CBS PUBLICATION

SOLID WASTE ACCOUNT FOR URBAN MUNICIPALITIES OF NEPAL 2022

SYSTEM OF ENVIRONMENTAL ECONOMIC ACCOUNTING

Government of Nepal
National Planning Commission
Central Bureau of Statistics
Kathmandu, Nepal

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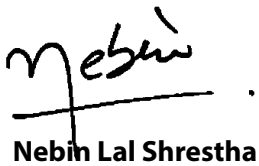
PREFACE

Central Bureau of Statistics (CBS) is pleased to publish the Report on Solid Waste Account as part of System of Environmental-Economic Accounting (SEEA) of the urban municipalities of Nepal. Solid waste management is a crosscutting issue that affects and impacts various areas of sustainable development in each of the three sustainability domains: environment, economy and society. The quantity of solid waste is increasing every year in all the urban municipalities due to rapid population growth and changing livelihood.

Recently, CBS has published solid waste management baseline data for the urban municipalities of Nepal and has realized the need of preparing a solid waste account. SEEA central framework is an internationally agreed statistical framework for environment economic account that seeks to understand the linkages between environment and economy. It guides in preparing the solid waste account organizing data on solid waste generation and management. Realizing the need of a reliable solid waste flow database, several countries in the world have prepared their national solid waste accounts. In Nepal, CBS has started to produce SEEA solid waste account using the data of the solid waste baseline survey and other data available from administrative sources. Such databases are necessary to monitor the progress towards the goals of reducing and proper management of solid waste. I would like to express my gratitude to all urban municipalities of Nepal for providing valuable data and support to bring out this publication in its present form.

I am thankful to Dr. Hem Raj Regmi, Deputy Director General of the Bureau for his overall guidance in bringing out this publication. Mr. Pramod Raj Regmi and Mr. Sushil Kumar Sharma, Directors, Environment Statistics Section deserve special thanks for shouldering the responsibility to accomplish the whole task of the data compilation and bringing out this publication in time. Statistics Officers Mr. Kul Prakash Neupane, Mr. Bhim Bahadur Shakha and Statistics Assistant Ms. Kamala Nath also deserve thanks for their sincere involvement in data collection and management for the preparation of this report. I also extend my special thanks to the Accelerating Implementation of Sustainable Development Goals in Nepal (AISN) project of NPC supported by UNDP and European Union country office for their technical and financial assistance in the preparation of this report. Members of the Technical Committee have provided invaluable inputs in all phases of the preparation of this report. I am equally thankful to them. Similarly, I would like to express my sincere thanks to the expert team of Central Department of Environmental Science, Tribhuvan University led by team leader Dr. Ramesh Prasad Sapkota and team members Prof. Dr. Kedar Rijal, Dr. Udhab Raj Khadka and Dr. Narayan Babu Dhital for their contribution in accomplishing the assignment and bring this publication in the current form.

CBS always welcomes comments and suggestions from users, stakeholders and all well-wishers for the implementation of similar surveys and publication in the future.



Nebin Lal Shrestha
Director General
Central Bureau of Statistics

July, 2022

सारसंक्षेप

नेपालमा फोहरमैला व्यवस्थापन एक पर्यावरणीय चुनौतीको रूपमा रहेको छ । फोहरमैला व्यवस्थापनको मुद्दा एकजटिल विषय रहेको महसुस गर्दै उत्पादन विन्दुमा फोहरमैलाको मात्रा घटाउँदै, त्यसको पुनःप्रयोग तथा चक्रीय उपयोग गर्दै उचित व्यवस्थापन गर्नु राष्ट्रिय प्राथमिकताको विषयको रूपमा रहेको छ । जनस्वास्थ्य सुरक्षा, तथा जल, वायु एवम् भूप्रदुषणको रोकथाम लगायत महत्वपूर्ण प्राकृतिक स्रोत साधनमा पर्ने अत्यधिक चाप कम गर्नसमेत फोहरमैलामा विद्यमान उपयोग योग्य वस्तुको यथासम्भव पुनःप्राप्ती गरि पुनःप्रयोग वा चक्रीय उपयोग गरी फोहरमैलाको यथोचित व्यवस्थापन अपरिहार्य भइसकेको छ । यसै सन्दर्भमा, फोहरमैलाको उचित व्यवस्थापन गर्न हाम्रो फोहरमैला कुन मात्रामा निष्कासन हुन्छ, यसमा कस्ता वस्तुहरू समावेश छन् र यी निष्कासित फोहर तथा त्यसमा रहेका वस्तुहरू कहाँ जान्छन भन्ने कुराको विश्वसनीय तथ्याङ्क तथा सूचना आवश्यक पर्दछ । यसका साथै हाल अभ्यासमा रहेको फोहरमैलाको रेखाकार (Linear) अर्थव्यवस्थाबाट चक्रीय (Circular) अर्थव्यवस्थातर्फ प्रवेश गर्नसमेत फोहरमैला व्यवस्थापनका विविध अवस्थाको विस्तृत जानकारी सहयोगी हुने देखिन्छ ।

यस सन्दर्भमा, System of Environmental-Economic Accounting (SEEA) वातावरणीय आर्थिक लेखापद्धति एक अन्तर्राष्ट्रिय मान्यता प्राप्त केन्द्रीय तथ्याङ्कीय ढाँचा हो जसले पर्यावरण तथा अर्थ व्यवस्थाबीचको अन्तरसम्बन्धहरूलाई वुझाउने प्रयास गर्दछ । यसका साथै यसले फोहरमैलाको प्रकारअनुरुप उत्पादन, प्रवाह, आपूर्ति तथा उपयोगसम्बन्धी लेखा तर्जुमा तथा व्यवस्थापन गर्न मार्गदर्शन प्रदान गर्दछ । यस ढाँचामा, आपूर्ति तालिकाले शेष फोहरमैला तथाउद्योग, कलकारखाना एवं घरेलु जस्ता विभिन्न क्षेत्रबाट निस्कने फोहरमैलाको परिमाणसम्बन्धी तथ्याङ्कलाई एकत्रित ढंगले प्रस्तुत गर्दछ । त्यसैगरी, यस ढाँचाको उपयोग तालिकाले फोहरमैलाको प्रवाह तथा गन्तव्यबारे जानकारी प्रदान गर्दछ । यस पृष्ठभूमिमा, यस अध्ययनले नेपालमा हालसम्म भएका फोहरमैला उत्पादन तथा उपयोगसम्बन्धी पुर्वअध्ययन प्रतिवेदन, प्रकाशित प्रतिवेदन तथा अनुसन्धानमुलक लेखहरूको अध्ययन गरी उपलब्ध तथ्याङ्क तथा सूचनाहरू संकलन गरी System of Environmental-Economic Accounting (SEEA) ढाँचालाई अवलम्वन गर्दै एक राष्ट्रिय फोहरमैला लेखा पद्धति तयार गरेको छ । यस अध्ययन प्रतिवेदनले गाँउपालिका बाहेक देशभरका सम्पूर्ण महानगरपालिका, उपमहानगरपालिका र नगरपालिकाहरूको फोहरमैला सम्वन्धी तथ्याङ्कहरू समावेश गर्दै देशको समग्र भौगौलिक क्षेत्रलाई समेटेको छ ।

यस अध्ययनले देशभरिबाट वार्षिक करिव १० लाख टन फोहर उत्पादन हुने र यसमध्ये प्रतिवर्ष ३ लाख ८६ हजार ६ सय ९० टन आवासीय क्षेत्रबाट, २ लाख ४५ हजार ८ सय ८४ टन व्यापारिक क्षेत्रबाट, १ लाख ३ हजार २ सय ४४ टन शैक्षिक संस्थाहरूबाट, ९४ हजार ३ सय ९२ टन औद्योगिक क्षेत्रबाट, १ लाख १ हजार ५ सय ७ टन स्वास्थ्य सेवा क्षेत्रबाट र ६६ हजार २ सय २० टन अन्य क्षेत्रबाट निष्कासन हुने देखाएको छ । उत्पादित फोहरमैलामध्ये सबैभन्दा बढी वार्षिक ३ लाख ८९ हजार ९ सय ८३ टन ल्याण्डफिल साइटमा जम्मा हुने, ३ लाख १५ हजार ६९ टन नदी किनार तथा बगर जस्ता वातावरणीय क्षेत्रमा जाने र २२ हजार ७५ टन दहन गरिने देखाएको छ । यसरी फोहरमैलाको पुनःचक्रीय उपयोगमा जान सक्ने प्लाष्टिक, धातु, कागज तथा कागजजन्य वस्तु अत्यन्तै न्यून (८,६९० टन) परिमाणमा पुनःचक्रीय रूपमा उपयोग हुने देखिएको छ । साथै, यस अध्ययनले नेपालका स्थानीय, प्रादेशिक तथा संघीय तहमा समेत फोहरमैला सम्वन्धी तथ्याङ्कहरू अन्तराष्ट्रिय मापदण्डअनुसार तथा SEEA ढाँचा अनुरुप नरहेको समेत देखाएको छ । तसर्थ, यस अध्ययनमा हाल उपलब्ध तथ्याङ्को आधारमा SEEA को मान्यता प्राप्त ढाँचालाई केही रूपान्तरण गरी फोहरमैला उत्पादन एवं खपत क्षेत्र तथा फोहरमैलाको वर्गीकरण गरिएको छ । तसर्थ, नेपालका सम्पूर्ण महानगरपालिका, उपमहानगरपालिका, नगरपालिका तथा अन्य सम्बद्ध संघसंस्थाहरूले फोहरमैलाको वर्गीकरण, उत्पादन तथा खपत मात्रासम्बन्धी तथ्याङ्क SEEA ढाँचा अनुरूप संकलन गर्न आवश्यक देखिन्छ । यसका लागि स्थानीय, प्रादेशिक तथा संघीय तहका फोहरमैला व्यवस्थापनसँग सम्बद्ध सम्पूर्ण पेशाकर्मी तथा सरोकारवालहरूको क्षमता अभिवृद्धि गर्न आवश्यक देखिन्छ ।

EXECUTIVE SUMMARY

Solid waste management has long been a major environmental challenge in Nepal. Given the increasing complexity of the solid waste management issue, reducing waste generation through prevention, reduction, recycling, reuse, and management of solid waste have been the national priority in the Nepalese context. Management of solid waste with resource recovery to the extent possible is needed to protect public health, prevent the contamination of air, water, and soil, as well as to reduce pressure on valuable environmental resources. However, proper management of solid waste requires a regular and reliable database on the generation and fate of wastes. A better understanding of different waste management stages would also help move from a linear economy towards a circular economy of waste management approaches. The System of Environmental-Economic Accounting (SEEA) Central Framework is an internationally agreed statistical framework for environmental-economic accounting, that seeks to understand the linkages between environment and economy. It guides in preparing the solid waste account organizing data on solid waste generation and management flow by waste types and supply and use sectors. The supply table consolidates data on the generation of solid waste residuals and presents the quantity of solid waste generated by different sectors, such as industries and households. Likewise, the use table presents the quantitative information regarding the fate of the solid waste. This study reviewed and compiled the published data and information on solid waste generation and use in Nepal to prepare a national solid waste account following the SEEA Central Framework. The study covered only the municipalities of the country, excluding the rural municipalities.

Results showed that the total amount of waste generated from the country is approximately one million mt/year, of which 3,86,690 mt/year is contributed by households, 2,45,884 mt/year by business houses, 1,03,244 mt/year by educational institutes, 94,392 mt/year by industries, 1,01,507 mt/year by health institutions, and 66,220 mt/year by other sectors. The largest use sector was landfill with 3,89,983 mt of waste being dumped annually in the landfill sites. The second largest use sector was the environment (3,15,069 mt/year), followed by burning (22,075 mt/year). Recycling represented the use sector with the lowest quantity of waste flow annually (8,690 mt/year). The waste types under the recycling sector were plastics, paper and paper products, and metals.

The solid waste data available for Nepal at the local, provincial, and federal levels were deemed to be insufficient for preparing the solid waste account. The waste account format (e.g., supply and use sectors, waste categories) adopted in the present study was the modified version of that suggested by the SEEA Central Framework. It is suggested that municipalities of Nepal keep a regular administrative record of solid waste information in their databases, segregated by waste types, supply and use sectors, as suggested by the SEEA Central Framework, which will aid in the preparation of more accurate solid waste account tables in the future.

