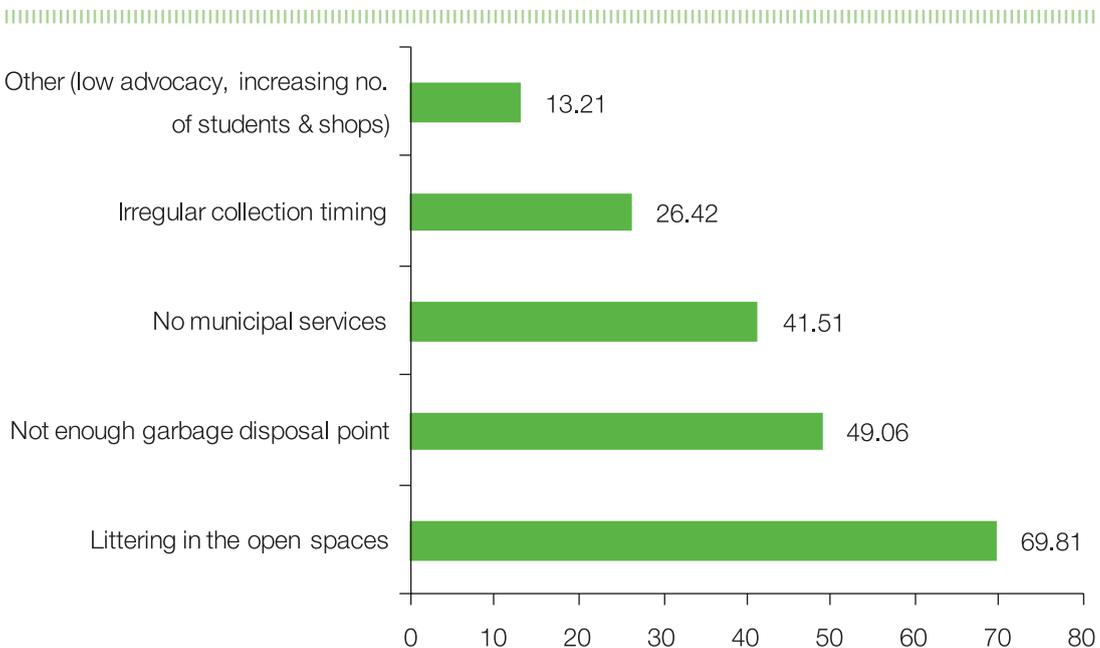
As shown in Figure 21, the survey reveals that 55.66 percent of the 552 institutes (schools, colleges and training centres) perceive waste as problem in their area. Institutes have identified littering in open areas (69.81%), not enough garbage disposal point (49.06%) and lack of municipal services (41.51%) as the three main waste management problems in their area. The total percentage in the figure exceeds 100 indicating multiple responses.

The three main reasons attributed to the problems the institutes faced were poor civic sense (64.15 percent), poor collection facilities (56.6 percent) and poor advocacy on waste management (32.08 percent).

**Figure 20** Composition of the waste generated from institutes



**Figure 21** Problems related to waste management in institutes



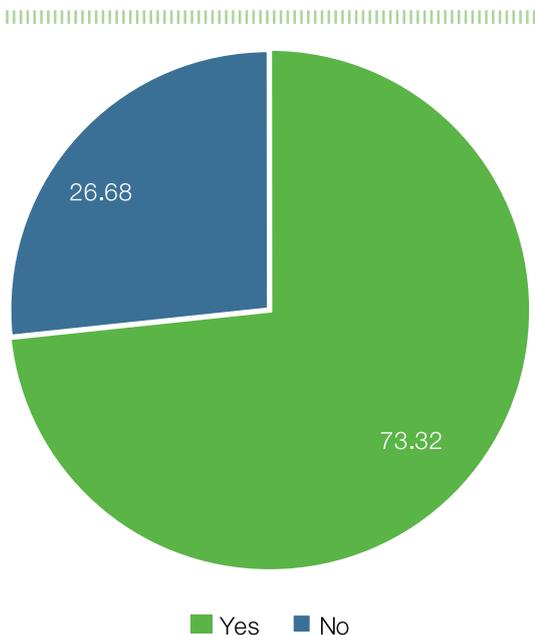
More than half the institutes reported lack of waste collection services. However, the three major ways institutes reported disposing their wastes were:

Using municipal collection service; open pit dumping; and open burning

Of the total institutes, 73.32 percent reported segregating dry and wet waste at source, while 62.85 percent reported segregating waste for recycling. Some of the wastes often segregated for recycling were paper wastes, pet bottles, metal items and glasses.

