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Nepal: Capacity Building for Waste Management

Prepared by

IPE Global Private Limited in association with
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Asian Development Bank

Status of Solid Waste Management in 58 Municipalities of Nepal

Solid Waste Management Baseline Study Report

July 2012

Preface

The SWM baseline study team conducted the survey in 58 municipalities of Nepal in April to May 2012 during the dry season under the direct supervision of a project coordinator from Solid Waste Management Technical Support Center (SWMTSC) with financial assistance of Asian Development Bank (ADB). A group of environmental officers with sufficient knowledge in subject matters and research experience were employed for the fieldwork under the supervision of supervisors, team leader of SWM baseline study and candidate municipality.

The objectives of the study are to conduct the systematic and comprehensive study of quantification of municipal waste and its composition and to compile factual information on the state of solid waste management in the 58 municipalities of Nepal. The information collected from the 58 municipalities was analyzed and documented in the form of this report. In addition, the field reports of 58 municipalities have been prepared to provide detail information of each municipality.

The outputs of this study can be helpful to the SWMTSC and municipalities for formulating appropriate and sustainable waste management plans to implement the SWM Act 2011. The SWM baseline data collected by this survey have to be updated and refined regularly in future through further research and analysis.

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SWM Baseline Study

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Appreciation is extended to National Program Director of ADB TA and Head of Environmental Section of Ministry of Federal Affairs and Local Development.

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I am very thankful to Keshav Parajuly and Yogesh Shakya, the supervisors of the SWM baseline study team for their sincere and continuous supervision and review of field reports of 58 municipalities. Thanks are due to Keshav Parajuly for a critical reading of this report, which helped to improve the quality of the report. I am thankful to Bal Krishna Khadka, consultant statistician in his efforts for supporting to design standard questionnaire, SWM baseline training and sampling for survey. He analyzed and presented the information in a standard format as well as contributed to prepare this report. My sincere thanks also go out to data entry staffs for their sincere efforts and passion. Thanks are due to following environmental officers who devoted their time and effort into conducting the field study, collecting the necessary information and preparing the field report of the assigned municipality.

At last, but not least, special thanks also go to ERMC (P) Ltd., Kathmandu and its partner organizations for their timely logistic arrangements throughout the project period.

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Executive Summary

Increasing unplanned urbanization, poor management along with user's mind-set of 'out of sight out of mind' of wastes have intensified environmental pressures including unorganized waste disposal in many municipalities of Nepal. Thus, solid waste management (SWM) has become a major concern for the municipalities and towns of Nepal. However, executing authorities such as Solid Waste Management Technical Support Center (SWMTSC) and Local Governments (LGs) including municipalities are having trouble in developing management plans and in decision making while addressing the emerging issues due to the lack of the SWM baseline information and data related to the functional elements of SWM.

The goal of the SWM baseline study was to conduct the systematic and comprehensive study of quantification of municipal waste and its composition and to compile factual information on the state of solid waste management in the existing 58 municipalities of Nepal. The study also identified the status and background information on the municipal solid waste, management practices, problems and future prospects in the municipalities.

The SWM baseline study team conducted the survey in 58 municipalities of Nepal in April to May 2012 during the dry season. A total of 64 field surveyors with sufficient knowledge in subject matters and research experience were employed for the fieldwork under direct supervision of supervisors, team leader of SWM baseline study and candidate municipality. The waste quantity and quality survey with sample size of 3,233 households, 627 institutions (schools/colleges/offices) and 627 commercial establishments (shops/hotels/restaurants) were undertaken by employing random (probability) sampling technique. In addition to waste quantity and quality survey, separate sets of questionnaires were developed for household and municipality to collect and to update SWM related information of different aspects.

The total sample size of 3233 households from 58 municipalities, varying from the minimum 50 households to 220 households gave an average per-capita household waste generation figure of 170 gram/capita/day. This study also uncovered that the household waste generation rates were varied depending upon the economic status and climatic condition. In case of institutional establishments, the average daily waste generation was 1.4 kg per school and 2.5 kg per office. Similarly, the average daily waste generation from shops and hotel/restaurant was found to be 1.4 kg per shop and 5.7 kg per hotel/restaurant respectively.

Based on our analysis and findings, it can be estimated that, as the household waste in general contributes to about 50 to 75% of the total municipal waste generation depending upon the municipality. Thus, the per-capita municipal waste generation, as per survey results, was found to be 318 gram/capita/day. Based on these per-capita waste generation figures and population for the year 2011, the total municipal waste generation of 58 municipalities was found to be more than 525, 000 tons/year.

The analysis of household waste composition indicated that the highest waste fractions were organic matter (65%) followed by plastics (11%). Paper and paper products and others comprised 9% and 7% of the waste respectively. Glass, metal, rubber and leather, textile components all were at or below 3%. The composition analysis of institutional waste revealed 19% organic wastes, 18% plastics, 45% paper and paper products, 12% others with glass, textiles, metals and rubber/leather all below or at 2%. Similarly, the composition of commercial waste was made up of 40% organic wastes, 21% paper and paper products, 22% plastics, 7% other wastes, 5% glass, 2% textiles, 2% metals and 1% rubber and leather.

The study uncovered that about 30% of surveyed households in the municipalities were practicing segregation of waste at the source and composting in traditional ways. Such practices were found mainly in rural area of municipalities. Beside the household level composting, community or municipal level composting plant could be found to some extent and some are in planning phases in some municipalities. Analyzing the information provided by municipalities, the present collection efficiency ranges between 70 to 90% in major cities, whereas in several smaller cities it is below 50%. Only 6 municipalities use sanitary landfill site for final disposal but dumping in riverbanks, depressed land/dumps, open pit or temporary open piles are the ways of final disposal to the remaining municipalities.

Of total 58 municipalities, 17 municipalities do not have designated section to look after SWM. In these municipalities, either the municipality is not providing any waste management services at all or the municipality has a few sweepers who work under the ward offices or one of the other units. Of the total budget, the municipalities spend an average of 10% for SWM, in which nearly 60-70% towards street sweeping and collection, 20-30% on transportation.

The findings of this study showed that the household waste of all municipalities, in general, is good viable for producing compost. It also revealed that, in case if all compostable and reusable/recyclable wastes could be utilized to their potentials, less than 10% waste in more than 40 municipalities would have to be finally disposed to landfill site. Moreover, the outputs of this study can be used for implementing proper waste disposal and management plans and practices for recovery of resources before deciding on the appropriate method of its disposal.

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CHAPTER I

1 Introduction

1.1 Background

Solid Waste Management (SWM) is one of the major environmental issues particularly in municipalities of many developing countries like Nepal that suffer from serious pollution problems. Urban population growth and economic development are considered vital for Municipal Solid Waste (MSW) generation, as these factors not only accelerate consumption rates but also increase waste generation (Alamgir et al., 2005). The migration is creating unplanned urbanization and these areas produce a lot of unmanageable quantities of solid waste in all major municipalities and cities of Nepal. Increasing unplanned urbanization along with user's mind-set of 'out of sight out of mind' of wastes have intensified environmental pressures including unorganized waste disposal in many municipalities of Nepal. In addition to these, the use of the products that produces hazardous waste is another concern. Unmanaged disposal of medical wastes generated from the hospitals and clinics are also contributing to the pollution and health hazards in the localities. Thus, SWM has become a major concern for the municipalities and towns of Nepal.

Although, SWM is one among the basic services provided by municipalities to keep urban centers clean, and there is a need to develop appropriate SWM system in order to prevent future environmental health problems (LGSA, 1999; SWMA, 2011), managing solid waste is a low priority mainly because the demand is higher for other public services in many municipalities of Nepal. As provisioned in solid waste management act 2011, Solid Waste Management Technical Support Centre (SWMTSC) shall provide technical support to all local governments (LGs) for effective and sustainable SWM with the advancement of research and development (R & D) in this sector. However, executing authorities such as SWMTSC and LGs including municipalities are experiencing difficulties in developing management plans and in decision making while addressing the emerging issues due to the lack of SWM baseline information and data related to the functional elements of SWM. It is essential to know the composition and characterization of solid waste for implementing proper waste disposal and management plans and practices for recovery of resources before deciding the appropriate method of its processing and disposal.

Previous studies have been conducted to collect SWM baseline information, but most of those were limited to Kathmandu Valley's municipalities (Dangi et al., 2011, 2009; Manandhar, 2005; Nippon Koei Co. Ltd. and Yachiyo Engineering Co. Ltd., 2004). A nationwide SWM baseline study in all 58 municipalities of Nepal was carried out by Solid Waste Management & Resource Mobilization Center (SWMRMC) in 2003 (SWMRMC, 2004). It was the first attempt to conduct SWM baseline study in national level. SWMRMC

has made effort to update these data in different time windows over the period of 2004 to 2009; however, these reports on waste quantities are incomplete due to the lack of scientific and systematic methodology. Despite these efforts, few studies were carried out in solid waste quantity and quality in few municipalities (SEAM-N, 2009). However, the findings of the previous studies are not consistent in waste quantity and quality in municipalities due to the lack of consistent scientific methods, the assumptions made to quantify the waste generated from different sources.

This study was intended to conduct the systematic and comprehensive study of quantification of municipal waste and its composition and to compile factual information on the state of solid waste management in the 58 municipalities of Nepal. The study also identified the current status and background information on the MSW, management practices, problems and future prospects in the municipalities.

1.2 Geographical distribution of municipalities

The geographical distribution of these cities and towns as per development region and ecological zones is as shown Table 1-1. Table 1-1 indicates that the municipalities are concentrated in on eastern and central development regions in Terai rather than the hilly-mountain areas. Of total municipalities, 31 municipalities are located in Terai whereas 25 municipalities lie in hilly region and only 2 municipalities in Mountain Region. The Terai in the EDR has ten municipalities whereas FWDR has only three municipalities in the Terai area. However, the hilly-mountain area in the CDR has ten municipalities whereas the same region in the MWDR has only two municipalities despite of its greater geographical coverage.

The physical factors such as altitude, temperature, rainfall, humidity as well as socio-economic factors such as population, economic status and consumption patterns etc. are varied from one region to others. These factors influence the waste generation, characteristics as well as treatment and final disposal technologies of waste. This analysis provides a basis for the comparison of the various indicators describing the state of solid waste management in the municipalities of different regions and finally helps to recommend appropriate waste treatment and management approach.

Table 1-1 Geographical distributions of the municipalities

Development region	Ecological region	Municipality	No. of municipalities
Eastern Development Region	Mountain	Khandbari	1
	Hill	Ilam, Dhankuta, Triyoga	3
	Terai	Damak, Inaruwa, Bhadrapur, Itahari, Siraha, Biratnagar, Rajbiraj, Lahan, Dharan, Mechinagar	10
Central Development Region	Mountain	Bhimeshowr	1
	Hill	Panauti, Kirtipur, Thimi, Bidur, Banepa, Dhulikhel, Kathmandu, Bhaktapur, Lalitpur	9
	Terai	Malangawa, Bharatpur, Hetauda, Janakpur, Gaur, Ratnanagar, Birgunj, Kalyaiya, Jaleshowr, Kamlamai	10
Western Development Region	Hill	Putalibazar, Lekhnath, Gorkha, Vyas, Waling, Pokhara, Tansen, Baglung	8
	Terai	Butwal, Kapilbastu, Ramgram, Siddharthanagar	4
Mid-western Development Region	Hill	Birendranagar, Narayan	2
	Terai	Gularia, Nepalgunj, Tulsipur, Ghorahi	4
Far-western Development Region	Hill	Amargadhi, Dasharathchand, Dipayal-Silgadhi	3
	Terai	Bhimdatta, Dhanghadi, Tikapur	3

Total Mountain = 2; Total Hill = 25; Total Terai = 31

1.3 Land use pattern

The municipalities cover about 2.25% of the total area of country. The smallest municipality in terms of area coverage seems to be Banepa with an area of 6.07 square kilometer (sq km) and the largest one is Triyuga of Udayapur district with an area of 322 sq km (Annex A/Table1). The figures indicated that the highest built-up area was found to be 36 sq km in Kathmandu Metropolitan City (KMC). Land use pattern is an important factor in solid waste management as the solid wastes generated in rural areas are normally managed locally.

1.4 Urban-rural setting

For purpose of this SWM baseline study, area of each municipality was categorized into urban and rural wards. Ward is the smallest administrative unit of each municipality. The urban ward is referring to those areas having higher population density with intense commercial and industrial activities. The rural wards in the municipalities are those areas of lesser population density with no commercial activities. Of total 58 municipalities, only few municipalities like Kathmandu valley's municipalities, Biratnagar have no rural wards, whereas Bhimdutta has 17 rural wards in total 19 wards. Similarly other many municipalities like, Kamalamai, Kapilbastu, Triyuga, Dashrathchand, Gulariya, Khadbari etc., are dominated by rural wards.

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

1.5 Demographic information

Nepal has 58 municipalities having a population of 4.5 million that accounts for 17% of the total population in the country. Among the municipalities, the Kathmandu Metropolitan City constitutes the largest population of 1,006,656 followed by Pokhara, Lalitpur and Biratnagar Sub-Metropolitan City. Dhulikhel has the lowest population, 16,406, among the municipalities followed by Dasharath Chand, Bhadrapur and Ilam municipalities (CBS, 2011). These municipalities can be classified in 4 groups as under:

Table 1-2 Classification of municipalities based on population (Source: CBS, 2011)

Population range	No. of municipalities	Total population
> 100000	10	2419273
50000 - 100000	17	1193935
25000 - 50000	22	721400
< 25000	9	186842
Total	**58**	**4521450**

Biratnagar, Birgunj, Bharatpur, Bhim Dutta, Butwal, Dhangadhi, Dharan, Kathmandu, Lalitpur and Pokhara having a population above 100,000 which account more than 50% of the total municipalities' population. Similarly, the municipalities having population less than 25,000 are 9 which include Amarghadi, Bhadrapur, Bhimeshwor, Dasharath Chand,

Dhulikhel, Ilam, Jaleshwor, Narayan and Waling. The population of the rest of the municipalities lies between 25,000 and 100, 000 as given in Annex A/Table 1.

1.6 Objectives of study

The main objectives of this study are to determine the municipal waste generation and its composition in the municipalities of Nepal and to present status, practices and issues of SWM in 58 municipalities of Nepal.

The specific objectives of the study are:

- to determine the per capita household waste generation, amount and the different waste composition;
- to estimate the quantity of institutional and commercial waste generation and their composition;
- to estimate the average per capita municipal waste generation and its total quantity;
- to exhibit the current practices of municipal waste in 58 municipalities in terms of segregation, collection, treatment and final disposal;
- to assess the level of services and allocation of financial and human resources in SWM;
- to study current policies, regulations related to SWM; and
- to analyze the information, identify the focal areas for improvement and to provide recommendations in relation to the status-quo and issues of municipal solid waste management.

1.7 Study limitations

Although the study covers municipal solid waste quantity and quality survey, vegetable waste, street waste etc., waste generated from parks/gardens and treated hospital waste were not accounted in the study even they are considered as MSW. Moreover, industrial and hospital waste were not considered though they are not MSW but go to the MSW stream with partial or no treatment in many municipalities of Nepal.

Small sample size and one time sampling of waste generation may vary average value, difficulty for estimation of total institutional and commercial waste quantity was still remained because the data obtained were fluctuated and the statistics of commercial and institutional sources were not also updated.

The rapidly changing political situation in Nepal in the April/May of 2012 has disrupted the SWM survey in few municipalities. However, survey was resumed when situation became favorable.

2 Study methods

2.1 Study area, type of waste and composition

The SWM baseline study was conducted to 58 municipalities of Nepal. Location of the 58 municipalities is given in Figure 2-1.

