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**ADDIS ABABA UNIVERSITY  
SCHOOL OF GRADUATE STUDIES**

**ASSESSMENT OF MUNICIPAL SOLID WASTE MANAGEMENT  
SERVICE IN DESSIE TOWN**

**BY:**

**SOLOMON CHERU**

**JUNE, 2011**

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SERVICE IN DESSIE TOWN**

**A Thesis Submitted to the School of Graduate Studies of Addis Ababa  
University in Partial Fulfillment of the Requirements for the Degree of  
Master of Arts in Geography and Environmental Studies**

**BY:**

**SOLOMON CHERU**

**ADVISOR: YIRGALEM MAHITEME (Dr.)**

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**DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES**

**APPROVED BY THE BOARD OF EXAMINERS**

**SIGNATURE**

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**DEPARTMENT'S CHAIRMAN**

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**ADVISOR**

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**INTERNAL EXAMINER**

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## LIST OF ACRONYMS

AAU	=	Addis Ababa University
BPR	=	Business Process Reengineering
CBOs	=	Community Based Organizations
FEDO	=	Finance and Economic Development Office
GPS	=	Global Positioning System
HH	=	Household
JICAIC	=	Japan International Cooperation Agency Institute for International Cooperation
MoH	=	Ministry of Health
MSSE	=	Micro and Small Scale Enterprise
MSW	=	Municipal Solid Waste
MSWM	=	Municipal Solid Waste Management
NGOs	=	Non Governmental Organizations
SBPDD	=	Sanitation, Beautification and Parks Development Department
UK	=	United Kingdom
UNCHS	=	United Nations Center for Human Settlement
UNEP	=	United Nations Environmental Program
US	=	United States
WHO	=	World Health Organization
WP	=	Work Process

## DEFINITION OF TERMS

BPR:	The fundamental rethinking and radical design of work process to achieve dramatic improvements in work.
Case team:	A group of experts that work together in one work process.
Household:	Persons who live together in one house or dwelling.
Kebelle:	The lowest administrative unit in Ethiopia (Zebenay, 2010).
Liwach:	A name given to individuals that exchange old shoes and old cloths of the society by house materials informally through door to door visit
Quraleos:	A name which is given to individuals that buy reusable, and recyclable solid wastes from the society informally through door to door visit.
Sanitation agents:	A person employed by the concerned organ to supervise and control over the illegal disposal solid waste.
Work process:	Represents specific departments of an institution that organize to perform its assigned tasks.

## **ABSTRACT**

*This study is aimed at the overall assessment of the existing MSWM service in Dessie town. Besides this, the study had also specific objectives such as investigation of households' solid waste generation rate, physical composition and management practices, the existing status and spatial coverage of MSWM, and current institutional arrangement and capacity of MSWM service delivery of the town. In order to accomplish these objectives, the researcher used both primary and secondary sources. The primary data were gathered through questionnaires, interviews, field measurement, and field observations. Whereas secondary data were extracted from different published and unpublished materials. The analysis of this paper was carried out using both qualitative and quantitative techniques.*

*The findings of this study revealed that the present system of MSWM in Dessie town entirely relied on the municipality which provided the full range of waste collection, transportation and disposal service. But, the provision of this service is not kept in pace with the town solid waste generation. Based on the findings of this research, the town households' dominantly produced biodegradable solid wastes (75.6%) with generation rate of 0.231kg/person/day. This made the daily total solid waste generation of households to 100.91m<sup>3</sup> (37337.223kg). Together with other four solid waste sources the total daily solid waste generation of the town is about 136.11m<sup>3</sup>(50360.7kg) but only 32 m<sup>3</sup>(23.51%) of this is collected and disposed to the town disposal site. So that MSWM of the town is found in very low status and spatial coverage. This poor status of MSWM is also intensified by three critical factors. The first one is poor institutional structure and capacity of Sanitation, Beautification and Parks Development Department. The second shortcoming is limited participation and contribution of stakeholders' i.e. unsatisfactory participation of communities, no collaboration of various CBOs and NGOs, no private sector involvement, very limited contribution of MSSE, solid waste miners and handcrafts of Dessie town. The third constraint is poor households' solid waste management practices resulted from improper handling of solid waste storage materials, low level of solid waste separation and resource recovery activities, and illegal solid waste disposal system. Therefore, the best ways that used to tackle the above problems are: execution of sustainable solid waste management systems (reuse, recycle, composting, and incineration) through awareness creation and training, improvement of SBPDD institutional structure and capacity, and implementation of integrated MSWM approach which recognizes and comprises all stakeholders.*