It was reported that almost 99 percent of the institutes provide education and awareness on waste management. A majority of the institutes also reported observing the monthly "Zero Waste Hour".

**Figure 22** Proportion of institutes segregating dry and wet wastes at source



### 3.4 Industrial waste

#### 3.4.1 Waste generation and composition

Waste from industries was collected for two days. The survey collected only the solid general wastes from industries and not the toxic and hazardous ones like chemicals, slags, etc. The survey finding shows that the estimated daily waste generated from the industries across the country was 5719.34kg a day. On an average, each industry generated 16.16kg of solid waste a day.

Figure 23 shows that almost 40 percent of the total waste from industries comprises paper, paper products and cardboards. Even for industries, food waste constitutes one-fifth of the total waste. Plastics, at 13.5 percent came in third. Around five percent of the total waste comprises other waste like sanitary pads, green plants, etc.

#### 3.4.2 Waste management practices and perception

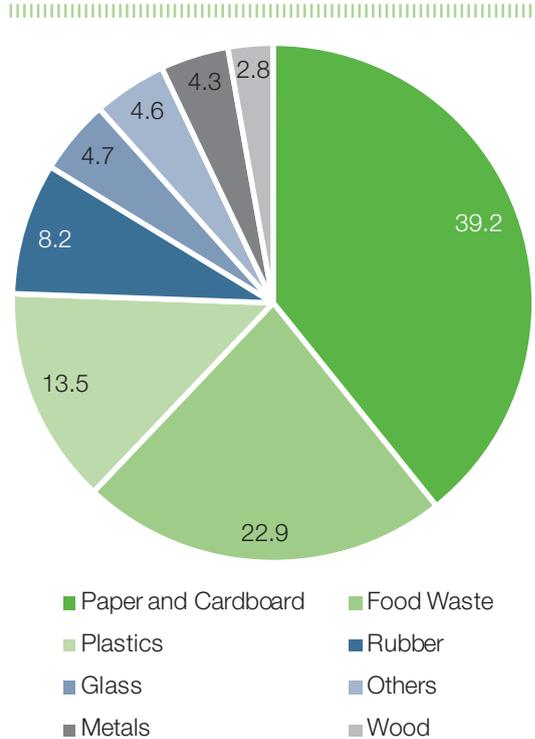
More than half, or 55 percent, of the industries across the country reported having dedicated staff to manage waste. Around 60 percent of the total industries reported having separate waste storage facility. However, lack of space for waste storage, lack of proper disposal sites, absence of collection services and poor mentality among employees towards waste management were issues industries faced in managing waste.

Some of the methods/policies adopted by the industries to minimize waste generation are as follows:

- Encourage using of paper for packaging;
- Observing Zero Waste Hour
- Installing water filter to reduce bottled water;
- Selling by-products for other purpose
- Use of high quality raw materials so that it last longer

Of the total of 354 industries, around 90 percent claimed awareness of relevant sections of environmental Acts and regulation, out of which, more than 85 percent reported the existing Acts and regulations were adequate for managing waste. Of the total, 44 industries, or 15 percent reported that the existing Acts and regulations were inadequate for managing waste. Sixty percent reported the need for harsher penalties against 40 percent who reported the need for lenience of the existing penalties. Similarly, of the 354 industries across the country, 75 percent expressed willingness to support extended producer’s responsibility and collect the waste their products generated.

**Figure 23 Composition of waste from industries**



### 3.5 Health centres

#### 3.5.1 Waste generation and composition

For health centres, field enumerators were asked to collect only the general waste and not medical wastes for safety reasons. Information on medical waste was obtained from records the respective health centres maintained.

Health ministry records showed that 241 health centres (hospital and BHUs) collectively produced a total of 1,984.34 kg waste a day and each health centres on an average generated 8.23 kg a day.