Keywords: Physical Flow; System of Environmental-Economic Accounting; Solid Waste Account; Supply Table; Use Table

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
CBS	Central Bureau of Statistics
GoN	Government of Nepal
mt	Metric Tonne
NPC	National Planning Commission
SDG	Sustainable Development Goal
SEEA	System of Environmental-Economic Accounting
ToR	Terms of Reference
UNDP	United Nations Development Programme

1 INTRODUCTION

1.1. Background

Solid waste management has long been a major environmental challenge in Nepal (ADB, 2013; Maharjan and Lohani, 2020; Pokhrel and Viraraghavan, 2005). Urban growth and sprawl and intensifying economic and industrial activities have led to the increase in the generation of municipal, hazardous, as well as toxic solid waste in the urban centers of Nepal (ADB, 2013). However, illegal and improper dumping, as well as open burning of solid waste, are rampant in most of those urban centers (Dangi et al., 2013; Das et al., 2018; Pokhrel and Viraraghavan, 2005). A recent study estimated that approximately 3% (20 tons/day) of the municipal solid waste generated in the Kathmandu Valley ends up with open burning, leading to the emission of a significant quantity of particulate, gaseous, and several toxic air pollutants into the atmosphere (Das et al., 2018). Likewise, improper dumping of solid waste is likely to contaminate water resources (Dangi et al., 2013). Currently adopted techniques of collection, transport, and disposal of solid waste by most municipalities in Nepal are rudimentary, improper, and inefficient (Dangi et al., 2013; Maharjan and Lohani, 2020). Although there is a huge potential for resource recovery from municipal solid waste (Bharadwaj et al., 2020; Dangi et al., 2013, 2011; Maharjan and Lohani, 2020), it has not been practiced in several urban centers in Nepal, and most of the collected solid waste ends up at the dumping sites.

Solid waste management is a crosscutting environmental issue with far-reaching implications (Bharadwaj et al., 2020). Improper waste management practices can have dire consequences on public health, livelihood, freshwater and terrestrial ecosystems, ambient air quality, and overall environmental, economic and societal sustainability (CBS, 2021; Dangi et al., 2013; Das et al., 2018; Pokhrel and Viraraghavan, 2005; Zhang et al., 2022). Given the increasing complexity of the solid waste management issue, reducing waste generation through prevention, reduction, recycling, reuse, and management of solid waste have been a national priority in the Nepalese context. For example, the Fifteenth Plan (2019/20-2023/24) of Nepal explicitly mentions about improving solid waste management systems and infrastructures in Karnali Integrated Settlement Development Project and Outer Ring Road with Integrated Settlements Project (NPC, 2020). These priorities are also reflected in Sustainable Development Goals (SDGs). One of SDG targets that explicitly mentions about solid waste management is "to reduce the adverse per capita environmental impact of cities, including by paying special attention to waste management, by 2030" (SDG-II, Target 11.6) (NPC, 2017).

Management of solid waste with resource recovery to the extent possible is needed to protect public health, prevent the contamination of air, water, and soil, as well as to reduce pressure on valuable environmental resources through circular economy. Promoting resource recovery would also generate financial resources needed for solid waste management (Bharadwaj et al., 2020), thus making waste management systems more sustainable. However, proper management of solid waste requires a reliable and comprehensive database on the generation and fate of wastes. A

better understanding of different waste management stages would also help moving from the wasteful linear economy towards a more circular economy (Taelman et al., 2018).

The System of Environmental-Economic Accounting (SEEA) Central Framework is an internationally agreed statistical framework for environmental-economic accounting, that seeks to understand the linkages between environment and economy (United Nations, 2014). It guides in preparing the solid waste account organizing data on solid waste generation and management flow by waste types and supply and use sectors. SEEA for solid waste helps tracking the linkages between solid waste and economy. It guides the compilation of economic and environmental data and information to help policy and decision-making processes. The structure of solid waste account suggested by the SEEA Central Framework consists of two datasets, namely the supply table and the use table. The supply table consolidates data on generation of solid waste residuals, and presents the quantity of solid waste generated by different sectors, such as industries and households. Likewise, the use table presents the quantitative information regarding the fate of the solid waste. It shows the quantity of solid waste residuals collected and disposed of through different activities/methods/sectors. Both the supply and use tables present solid waste types on the rows, while solid waste supply/use sectors in the columns. Solid waste account consisting of the supply and use tables and physical flows, segregated by activities and waste types is crucial in identifying opportunities to reduce and properly manage wastes and areas that may need interventions. This can help quantify the costs of resource depletion and environmental impacts in the monetary terms (Sun et al., 2021). Moreover, such databases are also necessary to monitor the progress towards the goals of reducing and proper management of solid waste.

Realizing the need of a reliable solid waste flow database, several countries around the world have prepared their national solid waste accounts (NSB-Bhutan, 2021). In the context of Nepal, available data on solid waste generation and use are mostly scattered in different sources and also incomplete. These data, available from different sources and obtained through different methodologies, need to be aggregated and checked for inconsistencies before a reliable solid waste account can be prepared. Moreover, there exist data gaps that must be filled to prepare a national solid waste account. Recently, Central Bureau of Statistics (CBS) of the Government of Nepal (GoN) has published solid waste management baseline data for Nepal (CBS, 2021) and has realized the need of preparing a solid waste account. In this context, this project reviewed and compiled available data, including the baseline data published by CBS, on solid waste generation and use in Nepal to prepare a national solid waste account following the System of Environmental-Economic Accounting (SEEA) Central Framework, and also to collected primary data to fill data gaps, wherever deemed necessary.

1.2. Solid waste generation statistics of Nepal

The Waste Management Baseline Survey of Nepal 2020 published by CBS (CBS, 2021) is one of the most recent and comprehensive databases available on solid waste statistics in Nepal. It covers the solid waste generation and use statistics for municipalities, sub-metropolitan cities, and metropolitan cities of Nepal. The annual average total waste collected per municipality amounted to approximately 2,231 metric tonne (mt) in 2073/74, 2,164 mt in 2074/75, and 2,233 mt in 2075/76 (Table 1). These figures convert to an average daily waste collection per municipality equals to 6.1 mt, 5.9 mt, and 6.1 mt, respectively, for the three years.

Table 1. Quantity of solid waste collected from metropolitan cities, sub-metropolitan cities, and municipalities of Nepal by waste types

Waste Type	FY	Metropolitan city (mt/year)	Sub-metropolitan city (mt/year)	Municipality (mt/year)	Annual average (mt/year/ municipality)	Daily average (mt/Day/ Municipality)
Organic	2073/74	12,734.0	2,269.8	829.8	1,153.3	3.2
	2074/75	13,478.0	3,044.2	950.0	1,214.6	3.3
	2075/76	10,669.5	4,088.2	824.2	1,206.1	3.3
Inorganic	2073/74	8,787.0	1,005.7	518.3	698.0	1.9
	2074/75	9,725.0	1,338.7	504.6	666.8	1.8
	2075/76	7,100.0	1,525.9	551.9	743.5	2.0
Other	2073/74	5,145.0	228.0	194.8	379.6	1.0
	2074/75	5,446.0	213.5	155.6	283.0	0.8
	2075/76	6,200.0	229.7	177.5	283.0	0.8
Total	2073/74	26,666.0	3,503.5	1,543.0	2,231.0	6.1
	2074/75	28,649.0	4,596.3	1,610.2	2,164.4	5.9
	2075/76	23,969.5	5,843.7	1,553.6	2,232.7	6.1

In terms of per capita waste generation, the Asian Development Bank reported 317 g/capita/day solid waste generation in 2012. Based on this per capita waste and the population data of 2011 census, the total municipal solid waste generation of the 58 municipalities was estimated to be 1,435 tons/day which equals to 24.7 mt per day per municipality or 9,030 mt per year per municipality (ADB, 2013).

The Waste Management Baseline Survey of Nepal (CBS, 2021) indicated that the organic waste fraction was higher than inorganic and other waste fractions for all metropolitan cities (Figure 1), sub-metropolitan cities (Figure 2), and municipalities (Figure 3). Organic wastes accounted for the highest proportion, followed by inorganic and other waste types. For instance, organic waste constitutes 54.0% in 2075/76 against 33.3% inorganic, and 12.7% other wastes. Likewise, Pokhrel and Viraraghavan (2005) reported more than 70% of the municipal solid waste fraction to be organic in nature. Similarly, ADB (2013) reported the percentage of organic waste to be 56% (excluding agriculture waste).

Figure 1. Composition of collected waste for metropolitan cities with years

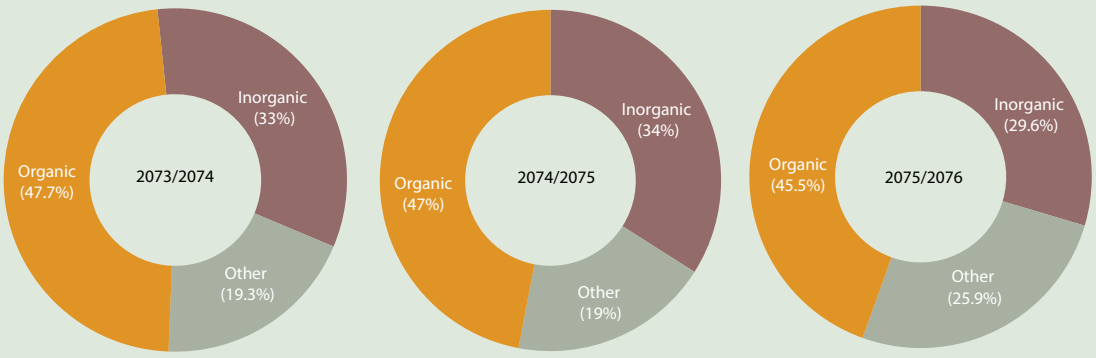


Figure 2. **Composition of collected waste for sub-metropolitan cities with years**

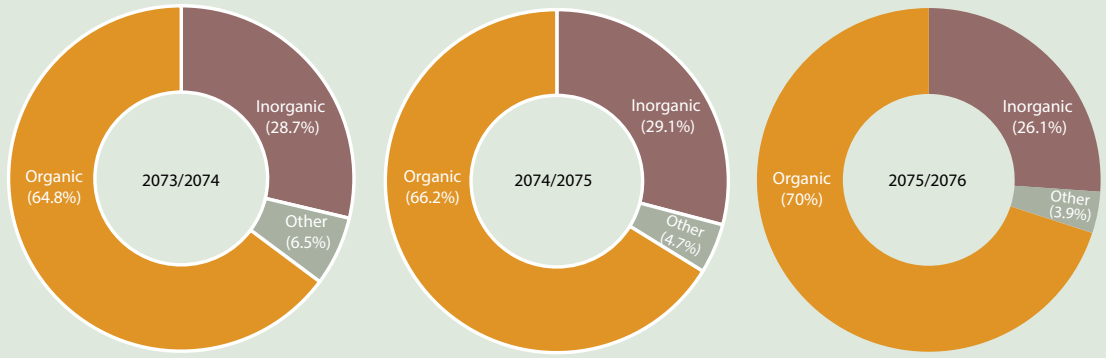
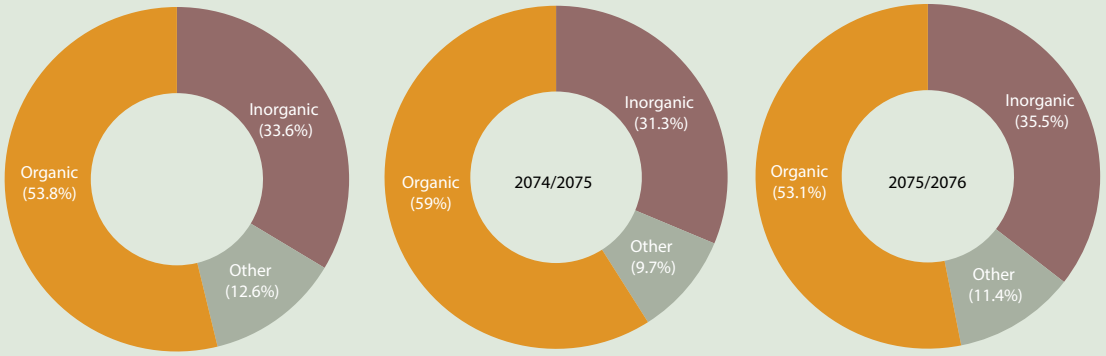


Figure 3. **Composition of collected waste for municipalities with years**



1.3. Objectives

The broad objective of this project is to prepare a solid waste account of the municipalities of Nepal, following the guidelines of SEEA. The specific objectives are as follows:

- To review the existing databases on solid waste generation and management in Nepal.
- To determine solid waste proportions segregated by waste types and supply/use sectors at the municipality, sub-metropolitan city, and metropolitan city levels in Nepal.
- To prepare the solid waste use and supply tables following the SEEA guidelines.