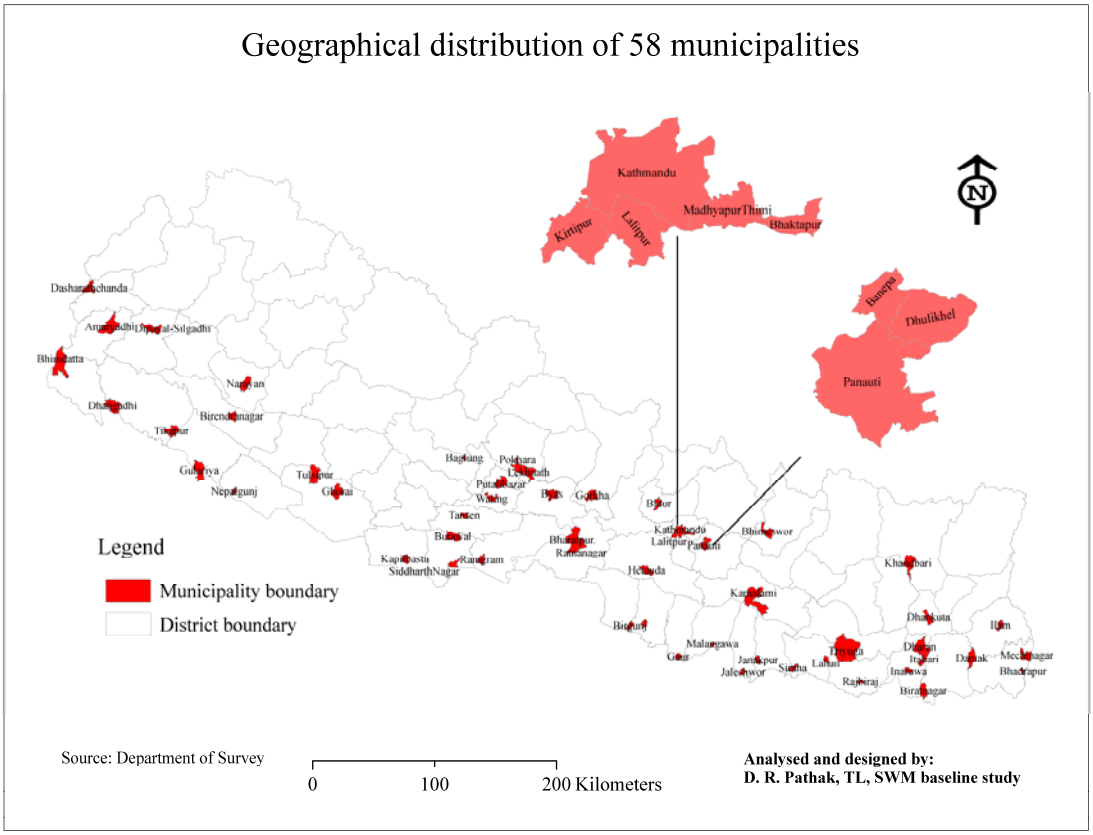

FIGURE 2-1 LOCATION OF 58 MUNICIPALITIES

The households, commercial establishments, institutions, industries, health institutions, etc are the potential waste generators in the municipality. However, this SWM baseline study covers the households, commercial and institutional establishments as waste generators in existing 58 municipalities of the country. Solid waste survey for composition of 58 municipalities was sorted out as:

- Organic waste
- Plastics
- Paper and paper products
- Textile
- Rubber and Leather

- Metals
- Glass
- Others (inert materials etc.)

2.2 Sampling and survey design

The study covers 58 municipalities with sample size of 3,233 households, 627 institutions/offices and 627 commercial establishments (shop/hotel/restaurant) which were undertaken by employing random (probability) sampling technique. This size of sample produces results with +/-1.7 percent of the error margin at a 95 percent confidence level at the national level[1].

2.2.1 Household sampling

Sampling for the selection of respondents was done in four stages. The sampling framework is outlined in brief below in Figure 2-2.

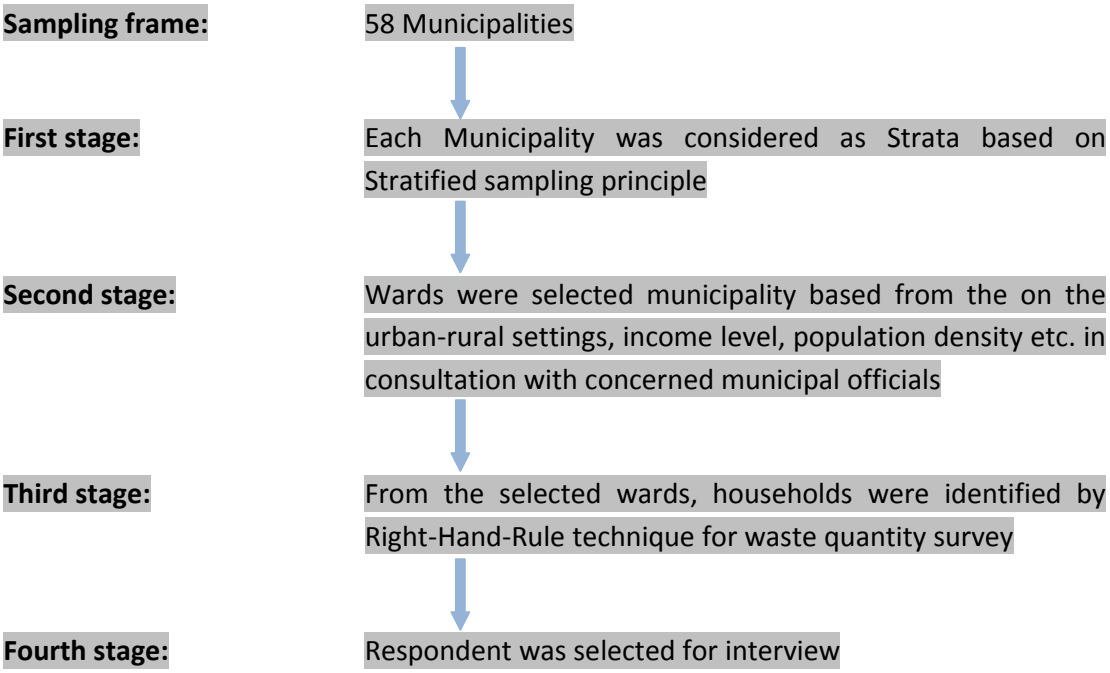

FIGURE 2-2 SAMPLE DESIGN FOR HOUSEHOLD WASTE QUALITY AND QUANTITY SURVEY

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

[1]Statistically, error margin is the range within which the result may vary and still be acceptable; confidence level indicates the probability that the result will fall within that range. The 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 Rs. 4000, confidence level is 95% and error margin is +/- 4%, then the true value will be no less than Rs. 3840 and no more than Rs.4160, in that result the researcher have 95% confidence.

proportional to size (PPS) sampling technique (i.e. greater the stratum size; greater the sample size). However, the minimum sample size for each stratum was determined to 50 households.

In the second stage, proportional numbers of wards were selected from every municipality mainly based on the urban-rural settings, income level, population density etc. in consultation with concerned municipal officials. The numbers of sample wards vary according to the size of the municipality. One ward was selected for every 10 households: for example, if 100 households are to be selected from a municipality, ten wards, each with the minimum 10 households, could be selected. In this study, 220, 150 and 100 households were selected in KMC, LSMC and Bhaktapur municipality while the minimum 50 households were selected from rest of the municipalities.

In the third stage, households in each sample ward were selected randomly by employing the Right-Hand-Rule technique[2]. Finally, in the fourth stage, household head, if possible, was selected as respondents for interview who can provide information about solid waste management practices.

2.2.2 Sampling of Institution and commercial establishment

Waste quantity and quality survey of Institutional and commercial establishment were also conducted simultaneously. A total of 627 schools or Non/government offices were selected. These institutional establishments spread across the 58 municipality of country. The minimum five schools and five Non/government offices were selected from every municipality. Generally, the similar wards that were identified for household survey were also chosen for sampling of institution (office) and commercial establishment. One school and one office (government/non-government or private) from each ward were selected, except for wards where school or office was not available. In such case, two or more than two schools or offices were sampled from a single ward.

Similarly, 627 shops or hotel/restaurants were selected for waste quantity and quality survey. These 627 shops and hotel/restaurants were spread across the 58 municipality of country. The minimum five shops and hotel/restaurants were selected from every municipality. One shop and one hotel/restaurant were randomly selected from each ward.

[2] The starting points for the "Right-Hand-Rule" are recognizable locations such as schools, crossroads, *Chautaras*, bazaars etc. At first, interviewers start to walk towards any direction randomly from a starting point counting number of households at the same time. If it is less than 20, an interviewer will select the first 10 households on the right hand side of his/her route. If it is between 20 to 29, an interviewer will select the first household and then select each 3rd household on the right hand side of the interviewer route until he/she covered 10 households. If it is 30 or more than 30, an interviewer will select the first household and then select each 4th household on the right hand side of the interviewer route until s/he covers 10 households.

Sampling for the selection of institutions (school/colleges/offices) and commercial establishments (shop/hotel/restaurant) were done in four stages. The sampling framework is outlined in brief below in Figure 2-3.

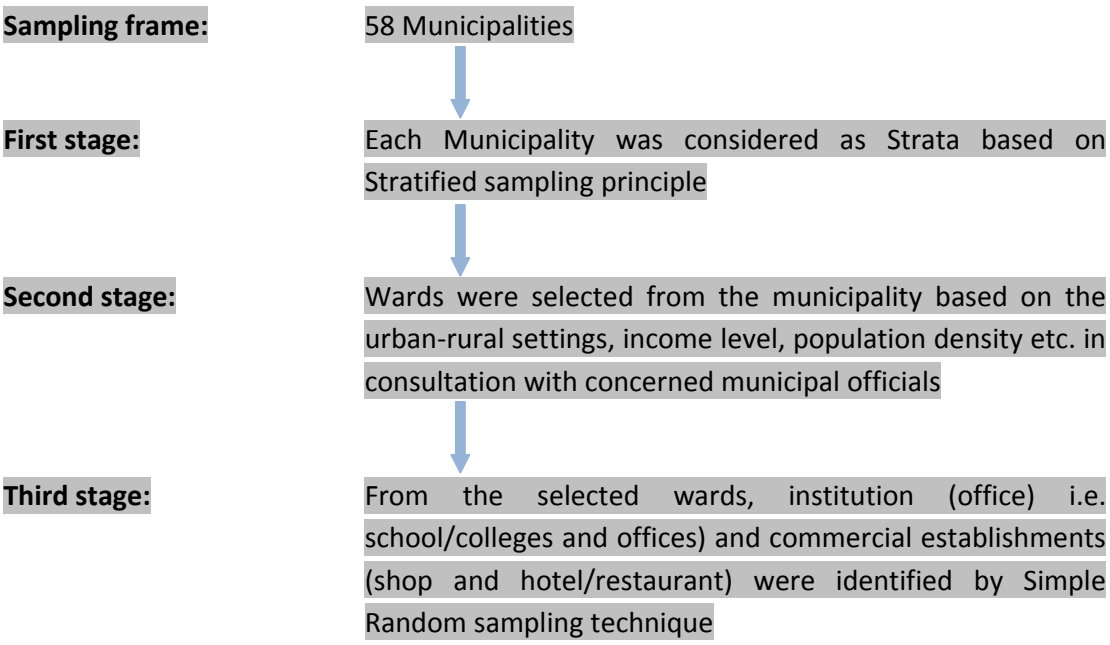

FIGURE 2-3 SAMPLE DESIGN FOR INSTITUTIONAL AND COMMERCIAL WASTE CHARACTERIZATION SURVEY

2.3 Recruitment, training and equipment

In the first stage, a total of 68 graduate students or research assistants of Environmental Engineering or Science or Management from Tribhuvan, Kathmandu and Pokhara University and National Academy of Science and Technology (NAST) were selected as SWM baseline surveyors. In the selection of field surveyors, people that are well conversant in the both language Nepali and English as well as local languages were given preference. Before deploying the field surveyors in the field, a two-day orientation training program was conducted, held on 9th to 10th April, 2012. In this training, overall framework, approach and objectives of the baseline survey was shared along with descriptions about waste collection and characterization methodology. They were also briefed about the structured questionnaire so that they become fully familiar with the intention of each of the question. They were instructed on how to add clarification to a question and encourage the respondents if they are confused or hesitant to answer during the interview. To test their capacity, a mock-survey was conducted among themselves during the course of the training. The field supervisors were provided a special training on field supervision. The detail of 2-day training program can be found in the proceedings given in Annex B.

Out of 68 participants, a total of 64 participants successfully completed training programs. Upon completion of the training, surveyors were assigned to conduct SWM baseline study in each municipality based on lottery system. A surveyor was assigned in each municipality except Kathmandu Metropolitan City (KMC), Lalitpur Sub Metropolitan City (LSMC) and Bhaktapur municipality. The four surveyors engaged in KMC whereas three and two surveyors were involved in LSMC and Bhaktapur municipality respectively. All the surveyors engaged in SWM baseline study were provided with hand gloves, dust masks, digital weighing machine, 7 sets of pre-designed questionnaires and record sheets.

2.4 Field survey and data collection

2.4.1 Field study

The SWM baseline study team conducted the survey in 58 municipalities of Nepal in April to May 2012 during the dry season. Field surveyors with sufficient knowledge in subject matters and research experience were employed for the fieldwork under direct supervision of supervisors, team leader of SWM baseline study and candidate municipality. Surveyors had spent the minimum 10 nights to complete their field study in their assigned municipality.

Due to the difficulty of handing waste from more than 3200 households and 1200 institutions or commercial establishments of 58 municipalities with limited resources and time as well as based upon the findings of Nippon Koei Co. Ltd. and Yachiyo Engineering Co. Ltd. (2005) and Dangi et al. (2008) in municipalities of Kathmandu valley, this study utilized a one-day sampling of waste. The findings of Nippon Koei Co. Ltd. and Yachiyo Engineering Co. Ltd. (2005) are presented in next chapter.

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 and not by the number of rooms or house types. During the survey, the surveyors informed each households, commercial sectors, government and non-government institutions and educational institutions that their wastes generated in a 24 hour period would be analyzed and provided waste collection bags. The surveyors collected the waste the next day to measure quantity (in wet weight basis) of the eight different wastes mentioned in subsection 2.1.

2.4.2 Standard questionnaires

A pre-coded structured questionnaire was formulated with the help of experts within the team. The separate set of questionnaires was developed for household and municipality to collect and to update SWM related information of different aspects. Length of the questionnaire was also considered in such a way that its administration in the field would not take more time. The questionnaire was formulated in English and the English version was used for administering. The enumerator actually translates the questionnaire in Nepali during the interview process.

A pre-test was carried out and the questionnaire fine-tuned before actually administering it in the field.

2.5 Data analysis techniques

Upon completion of the field survey in 58 municipalities, data was analyzed using CS-Pro, SPSS and MS Excel. In order to maintain the data clean, legal codes, authorized range check, consistency check and extreme case check systems was developed in the data entry program. After the completion of the data entry, the data was imported to SPSS where analysis and presentation in a tabular form was performed. After the analysis, the data was imported in the MS Excel to produce necessary charts and graphs.

2.6 Quality assurance and quality control

To make the SWM baseline study results more accurate and realistic, different quality assurance and quality control procedures were carried out during period of whole study. The qualified and competitive surveyors, who have sufficient knowledge in subject matters and research experiences, were selected to conduct this study. The questionnaires were designed in simple and understandable format to get the detail information of various aspects of SWM. Before deploying in the field, the surveyors were fully trained during the 2-day training with sufficient field exercises. To make accurate and realistic measurement of waste, digital weighing machine were provided to each surveyor. All the municipalities were informed about the SWM baseline study along with the details of terms of references (ToR) of surveyor. Each surveyor had carried out his/her field survey in direct consultation and direct supervision under concerned municipal officials of assigned municipality. Moreover, municipalities were requested to provide recommendation letter to ensure whether surveyors were fully engaged in their field study to assigned municipality. The supervisors from SWM baseline study team had supervised and provided 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 case of unrealistic waste quantity observed.

CHAPTER III

3 Municipal solid waste generation and composition

3.1 Household waste generation

The wards in this study were chosen mainly based on the urban-rural settings, income level, population density etc to quantify the realistic representative average per capita waste generation in each municipality. The per capita waste generation of each household was calculated by dividing the total waste produced with the number of people living in that household that day. The clusters were chosen based on urban-rural settings, population density and economic status in each municipality where the representative households were selected randomly by employing the Right-Hand-Rule technique. The total sample size of 3233 households from 58 municipalities, varying from the minimum 50 households to 220 households gave an average per-capita household waste generation figure of 170 gm/capita/day. This study also showed that the household waste generation rates were varied depending upon the economic status. Figure 3-1 showed that households those have higher average expenditures also have generated higher amount of waste per day. It is clear that household that spend a lot mean that they might have high consumption rates, which resulted more generation of waste.

Tchobanoglous et al. (1993) and Vesilind et al. (2002) showed that waste generation rates could vary depending on the season, month and day of the week. However, Nippon Koei Co. Ltd. and Yachiyo Engineering Co. Ltd. (2005) did not find conventional season-specific impacts on household waste generation in KMC. Instead, they found 223 gram/capita/day with 248 gram/L of bulk density among 40 households examined in April 2004 (the dry season) and 248 gram/capita/day with a bulk density of 174 gram/L for 400 households studied in September 2004 (the wet season). Nippon Koei Co. Ltd. and Yachiyo Engineering Co. Ltd. (2005) also found the similar waste generation from households sampled during weekdays and weekends. Similarly, Dangi et al. (2008) also found that the daily average household waste generation in 200 KMC households did not vary much during a 14-day study conducted in December 2005. But, it is noted that geographical location with climatic variation varied the average household generation rate as shown as Figure 3-2. The Figure 3-2 compared the average household waste generation of municipalities located in different ecological regions: Mountain, Hill and Terai.