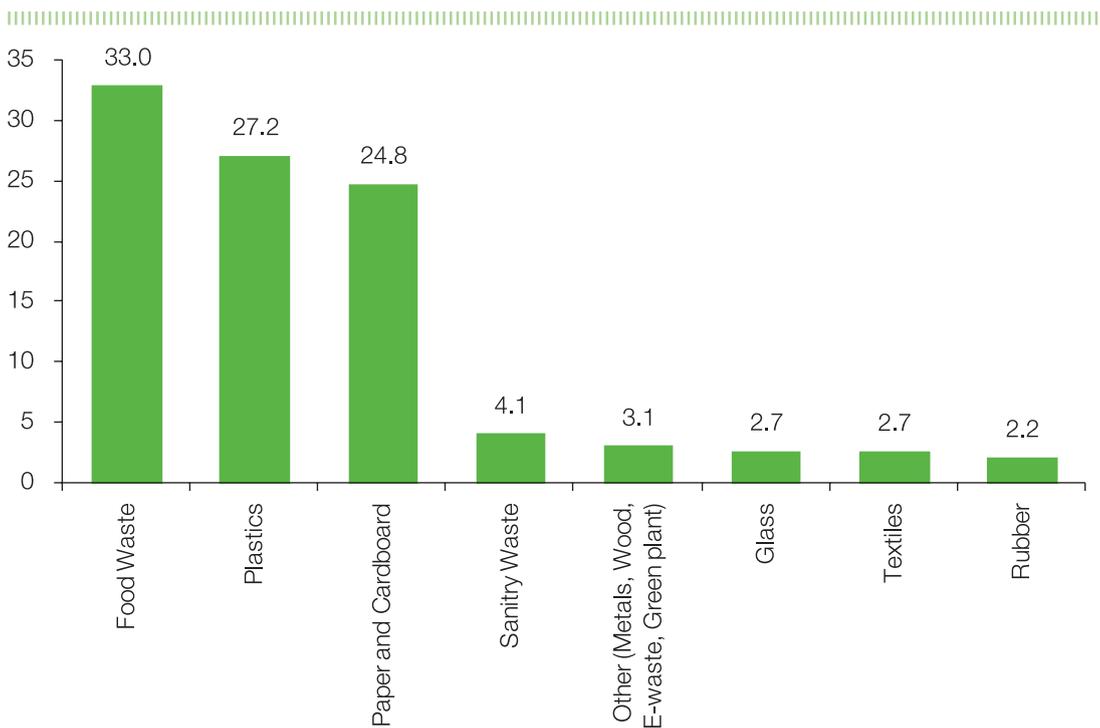
At 33 percent, food waste tops the category on general waste the health centres generated, followed by plastics at 27.2 percent and paper wastes at 24.8 percent. Health centres produced similar quantities of soft plastic wastes at 14.2 percent and hard plastic wastes at 13 percent.

In addition to general waste, health centres collectively generated around 996.20 kg of medical waste a day. Medical wastes constitute infectious, pathological, and pharmaceutical wastes, including sharps, chemicals, pressurised and radioactive wastes.

### 3.5.2 Waste management practices and perception

More than 65 percent of the country’s health centres reported having waste storage facility. Of that, 45 percent stated facing issues and challenges in waste storage. Some of the issues and challenges include lack of proper storage and dumping facilities, generation of waste in huge quantities and lack of manpower to handle waste. Almost 95 percent of the health centres reported they segregated different types of waste. However, lack of proper disposal sites, awareness and public negligence were some of the challenges faced while segregating waste.

**Figure 24** Composition of general waste from health centres



Around 35 percent of the health centres resorted to open burning. More than one-fifth, or 23.36 percent of the health centres reported dumping waste in pits. Almost 15 percent reported using municipal services to dump their general waste. Among health centres generating pathological and infectious waste, more than half the health centres or 51 percent reported either burning or bury the pathological and infectious waste generated from their health centre. Around 25 percent stated that they autoclave or do chemical treatment for pathological and infectious waste. Rest of the health centres reported that they dump in separate pits or treat with bleaching powder prior to dumping.

