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Solid Waste Management in Nepal

Current Status and Policy Recommendations

Asian Development Bank

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Asian Development Bank
6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
Tel +63 2 632 4444
Fax +63 2 636 2444
www.adb.org

For orders, please contact:
Department of External Relations
Fax +63 2 636 2648
adbpub@adb.org

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Foreword

Managing solid waste is one of the major challenges of urbanization. Many urban areas in Nepal face difficulties with the provision of basic services such as water supply, wastewater treatment, and solid waste management. Municipalities are wholly responsible for the collection, transport, treatment, and final disposal of solid waste. Many are not well equipped to do the job. Few have basic data on waste generation and composition. Almost all lack finance and management capabilities to be both effective and efficient in this area.

This publication summarizes the state of solid waste management in 58 municipalities in Nepal. The work is based on baseline surveys undertaken during 2011–2012 under an Asian Development Bank (ADB) capacity development technical assistance. The surveys produced data on household waste generation and composition, and an account of collection and disposal methods. It also touched upon financial and organizational aspects of solid waste management in each of the municipalities. The findings suggest municipalities need to radically improve management practices to reduce, reuse, and recycle waste. They also call for more integrated solid waste management systems. ADB has been financing solid waste management projects along these lines in recent years and expects to see improvement in this area.

This publication is intended to increase awareness about this subject. We hope it will bring to the fore some of the main issues and ideas on how to solve them.

Juan Miranda
Director General
South Asia Department

Acknowledgments

This report was principally developed from the findings of a capacity development technical assistance (TA) to Nepal for Capacity Building for Waste Management. The report was written by Norio Saito, principal urban development specialist, Urban Development and Water Division (SAUW), South Asia Department, Asian Development Bank (ADB), who also supervised the TA. The report builds upon the summary report prepared by D.R. Pathak, who led the baseline survey of solid waste management for all 58 municipalities in Nepal. The study was technically supported by a team of experts, engaged under the TA. The team included P.U. Asnani, team leader; Surya Man Shakya, deputy team leader; and team members Anil Bansal, Rajendra Giri, Pawan Lohani, and Murali Prasad Sharma. Hardy M. Wong and N.B. Mazumdar also made technical contributions.

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Finally, this report has benefited from guidance provided by Fei Yue, director, SAUW, ADB. Laxmi Sharma, senior project officer (infrastructure), Nepal Resident Mission, South Asia Department, ADB, also provided valuable inputs to the TA. The report also benefited from suggestions by Rudolf Frauendorfer, Jingmin Huang, Atsushi Kaneko, and Ron Slangen, who served as peer reviewers in ADB. Elyn Ruth Ravancho, operations assistant, SAUW, provided editorial support to this publication.

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(as of 11 July 2013)

Currency Unit	–	Nepalese rupee/s (NRe/NRs)
NRe1.00	=	$0.010
$1.00	=	NRs96.01

Abbreviations

ADB	–	Asian Development Bank
CBO	–	community-based organization
JICA	–	Japan International Cooperation Agency
KMC	–	Kathmandu Metropolitan City
KPI	–	key performance indicator
MSW	–	municipal solid waste
NGO	–	nongovernment organization
SWM	–	solid waste management
SWMRMC	–	Solid Waste Management and Resource Mobilization Center
SWMTSC	–	Solid Waste Management Technical Support Center
TA	–	technical assistance
TLO	–	tole lane organization

Weights and Measures

g	–	gram
L	–	liter
kg	–	kilogram
km^2	–	square kilometer
m^3	–	cubic meter

Glossary

Local bodies – municipalities and village development committees, the smallest unit of local government

Municipal solid waste – Waste from households, commercial and institutional establishments, parks and gardens, street sweepings, and treated hospital waste

Terai – Southern plain land in the country

Tole lane organization – Community groups formulated to work for local development and poverty alleviation at the grassroots level

NOTES

(i) The fiscal year (FY) of the Government of Nepal ends on 15 July. FY before a calendar year denotes the year in which the fiscal year ends, e.g., FY2012 ends on 15 July 2012.

(ii) In this report, "$" refers to US dollars.

Executive Summary

Rapid and uncontrolled urbanization, lack of public awareness, and poor management by municipalities have intensified environmental problems in towns in Nepal, including unsanitary waste management and disposal. While solid waste management (SWM) has become a major concern for municipalities and the country as a whole, the status of SWM is not fully understood due to the lack of SWM baseline data, which are also essential for effective planning.

Rapid and uncontrolled urbanization, lack of public awareness, and poor management by municipalities have intensified environmental problems in towns in Nepal, including unsanitary waste management and disposal

The main objective of the SWM baseline survey was to derive systematic and comprehensive data and information on SWM, including the quantity and composition of municipal solid waste (MSW) and other factual information on the state of SWM in all 58 municipalities of Nepal. The survey was conducted in April and May 2012 during the dry season. Based on the baseline survey, improvements for policy and management are assessed.

The household survey revealed an average per capita household waste generation rate of 170 grams (g)/capita/day. The study also uncovered that the household waste generation rates vary with the economic status and climatic conditions. On average, households with monthly expenditures of NRs40,000 ($417) and above generate more than twice as much waste as households with monthly expenditures of less than NRs5,000 ($52). Households in Terai municipalities generate nearly 80% more waste than those in mountain region municipalities. For institutional establishments, the average daily waste generation was 4.0 kilograms (kg) per school and 1.4 kg per office. Similarly, the average daily waste generation of commercial establishments was 1.4 kg per shop and 5.7 kg per hotel or restaurant.

Based on the analysis and findings, it is estimated that waste from households in general contributes about 50%–75% of the total MSW generated. Thus, the average MSW generation was found to be 317 g/capita/day. Using these per capita waste generation rates and the population in 2011, the total MSW generation of the 58 municipalities was estimated at about 1,435 tons/day and 524,000 tons/year.

The analysis of household waste composition indicated that the highest waste category was organic waste with 66%, followed by plastics with 12%, and paper and paper products with 9%. The composition analysis of institutional wastes revealed 45% paper and paper products, 22% organic wastes, and 21% plastics. The study found that commercial wastes comprised 43% organic wastes, 23% paper and paper products, and 22% plastics. In aggregate, MSW is composed of 56% organic waste, 16% plastics, and 16% paper and paper products. This indicates great potential for producing compost from organic waste, and reusing and recycling other materials, with only about 10% going to final disposal if resource recovery is maximized.

The study uncovered that about 30% of surveyed households in the municipalities were practicing segregation of waste at source and composting using traditional methods. Such practices were found mainly in the rural areas of municipalities. Besides household composting, community or municipal composting plants are found in some municipalities and more are being planned. An analysis of the information provided by municipalities reveals that the present collection efficiency ranges between 70% and 90% in major towns, and is below 50% in several smaller towns, giving an average of 62%. Only 6 municipalities use sanitary landfill sites for final disposal, and 45 are practicing open dumping, including riverside and roadside

dumping. In total, 37% of MSW in Nepal is disposed of in sanitary landfills, although not necessarily in a sanitary manner.

While the majority of the municipalities have a separate section or unit responsible for SWM, 17 municipalities do not have a designated section or unit. These municipalities are either not providing any SWM services or have only a few sweepers who work under the ward offices or another unit. Of the total budget, the municipalities spend an average of 10% for SWM, of which 60%–70% is used for street sweeping and collection, 20%–30% on transport, and any remaining small amount for final disposal. On average, municipalities spend about NRs2,840 ($30) per ton of waste for collection, transport, and disposal. In terms of revenue collection, some municipalities collect a SWM service fee, a door-to-door collection service fee, a surcharge on property or business tax, and a service fee from major waste generators. However, sample surveys of nine relatively large municipalities found that the SWM charge is only about 2% of the municipal own source revenue and 5% of SWM expenditures.

The data on waste quantity and composition are generally comparable with neighboring countries in South Asia and countries with a similar level of economic development. The relatively high ratio of recyclable materials, including plastics and paper, indicates a large potential for reuse and resource recovery, in addition to the potential for organic waste composting.

The survey and other assessment undertaken under the technical assistance identified eight key policy recommendations for SWM in Nepal. First, an appropriate policy and strategic framework needs to be developed, together with technical guidelines on key issues such as organic composting and landfill operations, to properly guide local bodies in effective SWM. Second, reduce, reuse, and recycle (3R) should be promoted. The survey identified great potential for resource recovery in Nepal, which could be realized with better public awareness and initiatives by local bodies and communities. Third, strengthening the capacity of local bodies is essential, as they are mandated to provide SWM services to the citizens. Fourth, enhancement of public participation and consultation would be effective in advancing SWM practices. Fifth, costs for SWM need to be recovered, albeit partially at first, to provide better services. The public is generally willing to pay for services if the level of services is improved. Sixth, current poor management practices such as open dumping and open burning should be stopped immediately to allow for more integrated SWM. Seventh, public–private partnership offers opportunities for operational efficiency and cost effectiveness. The role of the private sector will be more important for complex tasks such as the operation of landfill sites, as municipalities are less experienced in these areas. Lastly, the management, updating, and dissemination of basic data will play an important role in improving planning by the local bodies and monitoring implementation progress.

I. Introduction

A. Background

Solid waste management (SWM) is one of the major environmental issues in cities of many developing countries, including Nepal. Urban population growth and economic development lead to increasing generation of municipal solid waste (MSW). The use of products that generate hazardous waste is another concern. Unmanaged disposal of medical wastes from hospitals and clinics also contribute to pollution and public health hazards in the localities. Therefore, SWM has become a major concern for the municipalities of Nepal.

The Government of Nepal enacted the Solid Waste Management Act of 2011 effective from 15 June 2011. The objectives of the act include maintaining a clean and healthy environment by minimizing the adverse effects of solid waste on public health and the environment. The local bodies, such as municipalities, have been made responsible for the construction, operation, and management of infrastructure for collection, treatment, and final disposal of MSW. The act mandates local bodies to take the necessary steps to promote reduce, reuse, and recycle (3R), including segregation of MSW at source. It also provides for the involvement of the private sector, community-based organizations (CBOs), and nongovernment organizations (NGOs) in SWM through competitive bidding. Procedures for bidding, selection of the successful bidder, and authority of the bidder in collecting tipping fees (tariffs) against SWM services are provided. In addition, the act authorizes the imposition and collection of service fees against SWM services, and prescribes the basis for fixing such fees and procedures for their collection and usage. It also authorizes the local bodies to formulate rules, by-laws, and guidelines, with the approval of the municipal board. As provisioned in the act, the SWM Technical Support Center (SWMTSC) under the Ministry of Urban Development shall provide technical support to all local bodies for effective and sustainable SWM and advance research and development in this sector.

Managing solid waste has been accorded a low priority mainly because the demand is higher for other public services in many municipalities in Nepal

Managing solid waste has been accorded a low priority mainly because the demand is higher for other public services in many municipalities in Nepal. Local bodies are experiencing difficulties in developing management plans due to the lack of SWM baseline information and data related to the functional elements of SWM. It is essential to know the quantity and composition of MSW when designing and implementing proper waste management plans that include resource recovery through appropriate methods.

Previous studies have been conducted to collect SWM baseline information, but most of these were limited to municipalities in the Kathmandu Valley.[1] A nationwide SWM baseline study of all 58 municipalities in Nepal was carried out by the SWM and Resource Mobilization Center

[1] Dangi, M.B., Pretz, C.R., Urynowicz, M.A, Gerow, K.G., and Reddy, J.M. 2011. Municipal Solid Waste Generation in Kathmandu, Nepal. *Journal of Environmental Management*. 92. pp. 240–249; Dangi, M.B., Cohen, R.R.H., Urynowicz, M.A., and Poudyal, K.N. 2009. Searching for a Way to Sustainability: Technical and Policy Analyses of Solid Waste Issues in Kathmandu. *Waste Management and Research*. 27. pp. 295–301; Japan International Cooperation Agency. 2005. *The Study on the Solid Waste Management for the Kathmandu Valley, Final Report: Main Report (1)*. Kathmandu; Manandhar, R. Basic Fact Sheet of Solid Waste Management of Kathmandu Metropolitan City. Unpublished.

(SWMRMC, which has been renamed the SWMTSC) in 2003.[2] This was the first attempt to collect SWM baseline information at the national level. The SWMRMC and others made efforts to update these data, but due to the lack of consistent scientific methods and the different assumptions made to quantify the waste generated from different sources, the findings of these waste quantity and quality studies were inconsistent.[3]

This baseline survey, undertaken as an activity under the technical assistance (TA),[4] intended to derive systematic and comprehensive data and information on SWM, including the quantity and composition of MSW and other factual information on the state of SWM in all 58 municipalities of Nepal. Based on the survey and other assessments undertaken under the TA, key policy recommendations have been identified. The details of survey findings in each municipality are compiled into survey reports for each municipality, which are available on the website of the Asian Development Bank (ADB).[5]

Poor waste management is a major concern in many municipalities in Nepal.
Source: Asian Development Bank.

B. Geographical Distribution of Municipalities

The geographical distribution of the 58 municipalities by development region and ecological zone is in Figure 1 and Table 1. The municipalities are concentrated in eastern and central development regions in the Terai. Of the 58 municipalities, 31 are located in the Terai, whereas 25 municipalities lie in the hilly region and only 2 are in the mountain region.

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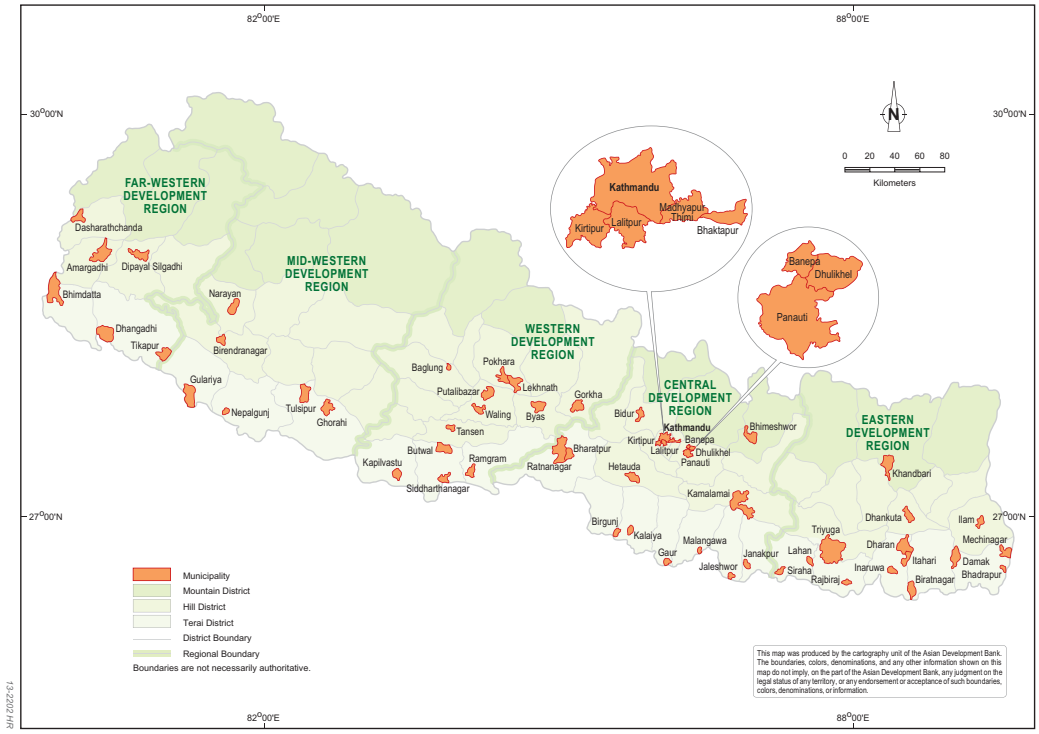
2 SWMRMC. 2004. *A Diagnostic Report on the State of Solid Waste Management in Municipalities of Nepal*. Pulchowk, Nepal.

3 Manandhar, R. 2009. *Situation Assessment of SWM at Municipalities in Eastern Regions. Project Report*, SEAM-N, Nepal.

4 ADB. 2010. *Technical Assistance to Nepal for Capacity Building for Waste Management*. Manila. The main outputs of the TA are outlined in Appendix 1.

5 ADB. Capacity Building for Waste Management: Status of Solid Waste Management in 58 Municipalities of Nepal. www.adb.org/projects/documents/capacity-building-waste-management-status-swm-58-municipalities-nepal-tacr

Figure 1: **Location of the 58 Municipalities**



Source: Asian Development Bank.

Physical factors, such as altitude, temperature, rainfall, and humidity, as well as socioeconomic factors, such as population, economic status, and consumption patterns, vary from one region to another. These factors influence the characteristics of the waste generated as well as the technologies used for waste treatment and final disposal.

C. Land Use Pattern

The municipalities cover about 2.3% of the total area of the country. The smallest municipality in terms of area coverage is Banepa with an area of 5.6 square kilometers (km^2), and the largest one is Triyuga with an area of 319.9 km^2 (Appendix 2). The largest built-up area is 36.5 km^2 in Kathmandu Metropolitan City (KMC). The land use pattern is an important factor in SWM as the solid waste generated in rural areas is normally managed locally.