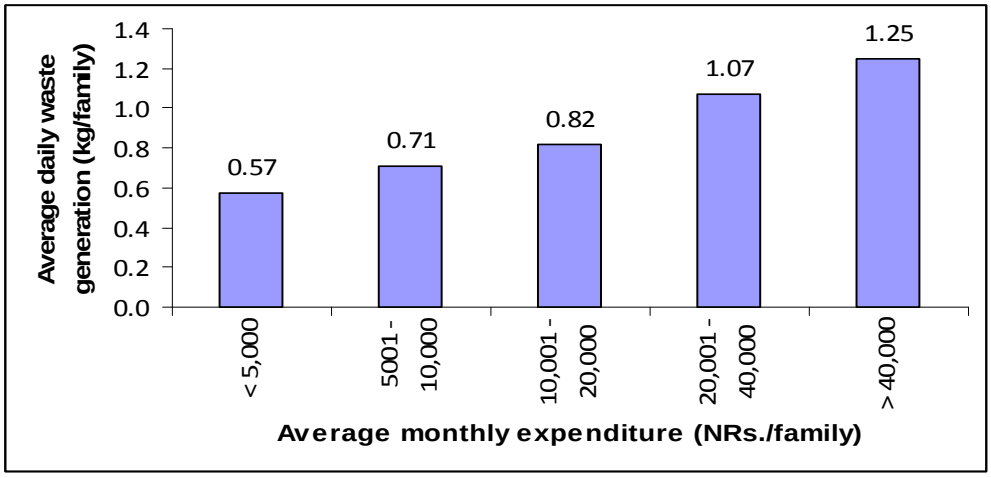

FIGURE 3-1 STATUS OF AVERAGE HOUSEHOLD WASTE GENERATION WITH VARIATION OF EXPENDITURES

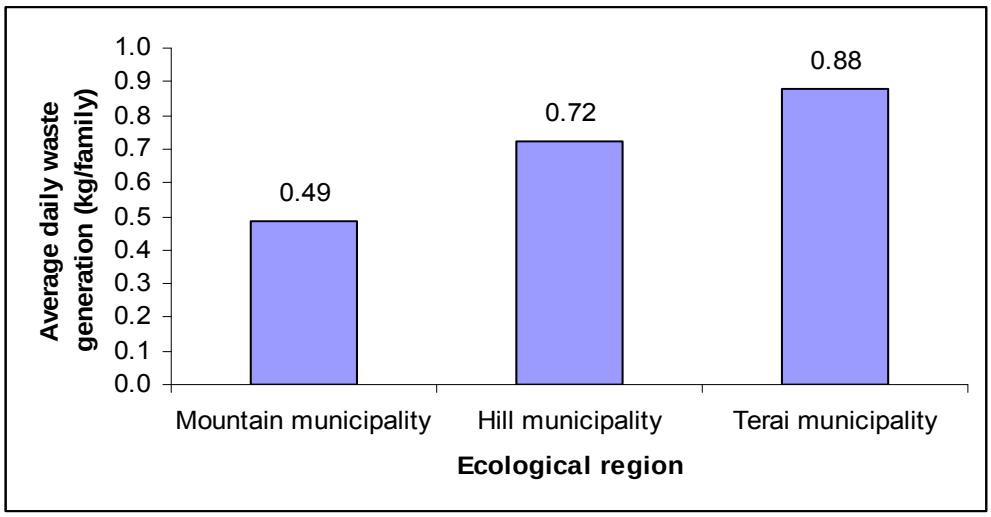

FIGURE 3-2 AVERAGE HOUSEHOLD GENERATION PATTERN IN DIFFERENT ECOLOGICAL REGION

As per survey results, the per-capita household waste generation is found to vary from a minimum value of 75 gm/capita/day (Triyuga Municipality) to a maximum value of 278 gm/capita/day (Inaruwa Municipality). It is noted that the households surveyed in some of the municipalities, especially from the rural wards were found to use most of the organic waste for feeding their cattle. Even when they were requested to keep all the waste generated in 24 hours from their households during the survey – thus resulting in very low rate of waste generation compared to the municipality average. Higher per capita waste generation was observed in Kathmandu, Pokhara, Banepa, Bharatpur etc., because fast urban growth and economic development of these cities have accelerated not only the consumption rates but also the waste generation. However, in case of few municipalities those have lesser urban growth and economic development especially located in Terai area like Inaruwa, Lahan, Kalaiya, Malangwa and Rajbiraj, most of the

households surveyed were found to generate wastes much more than average. Highly populated area with lack of basic knowledge in SWM and poor sanitation level might be the reasons of higher amount of waste generation in the households surveyed in these municipalities. The per capita household waste generation in each municipality is given to Annex A/ Table 2.

3.2 Institutional and commercial waste generation

The average school or college waste was calculated based on total sample size of 332 schools or colleges and 297 different types of offices from 58 municipalities. The average daily waste generation was 1.4 kg per school and 2.5 kg per office; 1.4 kg per shop and 5.7 kg per hotel/restaurant. However, the information like exact number of schools, colleges and offices provided by many municipalities and other relevant agencies is not complete and up to date which led the difficulty in exact estimation of institutional and commercial waste generation. Moreover, as the survey was conducted to school during the period of admission session, it was observed that school and colleges were not running with full capacity, which might be resulting a low generation of waste. But, it was the first attempt to conduct such nationwide study to quantity the waste generated from institutions and commercial establishments along with households of all the municipalities of Nepal. These figures provide clear pictures of those wastes in MSW streams of municipalities, which could be used as baseline information for planning of MSW management.

3.3 Municipal waste generation

In addition to the household waste, there are other wastes generated from different sources to be counted in municipal waste such as commercial waste (waste from restaurants, hotels, etc.), institutional waste (waste from schools, colleges, offices etc.), street waste (littered waste on the streets), agricultural waste, waste from parks and gardens and the waste brought from the surrounding Village Development Committees (VDCs). Under the above conditions, additional amount could be added to estimate actual amount of municipal solid waste generation based on the population taking into consideration commercial, street and VDC's wastes. As it was difficult to take samples from all institutional and commercial generation sources and to estimate exact generation due to lack of the updated information of those sources, some sources were selected for sampling which helped to provide clear pictures of those waste in MSW streams. In the case of large commercial and tourist cities, excessive amount of commercial, institutional and street waste were added to MSW stream. However, in the municipalities dominated by rural area, household waste could be a major fraction of MSW.

Based on our findings and analysis, it can be estimated that, as the household waste in general contributes to about 50 to 75% of the total municipal waste generation depending upon the municipality. Thus, the average per-capita municipal waste

generation, as per survey results, can be estimated 318 gram/capita/day. The per-capita household and municipal waste generation in each municipality has been given to Annex A /Table 2. Based on these per-capita waste generation figures and population for the year 2011, the total municipal waste generation has been calculated and presented in the same table. The total municipal waste generation of 58 municipalities was found to be more than 525,000 tons/year. It is however lower than that reported in other studies, like SWMRMC (2004, 2008), the 170 gram/capita/day and 318 gram/capita/day of Nepalese municipalities' household and municipal waste generation rate calculated in this study appears to be reasonable. For example, this study revealed the household waste generation rate of KMC 232 gram/capita/day, which is levelheaded to the data presented by Nippon Koei Co. Ltd. and Yachiyo Engineering Co. Ltd. (2005). Data from the 440 KMC households that took part in their study yielded an average generation rate of 250 gram/capita/day. The majority of households sampled by the study yielded generation rate of 100 to 150 gram/capita/day in their frequency plot, and is in general agreement with the results of this study.

Generally, the lower generation rate was resulted in this study, which may have been due to the way household sources were selected, the sampling and handling method used. The low counts of valuable recyclables such as glass, paper, plastics and metals, which are often sold to informal collectors at the source, may have contributed to the rates obtained here. Furthermore, few previous project specific studies held in municipalities relied solely upon the questionnaires instead of physical site sampling, which have led to elevated per capita household solid waste generation rates. Most of the previous studies were limited to only core urban area of the municipality instead of covering urban, semi-urban and rural wards of municipalities proportionately. Considering the household from only core urban area, in fact, will give higher per capita household waste generation rates. In this study, the wards were chosen based on urban-rural settings, population density and economic status in each municipality where the representative households were selected randomly, which resulted the lower average household waste generation rates as compared to previous study.

3.4 Municipal waste composition

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

3.4.1 Household waste composition

Average composition of household waste of 58 municipalities in eight major waste components, i.e. organic, plastics, paper and paper products, glass, metal, rubber and leather, textiles and others like inert and dust (with average values by % wet weight), is represented graphically in Figure 3-3.

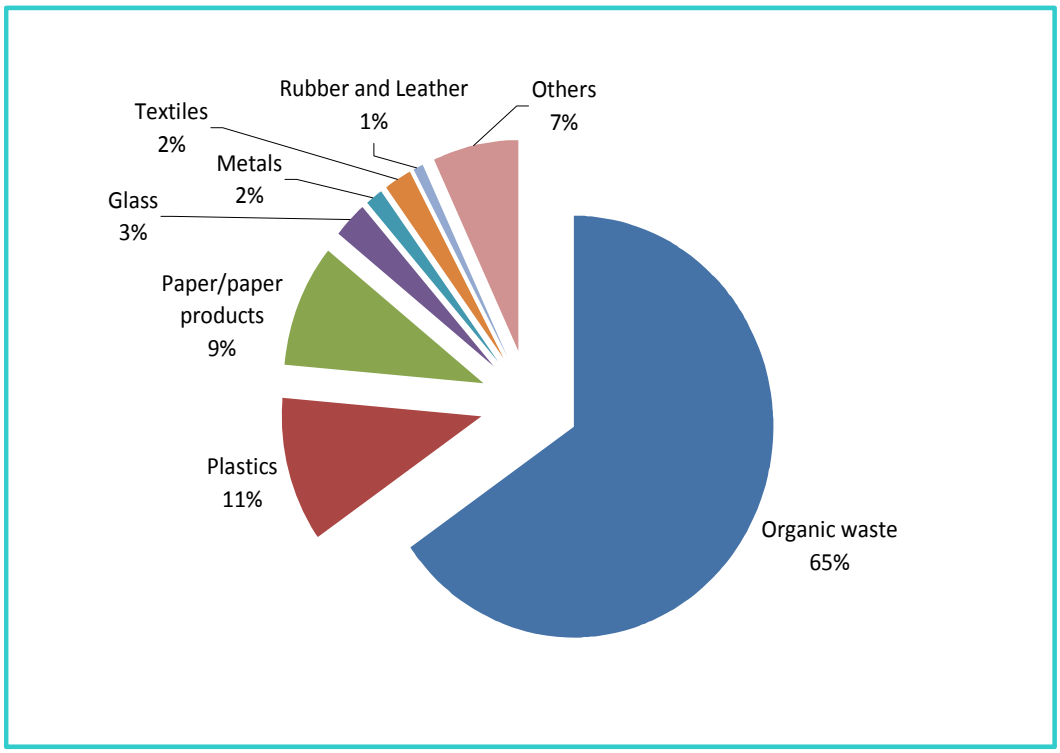

FIGURE 3-3 AVERAGE COMPOSITION OF HOUSEHOLD WASTE OF 58 MUNICIPALITIES

The analysis of waste composition indicated that the highest waste fractions were organic matter (65%) followed by plastics (11%). Paper and paper products and others comprised 9% and 7% of the waste respectively. Glass, metal, rubber and leather, textile components all were at or below 3%. The average composition of the household waste of 58 municipalities showed that there was a mixture of different types of components, with a significant portion (65%) of them being compostable. The high organic content indicated the necessity for frequent collection and removal, as well as having a good prospect of organic waste recycling through composting. Similarly, the content of major reusable/recyclable materials (i.e. plastic, paper and paper products, metal, glass, rubber and textiles) comprised with an average of 28%. Moreover, paper and paper products, textiles, plastics and rubber etc., can be used as Refused Derived Fuels (RDFs), which comprised about 23%.

It is also remarkable that geographical location with climatic variation also varies the composition of household waste. The Figure 3-4 compared the average household waste composition of municipalities located in different ecological regions: Mountain, Hill and Terai. Compared to Mountain and Hill region, the organic fraction was higher in the household waste of municipalities from Terai region.

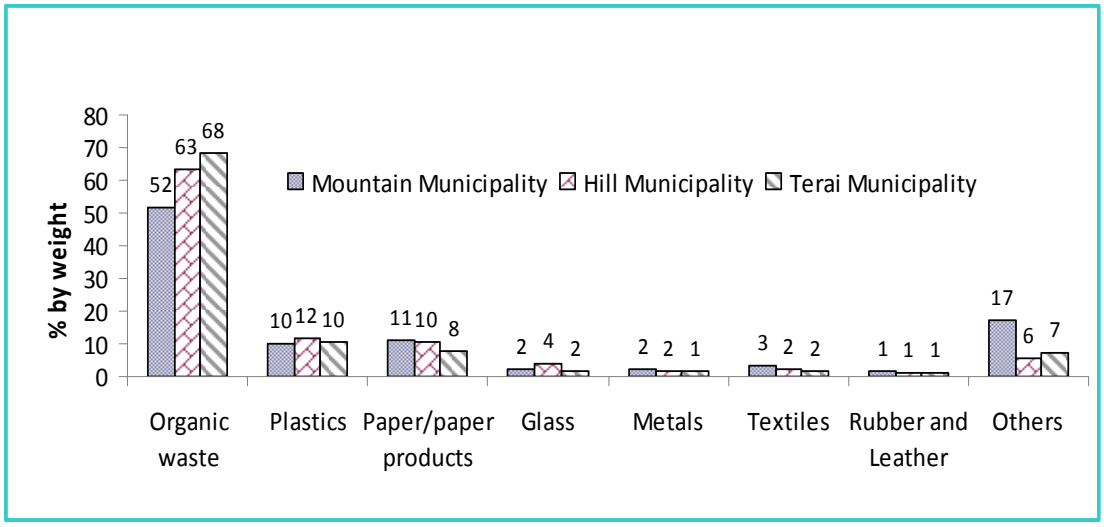

FIGURE 3-4 COMPOSITION OF HOUSEHOLD WASTE IN DIFFERENT ECOLOGICAL REGION

Moreover, the values for different waste fractions in terms of percentage composition obtained from the analysis of household waste samples of each municipality are elaborated in Annex A/ Table 3. As regards the comparative values for different waste fractions that play a vital role in treatment and recycling/ resource recovery aspects of waste management, following important information can be derived from the data tabulated in that Table. Content on organic materials varies up to 85.87% (Tulsipur Municipality), with an average value of 65.24%. The findings revealed that the household waste of all municipalities, in general is qualitatively good viable for producing compost.

The content on major reusable/recyclable materials (i.e. metal, paper, glass and plastic) varies from 6% (Gaur Municipality) to 57% (Baglung Municipality), with an average value of 28%. So far the plastic waste is concerned, which is generally creating a major waste disposal problem in almost all municipalities, the value varies from 2.5% (Gaur Municipality) to 24% (Baglung Municipality). In the municipalities, those have significant fraction of reusable/recyclable materials including plastic in the MSW stream, promotion of waste reduction and recycling activity could be an important measure for minimization of waste problem created by these waste fractions both quantitatively and qualitatively.

The content of inert materials (i.e. neither compostable nor recyclable) varies from 0% to 30%, with an average value of 7%. It indicates that, in case if all compostable and reusable/recyclable wastes could be utilized to their potentials, in more than 40 municipalities, less than 10% waste would have to be finally disposed to landfill site. Even those inert/residue fractions could be used for different purposes rather than disposed of, such as low strength brick/blocks for paving.

Overall, the average composition of household waste was in line with other studies conducted in 58 municipalities and municipalities within Kathmandu valley. SWMRMC (2004) reported the average composition of household waste comprised of organic (66%),

plastics (10%) and paper and paper products (9%), which were very similar to present findings.

The percent by weight of the waste identified by the field study is also within the range of urban waste characteristics for low-income countries specified by the World Bank (Cointreau, 2006).

3.4.2 Institutional waste characteristics

Waste generated from offices, schools and colleges were categorized as institutional wastes. The composition analysis revealed 19% organic wastes, 18% plastics, 45% paper and paper products 12% others with glass, textiles, metals and rubber/leather all below or at 2% (Figure 3-5).

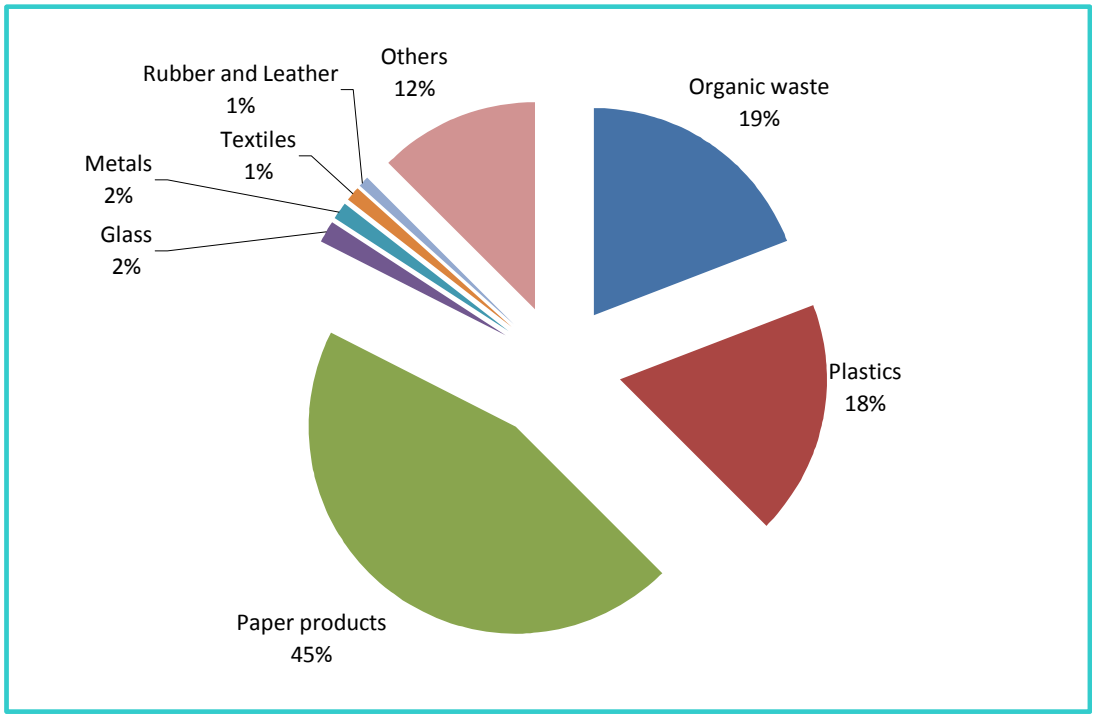

FIGURE 3-5 AVERAGE COMPOSITION OF INSTITUTIONAL WASTE OF 58 MUNICIPALITIES

The higher fraction of paper and paper products and plastics came from students' snack boxes and discarded white paper Generally, a low level of organic wastes was found in school waste because there was little handling of fresh food. The others contained dust, mud and broken bricks.