### 3.6 Vegetable markets

#### 3.6.1 Waste generation and composition

The total waste vegetable vendors across the country generated was 6,168.5 kg a day with an average generation of 5.46 kg a vendor per day.

Of the total waste generated, 73.43 percent was food and green plant waste, and textile waste was the least generated at 0.03 percent. Paper and cardboard waste, at 12.52 percent, came after food and green plant waste.

### 3.7 Government offices

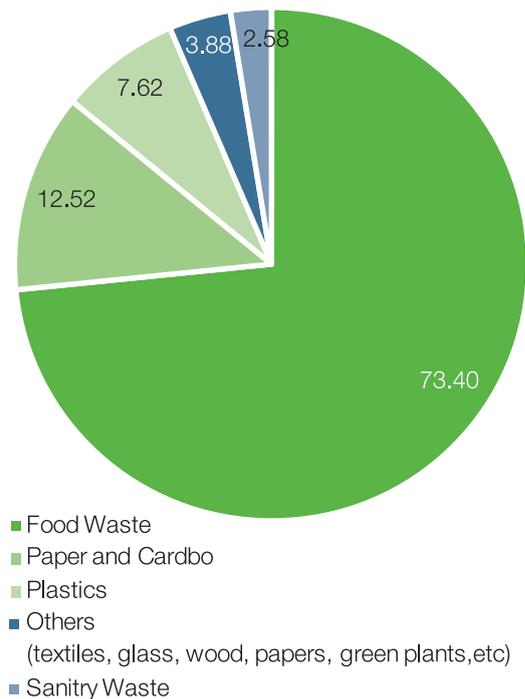
#### 3.7.1 Waste generation

The survey covered a total of 47 government offices at various levels. The total waste

generated in these offices was 226 kg a day and the total number of staff was 1,199 persons. Therefore, each staff was producing around 0.19 kg of waste. Since there was no list of offices including branches, it was not possible to provide the survey weight.

Waste from government offices was estimated using total number of civil servants (16,301) from Royal Civil Service Commission (civil service statistics, 2018) and the per capita waste obtained from 47 offices covered in the survey. The total number of civil servants here exclude the 9,029 staff working in Education and Training Services and 3,288 medical and health services since they were already

**Figure 25** Composition of waste from vegetable markets



included under institutes and health centres

The total waste government offices generated a day was estimated around 3,097.19 kg.

### 3.8 Private waste management companies

Of late, private entrepreneurs have taken keen interest in waste management. Thromdes and bigger towns, in particular, have private companies involved in waste management at different stages – recycling, reusing, composting and collecting.

The total amount of waste the companies collected in a week was 437.36 metric tons, of which, 123.4 metric tons were wet waste, 136.06 metric tons recyclable and 177.3 metric tons non-recyclable waste.

Some of the issues and challenges private companies faced were:

- a) Lack of government support;
- b) Lack of dignity of labour;
- c) Lack of fund and resources;
- d) Lack of awareness on waste;

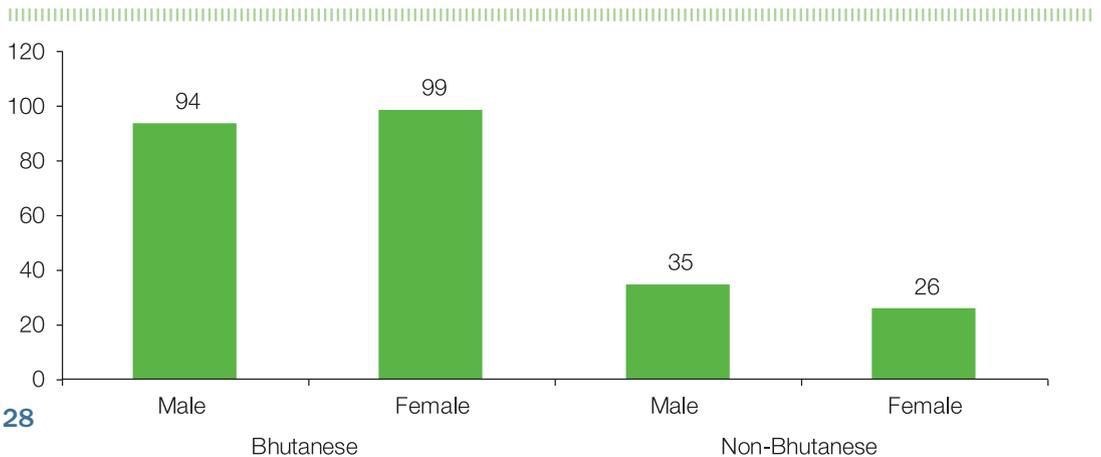
- e) Unsegregated wastes at source;
- f) Weak enforcement of rules and regulations on waste; and
- g) Vulnerable to health hazards.