2 STUDY METHODS

2.1. SEEA framework

The SEEA Central Framework is an internationally agreed statistical framework for environmental-economic accounting, that seeks to understand the linkages between environment and economy (United Nations, 2014). SEEA for solid waste would help tracking the linkages between solid waste and economy. It guides the compilation of economic and environmental data and information to help policy and decision-making processes. The SEEA Central Framework guides in preparing the solid waste account organizing data on solid waste generation and management flow by waste types and supply and use sectors (United Nations, 2014). This study followed the SEEA Central Framework to prepare the national solid waste account of Nepal. The general framework for the completion of the assignment has been given in Figure 4.

The basic structure of the solid waste account consists of a supply (generation of solid waste residuals) and use (collection and disposal of solid waste residuals) tables, each segregated by the activities (sectors) and waste types.

Figure 4. General methodological outline adopted for the assignment

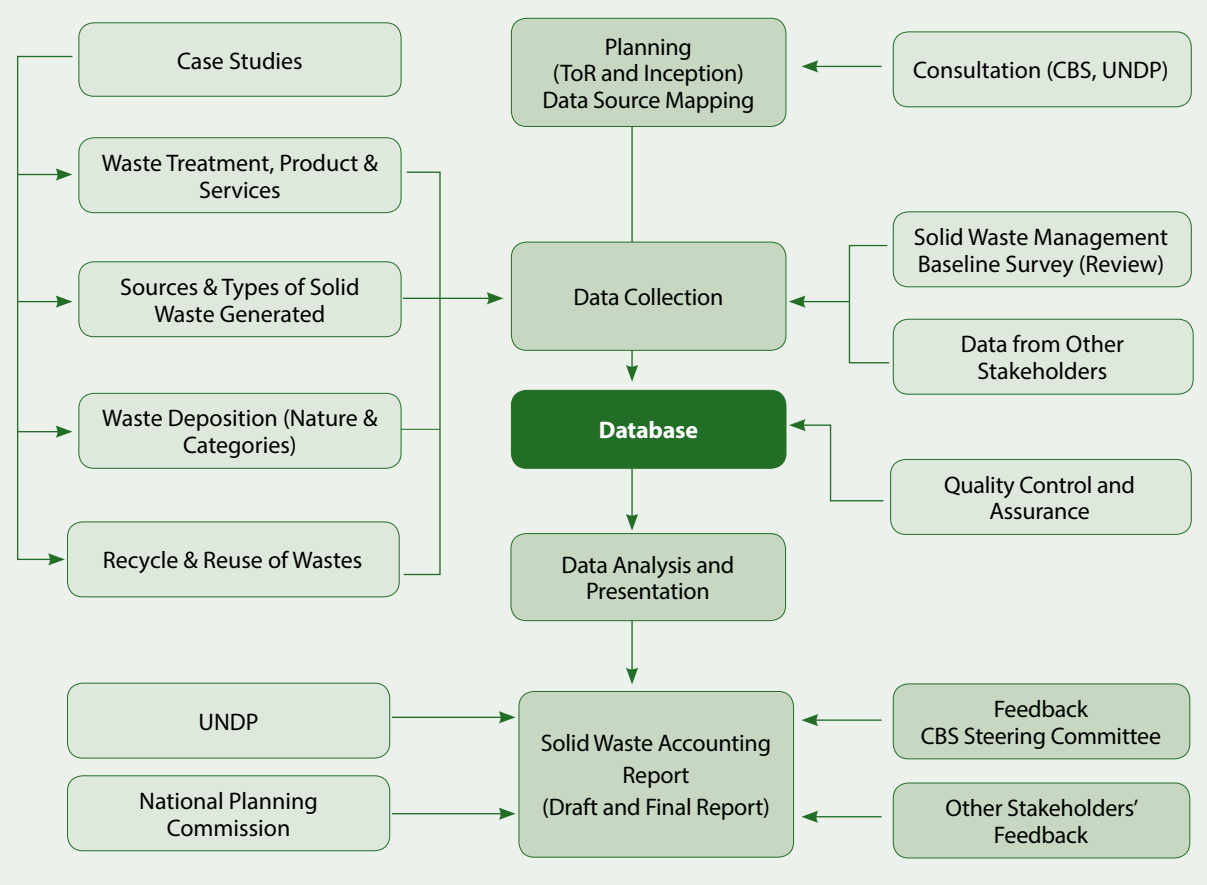
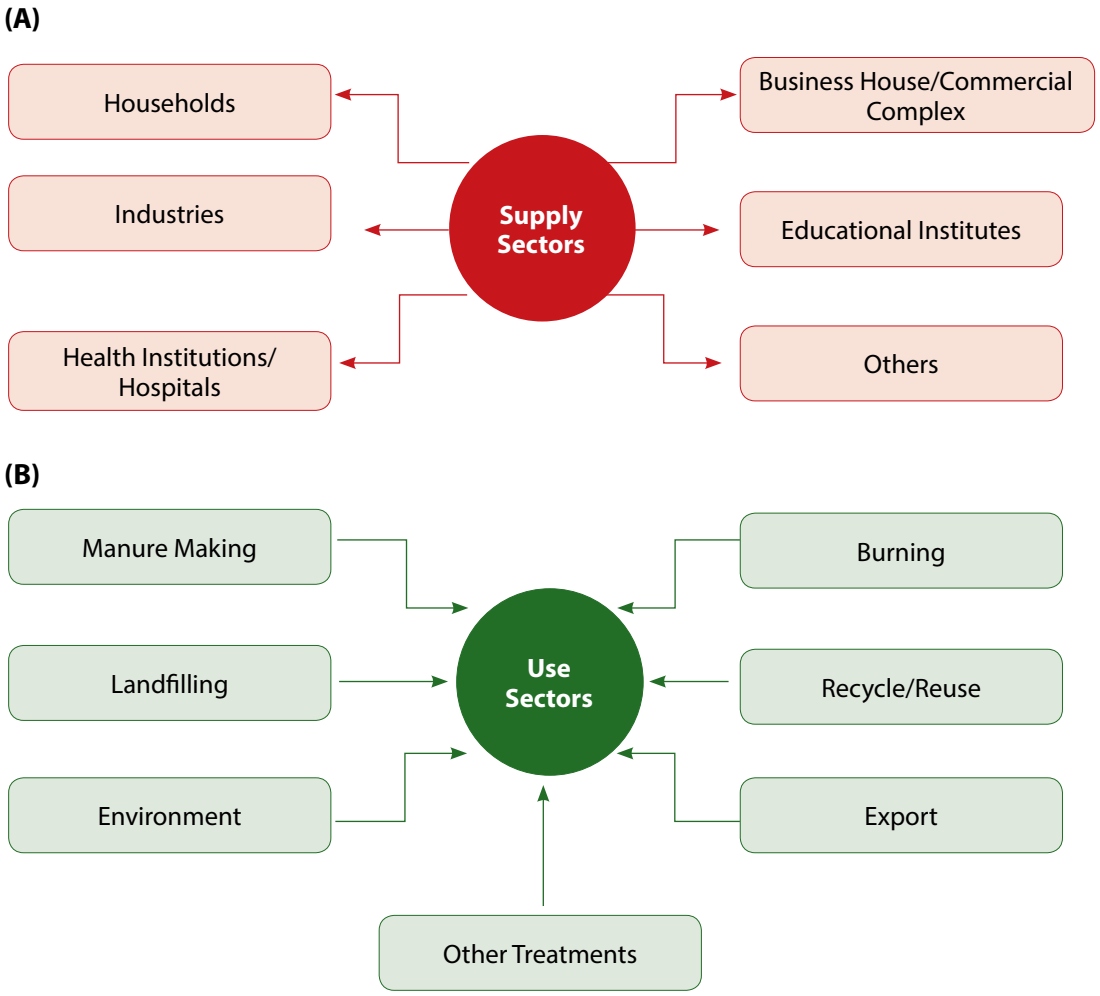


Figure 5. Major solid waste supply (A) and use (B) sectors



2.2. Supply and use sectors

A solid waste account should be able to segregate the waste quantities produced and used in different sectors. To the extent possible (based on the availability of data segregated by sectors and waste types), this study has adopted the six waste generation (supply) sectors outlined in the Waste Management Baseline Survey of Nepal 2020 (CBS, 2021), as shown in Figure 5(A). The supply sectors are households, business house/ commercial complex, industries, educational institutes, health institutions/ hospitals, and others. However, two or more sectors have been merged into a single sector when the segregated waste flow statistics are not available to the finest required levels. In case of unavailability of sufficient data, supply sectors have been re-categorized into more generic sectors.

Likewise, seven use sectors (sink), namely, manure making, landfilling, environment, burning, recycle/reuse, export, and other treatments, that included major solid waste residuals disposal/management options practiced in Nepal and also indicated in the solid waste management baseline survey of Nepal, were used in the present study. The use sectors are presented in Figure 5(B). However, data were not available for some of those use sectors. In that case, only the total waste use data were presented.

Figure 6. Classification of solid wastes in Waste Management Baseline Survey of Nepal 2020

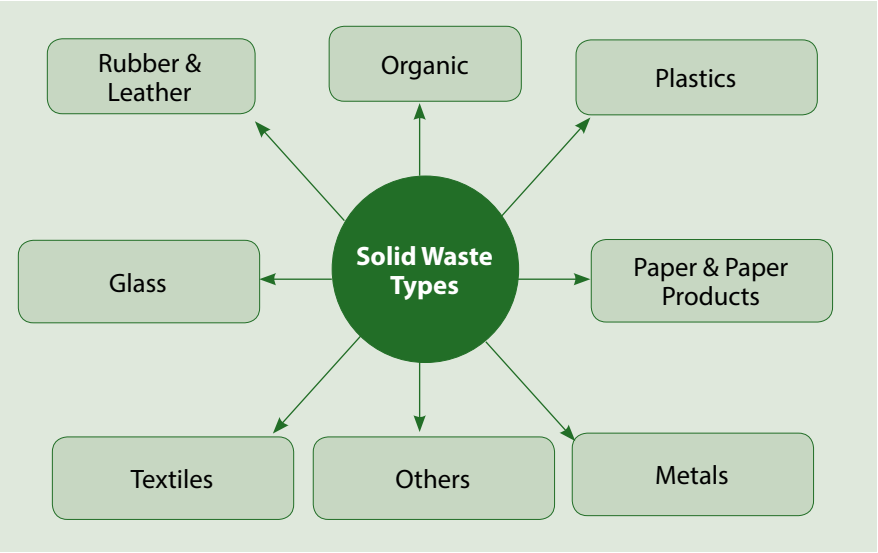
ORGANIC	INORGANIC	OTHERS
Agricultural/Garden Waste	Plastic	Hospital Waste
Paper	Glass	Electronic & Electrical Waste
Textile	Rubber	Toxic Waste
Leather	Metals & Minerals	Other Chemical Wastes
Other Organic Wastes	Other Inorganic Wastes	Other Wastes

2.3. Waste types

Solid waste accounts present the waste flows segregated not only by the sectors but also by the waste types. Therefore, the waste categories should be clearly defined. However, there is no international standard classification of solid waste (United Nations, 2014). CBS defined and adopted three major waste categories in the solid waste baseline survey of Nepal (CBS, 2021). Three generic waste types were organic, inorganic, and others (Figure 6). Organic wastes have been further sub-categorized as agricultural/garden waste, paper, textile, leather, and other organic wastes. Likewise, inorganic waste sub-categories are plastic, glass, rubber, metals and minerals, and other inorganic wastes. Other wastes sub-categories are hospital waste, electronic and electrical waste, toxic waste, other chemical wastes, and other wastes.

A comprehensive literature review on the waste composition statistics for Nepal (ADB, 2013; Dangi et al., 2013, 2011; Pathak et al., 2020) showed that solid waste data were not available as per the waste categories adopted by CBS (CBS, 2021). A few studies adopted ten categories of solid wastes, namely organic, plastics, paper and paper products, metals, glass, rubber and leather, textiles, dirt and construction debris, hazardous wastes, and other wastes (Dangi et al., 2013, 2011). However, ADB (2013) and Pathak et al. (2020) reported only eight categories out of the ten (dirt and construction debris and hazardous wastes not reported). These waste categories match only partially with those reported in the Waste Management Baseline Survey of Nepal 2020 (CBS, 2021). Therefore, to ensure the comparability of waste composition statistics reported by prior studies, new categories were formed, namely, organic, plastics, paper and paper products, metals, glass, rubber and leather, textiles, and others (Figure 7).