The composition of institutional waste obtained from the analysis of institution waste samples of each municipality are given in Annex A/ Table 4. The table indicated that the dominant fraction of institutional waste was observed to be paper and paper products in all the municipalities. It varies from 16 (Ilam Municipality) to 83% (Kapilbastu Municipality) with an average value of 45%. Organic fraction was found to be in the range

of 0% (Kapilbastu Municipality) to 60% (Ilam Municipality) whereas plastics vary from 4% (Inaruwa Municipality) to 36% (Jaleshwor Municipality).

3.4.3 Commercial waste characteristics

The waste composition of commercial establishments, such as shops, hotels, and restaurants, shown in Figure 3-6 was made up of 40% organic wastes, 21% paper and paper products, 22% plastics, 7% other wastes, 5% glass, 2% textiles, 2% metals and 1% rubber and leather.

The analysis of the composition of the commercial waste of each municipality is given in Annex A/Table 5. The table indicated that the organic fraction of commercial waste varies from 18% (Gulariya Municipality) to 67% (Dhulikhel Municipality). Plastics varies from 6% (Birendranagar Municipality) to 62% (Bhadrapur Municipality) while another major fraction; paper and paper products was the minimum in Kritipur Municipality (5%) and the maximum in Dashrath Chand Municipality (35%).

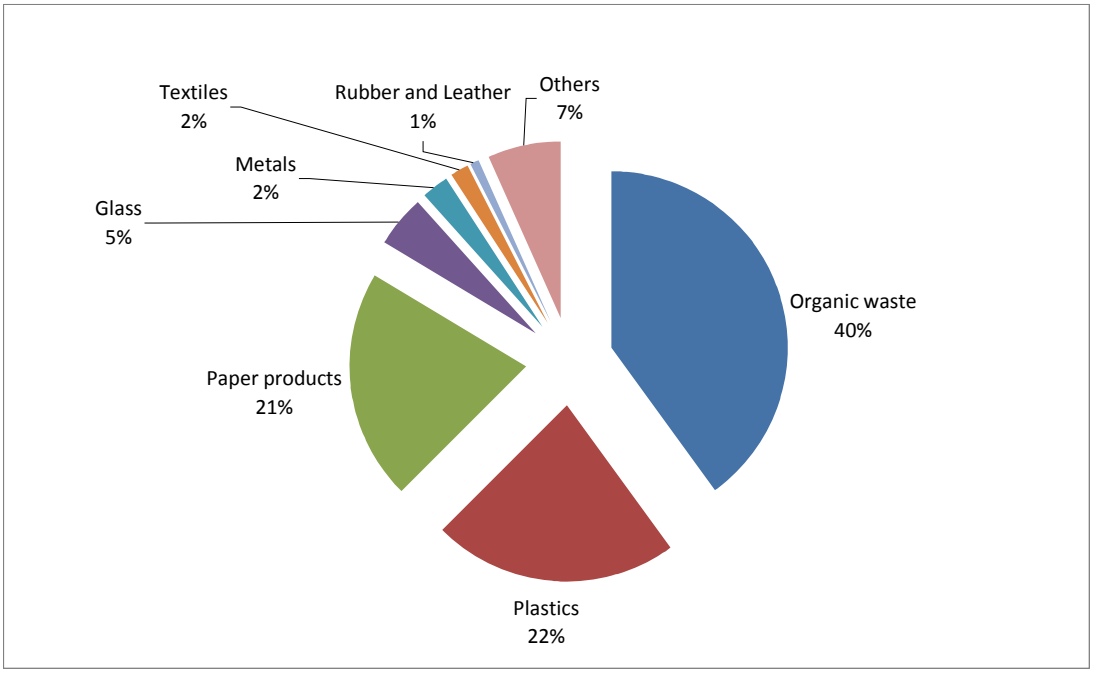

FIGURE 3-6 AVERAGE COMPOSITION OF COMMERCIAL WASTE IN MUNICIPALITIES OF NEPAL

The high percentage of plastics generally found in commercial waste, especially from shops, while organic fraction was observed more in hotel and restaurants. Compared to the household and institutional waste, the high rate of glass in commercial wastes was recorded which indicates the presence of discarded beer and wine bottles by hotel guests.

CHAPTER IV

4 Existing solid waste management system

4.1 Collection and segregation

The study uncovered that about 30% of surveyed households in the municipalities are practicing segregation of waste at sources, which means that waste generated from more than 70% of households in municipalities goes to MSW disposal site in the form of mixed waste. It is noted that the households surveyed in some of the municipalities, especially from the rural wards were found to segregate kitchen waste for their own purpose, e.g. feeding cattle etc. Even though 21 municipalities have conducted minimal activities for the promotion of waste segregation at sources in recent years, effective and mass scale segregation programs are yet to be implemented by almost all municipalities. It was also reported that the segregated waste at sources sometime, were mixed again during transportation due to the lack of separate treatment methods.

The solid waste collection system in many municipalities is not satisfactory. Analyzing the information provided by municipalities, the present collection efficiency ranges between 70 to 90% in major cities, whereas in several smaller municipalities it is below 50% (Annex A/Table 2). Still, the estimation of collected waste by the municipalities seems to be overestimated due to the lack of scientific recording system. The collection rate in each municipality is given in Annex A/Table2. Citizens dispose of waste within their compound either by unscientific composting or open burning or by throwing the waste in the open space around. The collection, city cleaning and sweeping is not made on a day-to-day basis. Only main market, main roads and some important residential area are served daily. Rests of the areas are served intermittently ranging from twice a week to twice a month. Many areas are neglected due to inefficiency and inadequacy of service. Container service, door to door collection and road side pickup from open piles or containers are the type of existing collection services generally practiced in Nepalese municipalities. The type of existing collection services, collection coverage and frequency in each municipality are listed in Annex A/Table 6. Public Private Partnerships in collection and transportation of waste is being attempted on a small scale which needs to be expanded substantially to improve the primary collection service and making the cities clean and livable.

4.2 Transportation, transfer station and final disposal

The vehicle and equipment available for waste collection/transportation in each municipality are listed in Annex A/Table 6.

The functional element of transfer and transport means facilities and appurtenances used to affect the transfer of wastes from relatively small collection vehicles to larger vehicles

and to transport them over extended distances to either processing centers or disposal sites. Transfer and transport operations become a necessity when haul distances to available disposal sites or processing centers increase to the point that directly hauling is no longer economically feasible. The transfer sites are not available in major municipalities except in Kathmandu and Lalitpur. This may be due to fewer distances of the disposal sites from city center.

Sites for construction of treatment facilities and sanitary landfills sites are yet to be identified by many municipalities and waste is currently being disposed off untreated at crude dumping sites causing problems of health and environment. There is an urgent need to identify and allot suitable parcels of land for setting up treatment and disposal facilities. The disposal sites in most of the municipalities are mainly riverbanks, depressed land/dumps, open pit or temporary open piles as given in Figure 4-1[3].

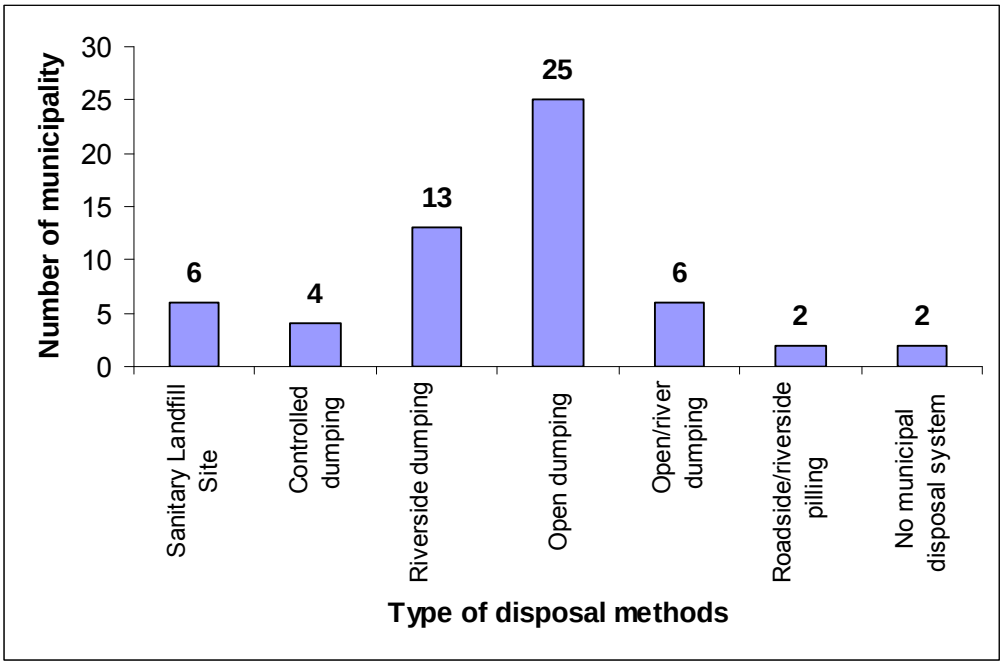

FIGURE 4-1 TYPE OF SOLID WASTE DISPOSAL METHODS IN MUNICIPALITIES OF NEPAL

Annex A/Table 7 presents the type of final waste disposal methods practiced in 58 municipalities. Only six municipalities; Kathmandu, Lalitpur, Pokhara, Ghorai, Dhankuta and Tansen have constructed sanitary landfill site. Even in these municipalities, especially

[3]Figure 4-1 refers existing final waste disposal methods practiced in 58 municipalities. Of total 58 municipalities, only six municipalities; Kathmandu, Lalitpur, Pokhara, Ghorai, Dhankuta and Tansen have constructed sanitary landfill site. Tansen municipality has just started to operate sanitary landfill site since October 11, 2012 after construction of access road. For the final disposal of waste generated In Kathmandu and Lalitpur, sanitary landfill site at Sisdol , Okharpauwa was constructed and operated as sanitary landfill site in early stage of operation but currently it is not operated as sanitary landfill site.

in Kathmandu and Lalitpur are facing the problems like; frequent local protest, lack of proper management, operation plan and unavailability of enough equipment etc. In many municipalities, there is public oppositions and political pressure for disposal of wastes. This shows that awareness of proper way of waste management is still lacking. The public and community, where disposal is to be done, need to be taken into confidence and they need to be made aware of the proper handling of wastes and compensation and other social programs need to be developed and implemented along with local CBOs and clubs.

In 21 municipalities there is no landfill site planned to date. But other municipalities have so far identified and planned for a kind of landfill. The details information of planned landfill site in each municipality is presented in Annex A/Table 7. The problems faced by the municipalities at present include waiting for approval and government decision for land purchasing, more land to be acquired, lack of technical support, financial problems, and problem in area selections, strong opposition of nearby people etc. The political interferences also have been observed in many municipalities and in some technical problems such as flooding, shallow water table, highly permeable soil, slope instability exist. In some municipalities, Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) have been already completed and in some municipalities, these are in under process.

It is remarkable that sustainable, cost effective and environment friendly technologies need to be introduced rather than land filling approach in the municipalities of Nepal. As MSW comprised of more than 65% organic fraction and nearly 20% to 25% reusable/recyclable fraction in the Nepalese municipalities, resources recovery approach such as composting, and promotion of 3R activities have to be implemented.

4.3 Resource recovery methods

With municipal budget constraints being tight and resources being scarce, municipalities are challenged to create a sound budget without increasing cost efficiency option. At the same time, MSW has become environmental, financial and social burden to each municipality. However, resource recovery methods instead of disposal methods in managing MSW not only minimize the above mentioned burdens of municipalities but also generate the resources. This study unveiled that minimal resource recovery activities were conducted in the municipalities of Nepal.

4.3.1 Recycling

The household waste composition survey revealed that more than 25% fraction of household waste and much higher % from institutional and commercial waste could be either reused or recycled. However, it was observed that there were not any formal system introduced for reuse and recycle of these components in the municipalities of Nepal. While it is encouraging to notice that people recover recyclable materials at sources and sell for a price to formal and informal sector, a large amount of recyclable

material continues to be disposed off on the streets and it lands up at the dumping grounds. According to the survey, 32 municipalities do have waste minimization program such as reuse and recycle activities via small entrepreneurs in the formal and informal sector. Of them, 27 municipalities do have information about the scrap dealers/workers, who collect or buy the recyclable and reusable products from MSW stream.

4.3.2 Composting

Content on organic materials varies up to 85.87% (Tulsipur Municipality), with an average value of 65.24% that could be used for producing compost. It was found that about 30% of surveyed households in the municipalities are practicing it. The most of them from rural areas of the municipality, who were managing their household waste through composting in traditional way but urban households are not generally doing composting. Community or municipal composting plant could be found to some extent and also in planning phases in many municipalities (Annex A/Table 8). Composting provides not only the fertilizer to farmers wherein they are facing the scarcity of getting chemical fertilizer, even in very high price, but also reduces large stream of solid waste to be handled and much less burden in terms of quantity for final disposal into a landfill. The windrow or box composting can be used either in community level or in municipality level depending upon the size of municipalities to handle large fraction of organic waste in the municipalities of Nepal.

4.4 Public awareness and community mobilization

Lack of public awareness is one of the major problems of SWM in most of the municipalities. In many municipalities, not only citizens but also the municipal staffs are not aware of managing solid waste even though they have knowledge in waste management. Therefore, it is first necessary to aware municipalities staffs prior to launch mass scale public awareness campaigns. Based on the survey data, there are public awareness program for SWM staffs in only 37 municipalities. Of them, only 10% municipalities do it regularly while more than 65% do it sometime. Regarding to the campaigns to public, few municipalities are doing it in collaboration with other actors like SWMTSC, NGOs and CBOs. Moreover, 33% of municipalities have conducted SWM awareness and promotion of 3R (reduce, reuse and recycle) activities sometime in collaboration with educational institutions. In contrast, household survey revealed that more than 65% households do not have any idea of SWM program by municipalities in last three years and more than 82% households have not participated in municipal SWM awareness program.

4.5 Special waste management

Special waste includes waste from special categories like dead animals, construction and industrial wastes, hazardous/infectious wastes from health institutions that need to be managed differently than general waste. It is observed that for medical waste,

incineration is done in majority of municipalities by hospitals themselves. The incineration means just burning in the hospital compound within chamber or open burning. In some municipalities, it is mixed with municipal waste. In some cases, it is burned or just crudely dumped. However, proper system of management of medical waste is missing and people are not much aware of the health impact including medical personnel in most hospitals. In Kathmandu, Bir hospital along with other few hospital have started in managing all type of hospital waste in safely manner. There is no proper slaughterhouse specifically designated in all the municipalities; however, it is being operated in Kathmandu, Lalitpur and other few municipalities. It is observed that dead animals are buried in many municipalities and dumped in remaining other municipalities. The burying is done near riverbanks, jungle area and dumping sites. Existing practices for special waste management in each municipality have been briefly presented in the individual municipality reports.

CHAPTER V

5 Managerial aspects of Solid Waste Management

5.1 Organizational structure

As SWM is one among the basic essential services that have to be provided by municipalities to keep urban centers clean by developing appropriate SWM system (LGSA, 1999; SWMA, 2011), many have separate sections or units, within their organization structures, to deal with this issue. Most waste management units are either part of the Social Development Section or Planning and Urban Development Section or Community Welfare Section of the municipalities. Some of the smaller municipalities, however, do not have waste management units. Of total 58 municipalities, 17 municipalities do not have designated section to look after SWM. In these municipalities, either the municipality is not providing any waste management services at all or the municipality has a few sweepers who work under the ward offices or one of the other units. It was observed that two or more units seem to have similar or overlapping responsibilities in some municipalities.

Because of the core function and importance of waste management services in order to prevent the municipalities' environment and public health and the unique nature of operating waste management systems, it is essential for all municipalities to have a separate unit to deal with SWM related issues. In smaller municipalities, this can be a part of the Social Development Section or Community Welfare Section or Urban Development Section, whatever is there. In large municipalities however, this should be a separate Section in itself.