To improve waste management in the country, private waste companies suggest:

- Strict implementation of waste related Acts and rules by relevant authorities;
- Segregation of wastes at source;
- Outsourcing waste related activities to private sectors with financial support from government;
- Establishing drop off centres at different zones of Thromde; and
- Conducting regular awareness on benefits of managing waste properly

Information collected on the employment status shows that the nine private waste companies surveyed in the study employed 254 people. Of the total employees, more than 75 percent were Bhutanese and around one-fourth or 25 percent were non-Bhutanese. The companies employed almost equal proportions of males and females.

**Figure 26** Total number of employees in waste companies by sex and nationality



# ANNEX I: STATISTICAL TABLES

**Table A1.1** Total waste generated from different sources in kilograms per day

Waste Sources	Total Weight	Percentages
Household	81500.50	47.34
Commercial Units	67299.70	39.09
Vegetable Markets	6168.50	3.58
Industries	5719.30	3.32
Institutes	5395.90	3.13
Government Offices	3097.19	1.83
Health Centres	2980.60	1.70
Total	172,161.09	100.00

**Table A1.2** Composition of waste generation in percentages

Composition	Percentages
Food Waste	45.88
Paper and Cardboard	15.76
Plastics Soft packaging	10.06
Plastics (Pet & HDPE)	7.02
Glass	5.28
Sanitary Waste	3.62
Metals	3.37
Textiles	2.18
Wood	1.70
Rubber	1.59
E-Waste	1.31
Other	1.17
Green plant materials	1.06

**Table A1.3** Proportion of household with access to waste collection service

Area	Urban	Rural	Bhutan
Yes	75.12	14.9	36.86
No	24.88	85.1	63.14
Total	100	100	100

**Table A1.4** Proportion of household using waste collection service

Do you use it	Urban	Rural	Bhutan
Yes	95.76	85.55	93.14
No	4.24	14.45	6.86
Total	100	100	100

**Table A1.5** Proportion of household segregating different wastes

Area	Yes	No	Bhutan
Urban	88.54	11.46	100
Rural	78.44	21.56	100
Bhutan	82.12	17.88	100

**Table A1.6** Proportion of household with knowledge of 3Rs

	Urban		Rural	
	Yes	No	Yes	No
Reduce	78.45	21.55	74.14	25.86
Reuse	86.03	13.97	81.46	18.54
Recycle	76.79	23.21	71.19	28.81

**Table A1.7** Proportion of household practicing 3Rs

	Urban		Rural	
	Yes	No	Yes	No
Reduce	78.14	21.86	75.73	24.27
Reuse	79.01	20.99	80.23	19.77
Recycle	26.79	73.21	29.83	70.17

**Table A1.8** Proportion of household willing to pay for waste collection service

willingness to pay	Urban	Rural	Bhutan
Yes	74.26	72.91	73.4
No	25.74	27.09	26.6
Total	100	100	100

**Table A1.9** Household awareness on waste management

	Strongly agree	Agree	Don't know	Disagree	Strongly disagree
With the increase in population and changing consumption habits and pattern, the amount of waste we generate is increasing.	123,338	34,627	898	2,390	0
A behavioral change in ourselves such as the use of environmentally friendly and reusable packing materials for shopping can reduce waste	103,789	52,910	1,529	2,659	367
Plastics are non-biodegradable	128,912	29,850	1,925	561	5
The use of plastics is banned by the government. As an individual, we abide by the government rules and regulation.	95,477	55,345	3,282	6,213	935
Waste management campaigns and program can help reduce waste. As a household, we support and participate in the campaigns	106,458	51,816	1,690	1,180	109
Garbage left unattended in open space scavenged by stray dogs could be public health issue	110,495	48,668	1,873	218	0
People near waste dumps and landfills are susceptible to disease.	105,076	52,846	2,917	414	0
Improper waste management leads to environmental problem	112,895	46,956	1,282	119	0
All landfills and dump should be properly managed and treated.	105,370	52,183	3,587	114	0