D. Urban–Rural Setting

For the purpose of the SWM baseline survey, the area of each municipality was categorized into urban and rural wards. A ward is the smallest administrative unit of each municipality. Urban wards are areas with higher population densities and intense commercial and industrial

Physical factors, such as altitude, temperature, rainfall, and humidity, as well as socioeconomic factors, such as population, economic status, and consumption patterns influence the characteristics of the waste generated as well as the technologies used for waste treatment and final disposal

Table 1: **Geographical Distribution of the 58 Municipalities**

Development Region	Ecological Region	Municipality	Number of Municipalities
Eastern Development Region	Mountain	Khandbari	1
	Hill	Ilam, Dhankuta, Triyuga	3
	Terai	Damak, Inaruwa, Bhadrapur, Itahari, Siraha, Biratnagar, Rajbiraj, Lahan, Dharan, Mechinagar	10
Central Development Region	Mountain	Bhimeshwor	1
	Hill	Panauti, Kirtipur, Madhyapur Thimi, Bidur, Banepa, Dhulikhel, Kathmandu, Bhaktapur, Lalitpur	9
	Terai	Malangawa, Bharatpur, Hetauda, Janakpur, Gaur, Ratnanagar, Birgunj, Kalaiya, Jaleshwor, Kamalamai	10
Western Development Region	Hill	Putalibazar, Lekhnath, Gorkha, Byas, Waling, Pokhara, Tansen, Baglung	8
	Terai	Butwal, Kapilvastu, Ramgram, Siddharthanagar	4
Mid-western Development Region	Hill	Birendranagar, Narayan	2
	Terai	Gulariya, Nepalgunj, Tulsipur, Ghorahi	4
Far-western Development Region	Hill	Amargadhi, Dasharathchanda, Dipayal Silgadhi	3
	Terai	Bhimdatta, Dhangadhi, Tikapur	3
Total	**Mountain**		**2**
	Hill		**25**
	Terai		**31**

Source: Asian Development Bank.

activities.[6] Rural wards are areas with lower population densities and no commercial activities. Of the 58 municipalities, only a few municipalities, such as those in the Kathmandu Valley and Biratnagar, have no rural wards, whereas in Bhimdutta 17 of the 19 wards are rural. Similarly, many other municipalities, including Kamalamai, Kapilvastu, Triyuga, Dasharathchanda, Gulariya, and Khandbari, are dominated by rural wards.

In this study, wards were chosen from both urban and rural settings in the municipalities for the waste generation and composition study, which resulted in a more comprehensive and representative average per capita waste generation rate in each municipality.

E. Demographic Information

Nepal has 58 municipalities with a total population of 4.5 million that accounts for 17% of the total population in the country. Among the municipalities, KMC's population of 1,003,285 is the largest, followed by Pokhara, Lalitpur, and Biratnagar submetropolitan cities. Dhulikhel's

[6] No specific value has been assigned to categorize a setting as urban or rural. It is based on professional judgment in consultation with municipalities.

population of 16,263 is the smallest among the municipalities.[7] The municipalities can be classified into four groups as summarized in Table 2.

Table 2: **Classification of Municipalities based on Population**

Population Range	No. of Municipalities	Total Population
>=100,000	10	2,438,408
50,000–100,000	17	1,182,522
25,000–50,000	21	689,696
<=25,000	10	213,194
Total	**58**	**4,523,820**

> = more than, < = less than.

Source: Government of Nepal, National Planning Commission Secretariat, Central Bureau of Statistics. 2012. National Population and Housing Census 2011. Kathmandu, Nepal.

The top 10 cities of Biratnagar, Birgunj, Bharatpur, Bhimdutta, Butwal, Dhangadhi, Dharan, KMC, Lalitpur, and Pokhara, with populations above 100,000, account for more than 50% of the total population of the municipalities. The population of each municipality is given in Appendix 2.

F. Objectives of the Study

The main objectives of this study are to determine the MSW generation and its composition in the municipalities of Nepal, and to present the status, practices, and issues of SWM in municipalities in the country.

The specific objectives of the study are to

- determine the per capita household waste generation and composition of household waste;
- estimate the quantity and composition of institutional and commercial wastes;
- estimate the average per capita MSW generation and its total quantity;
- determine the current practices of municipal SWM in the 58 municipalities in terms of segregation, collection, treatment, and final disposal;
- assess the level of services and allocation of financial and human resources in SWM; and
- identify key policy challenges and recommendations for improving municipal SWM in Nepal.

G. Scope of the Study

The survey mainly consisted of three parts: (i) a sample survey of households to measure the quantity and composition of household waste; (ii) a sample survey of institutional and commercial establishments to measure the quantity and composition of wastes from these establishments; and (iii) a survey of the existing SWM system and financial, organizational,

[7] Government of Nepal, National Planning Commission Secretariat, Central Bureau of Statistics. 2012. *National Population and Housing Census 2011*. Kathmandu, Nepal.

and institutional aspects of SWM through interviews with municipal staff and households. The survey covered all 58 municipalities with a sample size of 3,233 households, 627 institutions (schools and offices), and 627 commercial establishments (shops, hotels, and restaurants). Other potential sources of waste generation, such as industries and health institutions, were not covered. Methodologies for sampling and field work are in Appendix 3. The solid waste composition survey classified the waste into the following eight categories:

- Organic waste
- Plastics
- Paper and paper products
- Textile
- Rubber and leather
- Metals
- Glass
- Others (inert materials, etc.)

H. Study Limitations

Although the study covered MSW quantity and quality, including commercial and institutional wastes, waste generated from parks and gardens, street sweeping, and treated hospital waste, which fall under MSW, were not accounted for. Moreover, industrial and hospital wastes were not considered although they go to the MSW stream with partial or no treatment in many municipalities of Nepal.

The small sample size and one-time sampling of waste generation may provide an inaccurate average value. The estimation of the total quantity of commercial and institutional wastes was a particular challenge because the number and size of commercial and institutional establishments was not complete or updated. Therefore, the average MSW generation in each municipality was calculated from the household waste generation using professional judgment based on the characteristics of each municipality.

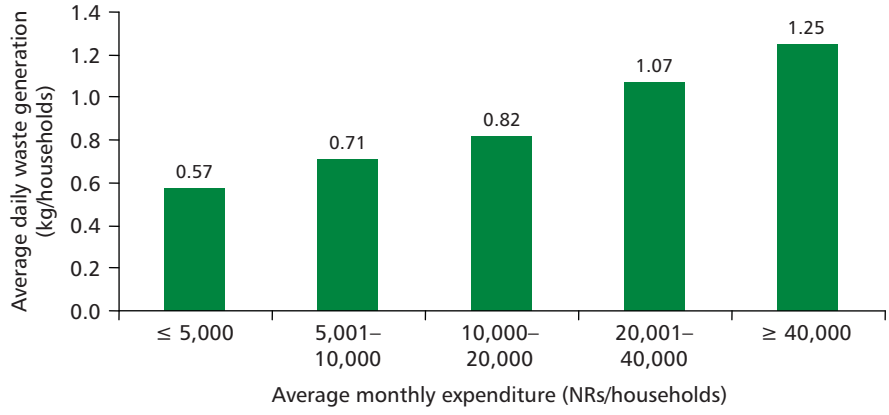
II. Municipal Solid Waste Generation and Composition

A. Household Waste Generation

The per capita waste generation of each household was calculated by dividing the total waste produced by the number of people living in that household on that day. The total sample size of 3,233 households from 58 municipalities, varying from a minimum of 50 households to a maximum of 220 households, gave an average household waste generation figure of 170 g/capita/day. This study also showed that the household waste generation rates varied depending on economic status. Households with monthly expenditures of NRs40,000 ($417) and above generate 1.25 kilograms (kg)/household/day on average, which is more than twice as much as the 0.57 kg/household/day generated by households with monthly expenditures of less than NRs5,000 ($52) (Figure 2).

Waste generation rates could vary depending on the season, month, and day of the week.[8] However, the Japan International Cooperation Agency[9] did not find conventional season-specific impacts on household waste generation in KMC. Instead, they found 223 g/capita/day with 248 g/liter (L) of bulk density among 40 households examined in April 2004 (dry season) and 248 g/capita/day with a bulk density of 174 g/L for 400 households studied in September 2004 (wet season). They also found similar amounts of waste generation by households sampled during weekdays and weekends. Similarly, Dangi et al. (2009)[10] also found that the daily average household waste generation in 200 households in KMC did not vary much during a 14-day study conducted in December 2005. However, it should be noted

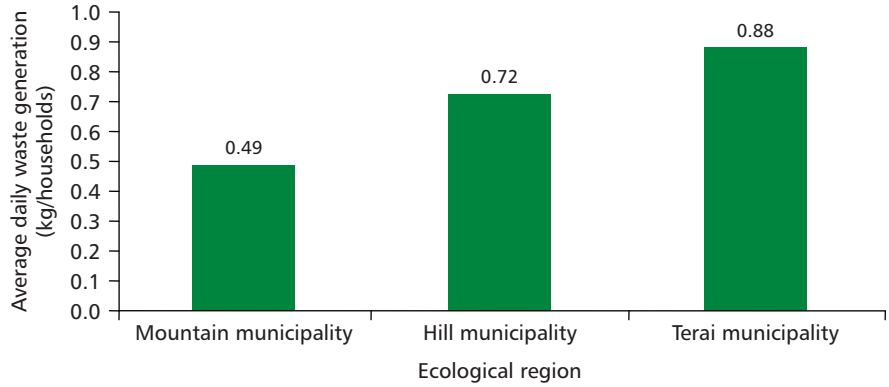
Figure 2: **Average Household Waste Generation by Monthly Expenditure Level**



> = more than, < = less than, kg = kilogram.
Source: Asian Development Bank.

[8] Tchobanoglous, G., Theisen, H., and Vigil, S. 1993. *Integrated Solid Waste Management*. McGraw-Hill, New York; Vesilind, P.A., Worrell, W., and Reinhart, D. 2002. Solid Waste Engineering. Books/Cole Thomson Learning, Pacific Grove, CA.
[9] Footnote 1.
[10] Footnote 1.

Figure 3: **Average Household Waste Generation Pattern in Different Ecological Regions**



kg = kilogram.
Source: Asian Development Bank.

that different ecological regions record different average household waste generation rates (Figure 3). Terai municipalities generate the largest amount of per capita daily waste.

The per capita household waste generation rate was found to vary from a minimum value of 75 g/capita/day (Triyuga) to a maximum value of 278 g/capita/day (Inaruwa). Households surveyed in some municipalities, especially from the rural wards, were found to use most of the organic waste for feeding their cattle, resulting in a lower rate of waste generation than the average. Higher per capita waste generation was observed in municipalities such as Banepa, Bharatpur, KMC, and Pokhara, because fast urban growth and economic development in these cities have accelerated consumption rates, leading to higher rates of waste generation. However, in a few municipalities that have lower urban growth and economic development, especially located in the Terai area, such as Inaruwa, Lahan, Kalaiya, Malangawa, and Rajbiraj, most of the households surveyed were found to generate much more waste than average. A lack of basic knowledge of SWM and poor sanitation in the densely populated areas of these municipalities might account for the greater amount of waste. The per capita household waste generation in each municipality is detailed in Appendix 4.

B. Institutional and Commercial Waste Generation

The total sample size of 330 schools or colleges and 297 different types of offices from the 58 municipalities gave an average daily waste generation rate of 4.0 kg per school and 1.4 kg per office. A survey of 627 shops, hotels, and restaurants, yielded an average waste generation rate for commercial establishments of 1.4 kg per shop and 5.7 kg per hotel or restaurant. However, information such as the number of schools and offices provided by many municipalities and other agencies was not complete or up-to-date, making it difficult to estimate the exact amount of institutional and commercial waste generation. Moreover, as the survey was conducted in schools during the admission period, the schools and colleges were not running at full capacity, which might have resulted in low levels of waste generation. Nevertheless, this was the first attempt to conduct a nationwide study to quantify the waste generated by institutions and commercial establishments along with households in all the municipalities in Nepal.

C. Municipal Solid Waste Generation

1. Estimates

In addition to the household, institutional, and commercial waste described, other waste generated from different sources are to be added to the total amount of MSW, such as street wastes (waste littering the streets), waste from parks and gardens, and the waste brought from the surrounding village development committees. However, the survey for estimating the amount of these wastes was not conducted. Therefore, in estimating the total MSW generation, professional judgment based on the findings and field observations was used: It is estimated that household waste in general contributes to about 50%–75% of the total MSW generated. In municipalities with a large daytime influx of population due to economic and commercial activities or with major tourist destinations, household waste contributes to a smaller degree, whereas household waste is a major fraction of MSW in the municipalities dominated by rural areas. Further notes on the calculation of per capita MSW generation in each municipality are in Appendix 4. From the survey results, the average MSW generation can be estimated at 317 g/capita/day. Based on these per capita MSW generation figures and the population in 2011, the total MSW generation of the 58 municipalities is estimated at about 1,435 tons/day or 524,000 tons/year. Although it is lower than that reported in other studies, such as those of the SWMRMC,[11] the 170 g/capita/day from households and 317 g/capita/day rate calculated by this study appears to be reasonable. For example, this study revealed a household waste generation rate for KMC of 232 g/capita/day, which is similar to the data presented by JICA (2005).[12] Data from the 440 households in KMC that took part in the JICA study yielded an average generation rate of 240 g/capita/day. In their frequency plot, most sampled households generated 100–150 g/capita/day, which is in general agreement with the results of this survey.

The lower generation rate estimated by this study may be due to the way households were selected. Previous project-specific studies held in municipalities usually relied on questionnaires instead of physical site sampling, which led to elevated per capita household waste generation rates. Most of the previous studies were limited to only the core urban areas of the municipality instead of covering urban, semi-urban, and rural wards of municipalities proportionately. Considering only households from core urban areas would give higher per capita waste generation rates. In this study, the wards were chosen based on urban–rural settings, population density, and economic status in each municipality and the representative households were selected randomly.

In municipalities with a large daytime influx of population due to economic and commercial activities or with major tourist destinations, household waste contributes to a smaller degree, whereas household waste is a major fraction of municipal solid waste in the municipalities dominated by rural areas

D. Municipal Solid Waste Composition

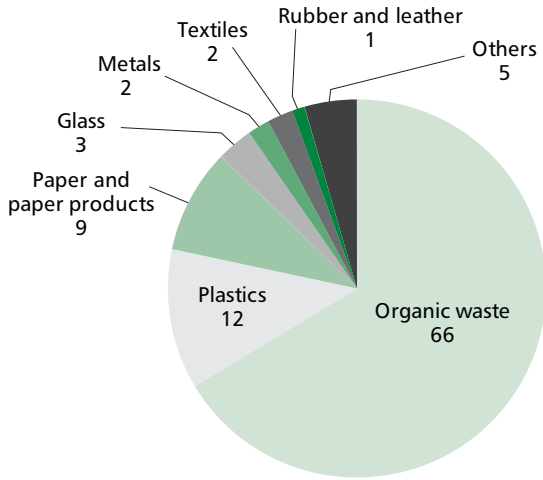
The characteristics of MSW collected from any area depend on various factors such as consumer patterns, food habits, the cultural traditions of inhabitants, lifestyles, climate, and economic status. The composition of MSW is changing with increasing use of packaging materials and plastics.

1. Household Waste Composition

The average composition of household waste of the 58 municipalities in the eight major waste categories is shown in Figure 4.

[11] SWMRMC. 2008. Baseline Study on Solid Waste Management in Municipalities of Nepal. Pulchowk, Nepal; (footnote 2).
[12] Footnote 1.

Figure 4: **Composition of Household Waste in the 58 Municipalities** (%)



Source: Asian Development Bank.

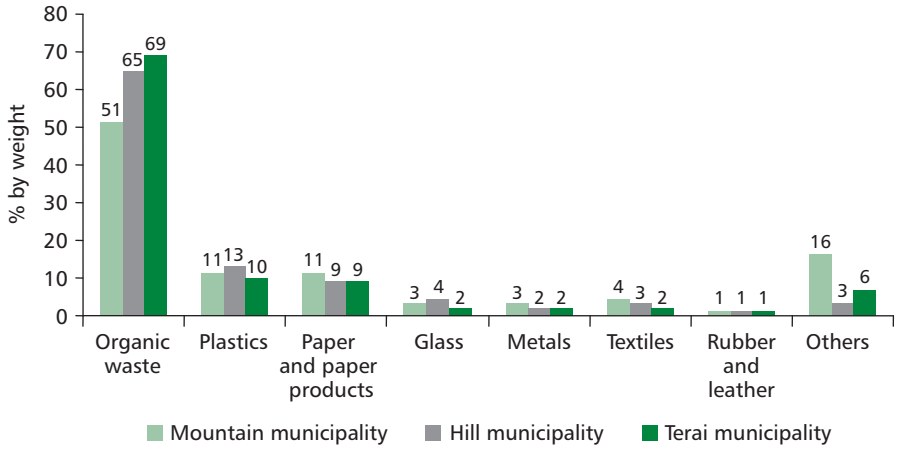
The waste composition analysis indicates that the highest waste fraction is organic matter (66%), followed by plastics (12%), paper and paper products (9%), others (5%), and glass (3%). Metal, textiles, and rubber and leather each accounted for 2% or less. The high organic content indicates a need for frequent collection and removal, as well as good prospects for organic waste resource recovery. The content of major reusable and recyclable materials (i.e., plastic, paper and paper products, metal, glass, rubber and leather, and textiles) comprised 29% on average.