5.2 Resources allocation for waste management

Waste management is a very important function of all municipalities and it requires substantial human and financial resources. However, often due to financial constraints municipalities are unable to provide adequate resources for waste management. Furthermore, due to technical and managerial inefficiencies, the available resources are often not utilized effectively. Almost all municipalities allocate the budget in SWM sector however, the breakdown of SWM expenditures are rare except in few municipalities. Based on the analysis of data provided by municipalities, about 10% of the total municipal budget is spent in SWM. Of the total SWM budget, the municipalities spend nearly 60-70% towards collection and street sweeping, 20-30% on transportation, which shows that more attention is required for efficient collection system, treatment and safe disposal of solid waste. The total municipal budget and budget for SWM in each municipality over the period of fiscal year (FY) 2009/10 to 2011/12 are presented in the Annex A/Table 9. Although most of the municipalities do not have any formal system of SWM service charges, few municipalities have introduced such system and generated revenue. However, in the municipalities where private sectors are involved in SWM, have collected

SWM charges from beneficiaries to sustain their business. The details of SWM fee structure and revenue generated from SWM service charges in the municipalities wherever be available are presented in individual municipality report.

The amount of financial and human resources dedicated to waste management varies significantly according to municipalities. For example, many small municipalities such as Khadbari have no solid waste management staff but a large city like Kathmandu has more than 1000 people working on waste management. In addition, Kathmandu also uses the services of several private companies and NGOs in waste management. The number of staff working on waste management through these organizations is not accounted for in this number. Moreover, regular training program for SWM staffs is very important to enhance their capacity in effective and sustainable SWM. However, there are training programs for SWM staffs in less than 50% municipalities. Of them, only 7% municipalities provide regular capacity building training to their SWM staffs however, 75% do it sometime. The details of human resources and their responsibilities in each municipality have been presented in the individual municipality report. The number of staff allocated for waste management generally depends on the characteristics of the municipality and their experience with dealing with waste management. Older municipalities, which tend to have large urban population and have dealt with the problems of waste management for a longer time tend to have a lot of staff to deal with the problem, while newer municipalities which generally have large rural population have very few staff dedicated to waste management.

5.3 SWM planning, monitoring and evaluation

Solid waste management is more a managerial issue than the technical. In the municipalities of Nepal, lacks of appropriate and sustainable management have created many environmental and social problems within the municipalities and neighboring VDCs, where waste disposal site is located. Therefore, it requires proper planning, budgeting, implementation strategy, regular monitoring and evaluation to ensure that the services are provided in a continuous manner. Based on the information provided by municipalities, 45% of municipalities reported that they do not have annual plan for SWM, while 67% and 62% municipalities have not formulated short-term and mid-term/periodic plan for SWM. It means that SWM is not still in priority of many municipalities even though it is one of the basic essential services to be provided to keep municipality clean and healthy. It was reported that SWM department/section/unit or senior officials responsible for SWM in the municipalities monitor and evaluate the SWM activities in regular basis to make more accountable to municipal staffs as well as other stakeholders. Municipalities those have such monitoring and evaluation mechanism claim that it has also helped to improve SWM service delivery in their municipalities. Majority of municipalities (39) have established such mechanism on SWM but is yet to be introduced by many municipalities.

5.4 Actors involved in SWM

There are various stakeholders in the MSWM like Institutional actors (national government, Local government etc.), the private sector stakeholders (formal and informal private sector), the civil society movement (CBOs, TLOs and NGOs) and finally the citizens. Furthermore there are other actors like "external support agencies" (multilateral, bilateral, development banks, etc.) into account as important stakeholders with power and influence. Analyzing the information provided by municipalities, 31 municipalities have formal working relation with other governments' institutions, NGOs, CBOs and private sectors in managing waste. Of them, 23 municipalities have collaborated with these organizations with financial commitments while 8 municipalities are working with them without financial commitments. Moreover, it was found that 22 municipalities have contract out any SWM activities to other actors, mainly NGOs, CBOs, TLOs. A partnership of municipality with NGOs, CBOs and TLOs are working well in various sector in many municipalities and could be used even more in relation to SWM.

5.5 SWM policies and legislation

With a view improve SWM, the then Government of Nepal established the Solid Waste Management Board under the then Ministry of Construction, Supply and Transportation. Various initiatives were taken between 1981 AD and 1986 AD.

5.5.1 Solid Waste Management and Resource Mobilization Act 1987

Realizing the need of having legislation on SWM, Solid Waste Management and Resource Mobilization Act, 2044 (1987 AD) was passed and brought into force in 1987 AD. This Act provided for establishment of the Solid Waste Management and Resource Mobilization Center as an autonomous body replacing the Solid Waste Management Board. For the effective implementation of the Act, the Solid Waste Management and Resource Mobilization Regulations and necessary by-laws were framed and some new previsions on solid waste management were incorporated through amendments in the Solid Waste Management and Resource Mobilization Act.

5.5.2 National Policy on Solid Waste Management 1996

The first Solid Waste Management National Policy was formulated in 2053 BS (1996AD) to tackle the emerging solid waste management problems due to urbanization. The policy emphasized on waste management in municipal and urban areas. This policy is still in force. The main objectives of this policy are to make solid waste management simple and effective, to minimize the impact of solid waste on environment and public health, to treat solid waste as resource, to include private sector participation in solid waste management, and to improve public participation by increasing public awareness on sanitation.

5.5.3 Environment Protection Act 2053 BS (1997 AD) and the related Regulations

In the process of internalizing the Environmental Assessment System in development proposals, the Government of Nepal enacted the Environment Protection Act (EPA) 1997 and the Environment Protection Rules (EPR), 1997, which make the integration of IEE and EIA legally binding to the prescribed projects. The Act (Section 7) prohibits the creation of pollution that may cause significant adverse impacts on the environment, or any such act that is likely to be hazardous to public life and people's health, or any act that disposes or causes to be disposed sound, heat, radioactive rays and wastes from any mechanical devices, industrial enterprises, or other places contrary to the prescribed standards. The Act made provision for appointing Environment Inspector in order to effectively carry out or cause to be carried out the acts of mitigation, avoidance or control of pollution or activities required to be carried out in accordance with the IEE or EIA.

5.5.4 Local Self Governance Act 2055 BS (1998 AD) and related Regulations

The Local Self Governance Act has made ward committees responsible for managing the waste within their respective areas. The functions, duties and powers of each Ward Committee under the Village Development Committee include cleaning the roads, ways, bridges, drainage, ponds, lakes, wells, deep water, taps, etc. within the Ward. The Ward Committees have to arrange for disposal of wastes, dirt and rotten materials and to make arrangements to encourage the inhabitants of the Ward for maintaining sanitation.

5.5.5 Environment Policy and Strategy on Periodic Plans of the Government

There is no specific provision in the Environment Policy and Strategy regarding solid waste management. The Present periodic Plan "Three Years Plan 2010-11, 2011-12, 2010-2013 AD" emphasized promoting and extending sanitation facilities through public awareness at the rural and urban areas with the participation and contribution of the local government and users' communities. It has further emphasized IEE and Environment Impact Assessment for implementing any infrastructure development project. The plan has, under infrastructure development, targeted to construct 10 landfill sites and conduct feasibility study for another 10 sites. The plan has associated solid waste management with sanitation and infrastructure development activities.

5.5.6 Solid Waste Management Act 2068 BS (2011 AD)

Finally with an objective to amend and consolidate the laws relating to solid waste management and to arrange for the systematic and effective management of solid waste by minimizing solid waste generation at source, re-using & processing the waste and providing for proper disposal of the solid waste. The Govt. of Nepal enacted Municipal solid Waste management Act 2068 BS (2011 AD) effective from 15th June 2011 AD. The objectives of the Act also include maintaining clean and healthy environment by minimizing the adverse effects of solid waste on public health and the environment.

The Local Bodies have been made responsible for construction, operation and management of infrastructures for collection, treatment and final disposal of solid waste, including construction of transfer stations, treatment plants, etc. However, healthcare institutions and industries are made responsible to manage their biomedical and hazardous wastes. A Local Body is authorized to specify the time, place and method for disposal of solid waste and prescribe collection centre for each settlement at such places which is convenient to all. The Local Body is required to manage transportation of waste & provide means of transport of solid waste. The Local Body is expected to encourage reduction, reuse and recycling of solid waste and coordinate with industries for reuse of packing materials for reducing the waste. The Local Body is allowed to construct transfer stations for managing the initially collected solid waste in such a way that it would not cause adverse effect to public health.

The Act makes the Local Body responsible for constructing sanitary landfill sites subject to Environment Protection Laws for management and final disposal of the waste. The Act prohibits management of waste without license and provides for issuance of license and prescribes the procedure for issuance of license to manage the waste. It provides for the involvement of the private sector firms, CBOs and NGOs in solid waste management through competitive bidding. It also provides procedures for bidding, selection of successful bidder, authority of the bidder for collecting tipping fees against solid waste management services. Section 16 authorizes the Local Body to give permission for construction and operation of sanitary landfill site, treatment plant or any other infrastructure subject to Environment Protection and other related laws. A Local Body is authorized to monitor the compliance of the specified standards and cancel any permit if needed.

The Act authorizes for imposition and collection of service fees against solid waste management services and prescribes the basis for fixing such fees (tariff) and procedures for collection of such fees and the usage of the fees. It authorizes the Local Bodies or authorized private operator to suspend or stop the services if any user fails to pay the fee. The Act allows for pecuniary punishment and/or imprisonment for violating the laws. The Act mandates the Local Body to carry out environment protection activities by preparing master plans for the affected area surrounding a landfill site. It authorizes the local bodies for formulation of rules, bye-laws and guidelines, and issue directives. As new SWM Act, 2011 AD authorizes the local bodies for formulation of rules, bye-laws and guidelines, and issue directives; it will be useful for every municipality to have waste management by-laws or guidelines that are approved by the Municipal Board.

The survey findings showed that only 46 municipalities were aware with SWM policy, 1996 while 49 municipalities were known about SWM Act, 2011. Moreover, there are also other laws, standards or guidelines to govern municipal waste management which provides some provisions on the related aspects. According to the Local Self-Governance

Act and its regulations, municipalities can however develop by-laws to suit their needs. Of 58 municipalities, 23 municipalities informed they have some by-laws/issue directives etc., related to SWM within the municipality but were not effectively implemented to carry out management of wastes. For example, Ilam issued the directive to ban polythene bag in the municipality and surrounding VDCs. To implement this directive successfully, municipality charges Rs. 500 if shops are found to selling polythene bags and Rs. 200 is charged for people if they are found carrying polythene bags. Similarly, other few municipalities have also initiated to enforce punishments/penalties to the violators of SWM. Moreover, 9 municipalities have operational guidelines for landfill site or controlled dumping site operation.

CHAPTER VI

6 Possibilities and Challenges

6.1 Challenges in management and implementation level

As discussed in previous chapters, the municipalities of Nepal are facing many complications and difficulties to achieve their goal of solid waste management. In the recent years, the management problems are becoming complicated and their magnitudes have been increased by many folds. The haphazard disposal of solid waste in densely populated areas, environmentally sensitive areas, riverbanks and heritage sites has made the adverse impacts on the public health and the environment of surroundings which puts a negative externality in anticipated improvement on the quality of life of people. The problems are existed at both management and implementation levels. Most common and frequently cited problems of the solid waste management in the municipalities are listed below:

- No separate section to look after Solid Waste Management;
- Lack of equipment and technical manpower, capacity building of manpower;
- Lack of data, statistical records, research, awareness and information, proper planning;
- Insufficient budget;
- No public private participation; and
- Political issues.

Analysis of present solid waste management practices by Nepalese municipalities shows that there are many problems that need to be addressed.

- Littering by residents after collection- user's mind-set of 'use and throw' of wastes have intensified environmental pressures including unorganized waste disposal in many municipalities of Nepal;
- Poor conditions of containers and areas around them – in many municipalities, primary collection and storage of waste is done using open storage enclosures, and these result in unhygienic conditions, foul smell and odor, and proliferation of flies and other vectors.
- No practice of source separation;
- Collection and transportation cost- Of the total SWM budget, the municipalities spend nearly 60-70% towards collection and street sweeping, 20-30% on transportation;

- Poor working condition – Manual collection and transfer without safety measures is unhygienic to the collectors;
- Collection and transfer systems – current collection and transfer of solid waste in the municipalities is conducted in an ad hoc manner, without any systematic approach. Multiple handling of organic waste without identifying proper transfer systems also created problems. GIS-based route analysis and optimization techniques can be used to determine optimal ways of utilizing scarce manpower and resources for waste collection and transfer;
- Treatment strategy and unscientific disposal techniques - solid waste is not being treated and all waste is openly dumped in more than 50 municipalities of Nepal. Moreover, compostable household and market wastes can be composted efficiently and economically, recyclable fraction can be recycled and reused and the quantity of waste going to the landfill can be reduced by 70–80% in all the municipalities.

6.2 Possibilities of sustainable SWM

Resource recovery is fundamental to sustainable SWM to all the municipalities. A recovery-centric approach to municipal solid waste management is not functional though many municipalities and households from those municipalities claim to have become aware of that need. This cannot be fully functional, however, without active citizen participation, willingness of the municipality and proper implementation of regulations. Since more than 65% of the solid waste generated in Nepal is of organic origin, composting is one of the best ways to manage solid waste. Moreover, paper and paper products, textiles, plastics and rubber etc., can be used as Refused Derived Fuels (RDFs), which comprised about 23% in Nepalese municipalities. Resource recovery methods like, composting, recycling and RDFs help reduce the waste transported to and disposed of in landfills in one hand and generate resources in other hand.

In addition to the resource recovery approach, introducing a cost recovery approach could be benefited in many municipalities of Nepal for the sustainable SWM. As many people are willingness to pay for SWM, cost recovery from beneficiaries could be a sustainable option for SWM. Under the same concept, few municipalities including Tansen and Dhankuta have been selected for a proposed solid waste Output-Based Aid (OBA) pilot project. The World Bank has initiated this project with the main government counterparts; the Solid Waste Management Technical Support Centre (SWMTSC), Town Development Fund (TDF) and the two participating municipalities (Tansen and Dhankuta) which were selected based on essential eligibility criteria which included: (i) expressing willingness to participate in the project; (ii) committing to improving levels of cost recovery for SWM services; (iii) having existing sanitary landfill sites etc. If this cost

recovery approach implemented successfully in the candidate municipalities, it would be replicated to other many possible municipalities for sustainable SWM.

6.3 Possibilities of private sector participation

In many countries, private companies are interested in providing solid waste management services and such partnerships are successively implemented by the responsible authorities (Zerbock, 2003). This is generally done to improve efficiency in waste management, reduce municipal investment, and share risks associated with introduction of a new technology or process. Based on the past experiences, private sector has already successfully played a major role in waste management in many developed countries and even in different cities of developing countries. In Chennai, a major port city in Southern India, the French multinational Onyx won a contract with the municipal corporation to collect the waste and sweep streets in one area of the city (Jayaraman, 2002). Remuneration per ton of waste collected is significantly lower than the previous expenses of the municipality and Onyx has won many praises from many residents for good service.

In Nepal, however, private sector participation in waste management is a relatively new phenomenon and very few municipalities have tried this approach. Even when municipalities have tried to involve the private sector, they have faced several difficulties. These include:

- Opposition from their own staff, who fear that they will loose their jobs;
- Lack of understanding of PSP process and no clear road-map for working with the private sector;
- Lack of capable private parties;
- Unclear policies;
- Poor coordination between private parties and municipalities;
- Insufficient monitoring and evaluation by municipalities.

As a result, in general municipalities have not been able to take advantage of PSP in waste management. Although many municipalities claim to be working with private sector in waste management, most of these are NGOs or community based organizations, which occasionally do solid waste management. Public Private Partnerships in collection and transportation of waste is being attempted on a small scale which needs to be expanded substantially to improve the primary collection service and making the cities clean and livable.

In fact, private sector participation is especially important when waste management becomes more complex and specialized. However, it should be critically reviewed to decide if private sector involvement in solid waste management is a sustainable and

preferable alternative to the conventional dependence on local government. For the Nepalese municipalities, where private sector participation is not common and relatively new phenomenon, the contractual document therefore must be well clear to describe in quantitative terms what services are required and what facilities and privileges are provided to private sectors. The ability and willingness of the government/local authorities to monitor the performance of the private partner and enforce sanctions if necessary are crucial for an effective partnership and for the long-term improvement of the cities situation.

6.4 Expectation of support

The municipalities have been made responsible for construction, operation and management of infrastructures for collection, treatment and final disposal of solid waste, including construction of transfer stations, treatment plants, etc in their territory. However, Nepalese municipalities, till date, do not have sufficient technical capacities, financial resources and willingness to handle the SWM properly. Hence, municipalities need technical support from SWMTSC as well as some assistance from donor agencies. These helps include both in the forms of hardware and software. Hardware supports include technical supports, physical equipment, financial support etc. Similarly, software which includes capacity building and empowerment of human resources, creating awareness and institutional assistance are also expected to achieve the objective of solid waste management. This survey also identified that almost all the municipalities are seeking support from SWMTSC and other external agencies in the various aspects of SWM.

CHAPTER VII

7 Conclusions and Recommendations

7.1 Conclusions

The goal of the SWM baseline study was to conduct the systematic and comprehensive study of quantification of municipal waste and its composition and to compile factual information on the state of solid waste management in the 58 municipalities of Nepal. The SWM baseline study team conducted the survey in 58 municipalities of Nepal in April to May 2012 during the dry season. The total sample size of 3233 households from 58 municipalities, varying from the minimum 50 households to 220 households gave an average per-capita household waste generation figure of 170 gram/capita/day. The household waste generation rates varied depending upon the economic status and climatic condition. Moreover, the average daily waste generation was 1.4 kg per school and 2.5 kg per office. Similarly, the average daily waste generation was found to be 1.4 kg per shop and 5.7 kg per hotel/restaurant respectively. Considering the household waste in general contributes to about 50 to 75% of the total municipal waste generation depending upon the municipality, the per-capita municipal waste generation was estimated to 318 gram/capita/day. Based on these per-capita waste generation figures and population for the year 2011, the total municipal waste generation of 58 municipalities was found to be more than 525, 000 tons/year.