Figure 7. Classification of solid wastes reported in the literature



2.4. Study framework

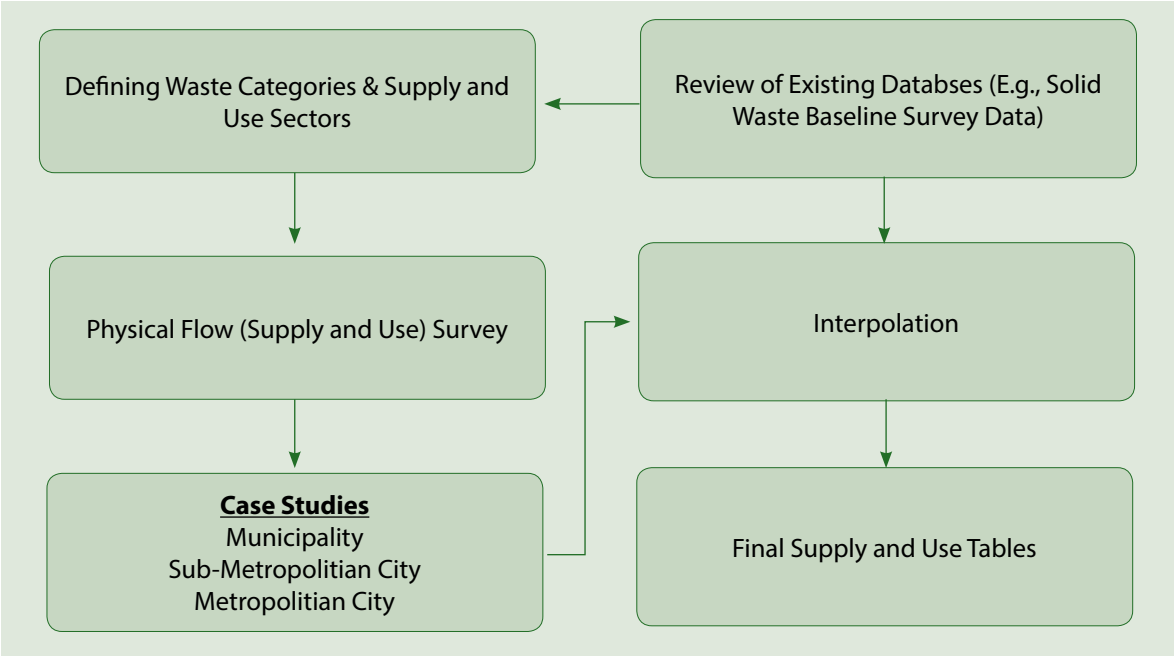
The generic framework of the present study has been presented in Figure 8. During the first phase of the study, different relevant databases on solid waste supply and use in Nepal were reviewed and aggregated. Based on the availability of data (data obtained from in-depth interviews and discussions made with persons involved in waste management), the supply and use sectors and the waste categories to be included in the waste account were finalized. However, a preliminary review of the existing databases and review of the secondary literatures indicated that solid waste quantities and flows segregated by both the waste types and supply/use sectors are not available in Nepal. Therefore, this study conducted three case studies at the municipality, sub-metropolitan city, and metropolitan city levels to determine the proportion of solid wastes under different supply/use sectors and waste categories. The statistics obtained from the case study were interpolated to the national level (total waste quantities available from the Waste Management Baseline Survey Database) to prepare the national solid waste account.

2.5. Limitations

The following were the limitations of this study:

- Case studies were conducted only on three municipalities, each representing a municipality, a sub-metropolitan city, and a metropolitan city.
- Due to unavailability and scatteredness in the data, adjustment was made in the SEEA central framework to account for supply and use tables in solid waste sectors.
- Data collected during case studies were based on a survey conducted with the officials involved in the waste sector. The values correspond to the estimates, rather than exact measurements.

Figure 8. The framework for preparing national solid waste account



3 SUPPLY AND USE OF SOLID WASTE

3.1. Case studies

3.1.1. Bhimeshwor Municipality

The supply table for the Bhimeshwor Municipality is shown in Table 2. The total quantity of the waste generated within the city is 15,011 kg/day. Of the total waste generated daily, 12,000 kg/day (80%) is contributed by household wastes, 754 kg/day (5%) by business house wastes, 151 kg/day (1%) by industries, and 753 kg/day (5%) by educational institutions, 901 kg/day (6%) by health institution wastes, and 452 kg/day (3%) by other unspecified sectors. In the municipality, organic wastes make the largest fraction (65%) of the total waste generated, followed by inorganic (25%) and other wastes (10%).

Table 2. Solid waste supply (kg/day) table for Bhimeshwor Municipality

Waste types	Household	Business house	Industry	Educational institute	Health institute	Others	Total
Organic wastes	**7,800**	**376**	**76**	**376**	**270**	**226**	**9,124**
Textile	780	75	– [a]	19	54	90	1,018
Leather	780	19	–	19	27	23	868
Paper	1,560	150	8	225	54	45	2,042
Agricultural/Garden management	3,900	113	15	94	81	45	4,248
Other Organic	780	19	53	19	54	23	948
Inorganic wastes	**3,000**	**339**	**75**	**339**	**180**	**226**	**4159**
Plastic	1,200	152	45	203	90	113	1,803
Glass	450	68	–	34	45	11	608
Rubber	150	17	4	17	9	23	220
Metals and Minerals	900	68	26	51	18	56	1,119
Other inorganic waste	300	34	–	34	18	23	409
Other waste	**1200**	**39**	**–**	**38**	**451**	**–**	**1,728**
Toxic	–	4	–	4	135	–	143
Hospital Waste	120	4	–	4	225	–	353
Electronic and Electrical Waste	360	23	–	15	45	–	443
Other Chemical Waste	480	4	–	11	23	–	518
Other	240	4	–	4	23	–	271
Total	**12,000**	**754**	**151**	**753**	**901**	**452**	**15.011**

[a] Data not available or not applicable.

The use table for the Bhimeshwor Municipality is shown in Table 3. Of the total waste generated daily (15,011 kg/day), approximately 53% (7951 kg/day) is collected and disposed of in landfills. Likewise, 46% of the total waste is estimated to be dumped into the environment. Since the quantity of waste managed at the household levels (e.g., composting) is not reported, it was assumed that the not-reported waste quantity is dumped in the environment, which may have introduced error in the estimation. Therefore, it should be noted that the waste quantity that was calculated to being dumped into the environment also includes the waste quantity that might have been managed at the source of the waste. Moreover, 205 kg/day (1.4%) of the total waste is recycled. The recycled waste fraction is contributed by paper (90 kg/day), plastics (60 kg/day), and metals and minerals (55 kg/day). The waste fraction that is exported, composted, or treated by other unspecified methods are either non-existent (zero) or not reported.

Table 3. Solid waste use (kg/day) table for Bhimeshwor Municipality

Waste types	Landfill	Environment [a]	Recycle	Export	Burn	Compost	Other	Total
Organic wastes	**4,834**	**4,200**	**90**					**9,124**
Textile	539	479	– [b]	–	–	–	–	1,018
Leather	460	408	–	–	–	–	–	868
Paper	1,082	870	90	–	–	–	–	2,042
Agricultural/ Garden management	2,251	1,997	–	–	–	–	–	4,248
Other Organic	502	446	–	–	–	–	–	948
Inorganic wastes	**2,202**	**1,842**	**115**	–	–	–	–	**4,159**
Plastic	955	788	60	–	–	–	–	1,803
Glass	322	286	–	–	–	–	–	608
Rubber	116	104	–	–	–	–	–	220
Metals and Minerals	593	471	55	–	–	–	–	1,119
Other inorganic waste	216	193	–	–	–	–	–	409
Other waste	**915**	**813**		–	–	–	–	**1,728**
Toxic	76	67	–	–	–	–	–	143
Hospital Waste	187	166	–	–	–	–	–	353
Electronic and Electrical Waste	235	208	–	–	–	–	–	443
Other Chemical Waste	274	244	–	–	–	–	–	518
Other	143	128	–	–	–	–	–	271
Total	**7,951**	**6,855**	**205**	–	–	–	–	**15,011**

[a] Includes the waste composted or otherwise managed at the household levels.
[b] Data not available or not applicable.

3.1.2. Janakpurdham Sub-Metropolitan City

The supply table for the Janakpurdham Sub-Metropolitan City is shown in Table 4. The total quantity of the waste generated within the city is 78,273 kg/day. The waste generation statistics were available only for four sectors, namely household, business house, industry, and health institutions. Of the total waste generated daily, 45,341 kg/day (57.9%) is contributed by household wastes, 28,414 kg/day (36.3%) by business house/educational institute wastes, 2,520 kg/day (3.2%) by industries, and 2,000 kg/day (2.6%) by health institution wastes. It should be noted that the wastes generated from educational institutions and business house are not separated in the table. Organic wastes make the largest fraction of the total waste generated, followed by inorganic and other wastes.

Table 4. Solid waste supply (kg/day) for Janakpurdham Sub-Metropolitan City

Waste types	Household	Business house/ educational institute	Industry	Health institute	Total
Organic wastes	**33,224**	**17,699**	**1,550**	– [a]	**5,2472**
Textile	4,794	2,554	224	–	7,572
Leather	2,761	1,471	129	–	4,360
Paper	5,914	3,150	276	–	9,340
Agricultural/Garden management	14,293	7,614	666	–	22,574
Other Organic	5,462	2,910	255	–	8,626
Inorganic wastes	**12,117**	**10,715**	**970**	–	**23,801**
Plastic	5,259	4,650	421	–	10,330
Glass	2,223	1,966	178	–	4,368
Rubber	1,458	1,289	117	–	2,863
Metals and Minerals	1,592	1,408	127	–	3,127
Other inorganic waste	1,585	1,402	127	–	3,113
Other waste	–	–	–	**2,000**	**2,000**
Toxic	–	–	–	–	–
Hospital Waste	–	–	–	2,000	2,000
Electronic and Electrical Waste	–	–	–	–	–
Other Chemical Waste	–	–	–	–	–
Other	–	–	–	–	–
Total	**45,341**	**28,414**	**2,520**	**2,000**	**78,273**

[a] Data not available or not applicable.

The use table for the Janakpurdham Sub-Metropolitan City is shown in Table 5. The waste flow data under landfill and recycle use sector were reported by the municipality, while the waste quantity under the "environment" use sector was estimated by subtracting the waste quantity that was landfilled or recycled from the total waste generation. Of the total waste generated daily (78,274 kg/day), approximately 58% (45,660 kg/day) is collected and disposed of in the landfills. Likewise, 36% (28,274 kg/day) of the total waste is estimated to be dumped into the environment. Since the quantity of waste managed at the household levels (e.g., composting) is not reported, it was assumed that the not-reported waste quantity is dumped in the environment, which may have introduced error in the estimation. Therefore, it should be noted that the waste quantity that was calculated to being dumped into the environment also includes the waste quantity that might have been managed at the source of the waste.

Likewise, it was reported that plastic wastes are generally collected for recycling. The waste quantity collected for recycling accounts for approximately 5.5% (4,340 kg/day) of the total waste generated.

Table 5. Solid waste use (kg/day) table for Janakpurdham Sub-Metropolitan City

Waste types	Landfill	Environment [a]	Recycle	Total
Organic wastes	**30,000**	**22,472**	**– [b]**	**52,472**
Textile	4,329	3,243	–	7,572
Leather	2,493	1,867	–	4,360
Paper	5,340	4,000	–	9,340
Agricultural/ Garden management	12,906	9,668	–	22,574
Other Organic	4,932	3,694	–	8,626
Inorganic wastes	**15,660**	**3,801**	**4,340**	**23,801**
Plastic	4,340	1,650	4,340	10,330
Glass	3,670	698	–	4,368
Rubber	2,406	457	–	2,863
Metals and Minerals	2,628	499	–	3,127
Other inorganic waste	2,616	497	–	3,113
Other waste	**–**	**2,000**	**–**	**2,000**
Toxic	–	–	–	355
Hospital Waste	–	2,000	–	578
Electronic and Electrical Waste	–	–	–	817
Other Chemical Waste	–	–	–	250
Other	–	–	–	–
Total	**45,660**	**28,274**	**4,340**	**78,274**

[a] Includes the waste composted or otherwise managed at the household levels.
[b] Data not available or not applicable.

3.1.3. Pokhara Metropolitan City

The supply table for Pokhara Metropolitan City is shown in Table 6. The total quantity of the waste generated within the city is 1,34,500 kg/day. Of the total waste generated daily, 94,150 kg/day (70%) is contributed by household wastes, 6,725 kg/day (5%) by business house wastes, 6,725 kg/day (5%) by industries, and 13,450 kg/day (10%) by educational institutions, 4,559.6 kg/day (3%) by health institution wastes, and 8,890.4 kg/day (7%) by other unspecified sectors. In the municipality, organic wastes make the largest fraction (73%) of the total waste generated, followed by inorganic (24%) and other wastes (3%).