It is also noteworthy that the composition of household waste varied greatly among different geographical locations. Figure 5 compares the average household waste composition of municipalities in different ecological regions: mountain, hill, and Terai. The organic fraction was higher in the Terai municipalities than in the mountain and hill regions.

The composition of household waste in each municipality is summarized in Appendix 5. The proportion of organic materials varies from 36% (Dasharathchanda) to 86% (Tulsipur). The content on major reusable or recyclable materials (i.e., metal, paper, glass, and plastics) varies from 5% (Gaur) to 51% (Baglung). Plastic waste, which is creating a major waste disposal problem in almost all municipalities, varies from 3% (Gaur) to 24% (Baglung). These figures indicate that if all compostable and reusable or recyclable wastes were utilized to the maximum, less than 10% of the waste would have to be disposed of at landfill sites in more than 40 municipalities. Even inert and residue fractions could be used for purposes such as making low-strength bricks or paving blocks.

Overall, the average composition of household waste was in line with other studies conducted in the 58 municipalities and municipalities in the Kathmandu Valley. The SWMRMC (footnote 2) reported the average composition of household waste as comprising 65% organic matter, 9% paper and paper products, and 8% plastics, which is very similar to the findings of this study.

Figure 5: **Composition of Household Wastes in Different Ecological Regions** (%)



Source: Asian Development Bank.

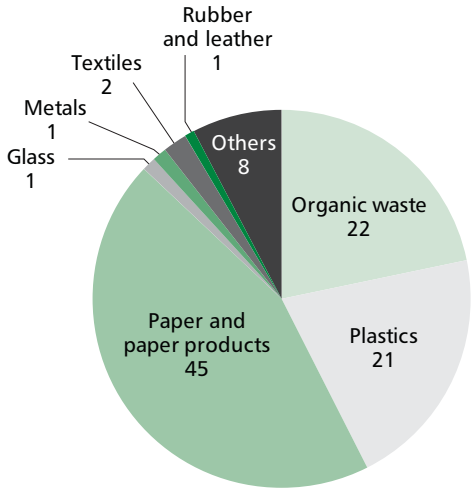
2 . Institutional Waste Composition

Waste generated from offices, schools, and colleges were categorized as institutional waste. The composition analysis revealed 45% paper and paper products, 22% organic wastes, 21% plastics, and 8% others. Glass, textiles, metals, and rubber and leather each made up 2% or less (Figure 6).

Waste generated from offices, schools, and colleges were categorized as institutional waste

The higher fraction of paper and paper products and plastics came from students' snack boxes and discarded white paper. A relatively low level of organic waste is generated in schools because little fresh food is handled. The other constituents were dust, mud, and broken bricks.

Figure 6: **Composition of Institutional Waste in the 58 Municipalities** (%)



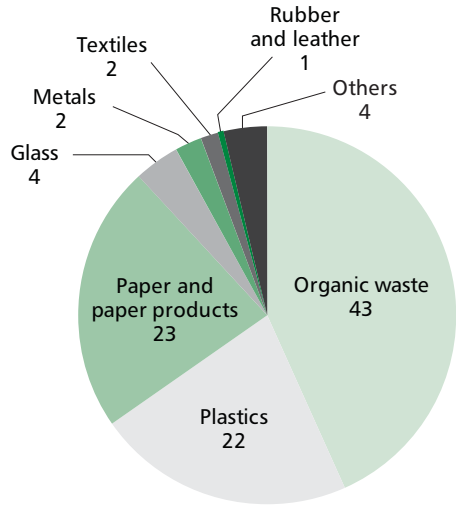
Source: Asian Development Bank.

The composition of institutional waste in each municipality is summarized in Appendix 6. The table indicates that in all the municipalities, the dominant fraction of institutional waste is paper and paper products. It varies from 16% (Ilam) to 83% (Kapilvastu). The organic fraction ranges from 0% (Kapilvastu) to 60% (Ilam), whereas plastics vary from 4% (Inaruwa) to 36% (Jaleshwor).

3. Commercial Waste Composition

The composition of waste from commercial establishments such as shops, hotels, and restaurants is in Figure 7. The average composition of commercial waste comprises 43% organic wastes, 23% paper and paper products, 22% plastics, 4% glass, and 4% others, with the rest accounting for 2% or less each.

Figure 7: **Composition of Commercial Waste in the 58 Municipalities** (%)



Source: Asian Development Bank.

The composition of the commercial waste of each municipality is summarized in Appendix 7. The table illustrates that the organic fraction of commercial waste varies from 18% (Gulariya) to 67% (Dhulikhel). Plastics vary from 6% (Birendranagar) to 62% (Bhadrapur). Paper and paper products were lowest in Kritipur (5%) and highest in Dasharathchanda (35%).

A higher percentage of plastics was generally found in waste from shops, while the organic fraction was observed to be higher in hotels and restaurants. More glass was found in commercial waste than in household and institutional waste, indicating the presence of beer and wine bottles discarded by hotel guests.

4. Overall Municipal Solid Waste Composition

When all three major sources of waste are combined, the average composition of MSW is as follows: organic waste 56%, plastics 16%, paper and paper products 16%, glass 3%, metals 2%, textiles 2%, rubber and leather 1%, and others 4%.

III. Existing Solid Waste Management System

A. Collection and Segregation

The study found that about 30% of surveyed households in the municipalities practice segregation of waste at source; which means that waste generated from about 70% of households in municipalities goes to the stream for collection and disposal by the municipalities in the form of mixed waste. The households surveyed in some of the municipalities, especially from the rural wards, were found to segregate kitchen waste for their own purposes, such as feeding cattle. Even though 21 municipalities have conducted some activities to promote waste segregation at source in recent years, effective and large-scale segregation programs are yet to be implemented by most municipalities. It was also reported that waste segregated at source is sometimes mixed again during collection and transport due to the lack of separate collection and treatment methods.

Analyzing the information provided by the municipalities, the present collection efficiency ranges between 70% and 90% in major towns and is below 50% in several smaller municipalities (Appendix 4). On average, the collection efficiency among the municipalities that have estimates is 62%. However, this may be overestimated by the municipalities due to the lack of scientific recording systems. Citizens dispose of waste within their compound either by unscientific composting, open burning, or throwing the waste in the surrounding open space. Collection, city cleaning, and sweeping is not done on a daily basis except in main markets, along main roads, and in some residential areas. The rest of the areas are served intermittently from twice a week to twice a month, or are not served at all. Many areas are

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Roadside waste piles are a public nuisance and health risk.
Source: Asian Development Bank.

neglected due to the inefficiency and inadequacy of the service. Container service, door-to-door collection, and roadside pickup from open piles or containers are the types of collection service generally practiced in municipalities, as listed in Appendix 8. While door-to-door collection is practiced by 24 municipalities, roadside pickup from open piles is still a prevailing practice, with 49 municipalities continuing this collection method.

B. Transport and Final Disposal

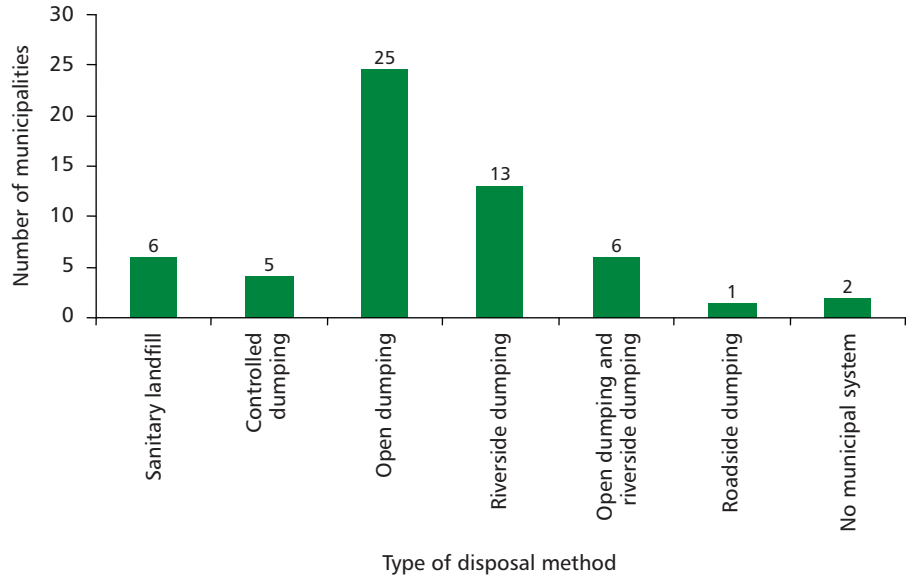
Open dumping, including riverside and roadside dumping, is practiced by as many as 45 of the 58 municipalities

The vehicles and equipment available for waste collection and transport in each municipality varies widely. Vehicles commonly used include rickshaws and carts for primary collection, tractors for secondary collection or transport, and dump trucks for transport to the disposal sites. Not all municipalities have all three types of vehicles. Facilities and equipment available in municipalities affect the efficiency of waste transfer from primary collection to processing centers or final disposal sites. Transfer operations become a necessity when haul distances to available disposal sites or processing centers increase to the point that direct hauling is no longer economically efficient. Transfer sites are not available in major municipalities except KMC, Lalitpur, and Madhyapur Thimi. This may be due to the shorter distances to the disposal sites from town centers in other municipalities.

Sites for treatment facilities and sanitary landfill are yet to be identified by many municipalities and waste is currently being disposed of without treatment in crude dumping sites, creating public health risks and environmental problems. Figure 8 shows the existing final waste disposal methods practiced in the 58 municipalities. Open dumping, including riverside and roadside dumping, is practiced by as many as 45 of the 58 municipalities. Only six municipalities—KMC,

Waste piled at Teku transfer station, Kathmandu.
Source: Asian Development Bank.

Figure 8: **Types of Solid Waste Disposal Method in Municipalities of Nepal**



Source: Asian Development Bank.

Lalitpur, Pokhara, Ghorahi, Dhankuta, and Tansen—have constructed sanitary landfill sites.[13] The proportion of MSW disposed of at sanitary landfills amounts to 37% of the total, as three largest generators of MSW—KMC, Pokhara, and Lalitpur—all have sanitary landfills. However, KMC and Lalitpur are facing the problems including frequent local protests, lack of proper management, and unavailability of necessary equipment, leading to unsanitary methods of disposal. While many municipalities have started to plan for a designated landfill site (whether sanitary or not), 14 municipalities still have no such plan.[14] The current final disposal method and planning for landfill sites are in Appendix 8.

The problems faced by the municipalities at present include waiting for the government's decision and approval for land acquisition of proposed landfill sites, lack of technical support, financial constraints, problems in area selection, and strong opposition from nearby communities. Political interference has also been observed in many municipalities as well as technical problems such as flooding, shallow water table, highly permeable soil, and slope instability.

The problems faced by the municipalities at present include waiting for the government's decision and approval for land acquisition of proposed landfill sites, lack of technical support, financial constraints, problems in area selection, and strong opposition from nearby communities

[13] Tansen municipality started to operate a sanitary landfill site in October 2012 after construction of an access road. For Kathmandu and Lalitpur, a sanitary landfill site at Sisdol, Okharpauwa was constructed with grant funding from the Government of Japan and operated as a sanitary landfill site in the early stage of operation, although currently it is not operated as a sanitary landfill site. The sanitary landfill in Pokhara was financed by ADB. Landfills in Dhankuta, Ghorahi, and Tansen were financed by the municipalities, with technical support from the SWMTSC.

[14] ADB is financing the construction of sanitary landfills through two ongoing projects as part of the overall improvement of SWM in five secondary towns: Birgunj, Butwal, Janakpur, Nepalgunj, and Siddharthanagar. ADB. 2010. *Report and Recommendation of the President to the Board of Directors: Proposed Loan and Administration of Loan to Nepal for the Secondary Towns Integrated Urban Environmental Improvement Project*. Manila; ADB. 2012. *Report and Recommendation of the President to the Board of Directors: Proposed Loan and Grant to Nepal for the Integrated Urban Development Project*. Manila.

Unsanitary disposal at a final disposal site.
Source: Asian Development Bank.

C. Resource Recovery Methods

Tight municipal budgets and scarce resources have made municipal SWM an environmental, financial, and social burden to the municipalities. Although resource recovery from managing MSW has the potential to reduce such burdens and even generate revenue, this study found that minimal resource recovery activities are being conducted in the municipalities of Nepal.

1. Recycling

The household waste composition survey revealed that more than 25% of household waste and a much higher proportion of institutional and commercial waste could be either reused or recycled, excluding organic waste. However, no formal system was observed for reuse and recycling in most municipalities. While it is encouraging to note that people recover recyclable materials at source and sell them to the formal or informal sectors, a large amount of recyclable material continues to be disposed of on the streets and ends up at the dumping grounds. The survey found that 32 municipalities have waste minimization programs, such as reuse and recycling activities via small entrepreneurs in the formal and informal sectors. Of these, 27 municipalities have information about the scrap dealers and workers who collect or buy the recyclable and reusable products from the MSW stream.

2. Composting

Organic materials that could be used for producing compost account for 66% of household waste on average. It was noted that about 30% of surveyed households in the municipalities are practicing composting. Most of them are in the rural areas of the municipalities and manage their household waste using traditional composting methods. However, urban households are not generally practicing composting. Some municipalities have or plan to set up community or

Resource recovery by the informal sector at a landfill site.
Source: Asian Development Bank.

municipal composting plants (Appendix 8). Composting not only provides fertilizer to farmers who otherwise have to buy chemical fertilizer at a very high price, but also reduces the volume of the solid waste stream to be handled and disposed of at final disposal sites.

D. Public Awareness and Community Mobilization

Lack of public awareness is one of the major problems of SWM. Based on the survey data, only 37 municipalities have awareness programs for SWM staff, only 10% of them conduct them on a regular basis, and more than 65% seldom conduct them. Several municipalities collaborate with other stakeholders such as the SWMTSC, NGOs, and CBOs to undertake public campaigns. Moreover, 33% of the municipalities have conducted SWM awareness and promotion of 3R activities in collaboration with educational institutions. In contrast, the survey revealed that more than 65% households are not aware of the SWM program implemented by their municipalities during the last 3 years, and less than 18% of households have participated in these programs.

E. Special Waste Management

Special waste includes categories of waste such as dead animals, construction and industrial waste, and hazardous or infectious waste from health institutions. This category of waste needs to be managed differently from general MSW. It is observed that for medical waste, incineration is practiced by hospitals in most municipalities, although this essentially involves merely burning the waste in a chamber or open burning in the hospital compound. In some municipalities, medical waste is mixed with municipal waste, and in some cases it is burned or crudely dumped. There is no proper system for the management of medical waste, and the

Organic composting has great potential in Nepal.
Source: Asian Development Bank.

staff, including medical personnel, in most hospitals are not aware of the health impacts. In Kathmandu, Bir and a few other hospitals have started managing all types of hospital waste in a safe manner. On the other hand, no proper slaughterhouse was observed in any of the municipalities. Dead animals are buried or dumped. The burying is done near riverbanks, in jungle areas, and at dump sites.

IV. Managerial Aspects of Solid Waste Management

A. Organizational Structure

As SWM is one of the basic essential services that need to be provided by municipalities to keep urban centers clean under the Local Self-Governance Act of 1999 and Solid Waste Management Act of 2011, many municipalities have a separate section or unit for this purpose within their organizational structure. Most waste management units are either part of the Social Development Section, Planning and Urban Development Section, or Community Welfare Section of the municipalities. Some of the smaller municipalities, however, do not have a waste management unit. Of the 58 municipalities, 17 do not have a designated section to look after SWM. These municipalities do not provide waste management services or just have a few sweepers who work under the ward offices or another unit. It was observed that two or more units seem to have similar or overlapping responsibilities in some municipalities.

B. Resources Allocation for Waste Management

SWM is a very important municipal function that requires substantial human and financial resources. However, often due to financial constraints, municipalities are unable to provide adequate resources. Furthermore, due to technical and managerial inefficiencies, the available resources are often not utilized effectively. Although almost all municipalities allocate budget for SWM, the breakdown of expenditures is rarely available. Based on the analysis of data provided by municipalities, about 10% of the total municipal budget is spent on SWM.[15] This is more or less in line with findings of another study undertaken under the TA for nine relatively large municipalities, which indicated that the SWM expenditures accounted for 16% of the total municipal expenditure.[16] The municipalities spend nearly 60%–70% of the total SWM budget on collection and street sweeping, 20%–30% on transport, and the rest on final disposal. These figures show the need for reducing collection and street sweeping costs through more efficient management, and allocating more for safe and effective final disposal.

Solid waste management is a very important municipal function that requires substantial human and financial resources

The total municipal budget and the budget for SWM in each municipality during fiscal years (FY) 2010–2012 are in Appendix 9. On average, municipalities spent about NRs2,840 ($30) per ton of waste for collection to disposal in FY2012.[17] Although many municipalities do not have a formal system of SWM service charges, some have introduced such a system and have generated revenue. Methods practiced by municipalities in Nepal include SWM service fees,

[15] SWM budget expenditures generally include the cost of all activities related to SWM such as equipment, spare parts, fuel, and the salary of staff and workers involved in SWM. If the collection services are provided by NGOs or the private sector without payment from the municipality, such costs are not included. There is no accurate and unified cost accounting system in Nepal.