The analysis of waste composition showed that the highest fraction was organic matter; 65% and 40% in household and commercial waste respectively, whereas, dominant fraction was paper and paper products (45%) in institutional waste. The findings of this study showed that the municipal waste of all municipalities, in general is good viable for producing compost. The households mainly in rural area of municipalities are doing household composting in traditional way, but urban households, where less land is available, are not generally doing household composting. Community or municipal level composting plant could be observed to some extent in some municipalities. It was also found that only 6 municipalities use sanitary landfill site for final disposal till date but dumping in riverbanks, depressed land/dumps, open pit or temporary open piles are the way of final disposal in the other municipalities.

Municipalities are unable to achieve its goal of solid waste management because of lack of technical and human resources, data, statistical records, proper planning, insufficient budget, less private participation and unnecessary political issues. Moreover, most of the municipalities have been facing the SWM problems due to mismanagement of available resources. Of total 58 municipalities, 17 municipalities do not have designated section to look after SWM. In these municipalities, either the municipality is not providing any waste management services at all or the municipality has a few sweepers who work under the ward offices or one of the other units. Of the total budget, the municipalities spend an

average of 10% for SWM, in which nearly 60-70% towards street sweeping and collection, 20-30% on transportation.

At present, SWMTSC is supporting to municipalities technically and financially as well. In addition to SWMTSC, various programs in SWM sector are being supported by many donor agencies. However, these are not sufficient and municipalities are seeking some external supports for the cost effective and sustainable waste management.

The outputs of this study can be used for implementing proper waste disposal and management plans and practices for recovery of resources before deciding on the appropriate method of its disposal.

7.2 Recommendations

Following are the recommendations to achieve the good waste management practices in the Nepalese municipalities:

- Based on the output of this SWM baseline study, establish data and information management systems for municipal waste management at the national/local level with consideration to a bottom-up approach in reporting e.g. information and data from LGs like municipalities to SWMTSC;
- Develop SWM strategy, management plans, treatment strategies, guidelines and/or policies at the national/local level addressing municipal waste management through 3R principles than landfilling approach, therefore looking into the effects on public health and impacts on the environment.
- Promotion of waste segregation at sources; separation of waste at the source in at least two fractions, i.e. compostable and reusable/recyclables, deserves due consideration for over minimization of waste problem in all the municipalities;
- Awareness campaigns in mass scale to separate waste at source and to change users' mindset of use and throw should be effectively enforced;
- GIS-based route analysis and optimization techniques can be used to determine optimal ways of utilizing scarce manpower and resources for waste collection and transfer;
- Initiative should be taken for resource recovery and cost recovery approach in the municipalities for sustainable SWM. For e.g. composting could be the best way of managing solid wastes in many Nepalese municipalities because of the higher value of organic materials that is about 65%. Paper and paper products, textiles, plastics, rubber etc., could be used as Refused Derived Fuels (RDFs), which comprised about 23% in Nepalese municipalities. Resource recovery methods like, composting, recycling and RDFs help reduce the waste transported to and disposed of in landfills in hand and generate resources in other hand;

- Strengthen capacity building and technical support activities to municipalities to enhance the technical and human capacity of municipality for SWM; allocation financial and human resources for SWM in municipalities should be increased and managed properly;
- SWMTSC should provide technical assistance to municipalities to develop an efficient and sustainable waste management system. It should be ensured that the assistance provided is based on local needs and suitable for local condition. Besides this, it should be effective and sustainable in the long run.
- Partnerships and cooperation of various stakeholders in SWM should be enhanced in the provision of resources for the effective implementation of the 3Rs and of waste management in the municipalities;
- Promote regular dialogue, consultation and consensus building among solid waste management stakeholders.
- Document and disseminate information on the importance of and good practices in SWM, which can be replicated to other municipalities.

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Annexes

Annex A: Details of collected data from municipalities

Annex B: Proceedings of 2-day SWM baseline training

The proceedings of 2-day SWM baseline survey training is published in separate volume.

Annex C: Field report of 58 municipalities

The individual reports of all 58 municipalities are published in separate volume.

Annex A/Table 1: Area and population in 58 municipalities of Nepal

S.N.	Name of district	Name of municipality	Total area (sq. km.)[4]	Total length of municipal boundary (km)[5]	Built up area (sq. km)[6]	Total population (CBS, 2011)
1	Dadeldhura	Amargadhi	138.96	81.26	0.358	21633
2	Baglung	Baglung	8.61	12.39	2.33	31046
3	Kavrepalanchok	Banepa	6.07	12.16	0.697	28237
4	Jhapa	Bhadrapur	10.69	20.78	5	18608
5	Bhaktapur	Bhaktapur	6.58	14.45	1.23	83893
6	Chitawan	Bharatpur	162.61	81.81	3.9	139790
7	Kanchanpur	Bhimdatta	171.24	93.30	4.28	102762
8	Dolakha	Bhimeswor	65.43	50.84	NA	24217
9	Nuwakot	Bidur	33.61	39.86	2.1	25934
10	Morang	Biratnagar SMPC	59.04	43.69	10.84	202061
11	Surkhet	Birendranagar	34.95	26.24	13	59273
12	Parsa	Birgunj SMPC	21.24	29.78	9.02	137976
13	Rupandehi	Butwal	69.37	47.69	2.76	119710
14	Tanahu	Byas	60.17	52.41	3.53	45122
15	Jhapa	Damak	71.40	45.33	26.9	74843
16	Baitadi	Dasharathchanda	55.00	43.16	1.6	17363
17	Kailali	Dhangadhi	103.75	62.44	13.44	104801
18	Dhankuta	Dhankuta	48.68	38.06	4.83	28916
19	Sunsari	Dharan	104.38	58.74	NA	118755
20	Kavrepalanchok	Dhulikhel	12.14	15.98	0.62	16406
21	Doti	Dipayal-Silgadhi	74.74	56.81	NA	25887
22	Rautahat	Gaur	21.74	20.53	3	35349
23	Dang	Ghorai	74.46	45.70	NA	65713
24	Gorkha	Gorkha	61.92	42.71	NA	33890
25	Bardiya	Gulariya	95.14	59.98	5.47	57326
26	Makwanpur	Hetauda	47.95	38.68	12.46	90593
27	Ilam	Ilam	26.93	33.33	2.71	19054
28	Sunsari	Inaruwa	22.57	24.67	4.25	29999
29	Sunsari	Itahari	42.78	42.10	25.18	74360
30	Mahottari	Jaleshwor	15.57	19.79	NA	23231
31	Dhanusa	Janakpur	24.75	27.75	NA	99560
32	Bara	Kalaiya	19.05	26.41	11.7	43888
33	Sindhuli	Kamalamai	209.11	112.13	13.23	41054
34	Kapilbastu	Kapilbastu	37.24	31.39	0.16	30887
35	Kathmandu	Kathmandu MPC	49.66	43.86	36.52	1006656
36	Sankhuwasabha	Khandbari	91.89	61.23	NA	27103
37	Kathmandu	Kirtipur	14.82	23.18	3.238	66070
38	Siraha	Lahan	20.37	20.45	0.67	34350
39	Lalitpur	Lalitpur SMPC	15.21	21.44	14	223285
40	Kaski	Lekhnath	77.64	56.17	5.46	59244

[4]Area of each municipality was calculated from VDC boundary map obtained from Department of Survey, Government of Nepal using GIS analysis

[5]Ibid

[6]Built up area of each municipality was obtained from respective municipality, except Pokhara SMPC. Built up area of Pokhara SMPC has been obtained from Rimal (2011) Urban growth and land use/land cover change of Pokhara SMPC, Nepal, Journal of Theoretical and Applied Information Technology, 26 (2), 118-129.

41	Sarlahi	Malangawa	9.44	16.00	1.74	*25199*
42	Jhapa	Mechinagar	56.41	47.75	3	57622
43	Dailekh	Narayan	67.01	43.30	0.44	22142
44	Banke	Nepalgunj	12.51	19.46	4.81	76053
45	Kavrepalanchok	Panauti	31.70	35.44	2.88	28570
46	Kaski	Pokhara SMPC	55.27	63.15	28.44	263477
47	Syangja	Putalibazar	70.51	44.13	NA	31280
48	Saptari	Rajbiraj	12.06	20.89	2.176	39181
49	Nawalparasi	Ramgram	34.76	37.50	4.12	27988
50	Chitawan	Ratnanagar	35.56	35.11	0.9	45698
51	Rupandehi	Siddharthnagar	36.08	40.69	3.6	64579
52	Siraha	Siraha	23.93	29.33	1.284	29785
53	Palpa	Tansen	21.75	24.80	NA	32037
54	Bhaktapur	Thimi	11.15	18.40	1.38	84259
55	Kailali	Tikapur	67.12	49.45	7.06	50782
56	Udayapur	Triyuga	322.24	96.60	1	70435
57	Dang	Tulsipur	92.18	51.62	1.5	59330
58	Syangja	Waling	35.12	41.63	4.49	24188
Total			**3282.23**	**2393.94**	**313.30**	**4521450**

Annex A/Table 2: The per-capita household waste, per-capita MSW, total generated MSW, estimated collected MSW and collection efficiency in 58 municipalities

S.N.	Name of Municipality	Average waste per HH per day in kg	Average HH size	Average per capita HH waste (gm/capita/day)	Total population (CBS, 2011)	Total HH waste (ton/day)	Total commercial waste (ton/day)	Total institutional waste (ton/day)	Average per capita MSW (gm/capita/day)	Total MSW generation (ton/day)	Estimated collected waste (ton/day)	Collection efficiency (%)
1	Amargadhi	0.50	5.92	84.43	21633	1.83	NA	NA	**112.57**	2.4	1.00	41
2	Baglung	0.66	4.66	142.49	31046	4.42	4.10	0.37	**284.98**	8.8	4.00	45
3	Banepa	1.36	5.64	240.80	28237	6.80	1.05	0.54	**344.00**	9.7	4.50	46
4	Bhadrapur	0.39	4.81	80.20	18608	1.49	0.13	0.06	**106.93**	2.0	1.00	50
5	Bhaktapur	0.85	5.47	155.43	83893	13.04	7.20	0.62	**345.40**	29.0	25.00	86
6	Bharatpur	1.25	5.66	220.04	139790	30.76	6.82	0.80	**440.07**	61.5	15.00	24
7	Bhimdatta	0.60	5.58	107.53	102762	11.05	1.30	1.14	**215.05**	22.1	NA	-
8	Bhimeswor	0.41	4.52	91.24	24217	2.21	0.22	0.12	**121.66**	2.9	NA	-
9	Bidur	0.47	4.81	97.21	25934	2.52	2.87	0.17	**194.42**	5.0	NA	-
10	Biratnagar SMPC	0.68	4.80	142.39	202061	28.77	NA	NA	**284.78**	57.5	50.00	87
11	Birendranagar	0.62	5.88	104.90	59273	6.22	3.18	0.46	**174.83**	10.4	1.00	10
12	Birgunj SMPC	0.84	6.14	137.23	137976	18.93	2.67	0.27	**274.46**	37.9	15.00	40
13	Butwal	0.56	5.00	112.10	119710	13.42	8.40	0.39	**224.21**	26.8	17.00	63
14	Byas	0.41	4.23	97.50	45122	4.40	2.46	0.64	**162.50**	7.3	NA	-
15	Damak	0.62	5.34	115.84	74843	8.67	1.85	0.32	**231.69**	17.3	7.00	40
16	Dasarath Chand	0.85	5.96	142.28	17363	2.47	0.25	0.31	**189.71**	3.3	0.50	15
17	Dhangadi	0.71	5.16	138.45	104801	14.51	11.00	0.40	**276.90**	29.0	12.00	41
18	Dhankuta	0.69	4.78	143.40	28916	4.15	NA	NA	**260.73**	7.5	6.00	80
19	Dharan	1.17	5.53	212.31	118755	25.21	7.53	0.44	**424.62**	50.4	35.00	69
20	Dhulikhel	0.64	5.59	115.16	16406	1.89	NA	NA	**153.54**	2.5	NA	-
21	Dipayal-Silgadhi	0.56	6.42	86.92	25887	2.25	0.72	0.11	**124.17**	3.2	NA	-
22	Gaur	0.73	7.38	99.02	35349	3.50	NA	0.59	**141.46**	5.0	NA	-
23	Ghorai	0.46	3.92	117.91	65713	7.75	1.52	0.15	**196.51**	12.9	10.00	77
24	Gorkha	0.56	4.12	136.46	33890	4.62	0.22	0.06	**194.94**	6.6	2.00	30
25	Gularia	0.76	6.46	116.97	57326	6.71	NA	NA	**194.94**	11.2	1.00	9
26	Hetauda	0.81	5.29	153.98	90593	13.95	NA	0.88	**256.63**	23.2	9.00	39
27	Ilam	1.14	5.66	201.34	19054	3.84	1.63	1.26	**366.08**	7.0	3.90	56
28	Inaruwa	1.36	4.88	277.89	29999	8.34	1.16	0.27	**396.98**	11.9	3.00	25
29	Itahari	1.00	5.12	196.10	74360	14.58	2.86	NA	**326.83**	24.3	6.00	25

30	Jaleswor	0.52	6.10	85.70	23231	1.99	0.43	NA	**114.27**	2.7	NA	-
31	Janakpur	0.61	6.08	101.00	99560	10.06	1.23	0.77	**168.33**	16.8	4.00	24
32	Kalaiya	1.43	6.28	227.10	43888	9.97	0.86	NA	**324.43**	14.2	1.50	11
33	Kamalamai	1.00	5.74	174.41	41054	7.16	1.37	2.65	**249.15**	10.2	4.00	39
34	Kapilbastu	0.71	6.16	114.97	30887	3.55	2.27	0.05	**164.24**	5.1	1.50	30
35	Kathmandu MPC	1.10	4.74	232.31	1006656	233.85	NA	NA	**464.61**	467.7	405.00	87
36	Khadbari	0.56	5.04	111.36	27103	3.02	0.53	0.17	**159.09**	4.3	NA	-
37	Kritipur	0.89	5.84	151.75	66070	10.03	NA	0.25	**252.91**	16.7	6.00	36
38	Lahan	1.42	6.06	235.08	34350	8.08	1.02	0.68	**335.83**	11.5	NA	-
39	Lalitpur SMPC	0.90	4.84	185.91	223285	41.51	NA	NA	**371.82**	83.0	60.00	72
40	Lekhanath	0.50	4.47	112.52	59244	6.67	0.77	0.28	**187.54**	11.1	NA	-
41	Malangawa	1.90	7.18	*264.20*	*25199*	6.66	0.66	0.12	**377.43**	9.5	1.50	16
42	Mechinagar	0.33	4.38	76.44	57622	4.40	0.73	0.45	**127.40**	7.3	7.00	95
43	Narayan	0.48	5.40	89.37	22142	1.98	NA	NA	**119.16**	2.6	0.50	19
44	Nepalgung	1.13	6.06	186.34	76053	14.17	22.38	0.48	**372.67**	28.3	NA	-
45	Panauti	0.60	4.94	121.86	28570	3.48	0.90	0.11	**174.09**	5.0	2.00	40
46	Pokhara	0.97	4.40	220.97	263477	58.22	27.29	4.00	**441.94**	116.4	50.00	43
47	Putalibazar	0.55	4.55	121.81	31280	3.81	0.18	0.13	**174.01**	5.4	4.50	83
48	Rajbiraj	1.39	5.24	265.59	39181	10.41	1.68	0.38	**379.41**	14.9	6.00	40
49	Ramgram	0.70	5.64	123.62	27988	3.46	0.07	0.28	**176.60**	4.9	1.50	30
50	Ratnagar	0.74	4.74	155.83	45698	7.12	7.64	0.38	**311.65**	14.2	11.00	77
51	Sidharthanagar	0.78	5.52	141.38	64579	9.13	0.77	0.29	**235.63**	15.2	4.00	26
52	Siraha	0.57	6.12	93.63	29785	2.79	0.59	0.05	**133.75**	4.0	1.00	25
53	Tansen	1.19	5.22	228.12	32037	7.31	2.86	0.32	**304.15**	9.7	2.50	26
54	Thimi	0.70	5.12	136.72	84259	11.52	NA	NA	**273.44**	23.0	12.00	52
55	Tikapur	0.58	5.76	100.90	50782	5.12	NA	NA	**168.17**	8.5	0.60	7
56	Triyuga	0.45	6.08	74.60	70435	5.25	2.60	0.36	**124.33**	8.8	NA	-
57	Tulsipur	0.54	4.64	115.91	59330	6.88	1.46	0.20	**193.18**	11.5	6.00	52
58	Waling	0.68	4.62	147.92	24188	3.58	3.07	0.15	**295.84**	7.2	1.00	14
Total/average value		**0.8**	**5.4**	**170**	**4521450**	**769**	**150**	**23**	**318.26**	**1439**	**822**	**57**