**Table A1.10** Most effective waste management awareness program (Households)

Most effective mode of waste management	Freq.	Percent
Clean up campaign	53,588	33.2
Door to door campaign	52,271	32.4
Television	31,244	19.4
School level campaign	12,559	7.8
Social media	9,173	5.7
Radio	1,963	1.2
Print media	456	0.3
Total	161,253	100

**Table A1.11** Composition of household waste in percentage by area

Composition	Urban	Rural	Bhutan
Food Waste	59.21	39.15	49.57
Green plant materials	0.28	1.30	0.77
Wood	0.11	0.81	0.44
Plastics	15.08	25.19	19.94
Paper and Cardboard	9.30	11.43	10.32
Glass	4.50	4.02	4.27
Metals	1.43	3.13	2.24
Textiles	1.83	3.51	2.64
E-Waste	0.78	0.92	0.85
Sanitary Waste	5.75	5.89	5.82
Rubber	0.91	4.05	2.42
Other	0.83	0.60	0.72
Total	100	100	100

**Table A1.12** Composition of waste generated from commercial units in percentage

Composition	Percentage
Food Waste	35.5
Green plant materials	0.3
Wood	3.6
Plastics (Pet & HDPE)	8.1
Plastics Soft packaging	9.6
Paper and Cardboard	12.8
Glass	11.5
Metals	7.8
Textiles	2.8
E-Waste	3.0
Sanitary Waste	3.1
Rubber	1.2
Other	0.7
Total	100

**Table A1.13** Waste disposal practices among commercial units

Practices	Percentage
Municipal collection service	82.27
Sale to scrap dealers	19.65
Private collection service	10.04
Open Burning	8.86
Drop off center	7.68
Throw in pit	5.61
Compost	1.77
In an open space	1.48
Others	1.33

**Table A1.14** Proportion of commercial units segregating dry and wet wastes

	Freq.	Percent
Yes	6,316.7	47.2
No	935.1	7.0
No wet waste	6,122.3	45.8
Total	13,374.0	100.0

**Table A1.15** Proportion of commercial units with access to waste collection service in percentage

area?	Freq.	Percent
Yes	10,472.45	78.3
No	2,901.55	21.7
Total	13,374	100

**Table A1.16** Waste management awareness (Tabular)

	Strongly agree	Agree	Don't know	Disagree	Strongly disagree
Population increase and changing consumption pattern	75	22.88	0.92	0.97	0.23
Behavioral change	50.43	41.64	3.28	2.31	2.35
Plastics are non-biodegradable	74.07	22.58	1.92	1.11	0.32
Compliance to rules and regulation.	53.86	36.81	2.53	5.47	1.33
Support waste management campaigns and program	56.83	40.29	1.74	1.06	0.09
Open dumping and health hazard	67.42	32.13	0.45		
Health impact settlements near the landfills and dumpsites	62.92	34.79	1.74	0.56	
Waste management and its impact on environment	67.23	31.76	0.83	0.18	
Need to manage landfills and dumpsites properly	67.19	31.63	1.19		

**Table A1.17** Most effective waste management awareness program (Commercial units)

campaign	Freq.	Percent	Cum.
Door to door campaign	3,328	24.9	24.9
School level campaign	914	6.8	31.7
Clean up campaign	4,045	30.3	62.0
Television	2,815	21.1	83.0
Radio	43	0.3	83.3
Print media	24	0.2	83.5
Social media	2,192	16.4	99.9
Not reported	12	0.1	100.0
Total	13,374	100	