[16] The study covered Biratnagar, Butwal, KMC, Lalitpur, Lekhnath, Madhyapur Thimi, Nepalgunj, Pokhara, and Siddharthanagar. ADB. 2010. *Technical Assistance to Nepal for Capacity Building for Waste Management*. Consultant's report. Manila.

[17] This figure was obtained by dividing the estimated amount of waste collection (available from Appendix 4) by the SWM budget in FY2012 for the municipalities where both data are available.

door-to-door collection service fees, surcharges on property or business taxes, and service fees from major waste generators. The municipalities often collect the SWM charge themselves. However, when the private sector is involved in SWM collection, the municipality may entrust the company to collect the fee, which it may then keep or share with the municipality. Although no detailed data are available on the level of revenue collection and cost recovery in SWM, the detailed study of nine municipalities (footnote 13) indicates that the share of various types of SWM fees and charges is about 2% of the municipal own-source revenue and 5% of SWM expenditures.

The amount of financial and human resources dedicated to waste management varies significantly among municipalities. For example, many small municipalities, such as Khandbari, have no SWM staff, but a large city like KMC has more than 1,000 people working on waste management. In addition, KMC also uses the services of private companies and NGOs. The number of staff allocated generally depends on the characteristics of the municipality and their experience in dealing with MSW. Older municipalities with large urban populations that have dealt with the problems of waste management for longer tend to have more staff, while newer municipalities, which generally have large rural populations, have very few dedicated staff.

Regular training of SWM staff is very important to enhance their capacity for effective and sustainable SWM. However, fewer than 50% of the municipalities hold training programs for SWM staff. Of these municipalities, only 7% provide regular capacity building training for their SWM staff, while 75% provide occasional training.

C. Solid Waste Management Planning

SWM is more of a managerial issue than a technical one. In the municipalities of Nepal, lack of appropriate and sustainable management has created many environmental and social problems in the municipalities and in neighboring village development committees where the waste disposal sites are located. Based on the information provided by municipalities, 45% do not have an annual plan for SWM, while 67% have not formulated a short-term plan for SWM and 62% do not have a midterm or periodic plan. These figures show that SWM is still not a priority in many municipalities despite being one of the basic essential services to be provided for a clean and healthy town.

D. Actors Involved in Solid Waste Management

There are various stakeholders in municipal SWM, including national and local governments, multilateral and bilateral development partners, the private sector, NGOs, CBOs, tole lane organizations (TLOs), and citizens. Information provided by municipalities showed that 31 municipalities have formal working relations with other government institutions, NGOs, CBOs, and the private sector in managing waste. Of these, 22 municipalities have contracted out some SWM activities, most commonly waste collection and transport, to mainly NGOs, CBOs, and TLOs. Partnerships between municipalities and NGOs, CBOs, and TLOs are generally working well in many municipalities.

Large municipalities usually have contractual arrangements with the private sector, NGOs, or CBOs. KMC has contracted out street sweeping, waste collection, and transport services in various areas of the city to about a dozen private companies for a number of years. Lalitpur

is involving NGOs and CBOs in waste collection, compost production, and awareness raising. Biratnagar introduced private sector participation as early as the late 1990s, but the firm engaged ran into serious financial difficulties due to the unstable political situation and lack of clear policy and legislation. After a few changes in the contract modality, Biratnagar has engaged a private firm for the entire SWM chain—door-to-door collection (although not the entire area), street sweeping, transport, final disposal (at a site designated by the municipality), public awareness programs, and management of recyclable materials. Similarly, Butwal, Hetauda, and Pokhara have outsourced door-to-door collection to the private sector or NGOs and CBOs that collect the waste collection fee and share it with the municipality in accordance with the contract. The monthly tariff for households generally ranges from NRs10 ($0.10) to NRs200 ($2.08).[18]

E. Solid Waste Management Policy and Legislation

Among the acts and policies pertaining to SWM, the 2011 Solid Waste Management Act and the 1996 National Policy on SWM are particularly relevant.

Among the acts and policies pertaining to solid waste management, the 2011 Solid Waste Management Act and the 1996 National Policy on solid waste management are particularly relevant

The National Policy on SWM was formulated in 1996 to address the emerging SWM problems due to urbanization. The policy emphasizes waste management in municipal and urban areas and is still in force. Its main objectives are to (i) make SWM simple and effective, (ii) minimize the impact of solid waste on the environment and public health, (iii) treat solid waste as a resource, (iv) include private sector participation, and (v) improve public participation by increasing public awareness about sanitation.

The survey findings showed that only 46 municipalities are aware of the National Policy of SWM, while 49 municipalities know about the SWM Act. According to the Local Self-Governance Act and its regulations, as well as the SWM Act, municipalities can develop by-laws to suit their needs. Of the 58 municipalities, 23 stated that they have some by-laws or directives related to SWM, but many of them have not been implemented effectively. However, good practices also exist. For example, Ilam issued a directive to ban polythene bags in the municipality and surrounding village development committees. To implement this directive successfully, the municipality charges NRs500 ($5.21) to shops selling polythene bags and NRs200 ($2.08) to people carrying polythene bags. Similarly, a few other municipalities have also begun to enforce punishments and penalties for violators of SWM directives. Moreover, nine municipalities have operational guidelines for the operation of landfill sites and controlled dumping sites.

[18] ADB. 2012. *Technical Assistance to Nepal for Preparing the Integrated Urban Development Project. Consultant's report*. Manila.

V. Nepal's Solid Waste Management Status in the Region

A. Solid Waste Generation

The per capita generation of solid waste in developing countries in Asia ranges from 0.3 kg/day to 1.0 kg/day, although different sources and studies provide different figures. Table 3 summarizes the level of waste generation in selected countries in Asia cited in various sources.

Generally, the higher the economic development and rate of urbanization, the greater the amount of solid waste produced

Generally, the higher the economic development and rate of urbanization, the greater the amount of solid waste produced. The findings of this survey of MSW generation in Nepal (0.32 kg/capita/day) are comparable with findings from other studies done in Nepal, but lower than the average in low-income countries (0.60 kg/capita/day) and South Asian countries (0.45 kg/capita/day). This may be because of the lower rate of urbanization in Nepal and the significant area with rural characteristics even in municipalities. These areas produce less waste due to their lower level of economic development and higher level of in-house reuse and recycling. If 3R is implemented effectively now, Nepal may be able to avoid the standard

Table 3: **Per Capita Waste Generation of Selected Countries in Asia**

Country	Gross National Product per Capita (2011)	Waste Generation Rate (kilograms/capita/day)			
		World Bank (1999)	Visvanathan and Glawe (2006)	Agamuthu et al. (2010)	World Bank (2012)
Bangladesh	780	0.49	0.1–0.5	0.25	0.43
India	1,420	0.46	0.3–0.9	…	0.34
Indonesia	2,940	0.76	…	0.76	0.52
Lao PDR	1,130	0.69	…	0.55	0.70
Malaysia	8,770	0.81	…	1.3	1.52
Nepal	540	0.50	0.25–0.5	0.40	0.12
Philippines	2,210	0.52	…	0.52	0.50
Sri Lanka	2,580	0.89	0.4–0.9	0.2–0.9	5.10[a]
Thailand	4,440	1.10	…	0.64	1.76
Viet Nam	1,270	0.55	…	0.67	1.46

… = data not available, Lao PDR = Lao People's Democratic Republic.

[a] This figure looks too high and may be an error.

Source: World Bank. 2013. *Gross National Income per Capita 2011, Atlas Method*. http://pdwb.de/archiv/weltbank/gnipc11.pdf; World Bank. 1999. What a Waste: Solid Waste Management in Asia. Washington, DC; Visvanathan, C., and Glawe, U. 2006. Domestic Solid Waste Management in South Asian Countries—A Comparative Analysis, Paper presented at 3R South Asia Expert Workshop, 30 August-1 September 2006. Kathmandu, Nepal; Agamuthu, P. et al. 2010. Sustainable 3R Practice in the Asia and Pacific Regions: the Challenges and Issues. In P. Agamuthu and M. Tanaka, eds. 2010. *Municipal Solid Waste Management in Asia and the Pacific Islands*, Bandung, Indonesia; World Bank. 2012. *What a Waste: A Global Review of Solid Waste Management*. Urban Development Series. Washington, DC.

pathway of "more development more waste" and prevent SWM problems from being further aggravated by an increase in waste generation.

B. Waste Composition

Organic matter generally accounts for 50%–80% of MSW in developing Asian countries. Overall waste composition derived from the survey as well as that of other selected studies, including the average of low-income countries and South Asian countries, are in Table 4.

Table 4: **Waste Composition of Municipal Solid Waste in Nepal and Other Selected Countries** (%)

Country or Region	Source	Contents of Municipal Solid Waste					
		Organic	Plastics	Paper	Glass	Metal	Others
Nepal	This survey	56	16	16	3	2	7
	1	80	3	7	3	1	7
Low-income countries	1	64	8	5	3	3	17
South Asia	1	50	7	4	1	1	37
Bangladesh	1	71	7	5	–	–	16
Indonesia	2	55.4	13.3	20.6	1.9	1.1	7.9
	1	62	10	6	9	8	4
Sri Lanka	3	63	6	6	2	3	20
	1	76	6	11	1	1	5
Thailand	4	64	17	8	3	2	6
	1	48	14	15	5	4	14

Source: 1: World Bank. 2012. *What a Waste: A Global Review of Solid Waste Management*. Urban Development Series, Washington, DC; 2: Dmanhuri, E. et al. 2010. Municipal Solid Waste Management in Indonesia. In P. Agamuthu and M. Tanaka, eds. *Municipal Solid Waste Management in Asia and the Pacific Islands.* Bandung, Indonesia; 3: Basnayake, B. and Visvanathan, C. 2010. Solid Waste Management in Sri Lanka. In P. Agamuthu and M. Tanaka, eds. *Municipal Solid Waste Management in Asia and the Pacific Islands.* Bandung, Indonesia; 4: Siriratpiriya, O. and Pradubsuk, S. 2010. Windows of R&D Opportunity for Municipal Solid Waste Management in Thailand. In P. Agamuthu and M. Tanaka, eds. *Municipal Solid Waste Management in Asia and the Pacific Islands.* Bandung, Indonesia.

The large differences between figures from different sources, even in the same country, make discussion of the waste characteristics of each country rather difficult. While the level of organic waste in MSW in Nepal is more or less comparable with neighboring countries and countries of similar economic status, it contains a higher proportion of plastics and paper. Nepal's composition is similar to that of upper-middle-income countries, which average 54% organic matter, 14% paper, and 11% plastics.[19] Although it is beyond the scope of this study to discuss this in detail, the following factors may explain this finding: (i) reuse and recycling of organic waste, including as cattle feed and in domestic composting in areas with rural characteristics led to lower generation of organic (and total) waste, thereby increasing the proportion of plastics and paper; (ii) most surveys in other countries may be for household waste only, leading to lower plastic and paper content; (iii) the exclusion of street waste and waste from parks and gardens in this survey led to the higher proportion of recyclable

[19] World Bank. 2012. *What a Waste: A Global Review of Solid Waste Management.* Urban Development Series. Washington, DC.

materials; and (iv) reuse and recycling of plastics and paper by the formal and informal sectors is more limited in Nepal than in other countries, where these are recycled and are therefore not captured in the surveys. This may warrant a further study, but there seems to be a great potential in Nepal to enhance reuse and material recovery of plastics and paper products.

C. Waste Management Practices

1. Waste Collection

MSW is collected in several ways, including door-to-door collection, collection through community bins, roadside pick-up, and self-delivery. High-income countries tend to have higher collection rates. The collection efficiency of 62% derived from this survey is better than the average for low-income countries (41%), and comparable with the average for South Asia (65%) (footnote 16).

2. Waste Disposal

Landfilling and thermal treatment are the most common methods of MSW disposal in high-income countries. Although reliable quantitative data on the disposal methods are scarce in low-income countries, open dumping is considered a common practice. Nepal still has a long way to go to improve disposal practices, with 37% currently disposed of in sanitary landfill sites, although not necessarily in a sanitary way.

3. Expenditures on Solid Waste Management

The study found that municipalities in Nepal spend about 60%–70% of their MSW budget on collection and street sweeping, and 20%–30% on transport. This is comparable with other low-income countries, which may spend as much as 80%–90% on waste collection and transport. On average, municipalities in Nepal spend about $30 per ton of MSW. This figure is within the standard range of $20–$50 for collection and transport in low-income countries (footnote 16). With the introduction of engineered or sanitary landfilling practices that will cost more than open dumping, municipalities in Nepal will face the challenge of securing a larger budget for SWM. They will also need to introduce cost-saving measures by making collection and transport operations more efficient.

VI. Key Policy Challenges and Recommendations

Based on the baseline survey of the 58 municipalities and other assessments, the following eight issues are highlighted as key policy issues for improving SWM in Nepal.

A. Development of Policy, Strategy, and Guidelines

While the enactment of the new Solid Waste Management Act in 2011 was a major step toward improving SWM practices in Nepal, it has not been effectively translated into actions and results on the ground. A national SWM policy and strategy that specifies key policy objectives, guiding principles, and an implementation strategy with a timeline and a clear monitoring and evaluation mechanism needs to be developed to provide clear strategic direction to local bodies. The government is in the process of formulating a new SWM policy. Under the policy and strategy, municipalities are encouraged to develop a time-bound implementation plan for improving SWM. Technical guidelines will also need to be developed for issues such as organic composting, resource recovery technologies, and landfill development and operation.

B. Promotion of Reduce, Reuse, and Recycle

Nepal's MSW has a large organic content, constituting 66% of household waste and 56% of waste overall. The large proportion of reusable and recyclable materials provides a great opportunity for increasing waste reuse and recycling. As mandated under the act, 3R should be promoted to significantly reduce the amount of waste to be disposed of at final disposal sites, thereby saving costs for final disposal and reducing public health and environmental risks. The key to success would be the segregation of waste at source. This would require better public awareness of the benefits of waste segregation and recycling, and technical skills and knowledge among municipal staff. The government also needs to consider providing equal treatment to organic composts and chemical fertilizers, as chemical fertilizers are currently subsidized by the government. The promotion of organic composting would also improve the government's balance of payments, as currently all chemical fertilizers are imported. Composting plants can be developed in communities or municipalities depending upon their capacity, size, population (including density), and level of interest. Once successfully introduced, composting can be gradually scaled up with due attention to compost quality and marketing strategies. Although aerobic composting with windrows is generally less complex, anaerobic digestion may be another option for recovering resources from organic waste.

As mandated under the new Solid Waste Management Act, 3R should be promoted to significantly reduce the amount of waste to be disposed of at final disposal sites, thereby saving costs for final disposal and reducing public health and environmental risk

C. Strengthening Capacity of Local Bodies

The Local Self-Governance Act and SWM Act have mandated municipalities to take charge of collection, transport, treatment, and final disposal of MSW. However, municipalities face a shortage of financial and human resources, as well as technical and managerial skills to

effectively manage MSW. Developing the in-house capacity of the municipalities is thus essential. Municipalities that do not have a dedicated MSW unit are suggested to establish one and staff it with suitably qualified individuals. The SWMTSC is best suited to provide short- and medium-term technical support to local bodies in planning, waste collection and transport, appropriate technologies for treatment, and final disposal, but it too needs capacity strengthening to support the local bodies effectively. Outsourcing should be considered as a viable alternative through a performance-based arrangement.

D. Public Participation and Consultation

Local bodies alone cannot meet the challenge of keeping towns clean and livable. Community participation needs to be ensured through information, education, and communication campaigns to enhance citizens' awareness of 3R and better solid waste management

Local bodies alone cannot meet the challenge of keeping towns clean and livable. Community participation needs to be ensured through information, education, and communication campaigns to enhance citizens' awareness of 3R and better SWM. Awareness should start from the basic "no littering" in public places. Once a municipality plans a new final disposal site or other facilities, communities living near the proposed site should be fully consulted and their views need to be addressed in the plan. This may include assurance of proper operation and management of the site by the local bodies, and development and implementation of social programs from which local communities can benefit. Introducing appropriate methods for waste segregation and collection also requires close consultation with and collaboration from communities so that their needs are incorporated into the arrangements.

E. Cost Recovery

The SWM Act directs the local bodies to levy service charges to meet the cost of SWM services and make the service self-sustaining. A separate study undertaken under the TA found that 82% of surveyed households would be willing to pay an SWM fee if the level of service improved. Currently, municipalities are collecting an SWM service charge through various measures, including a surcharge on property and business tax, and direct fees from households and bulk waste generators. Initially, the focus will be on increasing the coverage of fee collection rather than increasing the level of the fee, and the fee should be commensurate with the level of service provided. Later, a gradual fee increase could be considered in association with improvements in the level of service so that operation and maintenance costs are fully recovered first. Reduction in expenditures on SWM is equally important, and municipalities should review their existing practices to identify cost-saving measures. These may include the provision of performance-based incentives to their staff, performance-based outsourcing arrangements, and benefit-sharing arrangements with CBOs or TLOs while rationalizing the services that the municipalities themselves provide.