# CHAPTER ONE

## 1. INTRODUCTION

### 1.1 Background of the Study

The rapid urbanization that has been taking place during the 20<sup>th</sup> century virtually transformed the world into communities of cities and towns facing similar challenges on environmental issues in which most of them have to be addressed at international level (Smith, 2010). Among those environmental issues solid waste management is a critical one because as long as humans have been living in settled communities, solid waste generation has been an unavoidable and critical issue both in developed and developing nations. As a result, solid waste management became a worldwide agenda at United Nations Conference on Environment and Development in Rio de Janeiro in 1992 with a great emphasis on reducing wastes and maximizing environmentally sound waste reuse and recycling at first step in waste management (UNEP, 1996).

Solid waste management is defined as the collection, transportation, processing, recycling, and disposal of solid waste materials so as to reduce their effect on health, environment and aesthetics. It is highly related with urbanization and industrialization (web page accessed, August 20, 2010)<sup>1</sup>. For instance in early societies, solid waste management consisted of digging pits and throwing garbage into them. When cities began to be more concentrated; however, solid waste management became a serious and complex issue. Houses that did not have room to bury their garbage would throw it into the streets. In response, many cities started to set up municipal garbage collection teams which would dispose of unusable garbage. This is mainly because modern societies generate far more solid waste than early humans ever did. As a result, recent events in major urban centers both in developed and developing countries have shown that municipal solid waste management has become a big challenge (web page accessed, August 20, 2010).<sup>1</sup>

In developed countries the daily life of people can generate greater quantity of solid waste than developing countries, but most parts of developed nations are efficient in handling waste when compared to developing countries because of their technologically complex, institutionally efficient

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<sup>1</sup> Waste management, Wikipedia free encyclopedia. Retrieved from (<http://en.wikipedia.org/wiki/waste-management>) web page accessed, August 20, 2010

and cost effective solid waste management systems. On the contrary compared to developed countries, developing countries produce less per-capita solid waste. But the capacity of developing countries to collect, process and dispose waste is limited due to inadequate infrastructure, finance, political instability, inefficient institutional capacity and structure, and low level of awareness. For example, Sarageldin (1995) and Rushbrook (1999); cited in Solomon (2006) stated that “about 30 to 50 percent of the solid waste produced in urban areas of low income countries as well as poorest parts of middle-income countries is estimated to be left uncollected.” These situations introduced numerous discomforts to communities and threaten humans’ health through direct contact, contamination of water and soil.

Similarly, the current condition of municipal solid waste management service in different towns of Ethiopia is also becoming a challenge for municipalities. For instance, according to Birke’s (1999) cited in Degnet (2003) study of municipal solid waste management practices of 15 regional cities of Ethiopia, a controlled solid waste disposal system was practiced in only two of them. That means small proportions of the urban dwellers are served and a large quantity of solid waste left uncollected. In addition, a study conducted by (MoH, 1996) cited in Gebrie (2009) revealed percentage of solid wastes which are left uncollected and disposed anywhere without due attention regarding their consequences in different towns of Ethiopia.

Table 1.1 percentages of uncollected solid waste major towns of Ethiopia.