**Table A1.18** Industries aware of relevant sections of environmental Act and regulation

Awareness	No of Industries	Percent
Yes	318.600	90
No	35.400	10
Total	354.000	100

**Table A1.19** Adequate for waste management (industries aware of relevant sections in environmental Act only)

management?	Freq.	Percent	Cum.
Yes	274.350	86.11	86.11
No	44.250	13.89	100
Total	318.600	100	

**Table A1.20** Policies industries adopted to minimise waste

Encourages the use of paper for packaging purpose In order to minimize waste, we use the concept called Reduce, Reuse and Recycle (3Rs)
Observe zero waste hour
Reuse of timber as firewood.
Selling of byproduct to customers Integrated online system to reduce the cost production and environmental effect
Proposed the manufacturer of the raw material to send them materials in large containers instead of small containers so that waste is minimized
Reuse the waste such as pet bottles and cartoons
Adequate use of raw materials
Buy raw materials in less quantity based on the parameter framed
Buy raw materials only after certain measurement so as to reduce waste
By-product waste are stored for reproduction
Follow 'zero waste policy' - whatever waste is generated at the end, it is reused as raw materials
Installed water filter so that the consumption of packaged drink is minimize
Use of plastic bags banned
Reduction of paper usage
Use high quality oil so that it last longer and hence limiting liquid waste

**Table A1.21** Composition of industrial waste in percentage

Composition	Weight
Paper and Cardboard	39.24
Food Waste	22.85
Plastics Soft packaging	8.73
Rubber	8.17
Plastics	4.75
Glass	4.66
Metals	4.25
Wood	2.79
Green plant materials	2.47
Other	1.09
Textiles	0.93
Sanitary Waste	0.07
Total	100.00

**Table A1.22** Medical facilities with waste storage facilities

	Freq.	Percent	Cum.
Yes	160.12	66.44	66.44
No	80.88	33.56	100
Total	241.00	100	

**Table A1.23** Management of infectious and pathological waste by health centers

waste managed by your HCF	Freq.	Percent
Autoclave or chemical treatment	53.03	24.51
Bury or Burn	110.65	51.13
Dump in a bin	36.88	17.04
Dispose in separate pit of infectious waste	12.29	5.68
Segregate and treat with bleaching powder	3.56	1.64
Total	216.412	100

**Table A1.24** Management of pharmaceutical waste by health centers

HCF	Percent
Dump in the pit	39.20
Send back to medical store	27.05
Dump in landfill	2.73
Drop at the drop off center.	9.43
Stored in a room	9.43
Dump as per protocol	9.43
Waste are diluted and disposed in sewage	2.73
Total	100

**Table A1.25** General waste composition from health centers in percentage

Food Waste	32.99
Paper and Cardboard	24.85
Plastics Soft packaging	14.20
Plastics (pet & HDPE)	13.04
Sanitary Waste	4.14
Glass	2.74
Textiles	2.71
Rubber	2.19
Other	1.52
Metals	0.85
E-Waste	0.27
Green plant materials	0.26
Wood	0.26
Total	100.00

**Table A1.26** Composition of waste generated from institutes in percentages

Composition	Percent
Food Waste	38.08
Paper and Cardboard	24.25
Plastics Soft packaging	12.02
Plastics (pet & HDPE)	9.32
Textiles	3.28
Metals	2.14
Sanitary Waste	2.12
Glass	2.06
Wood	1.93
Green plant materials	1.48
E-Waste	1.33
Rubber	1.20
Other	0.78
Total	100.00

**Table A1.27** Waste issue in institutes

	Percent
Littering in the open spaces	69.81
Not enough garbage disposal point	49.06
No municipal services	41.51
Irregular collection timing	26.42
Other (low advocacy, increasing no. of students & shops)	13.21

## **ANNEX II: LIST OF AGENCIES PARTICIPATED IN STAKEHOLDER CONSULTATION WORKSHOP**

1. Clean Bhutan, Thimphu
2. Department of Industry, MoEA
3. Department of Medical Services, MoH
4. Department of School Education, MoE
5. Druk Waste, Paro
6. Gelegphu Thromde
7. Greener Way, Thimphu
8. National Commission for Women and Children
9. Phuntshogling Thromde
10. Policy and Planning Division, MoWHS
11. Samdrup Jongkhar Thromde
12. Thimphu Thromde

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