Table 6. Solid waste supply (kg/day) table for Pokhara Metropolitan City

Waste types	Household	Business house	Industry	Educational Institute	Health institute	Others	Total
Organic wastes	**68,871**	**3,026**	**3,362**	**2,690**	**684**	**4,445**	**83,078**
Textile	–[a]	–	–	–	–	–	–
Leather	–	–	–	–	–	–	–
Paper	–	–	–	–	–	–	–
Agricultural/Garden management	–	–	–	–	–	–	–
Other Organic	–	–	–	–	–	–	–
Inorganic wastes	**22,540**	**3,363**	**3,363**	**9,414**	**684**	**4,445**	**43,809**
Plastic	–	–	–	–	–	–	–
Glass	–	–	–	–	–	–	–
Rubber	–	–	–	–	–	–	–
Metals and Minerals	–	–	–	–	–	–	–
Other inorganic waste	–	–	–	–	–	–	–
Other waste	**2,740**	**336**	**–**	**1,345**	**3,192**	**0**	**7,613**
Toxic	–	–	–	–	–	–	–
Hospital Waste	–	–	–	–	–	–	–
Electronic and Electrical Waste	–	–	–	–	–	–	–
Other Chemical Waste	–	–	–	–	–	–	–
Other	–	–	–	–	–	–	–
Total	**94,151**	**6,725**	**6,725**	**13,449**	**4,560**	**8,890**	**1,34,500**

[a] Data not available or not applicable.

The use table for the Pokhara Metropolitan City is shown in Table 7. Of the total waste generated daily (1,34,500 kg/day), approximately 55% (73,975 kg/day) is collected and disposed of in landfills. Likewise, 38% of the total waste is estimated to be dumped into the environment. Since the quantity of waste managed at the household levels (e.g., composting) is not reported, it was assumed that the not-reported waste quantity is dumped in the environment, which may have introduced error in the estimation. Therefore, the waste quantity that was calculated to being dumped into the environment also includes the waste quantity that might have been managed at the source of the waste. Moreover, 9,000 kg/day (7%) of the total waste is recycled. The waste fraction that is exported, composted, or treated by other unspecified methods are either non-existent (zero) or not reported.

Table 7. Solid waste use (kg/day) table for Pokhara Metropolitan City

Waste types	Landfill	Environment [a]	Recycle	Total
Organic wastes	**45,693**	**35,885**	**1,500**	**83,078**
Textile	– [b]	–	–	–
Leather	–	–	–	–
Paper	–	–	–	–
Agricultural/ Garden management	–	–	–	–
Other Organic	–	–	–	–
Inorganic wastes	**24,095**	**12,214**	**7,500**	**43,809**
Plastic	–	–	–	–
Glass	–	–	–	–
Rubber	–	–	–	–
Metals and Minerals	–	–	–	–
Other inorganic waste	–	–	–	–
Other waste	**4,187**	**3,426**	**0**	**7,613**
Toxic	–	–	–	–
Hospital Waste	–	–	–	–
Electronic and Electrical Waste	–	–	–	–
Other Chemical Waste	–	–	–	–
Other	–	–	–	–
Total	**73,975**	**51,525**	**9,000**	**1,34,500**

[a] Includes the waste composted or otherwise managed at the household levels.
[b] Data not available or not applicable.

3.2. Solid waste composition by source

A comprehensive literature review was conducted to compile the waste composition statistics for Nepal. Then the average composition for the wastes collected from different sources (ADB, 2013; Dangi et al., 2013, 2011; Pathak et al., 2020) were summarized. Prior studies adopted different waste categories, making the comparison and compilation of statistics obtained from different studies difficult. For example, a few studies adopted ten categories of solid wastes, namely organic, plastics, paper and paper products, metals, glass, rubber and leather, textiles, dirt and construction debris, hazardous wastes, and other wastes (Dangi et al., 2013, 2011). However, ADB (2013) and Pathak et al. (2020) reported only eight categories out of the ten (dirt and construction debris and hazardous wastes not reported). These waste categories match only partially with those reported in the Waste Management Baseline Survey of Nepal 2020 (CBS, 2021). Therefore, to ensure the comparability of waste composition statistics reported by prior studies, new categories were formed, namely, organic, plastics, paper and paper products, metals, glass, rubber and leather, textiles, and others (dirt and construction debris, hazardous wastes, and other wastes were lumped together, whenever those categories were reported).

Most prior studies conducted in Nepal have reported household waste composition (ADB, 2013; Dangi et al., 2013, 2011; Pathak et al., 2020). The household waste composition has been summarized in Table 8. The reported waste composition represents the nature of household waste in urban areas (municipality, sub-metropolitan, and metropolitan city) of different regions across the country. As the table depicts, the average household waste composition was obtained as 60.3% ± 10.9% (organic, mean ± standard deviation), 11.0% ± 1.2% (plastics), 9.1% ± 3.5% (paper and paper products), 2.3% ± 1.9% (metals), 4.6% ± 2.9% (glass), 1.8% ± 2.1% (rubber and leather), 1.4% ± 0.5% (textiles), 9.7% ± 6.9% (others). As the data shows, there is a good to reasonable agreement among studies regarding the proportion of organic, plastics, paper and paper products, metals, glass, textiles, and other wastes. However, a high variation was observed in the proportion of rubber and leather in the household waste amongst the studies.

Table 8. Household solid waste characterization

Waste types	Waste composition (%)				Mean	SD
Organic	71	46	66	58	60.3	10.9
Plastics	12	10	12	10	11.0	1.2
Paper and paper products	7.5	6	9	14	9.1	3.5
Metals	0.5	5	2	1.5	2.3	1.9
Glass	1.3	7	3	7	4.6	2.9
Rubber and leather	0.3	5	1	1	1.8	2.1
Textiles	0.9	1	2	1.5	1.4	0.5
Others	6.7	20	5	7	9.7	6.9
Data source	(Dangi et al., 2011) [s]	(Dangi et al., 2013) [b]	(ADB, 2013) [c]	(Pathak et al., 2020) [d]		

[a] Kathmandu Metropolitan City; others include dirt and construction debris, hazardous wastes, and other waste types
[b] Tulsipur Municipality; others include dirt and construction debris, hazardous wastes, and other waste types
[c] Average of 58 municipalities
[d] Average of municipalities from seven provinces

Table 9. Business (commercial) house waste characterization

Waste types	Waste composition (%)				Mean	SD
Organic	57.8	53.4	43	51	51.3	6.2
Plastics	9.6	5.1	22	15	12.9	7.3
Paper and paper products	3.3	5.3	23	15	11.7	9.1
Metals	16.9	0.9	2	2	5.5	7.7
Glass	8.8	31.6	4	11	13.9	12.2
Rubber and leather	0	0	1	1	0.5	0.6
Textiles	0.4	1.5	2	1	1.2	0.7
Others	3.3	2.2	4	4	3.4	0.9
Data source	(Dangi et al., 2011) [a]	(Dangi et al., 2011) [b]	(ADB, 2013) [c]	(Pathak et al., 2020) [d]		

[a] Kathmandu Metropolitan City; hotel wastes; others include dirt and construction debris, hazardous wastes, and other waste types

[b] Kathmandu Metropolitan City; restaurant wastes; others include dirt and construction debris, hazardous wastes, and other waste types

[c] Average of 58 municipalities; commercial wastes

[d] Average of municipalities from seven provinces; commercial wastes

The business house (commercial) waste composition was compiled from four prior studies (ADB, 2013; Dangi et al., 2013, 2011; Pathak et al., 2020), which has been summarized in Table 9. The average composition of the business house waste was obtained as 51.3% ± 6.2% (organic), 12.9% ± 7.3% (plastics), 11.7% ± 9.1% (paper and paper products), 5.5% ± 7.7% (metals), 13.9% ± 12.2% (glass), 0.5% ± 0.6% (rubber and leather), 1.2% ± 0.7% (textiles), 3.4% ± 0.9% (others). As the data shows, there is a good agreement among studies regarding the proportion of organic, plastics, paper and paper products, glass, textiles, and other wastes. However, a high variation was observed in the proportion of metals in the business house waste amongst the studies.

The educational institute (school/offices) waste composition was compiled from three prior studies (ADB, 2013; Dangi et al., 2011; Pathak et al., 2020), which has been summarized in Table 10. The waste average composition was obtained as 27.2.3% ± 9.9% (organic), 21.4% ± 1.4% (plastics), 32.9% ± 17.6% (paper and paper products), 1.5% ± 0.9% (metals), 1.0% ± 1.0% (glass), 1.4%

Table 10. Office/school waste characterization

Waste types	Waste composition (%)			Mean	SD
Organic	38.6	22	21	27.2	9.9
Plastics	20.3	21	23	21.4	1.4
Paper and paper products	12.7	45	41	32.9	17.6
Metals	2.5	1	1	1.5	0.9
Glass	0	1	2	1.0	1.0
Rubber and leather	2.3	1	1	1.4	0.8
Textiles	2.7	2	1	1.9	0.9
Others	20.8	8	10	12.9	6.9
Data source	(Dangi et al., 2011) [a]	(ADB, 2013) [b]	(Pathak et al., 2020) [c]		

[a] Kathmandu Metropolitan City; school wastes; others include dirt and construction debris, hazardous wastes, and other waste types

[b] Average of 58 municipalities; institutional wastes

[c] Average of municipalities from seven provinces; school/office waste

± 0.8% (rubber and leather), 1.9% ± 0.9% (textiles), 12.9% ± 6.9% (others). As the data shows, the educational institute waste was characterized by a relatively high proportion of paper and paper products.

It was observed that the detailed composition (waste categories discussed above) of industrial wastes in Nepal is not reported in the published literature. Likewise, the waste composition of healthcare waste in Nepal is reported with a different waste categorization that does not compare with the waste categories discussed above and relevant in the preparation of solid waste account. For example, Joshi et al. (2017) reported the health care waste generation rates from the health care institutions in Nepal under the hazardous (infectious, pharmaceutical, sharps, chemical, and radioactive) and non-hazardous (degradable, recyclable) wastes.

3.3. Solid waste supply table

The solid waste supply table was generated for Nepal (rural municipalities excluded) using the average waste generation rates segregated by the sources for the municipality, sub-metropolitan city, and metropolitan city, obtained from the solid waste baseline survey of Nepal (CBS, 2021). The waste generation rates are summarized in Table 11.

The quantity of waste generated was calculated on an annual basis for municipalities (n = 276), sub-metropolitan cities (n = 11), and metropolitan cities (n = 6), separately. The CBS data presented in Table 11 represent the quantity of waste collected by municipalities, but not the quantity of waste generated in the municipalities. These two quantities may differ because not all the wastes are collected by the municipalities for treatment or disposal. The solid waste baseline survey of CBS indicated that, in an average, 50% of the total quantity of wastes generated are collected by the municipalities (CBS, 2021). Therefore, the waste quantities presented in Table 11 represents only the 50% of the total waste generated. Considering this fact, the quantity of waste generated from different sectors per administrative unit (metropolitan city, sub-metropolitan city, and municipality) was obtained by multiplying the respective quantities in Table 11 by two. Finally, the estimated waste generated rates per administrative unit were multiplied by the number of administrative units (6 metropolitan cities, 11 sub-metropolitan cities, and 276 municipalities), and the results were converted into mt/year. The results so obtained represented the estimated total waste generation for all metropolitan cities, sub-metropolitan cities, and municipalities annually (Table 12).

Table 11. Waste collection rate for municipalities, sub-metropolitan cities, and metropolitan cities

Administrative units	Waste collected from different sources (kg/day/administrative unit)					
	HH	BH	ED	IN	HI	Others
Metropolitan city	15,920	7,720	4,680	4,460	4,560	0
Sub-metropolitan city	3,316	3,025	1,322	1,544	594	1,171
Municipality	1,441	932	358	310	381	282

(HH: Household, BH: Business House, ED: Educational Institute, IN: Industry, HI: Health Institute)

Table 13. Estimated total waste generation from municipalities, sub-metropolitan cities, and metropolitan cities

Administrative units	Waste generated (mt/year)						
	HH	BH	ED	IN	HI	Others	Total
Metropolitan city	69,730	33,814	20,498	19,535	19,973	0	**1,63,550**
Sub-metropolitan city	26,627	24,291	10,616	12,398	4,770	9,403	**88,105**
Municipality	2,90,333	1,87,779	72,130	62,459	76,764	56,817	**7,46,282**
Nepal [a]	**3,86,690**	**2,45,884**	**1,03,244**	**94,392**	**1,01,507**	**66,220**	**9,97,937**

(HH: Household, BH: Business House, ED: Educational Institute, IN: Industry, HI: Health Institute)

[a] Except rural municipalities

Moreover, the CBS database (Table 11) does not provide the waste quantities segregated by the waste types. Therefore, the average waste composition for different sources obtained from the literature (See section 3.2) was adopted to segregate the waste generated from different sources into the waste categories. The summary of waste composition data has been presented in Table 13. The table shows that the household and business house wastes are dominated by organic wastes, while the educational institute wastes have major fraction of paper and paper products. However, the waste composition data were not available for industrial, health institutes, and other sector wastes, and to account the waste generated from those three sectors in the waste account table, it was necessary to add the "unclassified" waste category. Therefore, in Table 13, the unclassified waste category represents the waste fraction that could not be segregated into the known waste categories.