<b>Town</b>	<b>Percentage of uncollected solid wastes</b>
Jijiga	82
Hawassa	75
Dessie	70
Dire dawa	63
Jimma	63
Harar	53
Mekele	52
Addis Ababa	32

As it is indicated in table 1.1, from major towns of Ethiopia Dessie is one of the town by which proper provision of solid waste management services is still unsatisfactory and incomplete. In Dessie, illegal dumping of waste on open areas, in gullies, river courses is considered as routine task of residents. The efforts made by the municipality to change the situation in the town are also insufficient as it compared to the extent of the problem. Therefore, in order to reduce this situation and achieve efficient solid waste management system of the town, detail study of the existing condition of municipal solid waste management service is required.

## **1.2 Statement of the Problem**

Dessie town is characterized by rapid population growth caused by natural increase and migration. According to 1994 national census report, the town had 97,314 total populations while in 2007 national census it reached 151,094 with growth rate of 3.38%/annum. Such rapid increase in population together with rapid development of the town has produced increasing volumes of solid waste and in turn it induced greater infrastructural demand, institutional setup and community participation for its management. But, the town sanitation, beautification and parks development department (SBPDD) which runs the solid waste management activities of the town could not fulfill the above requirements. For instance, currently SBPDD has practice its activity by supplying one truck for collection, transportation and disposal of the town solid waste. In addition to this, there are no public solid waste storage containers and road side dust bins. So that it highly suffered from shortage of solid waste management infrastructures and faced unmatched burdens of collection, transportation and disposal of solid wastes. Furthermore, SBPDD is surrounded by different institutional constraints such as lack of sufficient manpower, weak financial and material resource, weak regulation and controlling mechanism, and insignificant movement for public awareness creation.

These limitations led to deterioration of the town environment and also reinforce incorrect disposal habits to the people. Most of solid wastes that are generated in the town remain uncollected and simply dumped in open areas, road sides, river courses, gullies. According to the report made by SBPDD of Dessie town in 2010, the total solid waste generated in 2010 is estimated to be 32188  $m^3$ .

From this amount only 11569  $m^3$  (36%) of solid wastes were collected and disposed but the remaining large proportion of the solid wastes (64%) were left uncollected. The disposal method that the town used is also open dumping type which widely practiced in many developing countries and has hazardous effect on health and the environment. Besides this, SBPDD of the town does not operate any waste recovery or recycling activity.

As a result, municipal solid waste management in Dessie has not been carried out in a sufficient and proper manner. The environmental and sanitary conditions of the town have become more serious from time to time, and people are suffering from living in such conditions. So that urgent need of efficient MSWM on one hand and steady growth of solid waste problem on the other side are still the main features of the town. Detail study of the overall condition of MSWM service should be the first move required for reducing this gap. Therefore, this study is focused on examining current status and spatial coverage of municipal solid waste management service of the town and its institutional arrangement and capacity side by side with household solid waste management.

### **1.3 Objectives of the Study**

**1. General objective;** this study was aimed at assessing the current municipal solid waste management service of Dessie town.

**2. Specific objectives;** having the above general objective, the study was geared to attain the following specific objectives.

- I. To investigate the generation rate and physical composition of households solid waste in the town
- II. To evaluate the condition of households solid waste management practices in the town
- III. To examine the existing status and spatial coverage of municipal solid waste management service in the town.
- IV. To assess present institutional arrangement and capacity of municipal solid waste management of the town.

## **1.4 Research Questions**

So as to achieve the intended objectives stated above, the following research questions were formulated.

- I. What is the rate of household solid waste generation and physical composition in the town?
- II. What is the condition of households' solid waste management practices in the town?
- III. What is the current status and spatial coverage of municipal solid waste management of the town?
- IV. What is the existing institutional arrangement and capacity of municipal solid waste management of Dessie town?

## **1.5 Significance of the Study**

This study may have two main significances. First it may give some guide line information to policy makers, solid waste managers and environmental protection agencies about existing situation municipal solid waste management of Dessie town. The study may also important in putting base line information to the next work who would like to conduct detailed and comprehensive studies either in Dessie or other study area.