Annex A/Table 3: Average composition of household waste in 58 municipalities

S.N.	Name of municipality	Organic waste	Plastics	Paper/Paper products	Glass	Metals	Textiles	Rubber and Leather	Others
1	Amarghadi	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	Bhimeswor	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	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	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	Dasarath Chand	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	Gularia	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	Jaleswor	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
33	Kamalamai	62.72	11.17	7.88	3.04	2.61	1.84	1.73	9.00
34	Kapilbastu	81.72	8.52	6.36	0.48	0.36	2.56	0.00	0.00
35	Kathmandu	64.24	15.96	8.66	3.75	1.72	3.40	1.12	1.15
36	Khadbaari	46.82	14.76	13.33	4.90	4.94	6.85	0.40	8.00
37	Kritipur	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	77.94	9.81	5.23	1.99	0.66	0.74	0.75	2.86
40	Lekhanath	59.80	9.12	10.63	10.13	1.73	0.00	0.00	8.59
41	Malangawa	60.45	6.63	5.63	4.44	2.61	4.64	2.14	13.46
42	Mechinagar	70.19	12.87	11.93	0.92	1.73	0.00	0.86	1.50
43	Narayan	84.62	6.95	5.83	0.00	0.71	0.76	1.13	0.00
44	Nepalgunj	76.27	12.75	6.94	0.09	0.84	1.91	0.52	0.67
45	Panauti	82.95	7.82	5.06	0.00	0.00	1.78	0.47	1.93
46	Pokhara	62.65	8.80	11.61	4.54	5.74	2.21	2.82	1.63
47	Putalibazar	71.84	8.69	3.86	11.82	0.00	0.23	0.00	3.57

48	Rajbiraj	80.04	8.02	3.93	1.27	0.95	2.40	0.11	3.29
49	Ramgram	51.06	7.83	15.34	0.10	0.28	3.33	0.52	21.54
50	Ratnagar	74.00	20.00	2.00	1.00	0.67	1.00	0.33	0.58
51	Siddharthanagar	64.15	16.54	15.22	2.09	1.99	0.00	0.00	0.00
52	Siraha	67.78	3.58	6.01	0.34	1.59	1.48	4.31	14.91
53	Tansen	44.18	10.25	10.11	6.40	5.06	3.86	3.63	16.52
54	Thimi	48.86	12.78	9.83	1.98	0.03	0.00	1.74	24.78
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		**65.0**	**10.7**	**9.5**	**2.9**	**1.6**	**2.1**	**1.0**	**7.3**

Annex A/Table 4: Average composition of institutional waste in 58 municipalities

S.N.	Name of municipality	Organic waste	Plastics	Paper/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	Bhimeswor	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	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	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	Dasarath Chand	10.20	11.16	36.31	7.97	12.71	5.44	5.01	11.21
17	Dhangadi	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	Ghorai	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	Gularia	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	Jaleswor	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
34	Kapilbastu	0.00	16.63	83.37	0.00	0.00	0.00	0.00	0.00
35	Kathmandu	20.29	24.55	44.28	1.37	1.13	3.89	1.14	3.35
36	Khadbaari	4.94	22.70	58.79	0.91	1.18	3.18	0.99	7.31
37	Kritipur	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	14.53	23.05	41.05	0.11	1.43	0.00	0.19	19.64
40	Lekhanath	11.19	11.51	48.58	6.17	1.92	0.00	2.39	18.24
41	Malangawa	5.85	21.57	28.23	5.70	0.73	4.78	0.00	33.14
42	Mechinagar	24.74	15.32	44.62	5.65	0.00	0.00	3.89	5.78
43	Narayan	16.56	29.03	54.41	0.00	0.00	0.00	0.00	0.00
44	Nepalgung	39.30	13.02	44.24	0.00	1.92	0.00	0.00	1.53
45	Panauti	33.67	16.54	44.43	0.07	0.00	3.01	0.65	1.63
46	Pokhara	26.19	8.14	65.35	0.00	0.00	0.00	0.00	0.32
47	Putalibazar	1.63	33.64	53.04	0.00	0.00	0.00	0.00	11.69

48	Rajbiraj	12.32	10.51	40.09	1.13	0.51	1.03	0.12	34.30
49	Ramgram	19.84	7.28	31.47	10.62	1.44	0.06	0.38	28.92
50	Ratnagar	10.26	18.94	60.31	0.20	0.62	0.21	0.93	8.53
51	Sidharthanagar	1.08	23.21	75.71	0.00	0.00	0.00	0.00	0.00
52	Siraha	29.10	4.17	43.19	0.27	2.57	1.56	2.66	16.49
53	Tansen	22.92	11.25	24.05	5.16	1.91	4.02	3.75	26.94
54	Thimi	0.77	19.18	60.20	0.10	0.00	0.00	0.83	18.92
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		**19.6**	**17.6**	**45.5**	**1.6**	**1.6**	**0.9**	**0.8**	**12.4**

Annex A/Table 5: Average composition of commercial waste in 58 municipalities

S.N.	Name of municipality	Organic waste	Plastics	Paper/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	Bhimeswor	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	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	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	Dasarath Chand	24.04	16.56	35.37	1.23	6.84	3.51	2.71	9.75
17	Dhangadi	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	Ghorai	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	Gularia	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	Jaleswor	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
34	Kapilbastu	46.04	24.28	21.34	0.00	0.00	0.00	8.34	0.00
35	Kathmandu	45.44	24.29	23.29	2.86	2.65	1.03	0.00	0.45
36	Khadbaari	29.20	20.89	32.31	5.36	4.07	3.29	0.19	4.69
37	Kritipur	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	39.36	21.05	30.14	1.01	0.25	0.06	0.16	7.97
40	Lekhanath	33.59	19.50	32.45	6.05	0.98	0.00	0.00	7.43
41	Malangawa	23.91	17.72	28.16	7.67	1.56	9.57	6.94	4.47
42	Mechinagar	32.91	24.65	31.85	1.33	4.08	0.00	1.26	3.93
43	Narayan	44.93	16.84	33.06	1.82	3.36	0.00	0.00	0.00
44	Nepalgung	54.96	13.67	16.34	11.23	3.49	0.31	0.00	0.00
45	Panauti	36.09	47.55	14.16	0.91	0.00	1.30	0.00	0.00
46	Pokhara	47.23	12.60	24.68	6.14	1.44	6.95	0.13	0.84
47	Putalibazar	23.87	28.42	24.10	0.00	0.00	0.00	0.00	23.62

48	Rajbiraj	46.42	12.94	23.50	0.85	3.08	1.03	0.61	11.58
49	Ramgram	43.12	21.83	22.31	0.00	1.18	5.33	0.00	6.23
50	Ratnagar	38.12	22.96	26.24	4.30	2.70	2.43	1.29	1.96
51	Sidharthanagar	37.44	47.14	15.13	0.00	0.30	0.00	0.00	0.00
52	Siraha	48.36	7.64	27.99	7.35	1.97	0.44	2.14	4.11
53	Tansen	46.49	10.80	24.53	3.36	1.57	0.20	0.29	12.76
54	Thimi	22.05	28.04	25.37	1.12	0.00	0.00	0.17	23.26
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		**39.70**	**22.12**	**21.24**	**5.03**	**2.38**	**1.68**	**1.06**	**6.80**

Annex A/Table 6: Type of existing collection services and transportation equipments in 58 municipalities

S. n.	Name of Municipality	Type of existing collection services			Collection Coverage and frequency	Existing collection and transportation equipments								
						Rickshaw/Cart		Tractor/Power tiller		Tipper/Dump trucks		Others		
						No.	Capacity (m3)	No	Capacity (m3)	No	Capacity (m3)		No	Capacity (m3)
1	Amargadi	Road Side Container (Few no. in city area)	Road side pick-up from open piles and containers	-	Daily, Ward-4, 5 and part of ward-1	.	0.5	.	3.5	.	8		.	
2	Baglung	-	-	Door to door collection	Thrice a week from 60 % of urban area	.	.	1	1	1	2		.	
3	Banepa	Road side collection depots (50 point in city area)	-	-	Twice a day in city area only	.	.	2	1	.			.	
4	Bhadrapur	Concrete ring as container service	Road side pick-up from open piles and containers	-	Daily in main city area, not at in other area	12	0.25	1	2	1	1.5		.	
5	Bhaktapur	-	Road side pick-up	Door to door collection	twice a day in city area	88	0.18	2	1.62	6	3.9	Kharpan, Plastic bucket, Pickup van	33, 100, 6	0.06, 0.01, 1.34

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6	Bharatpur	Road side collection depots	-	Door to door collection	Daily collected in ward 2, 3 and 10, waste collected sometime in ward 8 and 12 but not in other area	.	.	.		.			.	
7	Bhimdutta	-	Road side pick-up	-	Waste collected daily only in urban area especially ward 4	9	0.12	2	10	.			.	
8	Bhimeshwor	Road side collection depots	Road side pick-up	Door to door collection	Daily collected in ward 1, 3, 6 and 10, while collected sometimes from other area	4	1	.		1	3	Compacter	1	5 tons
9	Bidur	30 road side container in few wards	Road side pick-up from open piles and containers	-	Daily collected from urban area like Trisuli bazar and Devighat but thrice a month in rural area	-	-	1 (not in used)	3.06	2	10.83, 8		.	

10	Biratnagar	Road side dust bins at some localities	Road side pick-up from bins and open piles	Door to door collection	Collection covers 60% of urban population	25 Rickshaw, 3 Carts	300-500 kg and 50 kg	6	2 ton	10	3 ton	Three wheelers, Excavator	8, 1	
11	Birendranagar	Few road side containers in city area especially in ward 6	Road side pick-up from open piles and containers	-	Waste collected from city area (ward - 6 and 8)	2	.	2		1		Tanker	1	
12	Birgunj	-	Road side pick up from open piles	Door to door collection	Covers almost all area of municipality	40	1	12	3	2	4.5		.	
13	Butwal	Road Side Container (Few no. in city area)	Road side pick up from open piles and containers	-	Covers almost all area of municipality	18	0.85	6	3	3	5		.	
18	Dhankuta	Road side container	Road side pick up from containers and open piles	Door to door collection	Daily in main urban market, twice to thrice a week in other urban main roads, twice a week in urban branch roads and no service	.	.	2	2.5 tons				.	

					in rural areas									
19	Dharan	-	Road side pick up from open piles	Door to door collection	Daily collection from market area which is about 5.28 sq. km. while once or twice a week from other parts of municipality	8	.	5	2 - 3 tons	.			.	
20	Dhulikhel	Road side containers in city area	Road side pick up from open piles and containers	-	Daily collection mainly from city area covering 95% population	.	.	2					.	
21	Dipayal-Silgadi	Road side containers in ward 1 and 7	Road side pick up from containers and open piles	-	Collection coverage area is about 45%	.	.	1	1.2	.			.	
22	Gaur	-	Road side pick up from open piles	-	Covers about 25% of urban areas in	1	0.45	2	2.82	.			.	

					daily basis and only 7% of total population									
23	Ghorai	-	Road side pick up from piles	Door to door collection	Covers only urban area (ward-10 and half of ward-11) and served population is 34%.	1	.	1		1			.	
24	Gorkha	Road side dust bins at some area of city		Door to door collection	Daily collection from city area	.	.	1	2 ton	.			.	
25	Gulariya	-	Road side pick from open piles	-	Waste collected from only selected area of urban area but in daily basis	.	.	1	4 ton	.			.	
26	Hetauda	-	Road side pick up from open piles	Door to door collection	Daily collection from main urban area (ward - 1, 2, 3, 4, 5 and 10) and once or twice a month in the remaining	15	.	2		2		Water tanker, Bulldozer	.	

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					areas									
27	Ilam	-	Road side pick up from open piles	Door to door collection in core urban area	Daily collection in main city area	.	.	1	1 ton	1	2 ton		.	
28	Inaruwa	Road side container made from concrete rings in urban area	Road side pick up from open piles and containers	-	60 % of waste from urban area (ward - 1, 2, 3 and 5) twice a week but not collected from rural ward at all.	3	.	1		.			.	
29	Itahari	30 road side containers in different place of municipality	Road side pick up from containers and open piles	-	Daily collection in main city area from ward- 1, 4 and 8, twice a week in local street markets of ward -1 and 8 and thrice a week in some places of ward-5	4	1	2	9	1	18		.	

					(street markets)									
30	Jaleshwar	-	Road side pick up from open piles	-	50% of urban area and 20% of rural area but daily basis only in core urban area	.	.	1	2.5	1	3		.	
31	Janakpur	-	Road side pick up from open piles	-	Waste collection twice a day in core urban area but no service in rural wards	4	.	4		2			.	
32	Kalaiya	Carts used as road side containers	Road side pick up from open piles	-	Waste collection generally from road side of urban wards, occasionally from rural area	4	NA	2	6	2	-		.	

33	Kamalamai	-	Road side pick up from open piles	-	Waste is collected daily in main urban area while once a week from other part	.	.	1	3	.		Mini truck	1	6
34	Kapilbastu	Road side container bins	Road side pick up from open piles and containers	-	Regular collection from ward - 1, 2, 3 and 5	5	1	1	3	.			.	
35	Kathmandu	Road side containers	Road side pick up from open piles and containers	Door to door collection by private sector	Collection coverage area is more than 90%. Daily collection from many places, twice to thrice a week in remaining area of Kathmandu	.	.	2.	1.57	16 (Eicher), 10 (Mazda), 1	3.75, 4.5, 20	Compacter, Skip, Roller	11, 4, 1, 2, 17.	14, 4, 4.5, 6, 15
36	Khadbari	No municipal collection system, individual manage themselves				.	.	.		.			.	
37	Kirtipur	Road side containers	Road side pick up from open piles and containers	Door to door collection		.	.	.		2		Loader	1	

38	Lahan	Road side containers	Road side pick up from open piles and containers	-	Regular collection from market area	2	.	2		.			.	
39	Lalitpur	Road side containers	Road side pick up from open piles and containers	Door to door collection	In some areas the wastes are collected in daily basis whereas in other areas once a week or twice a week.	.	.	2	2.3	12	3.5	Secondary Vehicle container	4	15
40	Lekhnath	No municipal collection system, individual manage themselves				.	.	.		.			.	
41	Madhyapur Thimi	Road side containers	Road side pick up from open piles and containers	-	Daily collected in some areas whereas in other area of municipality once a week or twice a week from the public chowk and also from the roadside	17	.	.		1			.	

42	Malangwa	Few road side dust bins	Road side pick up from containers and open piles	-		2	0.2	1	4.32	.			.	
43	Mechinagar	Road side containers	Road side pick up from open piles and containers	-	Waste collection services in the wards those are connected with Highway	.	.	2	4.5	.			.	
44	Narayan	-	Road side pick up from open piles	Door to door collection	Regular waste collection only in ward -1	10	.	1		.			.	
45	Nepalgunj	Road side containers	Road side pick up from containers and open piles	-	Daily road side collection service in urban area and major roads	8	0.24	4	4	.			.	
46	Panauti	Road side collection depots	Road side pick up from open piles	-		.	.	1	2	.			.	
47	Pokhara	-	-	Door to door collection	Daily door to door collection service in core urban area while	.	.	2	4.5	7	6	Compacter	4	8

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					once a week in outer core area									
48	Putalibazar	-	Rod side pick up from collection point	Door to door collection	Regular waste collection in only ward-1 and 4 while waste in other area managed by individuals themselves	.	.	1	2.5	1	6		.	
49	Rajbiraj	Road side concrete made bin	Road side pick up from open piles and containers	-	Only 40% of the waste is collected mainly from core city area	11, 2	0.25, 0.135	2	2	-	-	-	-	-
50	Ramgram	Road side container service	Road side pick up from containers and open piles	-	Waste is collected from urban wards only	2	0.5	1	3	-	-	-	-	-
51	Ratnanagar	-	Road side pick up from open piles	-	Daily collection in urban area (ward - 1, 2 and 8) but twice a week in rural area	10	0.1	1	3	1	5		.	

52	Siddarthanagar	Few road side containers in ward 1	Road side pick up from containers and open piles	Door to door collection	Collected daily in urban area, once a week in suburban areas and not at all from rural area	.	.	5	3.46	.		Wheel barrow	12	0.4
53	Siraha	-	Road side pick up from open piles	-		.	.	.		1	3		.	
54	Tansen	-	Road side pick up	Door to door collection	Daily collection in urban wards while thrice a week in rural areas	.	.	1	6.48	1	10.97		.	
55	Tikapur	-	Road side pick up from open piles	-	Daily waste collection from block 1 and its adjoining blocks and once a week from remaining block of ward-9 whereas no collection from other areas	6	5	1	40	.			.	

56	Triyuga	Road side containers in core urban areas	Road side pick up from open piles and containers	-	Daily collection limited to core urban area (ward - 2 only), rest of areas have no waste collection services	.	.	2	3.75	.		Small Trolly	12	3.36
57	Tulsipur	Road side collection containers	-	Door to door collection	Waste collection in only ward - 5	.	.	1		.		Compacter	1	
58	Waling	-	-	Door to door collection	Regular collection in urban area	1			8.1	.			.	

Annex A/Table 7: Type of final waste disposal methods and details information of planned landfill site in 58 municipalities.