Table 14. Average composition of solid waste produced from different sources compiled from the literature

Waste types	Composition (%)					
	Household	Business house	Educational institute	Industry	Health institute	Others
Organic wastes	60.3	51.3	27.2	NA [a]	NA	NA
Plastics	11.0	12.9	21.4	NA	NA	NA
Paper and paper products	9.1	11.7	32.9	NA	NA	NA
Metals	2.3	5.5	1.5	NA	NA	NA
Glass	4.6	13.9	1.0	NA	NA	NA
Rubber and leather	1.8	0.5	1.4	NA	NA	NA
Textiles	1.4	1.2	1.9	NA	NA	NA
Others	9.6	3.1	12.6	NA	NA	NA
Unclassified [b]	– [c]	–	–	100	100	100
Total	**100**	**100**	**100**	**100**	**100**	**100**

[a] Data not available

[b] The unclassified waste category was added because the waste composition of total waste generated in industrial, health care and others sectors were not available

[c] Not applicable

Table 15. Solid waste supply table for 6 metropolitan cities of Nepal

Waste types	Total solid waste generated (mt/year)						
	Household	Business house	Educational institute	Industry	Health institute	Others	Total
Organic wastes	42,012	17,346	5,576	NA [a]	NA	NA	**64,934**
Plastics	7,670	4,370	4,393	NA	NA	NA	**16,434**
Paper and paper products	6,363	3,939	6,744	NA	NA	NA	**17,046**
Metals	1,569	1,843	307	NA	NA	NA	**3,719**
Glass	3,190	4,683	205	NA	NA	NA	**8,078**
Rubber and leather	1,273	169	294	NA	NA	NA	**1,735**
Textiles	941	414	389	NA	NA	NA	**1,745**
Others	6,711	1,048	2,590	NA	NA	NA	**10,349**
Unclassified [b]	– [c]	–	–	19,535	19,973	0	**39,508**
Total	**69,730**	**33,814**	**20,498**	**19,535**	**19,973**	**0**	**1,63,549**

[a] Data not available
[b] The unclassified waste category was added because the waste composition of total waste generated in industrial, health care and others sectors were not available
[c] Not applicable

Finally, the waste generation from all municipalities, sub-metropolitan cities, and metropolitan cities were aggregated to prepare the final solid waste supply table. The waste supply tables for metropolitan cities (Table 14), sub-metropolitan cities (Table 15), and municipalities (Table 16) are discussed in the following sections.

The total solid waste supply from six metropolitan cities of Nepal is presented in Table 14. The total waste quantity generated annually within the metropolitan cities was 1,63,549 mt. The household sector represented the largest waste generation sector (69,730 mt/year), followed by business house (33,814 mt/year), educational institute (20,498 mt/year), health institution (19,973 mt/year), and industry (19,535 mt/year).

The total solid waste supply from 11 sub-metropolitan cities of Nepal is presented in Table 15. The total waste quantity generated annually within the sub-metropolitan cities was 88105 mt. The household sector represented the largest waste generation sector (26,627 mt/year), followed by business house (24,291 mt/year), industry (12,398), educational institute (10,616 mt/year), other sectors (9,403 mt/year), and health institutions (4770 mt/year).

Table 16. Solid waste supply table for 11 sub-metropolitan cities of Nepal

Waste types	Total solid waste generated (mt/year)						Total
	Household	Business house	Educational institute	Industry	Health institute	Others	
Organic wastes	16,043	12,461	2,887	NA [a]	NA	NA	**31,392**
Plastics	2,929	3,140	2,275	NA	NA	NA	**8,344**
Paper and paper products	2,430	2,830	3,493	NA	NA	NA	**8,752**
Metals	599	1,324	159	NA	NA	NA	**2,082**
Glass	1,218	3,364	106	NA	NA	NA	**4,689**
Rubber and leather	486	121	152	NA	NA	NA	**760**
Textiles	359	298	202	NA	NA	NA	**859**
Others	2,563	753	1,341	NA	NA	NA	**4,657**
Unclassified [b]	– [c]	–	–	12,398	4,770	9,403	**26,571**
Total	**26,627**	**24,291**	**10,616**	**12,398**	**4,770**	**9,403**	**88,105**

[a] Data not available
[b] The unclassified waste category was added because the waste composition of total waste generated in industrial, health care and others sectors were not available
[c] Not applicable

The total solid waste supply from 276 municipalities of Nepal is presented in Table 16. The total waste quantity generated annually within the municipalities was 7,46,282 mt. The household sector represented the largest waste generation sector (2,90,333 mt/year), followed by business house (1,87,779 mt/year), health institution (76,764 mt/year), educational institutes (72,130 mt/year), industries (62,459 mt/year), and other sectors (56,817 mt/year).

Table 17. Solid waste supply table for 276 municipalities of Nepal

Waste types	Total solid waste generated (mt/year)						
	Household	Business house	Educational institute	Industry	Health institute	Others	Total
Organic wastes	1,74,925	96,331	19,619	NA [a]	NA	NA	**2,90,876**
Plastics	31,937	24,270	15,460	NA	NA	NA	**71,667**
Paper and paper products	26,493	21,876	23,731	NA	NA	NA	**72,100**
Metals	6,532	10,234	1,082	NA	NA	NA	**17,848**
Glass	13,283	26,007	721	NA	NA	NA	**40,011**
Rubber and leather	5,299	939	1,034	NA	NA	NA	**7,271**
Textiles	3,919	2,300	1,370	NA	NA	NA	**7,590**
Others	27,945	5,821	9112	NA	NA	NA	**42,878**
Unclassified [b]	– [c]	–	–	62,459	76,764	56,817	**1,96,040**
Total	**2,90,333**	**1,87,779**	**72,130**	**62,459**	**76,764**	**56,817**	**7,46,282**

[a] Data not available
[b] The unclassified waste category was added because the waste composition of total waste generated in industrial, health care and others sectors were not available
[c] Not applicable

Table 18. Solid waste supply table for all metropolitan cities, sub-metropolitan cities, and municipalities of Nepal

Waste types	Total solid waste generated (mt/year)						
	Household	Business house	Educational institute	Industry	Health institute	Others	Total
Organic wastes	2,32,981	1,26,138	28,082	NA [a]	NA	NA	**3,87,201**
Plastics	42,536	31,780	22,129	NA	NA	NA	**96,445**
Paper and paper products	35,285	28,645	33,967	NA	NA	NA	**97,898**
Metals	8,701	13,401	1,549	NA	NA	NA	**23,650**
Glass	17,691	34,055	1,032	NA	NA	NA	**52,778**
Rubber and leather	7,057	1,229	1,480	NA	NA	NA	**9,766**
Textiles	5,220	3,012	1,962	NA	NA	NA	**10,194**
Others	37,219	7,622	13,043	NA	NA	NA	**57,884**
Unclassified [b]	– [c]	–	–	94,392	1,01,507	66,220	**2,62,119**
Total	**3,86,690**	**2,45,884**	**1,03,244**	**94,392**	**1,01,507**	**66,220**	**9,97,936**

[a] Data not available
[b] The unclassified waste category was added because the waste composition of total waste generated in industrial, health care and others sectors were not available
[c] Not applicable

The final waste supply table for the whole country, excluding the rural municipalities, is presented in Table 17. It was estimated that the total amount of waste generated from the country is approximately one million mt/year, of which 3,86,690 mt/year is contributed by households, 2,45,884 mt/year by business houses, 1,03,244 mt/year by educational institutes, 94,392 mt/year by industries, 1,01,507 mt/year by health institutions, and 66,220 mt/year by other sectors.

3.4. Solid waste use table

To generate the use table, first of all, the total quantity of each waste type was obtained from the supply table. Then, the quantity of each waste type was segregated under different use sector, namely landfill, environment, recycling, burning, and unclassified, using the proportion in different use sectors. The proportion of different types of solid wastes that end up in different use sectors were obtained using data from case studies conducted in the present study, as well as data obtained from the relevant literature. The waste segregations under different use sectors are summarized in Table 18. The proportions of each waste type that is landfilled or recycled were obtained from the case study conducted in the present study (Bhimeshwor Municipality). The proportion of waste burned was adopted from the literature (Das et al., 2018). The portion of waste under the category of "environment" was obtained as the proportion that is not landfilled, recycled, or burned. Due to the unavailability of data for waste composted or otherwise managed at household level, the "environment" sector includes the waste composted or otherwise managed at the household level.

The quantity of waste in different use sectors was calculated on an annual basis for municipalities (n = 276), sub-metropolitan cities (n = 11), and metropolitan cities (n = 6), separately. Finally, the waste generation from all municipalities, sub-metropolitan cities, and metropolitan cities were aggregated to prepare the final solid waste use table. The waste use tables for metropolitan cities, sub-metropolitan cities, and municipalities are presented in the following sections.

Table 19. Average composition of solid waste in different use sectors

Waste types	Proportion (%)					
	Landfill	Environment	Recycle	Burn	Unclassified [a]	Total
Organic wastes	53.0	44.0	0.0	3.0	–	**100**
Plastics	53.0	40.7	3.3	3.0	–	**100**
Paper and paper products	53.0	39.6	4.4	3.0	–	**100**
Metals	53.0	39.1	4.9	3.0	–	**100**
Glass	53.0	44.0	0.0	3.0	–	**100**
Rubber and leather	53.0	44.0	0.0	3.0	–	**100**
Textiles	53.0	44.0	0.0	3.0	–	**100**
Others	53.0	44.0	0.0	3.0	–	**100**
Unclassified [a]	– [b]	–	–	–	100	**100**
Data source	Case study (Bhimeshwor Municipality)	Calculated [c]	Case study (Bhimeshwor Municipality)	(Das et al., 2018)	-	**-**

[a] The unclassified waste and use categories were added to account for the waste quantity that was unsegregated by waste type and use sectors
[b] Not applicable
[c] Calculated with the assumption that the waste quantity that is not landfilled, recycled, or burned ends up in the environment. It may also include the waste composted or otherwise managed at the household levels due to unavailability of data.

Table 19 shows the solid waste use quantity (mt/year) for six metropolitan cities. As the table shows, the predominant use sector was landfill with 65,742 mt of waste being dumped annually in the landfill sites of metropolitan cities. The second major use sector was environment (53,097 mt/year). Likewise, 3,721 mt solid waste is estimated to be burned annually. Recycling represented the use sector with the lowest quantity of waste flow annually (1,482 mt/year). The waste types under the recycling sector were plastics, paper and paper products, and metals. Additionally, as discussed above the use sector "environment" may include waste composted, burned, or managed otherwise at the household level or waste generation sites. The waste quantity composted, burned, exported, or managed otherwise were not available.

Table 20. Solid waste use table for 6 metropolitan cities of Nepal

Waste types	Quantity of solid waste in use sectors (mt/year)					
	Landfill	Environment	Recycle	Burn	Unclassified [a]	Total
Organic wastes	34,415	28,571	0	1,948	–	**64,934**
Plastics	8,710	6,684	547	493	–	**16,434**
Paper and paper products	9,034	6,749	751	511	–	**17,046**
Metals	1,971	1,454	183	112	–	**3,719**
Glass	4,281	3,554	0	242	–	**8,078**
Rubber and leather	920	764	0	52	–	**1,735**
Textiles	925	768	0	52	–	**1,745**
Others	5,485	4,554	0	310	–	**10,349**
Unclassified [a]	– [b]	–	–	–	39,508	**39,508**
Total	**65,742**	**53,097**	**1,482**	**3,721**	**39,508**	**1,63,549**

[a] The unclassified waste and use categories were added to account for the waste quantity that was unsegregated by waste type and use sectors
[b] Not applicable

Table 20 shows the solid waste use quantity (mt/year) for 11 sub-metropolitan cities in Nepal. As the table shows, the predominant use sector was landfill with 32,613 mt of waste being dumped annually in the landfill sites of sub-metropolitan cities. The second major use sector was environment (26,309 mt/year). It was also estimated that 1,846 mt solid waste is burned annually. Recycling represented the use sector with the lowest quantity of waste flow annually (766 mt/year). The waste types under the recycling sector were plastics, paper and paper products, and metals. Moreover, as discussed above the use sector "environment" may include waste composted, burned, or managed otherwise at the household level or waste generation sites. The waste quantity composted, burned, exported, or managed otherwise were not available.