## **1.6 Research Methodology and Sampling Procedures**

### **1.6.1 Research Design**

The research design of this study was explanatory method. Because, it was more appropriate to describe the existing situation of MSWM service of Dessie town by direct observation of the researcher and through grasping people and officials' responses, opinions, and perceptions about MSWM.

### **1.6.2 Data Source and Methods of Collection**

In this study, the researcher used both primary and secondary data sources. For gathering primary data researcher employed questionnaires, interviews, field measurement and field observations.

With regard to questionnaires, there were two types of questionnaires (both open and close ended) which were prepared in order to look the MSWM practices and capacities of the town together with

households' solid waste management activities. These questionnaires were first prepared in English but later it translated in to Amharic for making it easily understandable to samples. After preparation, around 30 questionnaires were randomly distributed as pre test in order to correct unclear and misleading questions. Then all questioners were brought to samples with the help of two data collectors employed by the writer from Wollo university graduate students with giving training and under a close supervision of the researcher. Moreover, primary data were also gathered with the help of semi structured and unstructured interviews with SBPDD head and workers about the overall institutional setting, capacity and constraints of SBPDD.

Apart from these, the researcher used field observation and field measurement as a major data sources for this study. Field observation was employed for assessing spatial distribution of MSWM infrastructures, households' solid waste handling practices, illegal dumping, solid waste collection and transportation systems and disposal site facilities of the town. Photographs were taken during field observation for partial exposure of transfer stations, disposal site, illegal dumping of residents.

While, field measurement was carried out for investigating households' solid waste generation rate and physical composition. GPS receiver data was also used for collection of data about spatial distribution of solid waste transfer stations.

On the other hand, secondary data were extracted from different sources including published and unpublished materials from administrative office, SBPDD, municipality, finance and economic development office, and health office of Dessie town.

### **1.6.3 Sampling Procedures and Sample Size**

In order to collect primary data, the researcher used three different sample sizes with different sampling procedures. In all cases, sample sizes were determined by considering financial, time and resource constraints.

The first sample size was designed for collection of data from households on their solid waste management practice, and their attitude towards MSWM practice of the town. For deciding this sample size and selecting samples, the researcher used three stages. The first stage was classifying 16 kebelles of the town in to 3 separate strata namely inner (kebelles close to the center), middle (kebelles located in the middle distance to the center), and periphery (rural kebelles of the town)

based on geographical location, population density and availability of different infrastructures. The second stage was selecting kebelles that represent those stratum. The researcher selected 6 kebelles, two from each stratum, using random sampling method. This was mainly because; the writer believed that those kebelles located in each stratum have homogenous characteristics with respect to proximity to the center of the town, population density, and availability of infrastructures. As a result, taking one kebele from each stratum can be representative.

In third stage, the researcher took a total sample size of 245 households from three sample kebelles in general. This was decided by using scientific statistical method from (Cochran (1977); cited in Melaku, 2008). The formula that used for determining sample size was the following.

$$n = \frac{NZ^2PQ}{d^2(N-1)+Z^2 PQ} \quad \text{Where } n = \text{total sample size}$$

N = Total number of sample households (sample frame i.e. 16321 in Table 1.1)

Z = standard normal deviation at the required confidence level that corresponds to 95% confidence interval equal to 1.96

d = the level of statistical significance (Allowable error) (0.05)

P = the proportion in the targeted population estimated to have characteristics being measured (from previous studies or studies in other comparable countries i.e. 0.8 from Melaku, 2008)

Q = 1-p i.e. 1-0.8 = 0.2

$$n = \frac{NZ^2PQ}{d^2(N-1)+Z^2 PQ} = \frac{16321(1.96^2) \times (0.8)(0.2)}{(0.05)^2(16321-1) + (1.96^2)(0.8)(0.2)} = \frac{10031.80058}{41.414656} = 244.2282725 = \underline{\underline{245}}$$

Therefore, n = 245 was the minimum sample size of households for reliable results. Finally, by using proportional allocation method the researcher was decided to take sample households from selected kebelles. These sample households was drawn for data collection using simple random sampling method.