S.N.	Name of Municipality	Final disposal methods	Planning for landfill site in near future	Detail of existing and planned landfill site					
				Location	Area (Ropani)	Amount of waste disposed (tons/day)	Distance from main city (Km)	Planned year of construction	Estimated lifespan (in Year)
1	Amargadi	Open dumping	No						
2	Baglung	Open dumping	Yes	Khudurke, Ward - 1	11	-	4	EIA under preparation	
3	Banepa	Open dumping	Yes	Balthali, khopasi	NA	NA	20	NA	50
4	Bhadrapur	Riverside dumping	No						
5	Bhaktapur	Controlled tipping	No						
6	Bharatpur	Open dumping	Yes	Ward -11, Taldevi Community Forest	190		5	IEE of the proposed site and design of landfill site completed.	30
7	Bhimdatta	Open dumping	Yes	At the border of ward -8 & 9					
8	Bhimeshwor	Open dumping	Yes	Ward - 1					
9	Bidur	Open dumping	No						
10	Biratnagar	Open dumping	Yes	Dangra landfill site	360	200	18	Within 2017	30

11	Birendranagar	Open dumping/riverside dumping	Yes	Gutheri, ward-1	13.31	5	7	IEE and design completed and Initially scheduled for 2010/11 but not still started due to lack of budget	10
12	Birgunj	Open dumping/riverside dumping	Yes	Ward - 19 Bhutandevi	210	63	4	2015	20
13	Butwal	River side dumping with wall fenced around waste disposed area	Yes	Proposed in different alternative site like, Tamnagar-14 and Shivanagar community forest area	-	42	-	-	50
14	Byas	Riverside dumping	Yes	Byas-8	15	7	5	2013	15
15	Damak	Riverside dumping	Yes	Not fixed	Not fixed	Not fixed	Not fixed	Not fixed	Not fixed
16	Dasharathchanda	Open dumping	Yes	Ward - 1 & 8	150	10	4	2015	5
17	Dhangadi	.	No						
18	Dhankuta	Sanitary landfill site	-	Sallariban, ward - 3	1	8	13	Under Operation	30
19	Dharan	Riverside dumping	Yes	Have a plan to be a part of Regional landfill site however; future of the project is still questionable.					
20	Dhulikhel	Open dumping	Yes	Thakuri gaun	30	6	3	Not fixed	

21	Dipayal-Silgadi	Open dumping in sloppy hills and jungle	Yes	Ward - 1	4.5	1	2	2011	15
22	Gaur	Open dumping/riverside dumping	Yes						
23	Ghorai	Sanitary landfill site							
24	Gorkha	Controlled tipping	Yes	Lamitar, ward- 8	30	2	3	2013/14	10
25	Gulariya	Open dumping	No						
26	Hetauda	Open dumping	No						
27	Ilam	Open dumping/dumping at sloppy land	Yes	Khalte, ward-3	30		6		25
28	Inaruwa	Open dumping/riverside dumping	No						
29	Itahari	Controlled tipping	Yes	Morag	373		24	2016	30
30	Jaleshwar	Open dumping	Yes	Ward -1	8.31	4	2 km	Under discussion	
31	Janakpur	Open dumping	Yes	Dhanusa Sinurjora	200	17	8	2013	20
32	Kalaiya	Riverside dumping	No						
33	Kamalamai	Open dumping	Yes	Kwandree kholsee land fill site	29	4	3	-	50
34	Kapilbastu	Open dumping	No	-	-	-	-	-	-

35	Kathmandu	Sanitary landfill site[7]	Yes	Bancharedada, Nuwakot	1700	600	28 km	EIA completed, Under discussion	29
36	Khadbari	Municipality is not currently involved in waste disposal and treatment	Yes	Ward -12, Satthimore	62	6	7	2014	50
37	Kirtipur	Riverside dumping	Yes	Ward -3			6 km	2012/13	
38	Lahan	Open dumping	No						
39	Lalitpur	Sanitary landfill site[8]	Yes	Bancharedada, Nuwakot	1700	600	28 km	EIA completed, Under discussion	29
40	Lekhnath	Currently, municipality is not involved in SWM disposal and treatment	Yes	Ward -13, Majhuwa	100	20	8 km	Alternative 3 sites were selected to proceed IEE for landfill site, IEE will be conducted in FY 2012/13.	25

[7]For the final disposal of waste generated In Kathmandu and Lalitpur, sanitary landfill site at Sisdol , Okharpauwa was constructed and operated as sanitary landfill site in early stage of operation but currently it is not operated as sanitary landfill site.

[8]Ibid

41	Madhyapur Thimi	Open dumping/controlled dumping	No						
42	Malangwa	Open dumping	No						
43	Mechinagar	Open dumping	Yes	Lalpani, Ward -2	92	7	7	Under discussion due to public obstruction	20
44	Narayan	Open dumping	No						
45	Nepalgunj	Open dumping	Yes	Hirminiya VDC	133	25	8	2012-2017	30
46	Panauti	Riverside dumping	Yes	Makaitar-13	9	8	5	2013	30
47	Pokhara	Sanitary landfill site	-						
48	Putalibazar	Open dumping/riverside dumping	Yes	Ward -7	25	4	7	2013	50
49	Rajbiraj	Road side piling	Yes	Jamuni madhepura VDC	NA	15	3	2017	20
50	Ramgram	Riverside dumping	Yes	Ward - 1, Sanda	133	5	3	2012/13	20
51	Ratnanagar	Controlled tipping	Yes	Panchakanya Community Forest	53	15	5.5	2011	5
52	Siddarthanagar	Riverside dumping	Yes						
53	Siraha	Open dumping/riverside dumping	No						

54	Tansen	Sanitary landfill site, operation started from October 11, 2012	-	Ward -2	29	6	5		15
55	Tikapur	Open dumping	Yes	Initially identified in flooding zone of Karnali, but area was rejected during IEE process in June 2011, After then municipality committed to identify the land for waste disposal, which is still under way.					
56	Triyuga	Riverside dumping	Yes	Ward -11	133	16	12	2013	35
57	Tulsipur	Open dumping	Yes	Phulbari VDC-1	38		14		100
58	Waling	Riverside dumping	Yes	Panche khola	10	Not fixed	2	2013/14	50

Annex A/Table 8: Existing and planned community or municipal composting plant in 58 municipalities

S.N.	Name of Municipality	Existing community level composting plant					Existing municipal level composting plant					Planned municipal level composting plant in near future				
		No. of plant	Location	Existing condition	Capacity (ton/day)	Distance from city center (km)	No. of plant	Location	Existing condition	Capacity (ton/day)	Distance from city center (km)	No. of plant	Location	Plan to be constructed	Capacity (ton/day)	Distance from city center (km)
1	Amargadi															
2	Baglung											1	Ward - 1 Khudurke	Within FY 2013/14	2	5
3	Banepa															
4	Bhadrapur															
5	Bhaktapur						2	Ward - 15			1	2	Ward - 2 and 6			
6	Bharatpur															
7	Bhimdatta															
8	Bhimeshwor															
9	Bidur															
10	Biratnagar	1	ward no 1(Namuna compost chamber)	Operational	6	within city	1	Ward - 7	Under construction		with in city	22(1 in each ward)				
11	Birendranagar	1	6	Non operational		0.1						1	6			
12	Birgunj											1	Ward - 19, near Bhutandevi	2016/17	63	4

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13	Butwal	1	Ramnagar, ward-2	operational	10	2	1	Hatbazar,ward - 7	Operational(Demonstration site)	1	0.5	2	Ward - 14 and 15	FY 2012/13 - 2013/14	15	3
14	Byas															
15	Damak											Few	Not fixed	Under planning	Not fixed	Not fixed
16	Dasharathchanda															
17	Dhangadi															
18	Dhankuta	1	Ward -3, waste management centre	Not in operation	3	3.5										
19	Dharan	1	Dharan-13,Amarhat			3										
20	Dhulikhel											1	Thakuri gaun-1	Under planning	6	3
21	Dipayal-Silgadi											1	1	NA	NA	1
22	Gaur											1	Ward - 9, Gaur	Within FY 2012/13		1 km from Gaur
23	Ghorai											1	9	2014/15	5	4.5
24	Gorkha															
25	Gulariya											3	Ward -11,8,6		1	4
26	Hetauda						1	Ward - 10		3	1.5					
27	Ilam											2	Ward -2 and 5	FY 2012/13		5
28	Inaruwa											1	Ward - 2, Gudri ghat	Under planning	-	0.5

29	Itahari															
30	Jaleshwar															
31	Janakpur															
32	Kalaiya															
33	Kamalamai	3		Operational	0.3	4						2	Ward -4	FY 2013/14	1	
34	Kapilbastu															
35	Kathmandu		Ward-5		-	-	1	ward - 12,teku	closed	5						
36	Khadbari															
37	Kirtipur	1	Kirtipur ward 6	Operational	0.01	0.5						1	Ward -3, kirtipur	-	7	1
38	Lahan															
39	Lalitpur											1	Tikathali,ward - 4		3	3 km
40	Lekhnath	1	Ward 8,Shisuwa	Normal	-	0.2						1	Ward-13, Majhuwa	Within 2016/17	1	8
41	Madhyapur Thimi															
42	Malangwa															
43	Mechinagar						1	Ward 2	Construction phase complete	3	7					
44	Narayan															
45	Nepalgunj											1	Hirminiya VDC	2012	19 ton	8
46	Panauti															
47	Pokhara			Recycling yard								1	Ward -18		.165 tons/day	12
48	Putalibazar											1	Badkhola -4, Bajra area	2013	4	1
49	Rajbiraj															

50	Ramgram															
51	Ratnanagar															
52	Siddarthanagar															
53	Siraha															
54	Tansen											2	Ward - 11 and 12	2013/14	1	4.5
55	Tikapur															
56	Triyuga											3	ward -1,2 and 11	2013/14	0.5	0.8
57	Tulsipur															
58	Waling											Each HH	Ward - 1,2,3,45,8	2012/13		

Annex A/ Table 9: Total municipal budget and SWM budget in 58 municipalities

S.N.	Name of Municipality	Total municipal budget (NRs.) in lakhs			Total SWM budget (NRs.) in lakhs			SWM budget (% of total municipal budget)			Average SWM budget in % of total municipal budget (FY 2009/10 - 2011/12)
		FY 2009/2010	FY 2010/2011	FY 2011/2012*	FY 2009/2010	FY 2010/2011	FY 2011/2012*	FY 2009/2010	FY 2010/2011	FY 2011/2012*	
1	Amargadi	501.50	610.38	604.66	7.14	7.06	7.75	1.42	1.16	1.28	1.29
2	Baglung	712.12	650.04	702.34	107.43	25.58	52.69	15.09	3.94	7.50	8.84
3	Banepa	NA	NA	860.00	NA	46.14	51.00	-	-	5.93	5.93
4	Bhadrapur	558.51	899.32	1253.24	14.71	14.11	18.50	2.63	1.57	1.48	1.89
5	Bhaktapur	2558.31	2721.05	3850.00	480.00	554.29	537.00	18.76	20.37	13.95	17.69
6	Bharatpur	NA	NA	NA	NA	NA	NA	-	-	-	-
7	Bhimdatta	NA	NA	NA	55.00	55.00	55.00	-	-	-	-
8	Bhimeshwor	486.61	581.45	510.64	9.00	11.18	9.00	1.85	1.92	1.76	1.84
9	Bidur	620.98	527.98	680.53	24.50	27.00	42.00	3.95	5.11	6.17	5.08
10	Biratnagar	2396.37	3451.90	3680.61	251.30	435.21	171.50	10.49	12.61	4.66	9.25
11	Birendranagar	824.73	909.66	990.69	28.00	28.95	34.90	3.40	3.18	3.52	3.37
12	Birgunj	NA	2589.25	3171.39	NA	587.49	590.20	-	22.69	18.61	20.65
13	Butwal	1454.58	2036.54	3220.99	157.80	178.73	192.00	10.85	8.78	5.96	8.53
14	Byas	853.62	980.09	879.68	43.23	27.36	38.40	5.06	2.79	4.37	4.07
15	Damak	941.53	1257.33	1664.63	11.56	18.84	21.50	1.23	1.50	1.29	1.34
16	Dasharathchanda	655.70	499.06	644.96	2.00	2.50	7.00	0.31	0.50	1.09	0.63
17	Dhangadi	976.87	1256.68	15349.52	23.98	NA	NA	2.46	-	-	2.46
18	Dhankuta	NA	NA	NA	44.42	59.80	50.00	-	-	-	-
19	Dharan	1775.93	2173.77	2400.68	84.43	87.31	126.71	4.75	4.02	5.28	4.68
20	Dhulikhel	713.92	768.42	1127.23	12.00	22.80	32.25	1.68	2.97	2.86	2.50
21	Dipayal-Silgadi	349.13	567.12	530.80	45.82	5.75	6.33	13.12	1.01	1.19	5.11
22	Gaur	762.25	576.65	745.34	14.17	36.62	41.00	1.86	6.35	5.50	4.57
23	Ghorai	712.16	798.21	997.28	60.00	80.00	85.00	8.43	10.02	8.52	8.99
24	Gorkha	NA	NA	768.44	NA	2.40	NA	-	-	-	-
25	Gulariya	54.27	80.52	750.33	4.32	6.48	NA	7.96	8.05	-	8.00
26	Hetauda	0.00	0.00	2258.64	98.58	90.45	100.00	-	-	4.43	4.43
27	Ilam	686.04	865.92	753.00	29.20	25.44	34.42	4.26	2.94	4.57	3.92
28	Inaruwa	520.01	536.86	660.52	9.00	14.00	20.63	1.73	2.61	3.12	2.49

29	Itahari	742.49	1010.08	1285.16	57.40	98.06	84.00	7.73	9.71	6.54	7.99
30	Jaleshwar	543.45	706.91	846.78	4.20	1.39	6.24	0.77	0.20	0.74	0.57
31	Janakpur	1438.79	1660.86	1630.08	91.85	92.49	103.45	6.38	5.57	6.35	6.10
32	Kalaiya	658.68	628.58	491.77	51.71	46.08	40.96	7.85	7.33	8.33	7.84
33	Kamalamai	1008.19	1048.86	897.34	3.82	4.57	10.50	0.38	0.44	1.17	0.66
34	Kapilbastu	574.25	693.48	0.00	12.00	15.07	NA	2.09	2.17	-	2.13
35	Kathmandu	12128.54	9474.08	19000.00	2786.12	2531.33	4431.00	22.97	26.72	23.32	24.34
36	Khadbari	634.71	556.48	NA	NA	0.40	NA	-	0.07	-	0.07
37	Kirtipur	NA	NA	1224.10	24.13	25.14	25.00	-	-	2.04	2.04
38	Lahan	501.58	450.26	5914.35	36.26	36.02	NA	7.23	8.00	-	7.61
39	Lalitpur	2349.51	4338.22	5586.89	131.10	221.73	312.20	5.58	5.11	5.59	5.43
40	Lekhnath	896.75	1084.14	1287.08	NA	NA	NA	-	-	-	-
41	Malangwa	329.68	222.46	930.70	16.15	21.41	30.50	4.90	9.63	3.28	5.93
42	Mechinagar	1035.12	1235.52	1390.62	15.00	19.87	29.50	1.45	1.61	2.12	1.73
43	Narayan	NA	NA	631.77	NA	NA	NA	-	-	-	-
44	Nepalgunj	964.87	1162.03	1511.10	50.95	16.32	206.17	5.28	1.40	13.64	6.78
45	Panauti	1550.45	1308.93	985.48	10.17	36.48	16.78	0.66	2.79	1.70	1.72
46	Pokhara	2730.36	3222.45	3685.84	245.00	286.00	303.30	8.97	8.88	8.23	8.69
47	Putalibazar	391.90	491.25	802.62	12.00	17.95	17.48	3.06	3.65	2.18	2.96
48	Rajbiraj	415.91	548.60	1053.00	36.29	26.12	38.00	8.73	4.76	3.61	5.70
49	Ramgram	552.16	625.55	629.34	4.98	6.13	8.00	0.90	0.98	1.27	1.05
50	Ratnanagar	706.83	883.38	923.31	15.43	28.80	29.45	2.18	3.26	3.19	2.88
51	Siddarthanagar	1089.22	1256.76	1505.93	45.82	53.48	65.30	4.21	4.26	4.34	4.27
52	Siraha	703.97	675.33	540.50	3.50	4.00	5.00	0.50	0.59	0.93	0.67
53	Tansen	215.49	325.37	746.14	24.47	27.65	42.00	11.36	8.50	5.63	8.49
54	Thimi	NA	NA	1625.41	29.70	NA	32.55	-	-	2.00	2.00
55	Tikapur	674.60	NA	NA	0.96	NA	NA	0.14	-	-	0.14
56	Triyuga	795.45	1199.00	1074.00	11.23	14.30	15.00	1.41	1.19	1.40	1.33
57	Tulsipur	485.12	541.34	965.60	20.00	30.00	12.50	4.12	5.54	1.29	3.65
58	Waling	422.22	464.71	515.68	4.26	3.09	5.51	1.01	0.66	1.07	0.91
Total/average value		**53655.42**	**61152.82**	**106736.72**	**5362.09**	**6114.34**	**8195.17**	**9.99**	**10.00**	**7.68**	**9.22**