Table 21 shows the solid waste use quantity (mt/year) for 276 municipalities in Nepal. As the table depicts, the largest use sector was landfill with 2,91,628 mt of waste being dumped annually in the landfill sites of municipalities. The second major use sector was environment (2,35,664 mt/year), followed by burning (16,507 mt/year). Recycling represented the use sector with the lowest quantity of waste flow annually (6,443 mt/year). The waste types under the recycling sector were plastics, paper and paper products, and metals. Moreover, as discussed above the use sector "environment" may include waste composted, burned, or managed otherwise at the household level or waste generation sites. The waste quantity composted, burned, exported, or managed otherwise were not available.

Table 21. Solid waste use table for 11 sub-metropolitan cities of Nepal

Waste types	Quantity of solid waste in use sectors (mt/year)					
	Landfill	Environment	Recycle	Burn	Unclassified [a]	Total
Organic wastes	16,638	13,812	0	942	–	**31,392**
Plastics	4,422	3,393	278	250	–	**8,344**
Paper and paper products	4,639	3,465	386	263	–	**8,752**
Metals	1,104	814	102	62	–	**2,082**
Glass	2,485	2,063	0	141	–	**4,689**
Rubber and leather	403	334	0	23	–	**760**
Textiles	455	378	0	26	–	**859**
Others	2,468	2,049	0	140	–	**4,657**
Unclassified [a]	– [b]	–	–	–	26,571	**26,571**
Total	**32,613**	**26,309**	**766**	**1,846**	**26,571**	**88,105**

[a] The unclassified waste and use categories were added to account for the waste quantity that was unsegregated by waste type and use sectors

[b] Not applicable

Table 22. Solid waste use table for 276 municipalities cities of Nepal

Waste types	Quantity of solid waste in use sectors (mt/year)					
	Landfill	Environment	Recycle	Burn	Unclassified [a]	Total
Organic wastes	1,54,164	1,27,985	0	8,726	–	**2,90,876**
Plastics	37,983	29,147	2,386	2,150	–	**71,667**
Paper and paper products	38,213	28,545	3,179	2,163	–	**72,100**
Metals	9,460	6,976	878	535	–	**17,848**
Glass	21,206	17,605	0	1,200	–	**40,011**
Rubber and leather	3,854	3,199	0	218	–	**7,271**
Textiles	4,023	3,340	0	228	–	**7,590**
Others	22,725	18,866	0	1,286	–	**42,878**
Unclassified [a]	– [b]	–	–	–	1,96,040	**1,96,040**
Total	**2,91,628**	**2,35,664**	**6,443**	**16,507**	**1,96,040**	**7,46,282**

[a] The unclassified waste and use categories were added to account for the waste quantity that was unsegregated by waste type and use sectors
[b] Not applicable

Table 22 presents the total solid waste use quantity (mt/year) for all metropolitan cities, sub-metropolitan cities, and municipalities of Nepal. As the table shows, the largest use sector was landfill with 3,89,983 mt of waste being dumped annually in the landfill sites. The second major use sector was environment (3,15,069 mt/year), followed by burning (22,075 mt/year). Moreover, the use sector for unclassified waste type (2,62,119 mt/year) was not available, and hence put under the unclassified use sector. Recycling represented the use sector with the lowest quantity of waste flow annually (8,690 mt/year). The waste types under the recycling sector were plastics, paper and paper products, and metals. As mentioned in the previous sections, the use sector "environment" may include waste composted, burned, or managed otherwise at the household level or waste generation sites. The waste quantity composted, burned, exported, or managed otherwise were not available and hence not reported.

Table 23. Solid waste use table for all metropolitan cities, sub-metropolitan cities, and municipalities of Nepal

Waste types	Quantity of solid waste in use sectors (mt/year)					
	Landfill	Environment	Recycle	Burn	Unclassified [a]	Total
Organic wastes	2,05,217	1,70,369	0	11,616	–	**3,87,201**
Plastics	51,116	39,224	3,211	2,893	–	**96,445**
Paper and paper products	51,886	38,759	4,316	2,937	–	**97,898**
Metals	12,534	9,243	1,163	709	–	**23,650**
Glass	27,973	23,222	0	1,583	–	**52,778**
Rubber and leather	5,176	4,297	0	293	–	**9,766**
Textiles	5,403	4,485	0	306	–	**10,194**
Others	30,679	25,469	0	1,737	–	**57,884**
Unclassified [a]	– [b]	–	–	–	2,62,119	**2,62,119**
Total	**3,89,983**	**3,15,069**	**8,690**	**22,075**	**2,62,119**	**9,97,936**

[a] The unclassified waste and use categories were added to account for the waste quantity that was unsegregated by waste type and use sectors
[b] Not applicable

4 CONCLUSIONS AND FUTURE DIRECTIONS

This study prepared the solid waste supply and use accounts prepared by following the SEEA Central Framework and based on the waste collection statistics obtained from the Waste Management Baseline Survey of Nepal 2020 published by CBS, other published literatures, and field data collected during the study. The study has covered the whole country as the geographical boundary, excluding the rural municipalities.

It was estimated that the total amount of waste generated from the country is approximately one million mt/year, of which 3,86,690 mt/year is contributed by households, 2,45,884 mt/year by business houses, 1,03,244 mt/year by educational institutes, 94,392 mt/year by industries, 1,01,507 mt/year by health institutions, and 66,220 mt/year by other sectors. Likewise, the largest use sector was landfill (3,89,983 mt/year) followed by environment (3,15,069 mt/year), and open burning (22,075 mt/year). Recycling represented the use sector with the lowest quantity of waste flow annually (8,690 mt/year). The waste types under the recycling sector were plastics, paper and paper products, and metals.

It was found that existing solid waste data in Nepal are inadequate to prepare the solid waste account strictly following the format suggested by the SEEA Central Framework. Therefore, the waste account format (e.g., supply and use sectors, waste categories) adopted in the present study was the modified version of that suggested by the SEEA Central Framework. Therefore, it is recommended that the local governments in Nepal keep the record of solid waste statistics segregated by the waste types and supply and use sectors suggested by the SEEA Central Framework in their databases, which would help prepare more accurate solid waste account tables in the future. Waste flow data segregated by the waste supply sectors and waste types will help in preparing future supply and use tables. Local governments are recommended to maintain the waste flow statistics within their jurisdiction so that it will help them prepare the solid waste account in the future. The technical capacity of the local governments, particularly in the waste management sector, needs to be strengthened.

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ANNEXES

Annex I
System of Environmental-Economic Accounting (SEEA)
Solid Waste Accounting (Field Survey Form)

Name of the Municipality/Sub-metro /Metro: | Date of Survey:

Current Population:

Table Ia: Average Waste Generation (Supply) in the Municipality by Waste Types and Sectors

S.N.	Waste Type	Sub-category	Household waste (kg/ day)	Business House/ Commercial Complex waste (kg/ day)	Industrial waste (kg/ day)	Educational Institutes waste (kg/ day)	Health Institutions/ Hospitals waste (kg/ day)	Other (kg/ day)	Total Quantity (kg/day)
1.	Organic	Textile							
		Leather							
		Paper							
		Agricultural/Garden management							
		Other Organic							
2.	Inorganic	Plastic							
		Glass							
		Rubber							
		Metals and Minerals							
		Other inorganic waste							
3.	Other	Toxic							
		Hospital Waste							
		Electronic and Electrical Waste							
		Other Chemical Waste							
		Other							
4.	Total								

Table Ib: Average Waste Disposed to Landfill in the Municipality by Waste Types and Sectors

S.N.	Waste Type	Sub-category	Household waste (kg/ day)	Business House/ Commercial Complex waste (kg/day)	Industrial waste (kg/ day)	Educational Institutes waste (kg/ day)	Health Institutions/ Hospitals waste (kg/day)	Other (kg/ day)	Total Quantity (kg/ day)
1.	Organic Wastes Used in Landfill	Textile							
		Leather							
		Paper							
		Agricultural/Garden management							
		Other Organic							
2.	Inorganic Wastes Used in Landfill	Plastic							
		Glass							
		Rubber							
		Metals and Minerals							
		Other inorganic waste							
3.	Other Wastes Used in Landfill	Toxic							
		Hospital Waste							
		Electronic and Electrical Waste							
		Other Chemical Waste							
		Other							
4.	Total								

Table Ic: Average Waste in Environment in the Municipality by Waste Types and Sectors

S.N.	Waste Type	Sub-category	Household waste (kg/ day)	Business House/ Commercial Complex waste (kg/day)	Industrial waste (kg/ day)	Educational Institutes waste (kg/ day)	Health Institutions/ Hospitals waste (kg/day)	Other (kg/ day)	Total Quantity (kg/day)
1.	Organic Wastes Used in Environment	Textile							
		Leather							
		Paper							
		Agricultural/Garden management							
		Other Organic							
2.	Inorganic Wastes Used in Environment	Plastic							
		Glass							
		Rubber							
		Metals and Minerals							
		Other inorganic waste							
3.	Other Wastes Used in Environment	Toxic							
		Hospital Waste							
		Electronic and Electrical Waste							
		Other Chemical Waste							
		Other							
4.	Total								

Table Id: Average Waste Recycle and Reuse in the Municipality by Waste Types and Sectors

S.N.	Waste Type	Sub-category	Household waste (kg/ day)	Business House/ Commercial Complex waste (kg/ day)	Industrial waste (kg/ day)	Educational Institutes waste (kg/ day)	Health Institutions/ Hospitals waste (kg/ day)	Other (kg/ day)	Total Quantity (kg/ day)
1.	Organic Wastes Used for Recycle and Reuse	Textile							
		Leather							
		Paper							
		Agricultural/Garden management							
		Other Organic							
2.	Inorganic Wastes Used for Recycle and Reuse	Plastic							
		Glass							
		Rubber							
		Metals and Minerals							
		Other inorganic waste							
3.	Other Wastes Used for Recycle and Reuse	Toxic							
		Hospital Waste							
		Electronic and Electrical Waste							
		Other Chemical Waste							
		Other							
4.	Total								

Table Ie: Average Waste Export in the Municipality by Waste Types and Sectors

S.N.	Waste Type	Sub-category	Household waste (kg/ day)	Business House/ Commercial Complex waste (kg/ day)	Industrial waste (kg/ day)	Educational Institutes waste (kg/ day)	Health Institutions/ Hospitals waste (kg/ day)	Other (kg/day)	Total Quantity (kg/ day)
1.	Organic Wastes Used for Export	Textile							
		Leather							
		Paper							
		Agricultural/Garden management							
		Other Organic							
2.	Inorganic Wastes Used for Export	Plastic							
		Glass							
		Rubber							
		Metals and Minerals							
		Other inorganic waste							
3.	Other Wastes Used for Export	Toxic							
		Hospital Waste							
		Electronic and Electrical Waste							
		Other Chemical Waste							
		Other							
4.	Total								

Table If: Average Waste Burn in the Municipality by Waste Types and Sectors

S.N.	Waste Type	Sub-category	Household waste (kg/ day)	Business House/ Commercial Complex waste (kg/ day)	Industrial waste (kg/ day)	Educational Institutes waste (kg/ day)	Health Institutions/ Hospitals waste (kg/ day)	Other (kg/ day)	Total Quantity (kg/ day)
1.	Organic Wastes Used for Burning	Textile							
		Leather							
		Paper							
		Agricultural/Garden management							
		Other Organic							
2.	Inorganic Wastes Used for Burning	Plastic							
		Glass							
		Rubber							
		Metals and Minerals							
		Other inorganic waste							
3.	Other Wastes Used for Burning	Toxic							
		Hospital Waste							
		Electronic and Electrical Waste							
		Other Chemical Waste							
		Other							
4.	Total								

Table Ig: Average Waste Compost in the Municipality by Waste Types and Sectors

S.N.	Waste Type	Sub-category	Household waste (kg/ day)	Business House/ Commercial Complex waste (kg/ day)	Industrial waste (kg/ day)	Educational Institutes waste (kg/ day)	Health Institutions/ Hospitals waste (kg/ day)	Other (kg/ day)	Total Quantity (kg/day)
1.	Organic Wastes Used for Composting	Textile							
		Leather							
		Paper							
		Agricultural/Garden management							
		Other Organic							
2.	Inorganic Wastes Used for Composting	Plastic							
		Glass							
		Rubber							
		Metals and Minerals							
		Other inorganic waste							
3.	Other Wastes Used for Composting	Toxic							
		Hospital Waste							
		Electronic and Electrical Waste							
		Other Chemical Waste							
		Other							
4.	Total								