F. Improvements toward Integrated Solid Waste Management

Current bad practices need to be stopped first. For example, collecting waste from open piles on the roadside, which is done by 49 municipalities, is not only inefficient but highly unhygienic, creating a public nuisance and health risks. Likewise, open dumping on riverbanks and roadsides, and in low-lying areas, practiced by 45 municipalities, is polluting the surrounding environment and may contaminate soil and drinking water sources (both surface and groundwater). Poor public awareness and collection efficiency leads to the dumping of garbage in roadside drains, which clogs drainage systems; and open burning emits hazardous gases, including dioxin. Moreover, solid waste that contains high organic content produces,

Riverside dumping needs to be stopped immediately.
Source: Asian Development Bank.

through anaerobic digestion, a large amount of methane, a powerful greenhouse gas that is a cause of climate change.

An integrated approach is needed from segregation at source and collection to resource recovery and final disposal. Resource recovery facilities may be built on the way to or near the final disposal sites so that residual wastes from recovery facilities can be brought efficiently for disposal. Smaller municipalities may gradually improve their final disposal method from open dumping to controlled dumping (with soil cover and controlled access), engineered landfill (including careful site selection, waste compaction, and surface and groundwater monitoring), and finally full-fledged sanitary landfill (including an impermeable liner, and leachate collection and treatment), as financial and technical capacity constraints permit. As there were no guidelines and standards for sanitary landfills, these were prepared under the TA.

The involvement of the private sector has great potential to improve operational efficiency and cost effectiveness in municipal solid waste collection, transport, treatment, and final disposal

G. Public–Private Partnership

The limited private sector participation in SWM in Nepal to date has yielded mixed results; therefore, working with NGOs and CBOs has been more common. However, the involvement of the private sector has great potential to improve operational efficiency and cost effectiveness in MSW collection, transport, treatment, and final disposal. While major capital investment by the private sector in SWM may remain a challenge in the current context of Nepal, engagement of the private sector, CBOs, and NGOs in collection and transport may be promoted on a larger scale. Considering that most municipalities have no experience of properly managing sanitary landfill sites, management contracts that tap the experience of qualified private sector partners should be considered as a viable alternative to ensure efficient operation of the landfills. Municipalities need strengthening in the areas of conducting competitive bidding; establishing appropriate scope and performance specifications in contracts; assessing

qualification requirements of private sector companies, CBOs, or NGOs; and monitoring performance in accordance with the provisions of the contract.

H. Data Management, Updating, and Dissemination

The baseline survey conducted under the TA provided very useful data and information on the state of SWM in municipalities in Nepal, which can be used for planning SWM. The government intends to regularly update the baseline data to track changes and implementation progress. Key performance indicators (KPIs) for municipal SWM, which may include waste collection efficiency, rate of resource recovery through composting and recycling, efficiency of SWM charges, and rate of cost recovery, need to be identified and data collected using a uniform methodology. Periodic updates of basic data on KPIs are also essential for monitoring the progress. Dissemination of data will help the general public and other stakeholders better understand the status of SWM and enable comparisons over time and among municipalities. The rating of municipalities' performance may be linked to the budget allocation from the central government, as practiced under the minimum conditions and performance measures in Nepal. The SWMTSC is expected to take the lead in establishing and operating management information systems for MSW.

The TA produced a number of draft documents that address the policy issues through intensive consultations with stakeholders. These include a national SWM policy and strategy; a business plan for the SWMTSC; national guidelines on a SWM service tariff; service level benchmarks and KPIs; guidelines and standards for planning, design, construction, and management of sanitary landfills; organic composting guidelines; and compost quality standards. These drafts are expected to be further scrutinized and reviewed by the government, as needed, before they are formally endorsed at an appropriate level of government. It is hoped that implementation of these policies, standards, and guidelines will bring a paradigm shift in SWM in Nepal.

VII. Conclusions

The objective of the SWM baseline survey was to conduct a systematic and comprehensive study to quantify MSW and its composition, and to compile factual information on the state of SWM in 58 municipalities of Nepal. The total sample size of 3,233 households from the 58 municipalities gave an average household waste generation rate of 170 g/capita/day. The household waste generation rates varied depending on economic status and climatic conditions. The average daily waste generation of institutional wastes was at 4.0 kg per school and 1.4 kg per office. Similarly, the average daily waste generation of commercial waste was at 1.4 kg per shop and 5.7 kg per hotel or restaurant. Household waste is estimated to contribute about 50%–75% of the total municipal MSW generated, which was estimated at 317 g/capita/day. Based on these per capita waste generation figures and the population in 2011, the total MSW generation from the 58 municipalities was estimated at about 1,435 tons/day and 524,000 tons/year.

The analysis of waste composition showed that organic matter accounted for the highest fraction, making up 66% of household waste and 43% of commercial waste; while the largest fraction for institutional waste was paper and paper products at 44%. The survey showed that there is great potential to promote composting of MSW in all municipalities. The households in predominantly rural areas of municipalities practice traditional household composting, but those in urban areas, where less land is available, generally do not use this method. Community or municipal composting plants are observed in some municipalities. Only 6 municipalities dispose of waste in sanitary landfill sites, and as many as 45 municipalities dump waste on riverbanks, roadsides, or other low-lying lands, or in open pits or temporary open piles.

Municipalities are unable to manage MSW effectively and efficiently because of the lack of technical and human resources, statistical records, and proper planning, as well as insufficient budget and lack of political leadership. The municipalities spend an average of 10% of their total budget on SWM, of which about 60%–70% is used for street sweeping and collection, 20%–30% for transport, and the rest for final disposal.

Based on the survey outputs and other assessments, eight priority policy recommendations have been identified: (i) development of policy, strategy, and guidelines; (ii) promotion of 3R; (iii) strengthening the capacity of local bodies; (iv) public participation and consultation; (v) cost recovery; (vi) improvements toward integrated management; (vii) public–private partnership; and (viii) data management, updating, and dissemination.

The outputs of this survey are expected to be used to implement proper SWM starting from waste segregation at source, efficient and hygienic collection and transport, resource recovery, and safe disposal. As the survey was limited to one-time sampling and was not able to capture all the data accurately, these weaknesses need to be addressed during future updates.

The outputs of the baseline survey are expected to be used to implement proper solid waste management starting from waste segregation at source, efficient and hygienic collection and transport, resource recovery, and safe disposal

APPENDIX 1

Main Outputs of the Technical Assistance

Output 1: Supporting the establishment of an effective framework for solid waste management. Under the overall direction defined in the Solid Waste Management Act, the establishment of an effective national solid waste management policy and institutional framework has been supported. In accordance with the act, solid waste management regulations and a national solid waste management policy and strategy have been drafted. A proposed organizational structure, job description, and human resources as well as a 3-year business plan for the Solid Waste Management Technical Support Center (SWMTSC) have been prepared in accordance with the new roles and functions given to the SWMTSC.

Output 2: Strengthening the technical capacity of the Solid Waste Management Technical Support Center. The technical assistance (TA) supported strengthening the capacity of government officials—mainly in the Ministry of Federal Affairs and Local Development and the SWMTSC.[1] The capacity development programs have been implemented in the areas of developing an integrated solid waste management system; planning, designing, and operating sanitary landfills, including leachate treatment; promotion of 3R (reduce, reuse, and recycle); and organic composting. Butwal and Siddharthanagar municipalities were selected as pilot cases, where public awareness raising on 3R and training on household composting were conducted, among other activities.

Output 3: Supporting the development of relevant regulations, standards and/or guidelines for improving solid waste management at the regional and local levels. The TA drafted the following guidelines and standards in close consultation with the government and stakeholders: (i) guidelines and standards for planning, design, construction, and management of sanitary landfills; (ii) organic composting guidelines; (iii) compost quality standards; (iv) guidelines on service tariff, based on the review of existing practices; (v) key performance indicators and targets of solid waste management services; and (vi) health care waste management rules. Based on the request from the SWMTSC, a baseline survey of all 58 municipalities was also undertaken, which became the basis of this report.

All the outputs are available on the ADB website.

[1] Toward the end of the TA, the Ministry of Urban Development was established, and the SWMTSC was transferred to the Ministry of Urban Development from the Ministry of Federal Affairs and Local Development.

APPENDIX 2

Area and Population of the 58 Municipalities of Nepal

	Municipality	District	Total Area (km^2)	Built-Up Area (km^2)	Total Population (2011)	Population Density (persons per km^2)
1	Amargadhi	Dadeldhura	138.95	0.36	22,241	160
2	Baglung	Baglung	18.35	2.33	30,763	1,676
3	Banepa	Kavrepalanchok	5.56	0.70	24,894	4,477
4	Bhadrapur	Jhapa	10.56	5.00	18,646	1,766
5	Bhaktapur	Bhaktapur	6.56	1.23	83,658	12,753
6	Bharatpur	Chitawan	162.16	3.90	147,777	911
7	Bhimdatta	Kanchanpur	171.24	4.28	106,666	623
8	Bhimeshwor	Dolakha	65.04	…	23,337	359
9	Bidur	Nuwakot	33.48	2.10	27,953	835
10	Biratnagar SMPC	Morang	58.48	10.84	204,949	3,505
11	Birendranagar	Surkhet	34.95	13.00	52,137	1,492
12	Birgunj SMPC	Parsa	21.17	9.02	139,068	6,569
13	Butwal	Rupandehi	69.28	2.76	120,982	1,746
14	Byas	Tanahu	60.02	3.53	43,615	727
15	Damak	Jhapa	70.63	26.90	75,743	1,072
16	Dasharathchanda	Baitadi	55.01	1.60	17,427	317
17	Dhangadhi	Kailali	103.73	13.44	104,047	1,003
18	Dhankuta	Dhankuta	48.21	4.83	28,364	588
19	Dharan	Sunsari	103.38	…	119,915	1,160
20	Dhulikhel	Kavrepalanchok	12.08	0.62	16,263	1,346
21	Dipayal Silgadhi	Doti	73.98	…	26,508	358
22	Gaur	Rautahat	21.53	3.00	35,370	1,643
23	Ghorahi	Dang	74.45	…	65,107	875
24	Gorkha	Gorkha	60.28	…	33,865	562
25	Gulariya	Bardiya	95.14	5.47	57,232	602
26	Hetauda	Makwanpur	47.77	12.46	85,653	1,793
27	Ilam	Ilam	26.63	2.71	19,427	730
28	Inaruwa	Sunsari	22.36	4.25	28,923	1,294
29	Itahari	Sunsari	42.37	25.18	76,869	1,814
30	Jaleshwor	Mahottari	15.49	…	24,765	1,599
31	Janakpur	Dhanusa	24.61	…	98,446	4,000
32	Kalaiya	Bara	18.98	11.70	43,137	2,273

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Appendix 2 Table *continued*

	Municipality	District	Total Area (km^2)	Built-Up Area (km^2)	Total Population (2011)	Population Density (persons per km^2)
33	Kamalamai	Sindhuli	207.95	13.23	41,117	198
34	Kapilvastu	Kapilvastu	37.20	0.16	30,890	830
35	Kathmandu MPC	Kathmandu	49.45	36.52	1,003,285	20,289
36	Khandbari	Sankhuwasabha	91.03	…	26,658	293
37	Kirtipur	Kathmandu	14.76	3.24	67,171	4,551
38	Lahan	Siraha	20.23	0.67	33,927	1,677
39	Lalitpur SMPC	Lalitpur	15.15	14.00	226,728	14,966
40	Lekhnath	Kaski	77.45	5.46	59,498	768
41	Madhyapur Thimi	Bhaktapur	11.11	1.38	84,142	7,574
42	Malangawa	Sarlahi	9.39	1.74	25,143	2,678
43	Mechinagar	Jhapa	55.72	3.00	57,909	1,039
44	Narayan	Dailekh	67.01	0.44	21,995	328
45	Nepalgunj	Banke	12.51	4.81	73,779	5,898
46	Panauti	Kavrepalanchok	31.73	2.88	28,312	892
47	Pokhara SMPC	Kaski	55.22	28.44	264,991	4,799
48	Putalibazar	Syangja	70.14	…	31,338	447
49	Rajbiraj	Saptari	11.96	2.18	38,241	3,197
50	Ramgram	Nawalparasi	34.72	4.12	28,973	834
51	Ratnanagar	Chitawan	35.62	0.90	46,607	1,308
52	Siddharthanagar	Rupandehi	36.03	3.60	64,566	1,792
53	Siraha	Siraha	23.78	1.28	28,831	1,212
54	Tansen	Palpa	21.72	…	31,161	1,435
55	Tikapur	Kailali	67.11	7.06	56,983	849
56	Triyuga	Udayapur	319.88	1.00	71,405	223
57	Tulsipur	Dang	92.22	1.50	52,224	566
58	Waling	Syangja	34.76	4.49	24,199	696
Total			**3,276.28**	**313.30**	**4,523,820**	**1,381**

… = not available, km^2 = square kilometer, MPC = metropolitan city, SMPC = submetropolitan city.
Source: Asian Development Bank; Government of Nepal, Central Bureau of Statistics. 2012.

APPENDIX 3

Methodology for Sampling and Field Work

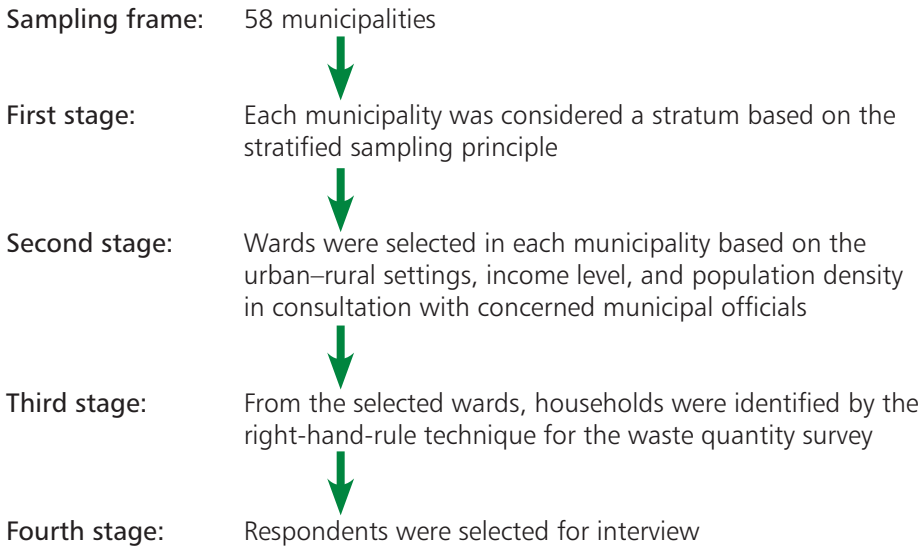
I. Sampling Design

The survey covered 58 municipalities with a sample size of 3,233 households, and 627 institutions (schools and offices) and 627 commercial establishments (shops, hotels, and restaurants). The survey employed random (probability) sampling. This size of sample produces results with +/–1.7% of the error margin at a 95% confidence level at the national level.[1]

A. Household Sampling

Sampling for the selection of respondents was done in four stages. The sampling framework is outlined in the following flowchart:

Sample Design for Household Waste Survey



In the first stage, 58 municipalities in Nepal were considered as strata using stratified sampling. The sample size for each stratum was determined by probability proportional to size sampling

[1] Statistically, an error margin is the range within which the result may vary and still be acceptable; the confidence level indicates the probability that the result will fall within that range. A confidence level of 95% means that there are 95 chances in 100 that the sample result represents the true condition of the population within a specified error margin. For instance, if the estimate sample value is NRs4,000, the confidence level is 95% and error margin is +/–4%, then the researcher has 95% confidence that the true value will be no less than NRs3,840 and no more than NRs4,160.

technique (i.e., the greater the stratum size; the greater the sample size). However, the minimum sample size for each stratum was set at 50 households.

In the second stage, proportional numbers of wards were selected from every municipality, mainly based on factors such as the urban–rural settings, income level, and population density, in consultation with concerned municipal officials. The number of sample wards varied according to the size of the municipality. One ward was selected for every 10 households; for example, if 100 households were to be selected from a municipality, 10 wards, each with 10 households, were selected. In this study, 220, 150, and 100 households were selected in Kathmandu Metropolitan City, Lalitpur, and Bhaktapur, while a minimum of 50 households were selected in other municipalities.[2]

In the third stage, households in each sample ward were selected randomly by employing the "right-hand-rule technique."[3] Finally, in the fourth stage, the household head, if possible, was selected as the interview respondent to provide information about solid waste management (SWM) practices.

B. Sampling of Institutional and Commercial Establishments

Waste quantity and quality surveys of institutional and commercial establishments were also conducted simultaneously. A total of 627 schools and nongovernment offices were selected. These institutional establishments were spread across the 58 municipalities. At a minimum, five schools and five nongovernment offices were selected from each municipality. Generally, the same wards selected for the household survey were also chosen for the sampling of institutions and commercial establishments. One school and one office from each ward were selected, except in wards where there are either no schools or no offices. In such cases, two or more schools or offices were sampled from a single ward.

Similarly, 627 shops, hotels, and restaurants were selected for the survey. These were spread across the 58 municipalities. A minimum of five shops, hotels, and restaurants were selected from each municipality. One shop and one hotel or restaurant were randomly selected from each ward.