Table 1.2: Kebele specific proposed number of sample households of Dessie town

Groups	kebelles	Sample kebelles	Number of households			Number of sample households		
			Kebelles (05,01,12)	Kebelles (06, 10,15)	Total	Kebelles (05,01,12)	Kebelles (06, 10,15)	Total
Kebelles close to the center	02,04,05, 06,07	05,06	2726	3649	6375	41	55	96
Kebelles located in the middle	01,03,08, 09,10	01,10	2456	4338	6794	37	65	102
Periphery(Rural kebelles) of the town	11,12,13, 14,15,16	12,15	1656	1496	3152	25	22	47
total	16	6	16321			245		

Source: Dessie town health office, 2011

The second sample size determination was used for examining institutional arrangement and capacity of the town sanitation, beautification and parks development which is responsible for town solid waste management. According to the manual of SBPDD of Dessie town, the department has a total of 34 employees who work on solid waste management aspect. For this study, the researcher took all these workers since they are manageable by the financial, time, and resource of researcher.

The final sample size determination was done for measuring daily households' solid waste generation rate and physical composition. For this study the researcher identified 36 households who are not involved in any type of business activities. They were taken from three income categories: higher income, middle income and lower income category. This is because the rate and quantity of solid waste production of households is a direct reflection of their income level or economic performance. The amount of monthly households' income was collected during data collection using questionnaire. In addition for categorizing these sample households the researcher also used ownership status of households' residence and housing condition as indicator of economic power of households. I.e. private cement houses as sign of higher income groups, private mud houses as pointer of middle income groups, and unqualified kebele houses and hats for lower income categories.

#### **1.6.4 Method of Data Analysis**

Both qualitative and quantitative techniques were used for data analysis. Quantitative methods include percentages, means, graphical and tabular analysis, maps, ratios, rates and frequency distribution. Qualitative techniques were cause and effect relationships, inductive and deductive reasoning.

#### **1.7 Limitation of the Study**

The researcher did not finish this research without short comings. Some of them were lack of data, shortage of money during data collection. The writer also faced shortage of secondary data. Official workers in the municipality of the town are also refused to give detail information related to operational cost of SBPDD work process of some consecutive years. But, the researcher tried to overcome some of those problems by finding reference documents about the town MSWM from public and other different colleges' libraries and by using its own money in addition to the fund raised by AAU .

#### **1.8 Delimitation of the Study**

The study was confined to southern Wollo zone, Dessie town. This was mainly because there is a severe problem of municipal solid waste management and limited surveys which were conducted so far regarding the town solid waste management. And also its accessibility for minimizing financial, time and other constraints as it is a home town of the researcher. On the other hand, the problem that the researcher studied was delimited to overview of current condition of municipal and households' solid waste management and institutional arrangements and capacity of SBPDD for delivery of proper MSWM in the town.

#### **1.9 Organization of the Thesis**

This paper is organized in to five chapters with four parts. The first part is chapter one which is an introductory part of the paper. The second chapter deals with review of related literature obtained from various published and unpublished reference materials. The second part of the thesis is chapter three that describe the background of the study area. The third part is result and discussion which present analysis and interpretation of data about the existing status and spatial coverage of municipal

solid waste management practice, and institutional arrangement and capacity of municipal solid waste management of town. The fourth and the last part of this study is chapter five which is conclusion and recommendation. Bibliographies and appendices are also attached at the end of the paper.

## **CHAPTER TWO**

### **2. REVIEW OF LITERATURE**

#### **2.1 Concepts of Municipal Solid Waste Management**

##### **2.1.1 Definitions of Key Terms**

Waste - according to UK environmental protection act (1990), “it is any substance which constitutes scrap materials, an effluent or other unwanted surplus arising from application of any substances or article which requires to be disposed of which has broken, worn out, contaminated or otherwise spoiled.”