Table Ih: Average Waste with Other Treatments in the Municipality by Waste Types and Sectors

S.N.	Waste Type	Sub-category	Household waste (kg/ day)	Business House/ Commercial Complex waste (kg/ day)	Industrial waste (kg/ day)	Educational Institutes waste (kg/ day)	Health Institutions/ Hospitals waste (kg/ day)	Other (kg/ day)	Total Quantity (kg/day)
1.	Organic Wastes Used in Other treatments	Textile							
		Leather							
		Paper							
		Agricultural/Garden management							
		Other Organic							
2.	Inorganic Wastes Used in Other treatments	Plastic							
		Glass							
		Rubber							
		Metals and Minerals							
		Other inorganic waste							
3.	Other Wastes Used in Other treatments	Toxic							
		Hospital Waste							
		Electronic and Electrical Waste							
		Other Chemical Waste							
		Other							
4.	Total								

Annex II

फोहोरको लेखा पद्धती सर्वेक्षण फाराम

नगरपालिका/उपमहानगरपालिका/महानगरपालिकाको नाम: | सर्वेक्षण मिति:

जनसङ्ख्या:

तालिका २क: नगरपालिकामा फोहोरको प्रकार र फोहोर निष्काशन गर्ने क्षेत्र अनुसार औसत फोहोर उत्पादन भएको मात्रा (आपूर्ति तालिका)

सि.नं.	फोहोरको प्रकार	फोहोरको प्रकारको वृस्तित वर्गिकरण	घरधुरीबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	व्यापारिक प्रतिष्ठानबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	औद्योगिक प्रतिष्ठानबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	शिक्षण संस्थाबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	स्वास्थ्य क्षेत्रबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	अन्य क्षेत्रबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	जम्मा परिमाण (के.जी. प्रतिदिन)
१.	जैविक	कपडाजन्य							
		छाला							
		पेपर							
		कृषि सम्बन्धि							
		अन्य							
२.	अजैविक	प्लाष्टिक							
		सिसा							
		रवर							
		धातु र खनिज							
		अन्य							
३.	अन्य	बिषादी							
		अस्पताल जन्य फोहोर							
		इलेक्ट्रिकल तथा इलेक्ट्रोनिक							
		अन्य रासायनिक फोहोर							
		अन्य							
४.	जम्मा परिमाण								

तालिका २४: नगरपालिकामा फोहोरको प्रकार र फोहोर निष्काशन गर्ने क्षेत्र अनुसार औसत फोहोर ल्यान्डफिल्ड साइटमा व्यवस्थापन गरिएको मात्रा (खपत तालिका)

सि.नं.	फोहोरको प्रकार	फोहोरको प्रकारको वृस्तित वर्गिकरण	घरधुरीबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	व्यापारिक प्रतिष्ठानबाट उत्पन्न हुने फो होर (के.जी. प्रतिदिन)	औद्योगिक प्रतिष्ठानबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	शिक्षण संस्थाबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	स्वास्थ्य क्षेत्रबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	अन्य क्षेत्रबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	जम्मा परिमाण (के.जी. प्रतिदिन)
१.	जैविक (ल्यान्डफिल्ड साइटमा खपत गरिएको मात्रा)	कपडाजन्य							
		छाला							
		पेपर							
		कृषि सम्बन्धि							
		अन्य							
२.	अजैबिक (ल्यान्डफिल्ड साइटमा खपत गरिएको मात्रा)	प्लाष्टिक							
		सिसा							
		रवर							
		धातु र खनिज							
		अन्य							
३.	अन्य (ल्यान्डफिल्ड साइटमा खपत गरिएको मात्रा)	बिषादी							
		अस्पताल जन्य फोहोर							
		इलेक्ट्रिकल तथा इलेक्ट्रोनिक							
		अन्य रासायनिक फोहोर							
		अन्य							
४.	जम्मा परिमाण (ल्यान्डफिल्ड साइटमा खपत गरिएको मात्रा)								

तालिका २ग: नगरपालिकामा फोहोरको प्रकार र फोहोर निष्काशन गर्ने क्षेत्र अनुसार औसत फोहोर वातावरणमा रहेको मात्रा (खपत तालिका)

सि.नं.	फोहोरको प्रकार	फोहोरको प्रकारको वृस्तित वर्गिकरण	घरधुरीबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	व्यापारिक प्रतिष्ठानबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	औद्योगिक प्रतिष्ठानबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	शिक्षण संस्थाबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	स्वास्थ्य क्षेत्रबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	अन्य क्षेत्रबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	जम्मा परिमाण (के.जी. प्रतिदिन)
१.	जैविक (वातावरणमा रहेको मात्रा)	कपडाजन्य							
		छाला							
		पेपर							
		कृषि सम्वन्धि							
		अन्य							
२.	अजैविक (वातावरणमा रहेको मात्रा)	प्लाष्टिक							
		सिसा							
		रवर							
		धातु र खनिज							
		अन्य							
३.	अन्य (वातावरणमा रहेको मात्रा)	बिषादी							
		अस्पताल जन्य फोहोर							
		इलेक्ट्रिकल तथा इलेक्ट्रोनिक							
		अन्य रासायनिक फोहोर							
		अन्य							
४.	जम्मा परिमाण (वातावरणमा रहेको मात्रा)								

तालिका २घः नगरपालिकामा फोहोरको प्रकार र फोहोर निष्काशन गर्ने क्षेत्र अनुसार औसत फोहोर पुनःप्रयोग गरिएको मात्रा (खपत तालिका)

सि.नं.	फोहोरको प्रकार	फोहोरको प्रकारको वृस्तित वर्गिकरण	घरधुरीबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	व्यापारिक प्रतिष्ठानबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	औद्योगिक प्रतिष्ठानबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	शिक्षण संस्थाबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	स्वास्थ्य क्षेत्रबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	अन्य क्षेत्रबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	जम्मा परिमाण (के.जी. प्रतिदिन)
१.	जैविक (पुनःप्रयोग गरिएको मात्रा)	कपडाजन्य							
		छाला							
		पेपर							
		कृषि सम्बन्धि							
		अन्य							
२.	अजैबिक (पुनःप्रयोग गरिएको मात्रा)	प्लाष्टिक							
		सिसा							
		रवर							
		धातु र खनिज							
		अन्य							
३.	अन्य (पुनःप्रयोग गरिएको मात्रा)	बिषादी							
		अस्पताल जन्य फोहोर							
		इलेक्ट्रिकल तथा इलेक्ट्रोनिक							
		अन्य रासायनिक फोहोर							
		अन्य							
४.	जम्मा परिमाण (पुनःप्रयोग गरिएको मात्रा)								

तालिका २ङः नगरपालिकामा फोहोरको प्रकार र फोहोर निष्काशन गर्ने क्षेत्र अनुसार औसत फोहोर निर्यात गरिएको मात्रा (खपत तालिका)

सि.नं.	फोहोरको प्रकार	फोहोरको प्रकारको वृस्तित वर्गिकरण	घरधुरीबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	व्यापारिक प्रतिष्ठानबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	औद्योगिक प्रतिष्ठानबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	शिक्षण संस्थाबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	स्वास्थ्य क्षेत्रबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	अन्य क्षेत्रबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	जम्मा परिमाण (के.जी. प्रतिदिन)
१.	जैबिक (निर्यात गरिएको मात्रा)	कपडाजन्य							
		छाला							
		पेपर							
		कृषि सम्बन्धि							
		अन्य							
२.	अजैबिक (निर्यात गरिएको मात्रा)	प्लाष्टिक							
		सिसा							
		रवर							
		धातु र खनिज							
		अन्य							
३.	अन्य (निर्यात गरिएको मात्रा)	बिषादी							
		अस्पताल जन्य फोहोर							
		इलेक्ट्रिकल तथा इलेक्ट्रोनिक							
		अन्य रासायनिक फोहोर							
		अन्य							
४.	जम्मा परिमाण (निर्यात गरिएको मात्रा)								

तालिका २चः नगरपालिकामा फोहोरको प्रकार र फोहोर निष्काशन गर्ने क्षेत्र अनुसार औसत फोहोर जलाइएको मात्रा (खपत तालिका)

सि.नं.	फोहोरको प्रकार	फोहोरको प्रकारको वृस्तित वर्गिकरण	घरधुरीबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	व्यापारिक प्रतिष्ठानबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	औद्योगिक प्रतिष्ठानबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	शिक्षण संस्थाबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	स्वास्थ्य क्षेत्रबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	अन्य क्षेत्रबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	जम्मा परिमाण (के.जी. प्रतिदिन)
१.	जैविक (जलाइएको मात्रा)	कपडाजन्य							
		छाला							
		पेपर							
		कृषि सम्बन्धि							
		अन्य							
२.	अजैविक (जलाइएको मात्रा)	प्लाष्टिक							
		सिसा							
		रवर							
		धातु र खनिज							
		अन्य							
३.	अन्य (जलाइएको मात्रा)	बिषादी							
		अस्पताल जन्य फोहोर							
		इलेक्ट्रिकल तथा इलेक्ट्रोनिक							
		अन्य रासायनिक फोहोर							
		अन्य							
४.	जम्मा परिमाण (जलाइएको मात्रा)								

तालिका २८: नगरपालिकामा फोहोरको प्रकार र फोहोर निष्काशन गर्ने क्षेत्र अनुसार औसत फोहोर कम्पोस्ट गरिएको मात्रा (खपत तालिका)

सि.नं.	फोहोरको प्रकार	फोहोरको प्रकारको वृस्तित वर्गिकरण	घरधुरीबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	व्यापारिक प्रतिष्ठानबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	औद्योगिक प्रतिष्ठानबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	शिक्षण संस्थाबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	स्वास्थ्य क्षेत्रबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	अन्य क्षेत्रबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	जम्मा परिमाण (के.जी. प्रतिदिन)
१.	जैबिक (कम्पोस्ट गरिएको मात्रा)	कपडाजन्य							
		छाला							
		पेपर							
		कृषि सम्बन्धि							
		अन्य							
२.	अजैबिक (कम्पोस्ट गरिएको मात्रा)	प्लाष्टिक							
		सिसा							
		रवर							
		धातु र खनिज							
		अन्य							
३.	अन्य (कम्पोस्ट गरिएको मात्रा)	बिषादी							
		अस्पताल जन्य फोहोर							
		इलेक्ट्रिकल तथा इलेक्ट्रोनिक							
		अन्य रासायनिक फोहोर							
		अन्य							
४.	जम्मा परिमाण (कम्पोस्ट गरिएको मात्रा)								

तालिका २ज: नगरपालिकामा फोहोरको प्रकार र फोहोर निष्काशन गर्ने क्षेत्र अनुसार औसत फोहोर अन्य तरिकाबाट प्रसोधन गरिएको मात्रा (खपत तालिका)

सि.नं.	फोहोरको प्रकार	फोहोरको प्रकारको वृस्तित वर्गिकरण	घरधुरीबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	व्यापारिक प्रतिष्ठानबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	औद्योगिक प्रतिष्ठानबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	शिक्षण संस्थाबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	स्वास्थ्य क्षेत्रबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	अन्य क्षेत्रबाट उत्पन्न हुने फोहोर (के.जी. प्रतिदिन)	जम्मा परिमाण (के.जी. प्रतिदिन)
१.	जैविक (अन्य तरिकाबाट प्रसोधन गरिएको मात्रा)	कपडाजन्य							
		छाला							
		पेपर							
		कृषि सम्बन्धि							
		अन्य							
२.	अजैविक (अन्य तरिकाबाट प्रसोधन गरिएको मात्रा)	प्लाष्टिक							
		सिसा							
		रवर							
		धातु र खनिज							
		अन्य							
३.	अन्य (अन्य तरिकाबाट प्रसोधन गरिएको मात्रा)	बिषादी							
		अस्पताल जन्य फोहोर							
		इलेक्ट्रिकल तथा इलेक्ट्रोनिक							
		अन्य रासायनिक फोहोर							
		अन्य							
४.	जम्मा परिमाण (अन्य तरिकाबाट प्रसोधन गरिएको मात्रा)								

Annex III
List of Photographs

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Photograph 5. Feedback collection from stakeholders at Pokhara

Photograph 6. Recyclable materials collected from sanitary landfill site of Pokhara Metropolitan City

NOTE

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