Sampling for the selection of institutions and commercial establishments was done in the same manner as in the household survey.

II. Recruitment, Training, and Equipment

A total of 64 graduate students and research assistants in environmental engineering or science or management from Tribhuvan, Kathmandu, and Pokhara universities and the National Academy of Science and Technology were selected as field surveyors. In the selection process,

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[2] As a few more samples were taken in some municipalities, the total sample size of 3,233 was slightly higher than the design size of 3,220.

[3] The starting points for the right-hand-rule technique are recognizable locations such as schools, crossroads, and bazaars. At first, interviewers start to walk in any direction randomly from a starting point counting number of households at the same time. If it is less than 20, the interviewer will select the first 10 households on the right-hand side of his or her route. If it is between 20 and 29, the interviewer will select the first household and then select each third household on the right-hand side of the interviewer's route until he or she has covered 10 households. If the households number 30 or more, the interviewer will select the first household and then each fourth household on the right-hand side of the interviewer's route until he or she has covered 10 households.

candidates who are well conversant in Nepali and English, as well as the local languages were given preference. A 2-day orientation training program was conducted before deploying the surveyors to the field. A briefing was also conducted on the structured questionnaire to familiarize them with the purpose of each question. They were guided on how to provide clarifications to questions and encourage respondents to answer. To test their capability, a mock survey was conducted among the surveyors during the training.

Upon completion of the training, one surveyor was assigned to each municipality except in Kathmandu Metropolitan City, where four surveyors were assigned; Lalirpur, where three were assigned; and Bhaktapur, where two were assigned. All the surveyors were provided with gloves, dust masks, a digital weighing machine, predesigned questionnaires, and record sheets.

III. Field Survey and Data Collection

A. Field Study

The SWM baseline survey team conducted the survey in April and May 2012 during the dry season. Field surveyors with research experience and sufficient knowledge of the subject matter were employed for the fieldwork under the direct supervision of supervisors, the team leader of the baseline survey, and staff of the concerned municipality. Surveyors spent a minimum of 10 days completing their field study in their assigned municipality.

Due to the difficulty of handling waste from more than 3,200 households and 1,200 institutions or commercial establishments in the 58 municipalities with limited resources and time, as well as based upon the findings of previous studies, this study utilized 1-day sampling of waste.[4].

The sampling of household waste was performed the day after the survey. For this study, a household was defined as a number of people using one kitchen rather than by the number of rooms or the house type. During the survey, the surveyors informed each household, institution, and commercial establishment that their waste generated in a 24-hour period would be analyzed, and provided them with waste collection bags. The next day, the surveyors collected the bagged waste and measured the quantity (in wet weight) of the eight different waste categories.

B. Standard Questionnaires

A precoded structured questionnaire was formulated with the help of experts within the survey team. Separate questionnaires were developed for households and municipalities to collect and update information on different aspects of SWM. The length of the questionnaire was also considered so that its administration in the field would not take too much time. It was formulated in English and used for administrative purposes. However, during the interview process, the questionnaire was translated by the enumerator into Nepali. A pretest was carried out and the questionnaire was fine-tuned before the actual interviews were carried out.

[4] The justification for utilizing 1-day sampling is discussed in chapter II of the main text.

IV. Quality Assurance and Quality Control

To make the SWM baseline survey results more accurate and realistic, different quality assurance and quality control procedures were carried out during the study period. Qualified and competitive surveyors with sufficient research experience and knowledge of the subject matter were selected to conduct the survey. The questionnaires were designed with a simple format and were easy to understand, allowing detailed information on various aspects of SWM to be collected. Before the fieldwork, the surveyors were fully trained for 2 days. To allow accurate and realistic measurement of waste, a digital weighing machine was provided to each surveyor. All the municipalities were informed about the SWM baseline survey and the detailed tasks of the surveyors. Each surveyor carried out his or her field survey in direct consultation and under the direct supervision of the concerned municipal officials in the assigned municipality. The supervisors provided the necessary inputs to each surveyor continuously during the field survey. During the waste quantity survey, waste samplings were repeated in households and other waste generators in cases where the waste quantity was found to be unrealistic.

APPENDIX 4

Municipal Solid Waste Generation and Collection Efficiency in the 58 Municipalities

	Municipality	Average HH Waste (kg/day)	Average HH size (number of members)	Average per Capita HH Waste (g/capita/day)	Total HH Waste (tons/day)	Total Commercial Waste (tons/day)	Total Institutional Waste (tons/day)	Average per Capita MSW (g/capita/day)	Total MSW Generation (tons/day)	Estimated Waste Collection (tons/day)	Collection Efficiency (%)
1	Amargadhi	0.50	5.92	84.43	1.88	0.55	0.08	112.57	2.50	1.0	39.9
2	Baglung	0.66	4.66	142.49	4.38	4.10	0.37	287.81	8.85	4.0	45.2
3	Banepa	1.36	5.64	240.80	5.99	1.05	0.54	344.00	8.56	4.5	52.5
4	Bhadrapur	0.39	4.81	80.20	1.50	0.13	0.06	106.93	1.99	1.0	50.2
5	Bhaktapur	0.85	5.47	155.43	13.00	7.20	0.62	345.40	28.90	25.0	86.5
6	Bharatpur	1.25	5.66	220.04	32.52	6.82	0.80	400.06	59.12	15.0	25.4
7	Bhimdatta	0.60	5.58	107.53	11.47	1.30	1.14	215.05	22.94	…	0
8	Bhimeshwor	0.41	4.52	91.24	2.13	0.22	0.12	121.66	2.84	…	0
9	Bidur	0.47	4.81	97.21	2.72	2.87	0.17	205.94	5.76	…	0
10	Biratnagar SMPC	0.68	4.80	142.39	29.18	25.48	3.70	284.78	58.37	50.0	85.7
11	Birendranagar	0.62	5.88	104.90	5.47	3.18	0.46	174.83	9.12	1.0	11.0
12	Birgunj SMPC	0.84	6.14	137.23	19.08	2.67	0.27	274.46	38.17	15.0	39.3
13	Butwal	0.56	5.00	112.10	13.56	8.40	0.39	224.21	27.13	17.0	62.7
14	Byas	0.41	4.23	97.50	4.25	2.46	0.64	168.58	7.35	…	0
15	Damak	0.62	5.34	115.84	8.77	1.85	0.32	231.69	17.55	7.0	39.9
16	Dasharathchanda	0.85	5.96	142.28	2.48	0.25	0.31	189.71	3.31	0.5	15.1
17	Dhangadhi	0.71	5.16	138.45	14.41	11.00	0.40	276.90	28.81	12.0	41.7
18	Dhankuta	0.69	4.78	143.40	4.07	2.91	0.42	260.73	7.40	6.0	81.1
19	Dharan	1.17	5.53	212.31	25.46	7.53	0.44	424.62	50.92	35.0	68.7

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Appendix 4 Table *continued*

	Municipality	Average HH Waste (kg/day)	Average HH size (number of members)	Average per Capita HH Waste (g/capita/day)	Total HH Waste (tons/day)	Total Commercial Waste (tons/day)	Total Institutional Waste (tons/day)	Average per Capita MSW (g/capita/day)	Total MSW Generation (tons/day)	Estimated Waste Collection (tons/day)	Collection Efficiency (%)
20	Dhulikhel	0.64	5.59	115.16	1.87	0.55	0.08	153.54	2.50	...	0
21	Dipayal Silgadhi	0.56	6.42	86.92	2.30	0.72	0.11	124.17	3.29	...	0
22	Gaur	0.73	7.38	99.02	3.50	1.31	0.19	141.46	5.00	...	0
23	Ghorahi	0.46	3.92	117.91	7.68	1.52	0.15	196.51	12.79	10.0	78.2
24	Gorkha	0.56	4.12	136.46	4.62	0.22	0.06	194.94	6.60	2.0	30.3
25	Gulariya	0.76	6.46	116.97	6.69	3.90	0.57	194.94	11.16	1.0	9.0
26	Hetauda	0.81	5.29	153.98	13.19	7.68	1.12	256.63	21.98	9.0	40.9
27	Ilam	1.14	5.66	201.34	3.91	1.63	1.26	366.08	7.11	3.9	54.8
28	Inaruwa	1.36	4.88	277.89	8.04	1.16	0.27	396.98	11.48	3.0	26.1
29	Itahari	1.00	5.12	196.10	15.07	8.77	1.28	326.83	25.12	6.0	23.9
30	Jaleshwor	0.52	6.10	85.70	2.12	0.62	0.09	114.27	2.83	...	0
31	Janakpur	0.61	6.08	101.00	9.94	1.23	0.77	168.33	16.57	4.0	24.1
32	Kalaiya	1.43	6.28	227.10	9.80	3.67	0.53	324.43	13.99	1.5	10.7
33	Kamalamai	1.00	5.74	174.41	7.17	1.37	0.36	249.15	10.24	4.0	39.0
34	Kapilvastu	0.71	6.16	114.97	3.55	2.21	0.05	191.61	5.92	1.5	25.3
35	Kathmandu MPC	1.10	4.74	232.31	233.07	203.49	29.58	464.61	466.14	405.0	86.9
36	Khandbari	0.56	5.04	111.36	2.97	0.53	0.17	159.09	4.24	...	0
37	Kirtipur	0.89	5.84	151.75	10.19	5.93	0.86	252.91	16.99	6.0	35.3
38	Lahan	1.42	6.06	235.08	7.98	1.02	0.68	335.83	11.39	...	0
39	Lalitpur SMPC	0.90	4.84	185.91	42.15	36.80	5.35	371.82	84.30	60.0	71.2
40	Lekhnath	0.50	4.47	112.52	6.69	0.77	0.28	187.54	11.16	...	0
41	Madhyapur Thimi	0.70	5.12	136.72	11.50	10.04	1.46	273.44	23.01	12.0	52.2
42	Malangawa	1.90	7.18	264.20	6.64	0.66	0.12	377.43	9.49	1.5	15.8
43	Mechinagar	0.33	4.38	76.44	4.43	0.73	0.45	127.40	7.38	7.0	94.9
44	Narayan	0.48	5.40	89.37	1.97	0.57	0.08	119.16	2.62	0.5	19.1

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Appendix 4 Table *continued*

	Municipality	Average HH Waste (kg/day)	Average HH size (number of members)	Average per Capita HH Waste (g/capita/day)	Total HH Waste (tons/day)	Total Commercial Waste (tons/day)	Total Institutional Waste (tons/day)	Average per Capita MSW (g/capita/day)	Total MSW Generation (tons/day)	Estimated Waste Collection (tons/day)	Collection Efficiency (%)
45	Nepalgunj	1.13	6.06	186.34	13.75	8.59	0.48	372.67	27.50	…	0
46	Panauti	0.60	4.94	121.86	3.45	0.90	0.11	174.09	4.93	2.0	40.6
47	Pokhara SMPC	0.97	4.40	220.97	58.55	27.29	4.00	441.94	117.11	50.0	42.7
48	Putalibazar	0.55	4.55	121.81	3.82	0.18	0.13	174.01	5.45	4.5	82.5
49	Rajbiraj	1.39	5.24	265.59	10.16	1.68	0.38	379.41	14.51	6.0	41.4
50	Ramgram	0.70	5.64	123.62	3.58	0.07	0.28	176.60	5.12	1.5	29.3
51	Ratnanagar	0.74	4.74	155.83	7.26	6.70	0.38	311.65	14.53	11.0	75.7
52	Sidharthanagar	0.78	5.52	141.38	9.13	0.77	0.29	217.50	14.04	4.0	28.5
53	Siraha	0.57	6.12	93.63	2.70	0.59	0.05	133.75	3.86	1.0	25.9
54	Tansen	1.19	5.22	228.12	7.11	4.30	0.43	379.91	11.84	2.5	21.1
55	Tikapur	0.58	5.76	100.90	5.75	3.35	0.49	168.17	9.58	0.6	6.3
56	Triyuga	0.45	6.08	74.60	5.33	2.60	0.36	124.33	8.88	…	0
57	Tulsipur	0.54	4.64	115.91	6.05	1.46	0.20	178.32	9.31	6.0	64.4
58	Waling	0.68	4.62	147.92	3.58	1.64	0.25	227.57	5.51	1.0	18.2
Total/average value		**0.79**	**5.37**	**170.12**	**769.6**	**447.17**	**65.01**	**317.22**	**1,435.05**	**822.0**	**62.3**

… = not available, g = gram, HH = household, kg = kilogram, MPC = metropolitan city, MSW = municipal solid waste, SMPC = submetropolitan city.

Notes on the calculation of MSW generation rate:

1. Total MSW generation in each municipality was calculated from the total household waste by using the professional judgment based on the findings and field observations. It was assumed that the household waste contributes between 50% and 75% of total MSW.
2. Institutional and commercial waste was estimated in municipalities where the estimates can be reasonably made based on the available information on the number of establishments. A difference between total MSW waste and the sum of household, commercial, and institutional waste, is considered other waste (from parks and gardens, street sweeping, and from neighboring village development committees). This difference is large in some municipalities where economic and tourism activities are high, such as Bharatpur, Birgunj, Dharan, and Pokhara. Only in a few municipalities where the difference becomes negative (i.e., the sum of three types of waste is larger than total MSW), total MSW was adjusted.
3. In municipalities where the reasonable estimates of institutional and commercial waste were not possible, the sum of these two types of waste is calculated by deducting the amount of household waste from total MSW. Then, the amount was split into two types of waste in proportion to the amount of generation of commercial and institutional waste where data are available. The ratio between commercial and institutional waste was 87.3% and 12.7%.

Source: Asian Development Bank.

APPENDIX 5

Composition of Household Waste in the 58 Municipalities (%)

	Municipality	Organic Waste	Plastics	Paper and Paper Products	Glass	Metals	Textiles	Rubber and Leather	Others
1	Amargadhi	71.50	9.13	11.88	1.35	0.21	3.79	1.04	1.09
2	Baglung	40.44	24.18	15.83	8.19	2.36	3.92	2.80	2.28
3	Banepa	68.11	11.19	9.14	1.33	1.83	1.19	0.32	6.90
4	Bhadrapur	72.99	11.58	8.04	0.00	0.00	6.27	0.62	0.50
5	Bhaktapur	77.48	8.52	6.79	0.55	0.79	0.69	0.00	5.19
6	Bharatpur	78.96	4.63	7.84	3.08	1.74	2.32	1.00	0.43
7	Bhimdatta	48.17	8.16	5.99	4.92	1.13	2.30	0.00	29.32
8	Bhimeshwor	56.68	5.56	8.63	0.00	0.00	0.00	2.58	26.55
9	Bidur	70.19	12.04	7.21	3.70	0.15	5.62	0.00	1.09
10	Biratnagar SMPC	85.77	5.05	5.18	1.03	0.22	1.00	0.43	1.32
11	Birendranagar	73.95	11.06	10.15	0.94	1.08	0.76	0.06	2.00
12	Birgunj SMPC	58.48	13.70	7.44	9.99	1.06	0.00	0.00	9.32
13	Butwal	74.60	8.82	5.73	1.99	1.57	1.57	1.42	4.30
14	Byas	70.87	10.89	7.97	2.92	0.59	2.06	1.05	3.66
15	Damak	63.40	5.35	6.51	0.66	1.06	2.12	1.23	19.67
16	Dasharathchanda	35.64	8.19	34.17	2.51	1.41	4.19	1.18	12.70
17	Dhangadhi	68.13	13.11	10.07	2.67	1.08	0.00	2.30	2.65
18	Dhankuta	59.61	17.86	11.90	0.00	1.28	3.05	0.25	6.04
19	Dharan	58.34	15.49	11.30	2.43	6.24	2.96	0.75	2.48
20	Dhulikhel	52.61	17.65	7.11	11.10	0.53	3.88	0.46	6.68
21	Dipayal Silgadhi	43.64	15.14	9.49	19.02	3.83	5.66	2.69	0.52
22	Gaur	76.78	2.51	2.29	0.30	0.31	0.69	0.00	17.12
23	Ghorahi	80.63	8.34	5.44	0.78	0.00	0.63	2.50	1.68
24	Gorkha	48.16	12.33	20.43	2.69	0.83	0.49	0.00	15.06
25	Gulariya	56.33	9.46	5.48	1.18	7.91	0.00	2.08	17.55
26	Hetauda	50.93	18.92	18.39	2.15	0.17	2.79	0.86	5.79
27	Ilam	57.98	9.18	14.22	4.51	3.84	2.38	4.10	3.78
28	Inaruwa	56.27	5.79	6.54	1.28	0.13	0.20	0.26	29.54
29	Itahari	61.23	12.56	19.35	1.49	0.00	2.05	0.00	3.32
30	Jaleshwor	70.13	17.11	9.05	0.00	0.00	1.12	2.59	0.00
31	Janakpur	71.53	17.23	10.51	0.00	0.41	0.00	0.32	0.00
32	Kalaiya	66.60	4.36	5.38	0.93	0.49	3.14	0.41	18.69

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Appendix 5 Table *continued*

	Municipality	Organic Waste	Plastics	Paper and Paper Products	Glass	Metals	Textiles	Rubber and Leather	Others
33	Kamalamai	62.72	11.17	7.88	3.04	2.61	1.84	1.73	9.00
34	Kapilvastu	81.72	8.52	6.36	0.48	0.36	2.56	0.00	0.00
35	Kathmandu MPC	64.24	15.96	8.66	3.75	1.72	3.40	1.12	1.15
36	Khandbari	46.82	14.76	13.33	4.90	4.94	6.85	0.40	8.00
37	Kirtipur	74.34	15.06	8.01	0.62	0.23	1.47	0.27	0.00
38	Lahan	84.52	7.93	5.61	0.10	1.04	0.00	0.65	0.14
39	Lalitpur SMPC	77.94	9.81	5.23	1.99	0.66	0.74	0.75	2.86
40	Lekhnath	59.80	9.12	10.63	10.13	1.73	0.00	0.00	8.59
41	Madhyapur Thimi	48.86	12.78	9.83	1.98	0.03	0.00	1.74	24.78
42	Malangawa	60.45	6.63	5.63	4.44	2.61	4.64	2.14	13.46
43	Mechinagar	70.19	12.87	11.93	0.92	1.73	0.00	0.86	1.50
44	Narayan	84.62	6.95	5.83	0.00	0.71	0.76	1.13	0.00
45	Nepalgunj	76.27	12.75	6.94	0.09	0.84	1.91	0.52	0.67
46	Panauti	82.95	7.82	5.06	0.00	0.00	1.78	0.47	1.93
47	Pokhara SMPC	62.65	8.80	11.61	4.54	5.74	2.21	2.82	1.63
48	Putalibazar	71.84	8.69	3.86	11.82	0.00	0.23	0.00	3.57
49	Rajbiraj	80.04	8.02	3.93	1.27	0.95	2.40	0.11	3.29
50	Ramgram	51.06	7.83	15.34	0.10	0.28	3.33	0.52	21.54
51	Ratnanagar	74.00	20.00	2.00	1.00	0.67	1.00	0.33	1.00
52	Siddharthanagar	64.15	16.54	15.22	2.09	1.99	0.00	0.00	0.00
53	Siraha	67.78	3.58	6.01	0.34	1.59	1.48	4.31	14.91
54	Tansen	44.18	10.25	10.11	6.40	5.06	3.86	3.63	16.52
55	Tikapur	61.77	9.10	12.87	3.64	6.26	6.36	0.00	0.00
56	Triyuga	55.55	4.75	18.25	0.50	3.81	2.75	2.13	12.26
57	Tulsipur	85.87	4.77	6.38	2.65	0.33	0.00	0.00	0.00
58	Waling	47.24	11.28	10.53	5.14	2.61	4.33	0.00	18.87
Average composition		**66.37**	**11.97**	**8.95**	**3.07**	**1.88**	**2.22**	**1.07**	**4.48**

MPC = metropolitan city, SMPC = submetropolitan city.
Source: Asian Development Bank.

APPENDIX 6

Composition of Institutional Waste in the 58 Municipalities (%)

	Municipality	Organic Waste	Plastics	Paper and Paper Products	Glass	Metals	Textiles	Rubber and Leather	Others
1	Amargadhi	13.36	13.14	63.74	1.12	5.68	0.98	1.06	0.92
2	Baglung	25.70	22.67	46.96	0.41	0.99	0.34	0.04	2.90
3	Banepa	15.13	31.17	42.75	2.47	3.90	0.24	4.33	0.00
4	Bhadrapur	16.52	5.72	77.76	0.00	0.00	0.00	0.00	0.00
5	Bhaktapur	30.35	18.77	29.35	2.95	3.15	3.46	1.68	10.29
6	Bharatpur	30.84	18.89	49.37	0.00	0.38	0.00	0.30	0.22
7	Bhimdatta	24.30	12.05	32.63	0.42	0.41	0.92	1.19	28.08
8	Bhimeshwor	11.74	4.97	46.21	0.00	0.12	0.12	0.00	36.83
9	Bidur	15.17	24.54	55.53	0.00	1.49	1.49	1.79	0.00
10	Biratnagar SMPC	41.56	19.48	35.49	0.00	1.54	0.39	0.00	1.54
11	Birendranagar	24.62	21.84	51.41	1.78	0.03	0.20	0.00	0.12
12	Birgunj SMPC	16.99	21.54	50.18	0.00	0.00	0.00	0.00	11.29
13	Butwal	24.48	17.32	29.55	0.00	0.35	2.36	2.58	23.37
14	Byas	42.11	21.02	29.90	1.63	0.69	0.72	0.61	3.33
15	Damak	38.04	12.16	20.95	0.02	8.00	1.66	0.61	18.56
16	Dasharathchanda	10.20	11.16	36.31	7.97	12.71	5.44	5.01	11.21
17	Dhangadhi	16.36	17.59	50.89	0.73	1.99	0.27	0.00	12.17
18	Dhankuta	16.90	20.80	40.25	0.00	0.46	0.00	0.46	21.12
19	Dharan	22.39	21.29	37.81	3.70	3.89	2.26	1.18	7.47
20	Dhulikhel	36.25	15.22	48.53	0.00	0.00	0.00	0.00	0.00
21	Dipayal Silgadhi	18.30	27.93	34.71	3.88	1.21	0.92	1.61	11.43
22	Gaur	22.42	6.59	21.87	4.44	0.00	0.00	0.00	44.68
23	Ghorahi	21.38	17.32	39.33	2.50	0.43	3.67	0.39	14.98
24	Gorkha	18.03	26.47	45.55	1.82	2.50	0.00	0.00	5.64
25	Gulariya	8.95	11.28	56.74	0.08	0.00	0.00	0.62	22.33
26	Hetuda	8.01	29.61	49.09	0.98	1.33	1.30	0.08	9.61
27	Ilam	60.10	6.83	16.34	1.96	0.97	0.88	0.82	12.10
28	Inaruwa	1.50	4.00	40.80	0.00	0.59	0.88	0.00	52.23
29	Itahari	25.64	24.90	40.13	2.95	0.00	0.00	0.00	6.38
30	Jaleshwor	17.09	35.70	46.44	0.77	0.00	0.00	0.00	0.00
31	Janakpur	11.23	25.58	43.38	0.00	0.00	0.00	0.00	19.81
32	Kalaiya	9.98	11.24	36.08	0.00	7.51	1.39	0.47	33.33
33	Kamalamai	12.28	17.48	50.12	4.54	1.93	0.00	1.74	11.91

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Appendix 6 Table *continued*

	Municipality	Organic Waste	Plastics	Paper and Paper Products	Glass	Metals	Textiles	Rubber and Leather	Others
34	Kapilvastu	0.00	16.63	83.37	0.00	0.00	0.00	0.00	0.00
35	Kathmandu MPC	20.29	24.55	44.28	1.37	1.13	3.89	1.14	3.35
36	Khandbari	4.94	22.70	58.79	0.91	1.18	3.18	0.99	7.31
37	Kirtipur	22.13	14.31	59.55	3.25	0.00	0.77	0.00	0.00
38	Lahan	27.95	14.30	50.87	0.01	1.17	0.00	0.52	5.19
39	Lalitpur SMPC	14.53	23.05	41.05	0.11	1.43	0.00	0.19	19.64
40	Lekhnath	11.19	11.51	48.58	6.17	1.92	0.00	2.39	18.24
41	Madhyapur Thimi	0.77	19.18	60.20	0.10	0.00	0.00	0.83	18.92
42	Malangawa	5.85	21.57	28.23	5.70	0.73	4.78	0.00	33.14
43	Mechinagar	24.74	15.32	44.62	5.65	0.00	0.00	3.89	5.78
44	Narayan	16.56	29.03	54.41	0.00	0.00	0.00	0.00	0.00
45	Nepalgunj	39.30	13.02	44.24	0.00	1.92	0.00	0.00	1.53
46	Panauti	33.67	16.54	44.43	0.07	0.00	3.01	0.65	1.63
47	Pokhara SMPC	26.19	8.14	65.35	0.00	0.00	0.00	0.00	0.32
48	Putalibazar	1.63	33.64	53.04	0.00	0.00	0.00	0.00	11.69
49	Rajbiraj	12.32	10.51	40.09	1.13	0.51	1.03	0.12	34.30
50	Ramgram	19.84	7.28	31.47	10.62	1.44	0.06	0.38	28.92
51	Ratnanagar	10.26	18.94	60.31	0.20	0.62	0.21	0.93	8.53
52	Sidharthanagar	1.08	23.21	75.71	0.00	0.00	0.00	0.00	0.00
53	Siraha	29.10	4.17	43.19	0.27	2.57	1.56	2.66	16.49
54	Tansen	22.92	11.25	24.05	5.16	1.91	4.02	3.75	26.94
55	Tikapur	27.92	19.16	47.00	0.00	4.60	0.00	0.00	1.32
56	Triyuga	10.89	14.34	67.24	0.00	3.21	1.46	0.45	2.41
57	Tulsipur	2.94	20.53	56.97	0.00	2.31	0.00	0.00	17.26
58	Waling	41.57	10.99	17.08	2.12	1.91	0.92	0.36	25.06
Average composition		**21.73**	**20.76**	**44.53**	**1.17**	**1.22**	**2.07**	**0.82**	**7.71**

MPC = metropolitan city, SMPC = submetropolitan city.
Source. Asian Development Bank.

APPENDIX 7

Composition of Commercial Waste in the 58 Municipalities (%)

	Municipality	Organic Waste	Plastics	Paper and Paper Products	Glass	Metals	Textiles	Rubber and Leather	Others
1	Amargadhi	35.13	19.28	27.43	15.11	2.92	0.03	0.12	0.00
2	Baglung	41.14	14.96	26.91	13.67	1.37	0.38	0.53	1.04
3	Banepa	41.28	17.47	23.89	8.08	2.62	0.00	0.81	5.86
4	Bhadrapur	24.35	61.71	11.99	0.00	0.00	0.00	0.00	1.95
5	Bhaktapur	38.73	21.29	18.03	2.14	6.20	0.73	0.37	12.51
6	Bharatpur	56.76	8.73	23.70	6.46	0.95	3.09	0.00	0.32
7	Bhimdatta	34.41	21.71	19.46	2.26	1.51	7.31	0.89	12.45
8	Bhimeshwor	25.04	35.20	16.66	5.79	0.00	0.21	0.00	17.12
9	Bidur	53.03	22.43	17.02	5.73	0.77	0.98	0.05	0.00
10	Biratnagar SMPC	58.53	18.86	19.11	0.00	0.00	0.00	2.18	1.32
11	Birendranagar	25.07	6.01	9.98	39.59	0.58	9.30	7.71	1.77
12	Birgunj SMPC	34.65	19.15	31.77	8.81	2.58	0.00	0.00	3.04
13	Butwal	41.08	20.77	19.67	6.67	1.60	0.00	0.00	10.21
14	Byas	47.24	15.85	21.56	5.98	3.19	3.43	1.19	1.55
15	Damak	52.04	11.34	17.48	0.64	6.44	0.35	3.02	8.70
16	Dasharathchanda	24.04	16.56	35.37	1.23	6.84	3.51	2.71	9.75
17	Dhangadhi	22.78	27.50	12.15	14.71	4.70	3.10	5.56	9.50
18	Dhankuta	37.93	17.42	21.07	0.00	4.16	8.15	0.00	11.28
19	Dharan	25.57	18.27	17.09	7.99	6.76	4.23	0.00	20.09
20	Dhulikhel	67.18	14.36	7.18	8.24	0.00	0.00	0.00	3.04
21	Dipayal Silgadhi	27.95	32.41	17.25	17.47	2.05	0.00	2.87	0.00
22	Gaur	46.32	9.68	15.44	0.00	0.00	0.00	0.00	28.57
23	Ghorahi	40.49	22.51	21.44	6.64	2.56	0.00	1.44	4.92
24	Gorkha	51.46	26.69	13.50	0.00	3.95	0.00	0.00	4.40
25	Gulariya	18.08	37.19	29.70	2.52	0.47	0.00	0.56	11.50
26	Hetuda	31.64	28.30	18.44	6.15	6.05	0.83	0.00	8.59
27	Ilam	56.13	14.04	11.73	2.41	5.05	3.04	4.11	3.50
28	Inaruwa	45.37	9.02	13.26	0.00	1.09	0.00	0.00	31.27
29	Itahari	23.13	36.17	30.41	0.53	2.52	2.63	0.00	4.61
30	Jaleshwor	38.23	51.00	7.85	0.00	0.00	0.00	2.92	0.00
31	Janakpur	38.62	22.82	28.38	0.00	0.00	0.61	1.52	8.06
32	Kalaiya	44.07	23.69	20.41	0.00	2.26	0.00	0.00	9.57
33	Kamalamai	37.54	17.04	29.36	7.07	1.02	0.00	0.00	7.96

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Appendix 7 Table *continued*

	Municipality	Organic Waste	Plastics	Paper and Paper Products	Glass	Metals	Textiles	Rubber and Leather	Others
34	Kapilvastu	46.04	24.28	21.34	0.00	0.00	0.00	8.34	0.00
35	Kathmandu MPC	45.44	24.29	23.29	2.86	2.65	1.03	0.00	0.45
36	Khandbari	29.20	20.89	32.31	5.36	4.07	3.29	0.19	4.69
37	Kirtipur	65.77	25.99	5.45	2.79	0.00	0.00	0.00	0.00
38	Lahan	42.46	33.41	14.96	0.72	4.98	0.00	0.00	3.48
39	Lalitpur SMPC	39.36	21.05	30.14	1.01	0.25	0.06	0.16	7.97
40	Lekhnath	33.59	19.50	32.45	6.05	0.98	0.00	0.00	7.43
41	Madhyapur Thimi	22.05	28.04	25.37	1.12	0.00	0.00	0.17	23.26
42	Malangawa	23.91	17.72	28.16	7.67	1.56	9.57	6.94	4.47
43	Mechinagar	32.91	24.65	31.85	1.33	4.08	0.00	1.26	3.93
44	Narayan	44.93	16.84	33.06	1.82	3.36	0.00	0.00	0.00
45	Nepalgunj	54.96	13.67	16.34	11.23	3.49	0.31	0.00	0.00
46	Panauti	36.09	47.55	14.16	0.91	0.00	1.30	0.00	0.00
47	Pokhara SMPC	47.23	12.60	24.68	6.14	1.44	6.95	0.13	0.84
48	Putalibazar	23.87	28.42	24.10	0.00	0.00	0.00	0.00	23.62
49	Rajbiraj	46.42	12.94	23.50	0.85	3.08	1.03	0.61	11.58
50	Ramgram	43.12	21.83	22.31	0.00	1.18	5.33	0.00	6.23
51	Ratnanagar	38.12	22.96	26.24	4.30	2.70	2.43	1.29	1.96
52	Sidharthanagar	37.44	47.14	15.13	0.00	0.30	0.00	0.00	0.00
53	Siraha	48.36	7.64	27.99	7.35	1.97	0.44	2.14	4.11
54	Tansen	46.49	10.80	24.53	3.36	1.57	0.20	0.29	12.76
55	Tikapur	28.40	18.44	33.05	5.58	9.27	5.27	0.00	0.00
56	Triyuga	51.93	13.90	17.49	1.49	0.00	6.13	0.00	9.08
57	Tulsipur	38.47	17.01	13.64	14.32	9.47	0.08	1.46	5.55
58	Waling	51.04	12.00	15.59	9.64	1.39	1.95	0.00	8.40
Average composition		**43.24**	**22.09**	**22.76**	**3.88**	**2.30**	**1.51**	**0.50**	**3.72**

MPC = metropolitan city, SMPC = submetropolitan city.

Source. Asian Development Bank.

APPENDIX 8

Solid Waste Management Systems in Municipalities

	Municipality	Types of Existing Collection Service			Collection Coverage and Frequency	Final Disposal Methods	Planning for Landfill Site in Near Future	Number of Existing Community Compost Plants	Number of Existing Municipal Compost Plants	Planned Municipal Compost Plant
		Roadside Container (Collection Depots)	Roadside Pick-Up from Open Piles	Door-to-Door Collection						
1	Amargadhi	Yes	Yes	No	Daily in wards 4, 5, and part of ward 1	Open dumping	No			No
2	Baglung	No	No	Yes	Thrice a week from 60% of urban area	Open dumping	Yes			Yes
3	Banepa	Yes	No	No	Twice a day in city area only	Open dumping	Yes			No
4	Bhadrapur	Yes	Yes	No	Daily in main city area, not in other areas	Riverside dumping	No			No
5	Bhaktapur	No	Yes	Yes	Twice a day in city area	Controlled dumping	No		2	Yes
6	Bharatpur	Yes	No	Yes	Daily in wards 2, 3, and 10; sometimes in wards 8 and 12	Open dumping	Yes			No
7	Bhimdatta	No	Yes	No	Daily only in urban area, especially ward 4	Open dumping	Yes			No
8	Bhimeshwor	Yes	Yes	Yes	Daily in wards 1, 3, 6, and 10; sometimes in other areas	Open dumping	Yes			No
9	Bidur	Yes	Yes	No	Daily from urban area such as Trisuli bazaar and Devighat, but thrice a month in rural area	Open dumping	No			No

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Appendix 8 Table *continued*

	Municipality	Types of Existing Collection Service			Collection Coverage and Frequency	Final Disposal Methods	Planning for Landfill Site in Near Future	Number of Existing Community Compost Plants	Number of Existing Municipal Compost Plants	Planned Municipal Compost Plant
		Roadside Container (Collection Depots)	Roadside Pick-Up from Open Piles	Door-to-Door Collection						
10	Biratnagar SMPC	Yes	Yes	Yes	60% of urban population covered	Open dumping	Yes	1	1	Yes
11	Birendranagar	Yes	Yes	No	City area (wards 6 and 8) covered	Open dumping and riverside dumping	Yes	1		Yes
12	Birgunj SMPC	No	Yes	Yes	Almost all areas covered	Open dumping and riverside dumping	Yes			Yes
13	Butwal	Yes	Yes	No	Almost all areas covered	Riverside dumping with wall around waste disposal area	Yes	1	1	Yes
14	Byas	No	Yes	Yes	Daily in wards 2, 3, 10, and 11; once a week in some parts of wards 1, 5, and 8	Riverside dumping	Yes			No
15	Damak	No	Yes	Yes	Coverage limited to urban area (8% of the total area but 65% of population): daily in core urban area (ward 11), twice a week in other areas	Riverside dumping	Yes			Yes
16	Dasharathchanda	Yes	Yes	No	Only city area (wards 1 and 2) covered	Open dumping	Yes			No
17	Dhangadhi	Yes	Yes	No	Twice a day in main city area	Riverside dumping	No			No

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Appendix 8 Table *continued*

	Municipality	Types of Existing Collection Service			Collection Coverage and Frequency	Final Disposal Methods	Planning for Landfill Site in Near Future	Number of Existing Community Compost Plants	Number of Existing Municipal Compost Plants	Planned Municipal Compost Plant
		Roadside Container (Collection Depots)	Roadside Pick-Up from Open Piles	Door-to-Door Collection						
18	Dhankuta	Yes	Yes	Yes	Daily in main urban market, twice to thrice a week in other urban main roads, twice a week in urban branch roads	Sanitary landfill site	–	1		No
19	Dharan	No	Yes	Yes	Daily in market area, which is about 5.28 km^2; once or twice a week in other areas	Riverside dumping	Yes	1		No
20	Dhulikhel	Yes	Yes	No	Daily in city area covering 95% of population	Open dumping	Yes			Yes
21	Dipayal Silgadhi	Yes	Yes	No	Coverage about 45% of the area	Open dumping in sloppy hills and jungle	Yes			Yes
22	Gaur	No	Yes	No	Daily in about 25% of urban areas (7% of population)	Open dumping and riverside dumping	Yes			Yes
23	Ghorahi	No	Yes	Yes	Only urban area (ward 10 and half of ward 11) covered (34% of population)	Sanitary landfill site				Yes
24	Gorkha	Yes	No	Yes	Daily in city area	Controlled dumping	Yes			No
25	Gulariya	No	Yes	No	Daily only in selected urban areas	Open dumping	No			Yes

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Appendix 8 Table *continued*

	Municipality	Types of Existing Collection Service			Collection Coverage and Frequency	Final Disposal Methods	Planning for Landfill Site in Near Future	Number of Existing Community Compost Plants	Number of Existing Municipal Compost Plants	Planned Municipal Compost Plant
		Roadside Container (Collection Depots)	Roadside Pick-Up from Open Piles	Door-to-Door Collection						
26	Hetauda	No	Yes	Yes	Daily in main urban area (wards 1, 2, 3, 4, 5, and 10); and once or twice a month in the remaining areas	Open dumping	No		1	No
27	Ilam	No	Yes	Yes	Daily in main city area	Open dumping	Yes			Yes
28	Inaruwa	Yes	Yes	No	Twice a week in urban area (wards 1, 2, 3, and 5)	Open dumping and riverside dumping	No			Yes
29	Itahari	Yes	Yes	No	Daily in main city area (wards 1, 4, and 8); twice a week in local street markets of wards 1 and 8; and thrice a week in some places in ward 5 (street markets)	Controlled dumping	Yes			No
30	Jaleshwor	No	Yes	No	Daily only in core urban area: 50% of urban area and 20% of rural area covered	Open dumping	Yes			No
31	Janakpur	No	Yes	No	Twice a day in core urban area	Open dumping	Yes			No
32	Kalaiya	Yes	Yes	No	Urban wards generally covered, occasionally in rural area	Riverside dumping	No			No

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Appendix 8 Table *continued*

	Municipality	Types of Existing Collection Service			Collection Coverage and Frequency	Final Disposal Methods	Planning for Landfill Site in Near Future	Number of Existing Community Compost Plants	Number of Existing Municipal Compost Plants	Planned Municipal Compost Plant
		Roadside Container (Collection Depots)	Roadside Pick-Up from Open Piles	Door-to-Door Collection						
33	Kamalamai	No	Yes	No	Daily in main urban area, once a week in other areas	Open dumping	Yes	3		Yes
34	Kapilvastu	Yes	Yes	No	Regularly in wards 1, 2, 3, and 5	Open dumping	No			No
35	Kathmandu MPC	Yes	Yes	Yes	More than 90% of area covered: daily in many places, twice to thrice a week in remaining areas	Sanitary landfill site	Yes (new site)		1	No
36	Khandbari	No municipal collection system					Yes			No
37	Kirtipur	Yes	Yes	Yes	…	Riverside dumping	Yes	1		Yes
38	Lahan	Yes	Yes	No	Regularly in market area	Open dumping	No			No
39	Lalitpur SMPC	Yes	Yes	Yes	Daily in some areas, once or twice a week in other areas	Sanitary landfill site	Yes (new site)			Yes
40	Lekhnath	No municipal collection system					Yes	1		Yes
41	Madhyapur Thimi	Yes	Yes	No	Daily in some areas, once or twice a week in other areas	Controlled dumping Transfer station for sanitary landfill	No			No
42	Malangawa	Yes	Yes	No	…	Open dumping	No			No
43	Mechinagar	Yes	Yes	No	Wards connected with highway covered	Open dumping	Yes		1	No

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Appendix 8 Table *continued*

	Municipality	Types of Existing Collection Service			Collection Coverage and Frequency	Final Disposal Methods	Planning for Landfill Site in Near Future	Number of Existing Community Compost Plants	Number of Existing Municipal Compost Plants	Planned Municipal Compost Plant
		Roadside Container (Collection Depots)	Roadside Pick-Up from Open Piles	Door-to-Door Collection						
44	Narayan	No	Yes	Yes	…	Open dumping	No			No
45	Nepalgunj	Yes	Yes	No	Daily in urban area and major roads	Open dumping	Yes			Yes
46	Panauti	Yes	Yes	No	…	Riverside dumping	Yes			No
47	Pokhara SMPC	No	No	Yes	Daily in core urban areas, once a week in outer core areas	Sanitary landfill site	–			Yes
48	Putalibazar	No	Yes	Yes	Regularly in only wards 1 and 4	Open dumping and riverside dumping	Yes			Yes
49	Rajbiraj	Yes	Yes	No	Only core city area covered	Road side piling	Yes			No
50	Ramgram	Yes	Yes	No	Only urban wards covered	Riverside dumping	Yes			No
51	Ratnanagar	No	Yes	No	Daily in urban area (wards 1, 2, and 8), twice a week in rural area	Controlled dumping	Yes			No
52	Siddharthanagar	Yes	Yes	Yes	Daily in urban areas, once a week in suburban areas	Riverside dumping	Yes			No
53	Siraha	No	Yes	No	…	Open dumping and riverside dumping	No			No
54	Tansen	No	Yes	Yes	Daily in urban wards, thrice a week in rural areas	Sanitary landfill site	–			Yes

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Appendix 8 Table *continued*

	Municipality	Types of Existing Collection Service			Collection Coverage and Frequency	Final Disposal Methods	Planning for Landfill Site in Near Future	Number of Existing Community Compost Plants	Number of Existing Municipal Compost Plants	Planned Municipal Compost Plant
		Roadside Container (Collection Depots)	Roadside Pick-Up from Open Piles	Door-to-Door Collection						
55	Tikapur	No	Yes	No	Daily from main market area in ward 9, once a week from remaining areas of ward 9	Open dumping	Yes			No
56	Triyuga	Yes	Yes	No	Daily in core urban area (ward 2 only)	Riverside dumping	Yes			Yes
57	Tulsipur	Yes	No	Yes	Only ward 5 covered	Open dumping	Yes			No
58	Waling	No	No	Yes	Regularly in urban area	Riverside dumping	Yes			Yes

… = not available, km^2 = square kilometer, MPC = metropolitan city, SMPC = submetropolitan city.

Source. ADB.

APPENDIX 9

Total Municipal Budget and Solid Waste Management Budget in the 58 Municipalities, Fiscal Years 2010–2012

SN	Municipality	Total Municipal Budget (NRs million)			Total SWM Budget (NRs million)			SWM Budget (% of total municipal budget)			
		FY2010	FY2011	FY2012	FY2010	FY2011	FY2012	FY2010	FY2011	FY2012	3-Year Average
1	Amargadhi	50.15	61.04	60.47	0.71	0.71	0.78	1.42	1.16	1.28	1.29
2	Baglung	71.21	65.00	70.23	10.74	2.56	5.27	15.09	3.94	7.50	8.84
3	Banepa	...	...	86.00	...	4.61	5.10	0	0	5.93	5.93
4	Bhadrapur	55.85	89.93	125.32	1.47	1.41	1.85	2.63	1.57	1.48	1.89
5	Bhaktapur	255.83	272.11	385.00	48.00	55.43	53.70	18.76	20.37	13.95	17.69
6	Bharatpur	...	...	...	...	...	...	0	0	0	0
7	Bhimdatta	...	...	...	5.50	5.50	5.50	0	0	0	0
8	Bhimeshwor	48.66	58.14	51.06	0.90	1.12	0.90	1.85	1.92	1.76	1.84
9	Bidur	62.10	52.80	68.05	2.45	2.70	4.20	3.95	5.11	6.17	5.08
10	Biratnagar SMPC	239.64	345.19	368.06	25.13	43.52	17.15	10.49	12.61	4.66	9.25
11	Birendranagar	82.47	90.97	99.07	2.80	2.90	3.49	3.40	3.18	3.52	3.37
12	Birgunj SMPC	...	258.93	317.14	...	58.75	59.02	0	22.69	18.61	20.65
13	Butwal	145.46	203.65	322.10	15.78	17.87	19.20	10.85	8.78	5.96	8.53
14	Byas	85.36	98.01	87.97	4.32	2.74	3.84	5.06	2.79	4.37	4.07
15	Damak	94.15	125.73	166.46	1.16	1.88	2.15	1.23	1.50	1.29	1.34
16	Dasharathchanda	65.57	49.91	64.50	0.20	0.25	0.70	0.31	0.50	1.09	0.63
17	Dhangadhi	97.69	125.67	1,534.95	2.40	...	...	2.46	0	0	2.46
18	Dhankuta	...	...	...	4.44	5.98	5.00	0	0	0	0
19	Dharan	177.59	217.38	240.07	8.44	8.73	12.67	4.75	4.02	5.28	4.68
20	Dhulikhel	71.39	76.84	112.72	1.20	2.28	3.23	1.68	2.97	2.86	2.50

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Appendix 9 Table *continued*

SN	Municipality	Total Municipal Budget (NRs million)			Total SWM Budget (NRs million)			SWM Budget (% of total municipal budget)			
		FY2010	FY2011	FY2012	FY2010	FY2011	FY2012	FY2010	FY2011	FY2012	3-Year Average
21	Dipayal Silgadhi	34.91	56.71	53.08	4.58	0.58	0.63	13.12	1.01	1.19	5.11
22	Gaur	76.22	57.67	74.53	1.42	3.66	4.10	1.86	6.35	5.50	4.57
23	Ghorahi	71.22	79.82	99.73	6.00	8.00	8.50	8.43	10.02	8.52	8.99
24	Gorkha	...	...	76.84	...	0.24	...	0	0	0	0
25	Gulariya	5.43	8.05	75.03	0.43	0.65	...	7.96	8.05	0	8.00
26	Hetauda	0.00	0.00	225.86	9.86	9.05	10.00	0	0	4.43	4.43
27	Ilam	68.60	86.59	75.30	2.92	2.54	3.44	4.26	2.94	4.57	3.92
28	Inaruwa	52.00	53.69	66.05	0.90	1.40	2.06	1.73	2.61	3.12	2.49
29	Itahari	74.25	101.01	128.52	5.74	9.81	8.40	7.73	9.71	6.54	7.99
30	Jaleshwor	54.34	70.69	84.68	0.42	0.14	0.62	0.77	0.20	0.74	0.57
31	Janakpur	143.88	166.09	163.01	9.19	9.25	10.35	6.38	5.57	6.35	6.10
32	Kalaiya	65.87	62.86	49.18	5.17	4.61	4.10	7.85	7.33	8.33	7.84
33	Kamalamai	100.82	104.89	89.73	0.38	0.46	1.05	0.38	0.44	1.17	0.66
34	Kapilvastu	57.43	69.35	0.00	1.20	1.51	...	2.09	2.17	0	2.13
35	Kathmandu MPC	1,212.85	947.41	1,900.00	278.61	253.13	443.10	22.97	26.72	23.32	24.34
36	Khandbari	63.47	55.65	...	...	0.04	...	0	0.07	–	0.07
37	Kirtipur	...	...	122.41	2.41	2.51	2.50	0	0	2.04	2.04
38	Lahan	50.16	45.03	591.43	3.63	3.60	...	7.23	8.00	0	7.61
39	Lalitpur SMPC	234.95	433.82	558.69	13.11	22.17	31.22	5.58	5.11	5.59	5.43
40	Lekhnath	89.67	108.41	128.71	...	...	...	0	0	0	0
41	Madhyapur Thimi	...	...	162.54	2.97	...	3.26	0	0	2.00	2.00
42	Malangawa	32.97	22.25	93.07	1.62	2.14	3.05	4.90	9.63	3.28	5.93
43	Mechinagar	103.51	123.55	139.06	1.50	1.99	2.95	1.45	1.61	2.12	1.73
44	Narayan	...	...	63.18	...	...	...	0	0	0	0
45	Nepalgunj	96.49	116.20	151.11	5.10	1.63	20.62	5.28	1.40	13.64	6.78
46	Panauti	155.05	130.89	98.55	1.02	3.65	1.68	0.66	2.79	1.70	1.72
47	Pokhara SMPC	273.04	322.25	368.58	24.50	28.60	30.33	8.97	8.88	8.23	8.69

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Appendix 9 Table *continued*

SN	Municipality	Total Municipal Budget (NRs million)			Total SWM Budget (NRs million)			SWM Budget (% of total municipal budget)			
		FY2010	FY2011	FY2012	FY2010	FY2011	FY2012	FY2010	FY2011	FY2012	3-Year Average
48	Putalibazar	39.19	49.13	80.26	1.20	1.80	1.75	3.06	3.65	2.18	2.96
49	Rajbiraj	41.59	54.86	105.30	3.63	2.61	3.80	8.73	4.76	3.61	5.70
50	Ramgram	55.22	62.55	62.93	0.50	0.61	0.80	0.90	0.98	1.27	1.05
51	Ratnanagar	70.68	88.34	92.33	1.54	2.88	2.95	2.18	3.26	3.19	2.88
52	Siddharthanagar	108.92	125.68	150.59	4.58	5.35	6.53	4.21	4.26	4.34	4.27
53	Siraha	70.40	67.53	54.05	0.35	0.40	0.50	0.50	0.59	0.93	0.67
54	Tansen	21.55	32.54	74.61	2.45	2.76	4.20	11.36	8.50	5.63	8.49
55	Tikapur	67.46	...	...	0.10	...	...	0.14	0	0	0.14
56	Triyuga	79.55	119.90	107.40	1.12	1.43	1.50	1.41	1.19	1.40	1.33
57	Tulsipur	48.51	54.13	96.56	2.00	3.00	1.25	4.12	5.54	1.29	3.65
58	Waling	42.22	46.47	51.57	0.43	0.31	0.55	1.01	0.66	1.07	0.91
Total/average value		**5,365.54**	**6,115.28**	**10,673.67**	**536.21**	**611.43**	**819.52**	**9.99**	**10.00**	**7.68**	**9.22**

... = not available, FY = fiscal year, MPC = metropolitan city, SMPC = submetropolitan city, SWM = solid waste management.
Source: Asian Development Bank.

Solid Waste Management in Nepal
Current Status and Policy Recommendations

Managing solid waste is one of the major challenges in urbanization. A survey conducted in all 58 municipalities of Nepal in 2012 found that the average municipal solid waste generation was 317 grams per capita per day. This translates into 1,435 tons per day or 524,000 tons per year of municipal solid waste generation in Nepal. Many of these technically and financially constrained municipalities are still practicing roadside waste pickup from open piles and open dumping, creating major health risks. The report identifies eight key policy recommendations: (i) development of policy, strategy, and guidelines; (ii) promotion of reduce, reuse, and recycle (3R); (iii) strengthening the capacity of local bodies; (iv) public participation and consultation; (v) cost recovery; (vi) improvements toward integrated management; (vii) public–private partnership; and (viii) data management, updating, and dissemination.

About the Asian Development Bank

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