Solid waste - can be defined as “any garbage, refuse, sludge, and other discarded solid materials resulting from industrial, commercial, agricultural operations, and community activities, but does not include dissolved materials” (U.S. Code of Federal Regulations, 1995 cited in Samuel, 2006,p.5). In short “it is anything that is neither liquid nor gas and is discarded as unwanted” (Federal Negarit Gazeta of Ethiopia, proclamation number 513 of 2007).

Municipal solid waste (MSW) - refers to materials discarded in urban areas for which municipalities are usually responsible for collection, transportation, and final disposal.

Municipal solid waste management - is an activity of planning and implementation of solid waste management components such as collection, transfer and transportation, recycling, resource recovery, and disposal MSW under jurisdiction of local government.

##### **2.1.2 Sources and Types of Municipal Solid Waste**

In order to categorize what exactly municipal solid waste constitutes, there have been different attempts of categorization based on numerous classification criteria. Some of those criteria are source from which solid waste emanates, and nature of solid waste components. On the basis of the nature of items that constitute solid wastes, it can be classified into organic or inorganic, combustible or non-combustible, and putrescible or non-putrescible (Edelman, 1997 cited in G/Tsadkan, 2002). With respect to source from which solid waste emanates, (Martin, 2000) categorized municipal solid waste as household (residential) refuse, institutional wastes, street sweepings, commercial areas

wastes, as well as construction and demolition debris. In developing countries, MSW also contains various amounts of industrial wastes from small scale industries. In these sources there are diverse types of solid wastes. But, some of typical solid wastes of those sources are described by (Dereje, 2001, p.36) as follows.

***Domestic solid wastes:** wastes generated from household activities such as food preparation, cleaning, fuel burning, old cloths, furniture, obsolete utensils and equipment, packaging, newsprint, and garden wastes. In developing countries, food waste and ashes dominate households' solid wastes.*

***Commercial wastes:** waste from shops, offices, hotels, restaurants, etc and typically consisting packaging materials, office supplies and food wastes. In low income countries food markets contribute the largest proportion of commercial waste.*

***Institutional wastes:** waste from schools, hospitals, clinics, government offices, military bases etc, and comprise hospital and clinical wastes including potentially infectious and hazardous materials.*

***Industrial wastes:** composition of industrial waste depends on the kind of industries involved. It consist food waste from kitchens, and canteens, packaging materials, plastics, papers and metal items.*

***Street sweepings:** dust, soil, paper, etc. In developing countries street sweeping also include fruit and vegetable residues, household wastes dumped along roads, drain cleanings, animal manure and plant remains.*

***Construction and demolition wastes:** its composition depends on type of construction materials used, but it typically includes soil, brick, stone, concrete, ceramic materials, wood, packaging materials and the like.*

### **2.1.3 Characteristics of Municipal Solid Waste**

For effective and efficient management of solid waste generated in a particular city, adequate knowledge and data about the characteristics of solid waste is essential. In order to decide or determine types of facilities required for solid waste management, best disposal options, and projecting future needs requires precise information about quantities, compositions, densities, moisture content and calorific value of solid waste produced in a city (Rushbrook, 1999 in G/tsadkan,2002). Though all the above characteristics are important, for this study the researcher emphasize only on municipal solid waste physical composition and generation rate.

**Solid waste generation rate:** refers to the “amount of waste disposed during a given period of time and the quantification of it involves different methods: by measurement at the point of generation, through use of vehicle survey and by examination of records at the disposal facility” (UNEP, 2009;

cited in Zebenay, 2010, p.18). The rate of solid waste generated in a given town is basically determined by demographic growth, seasonal variation, geographic location, economic development and people's attitude towards waste. Nashimirimana (2004) explained the influence of economic development by comparing gross national product of developed and developing countries with their waste generation rate. And he concludes that the higher the gross national product of a country result the higher the generation of waste. It means due to difference in level economic performance, waste generation rate of developed countries is highly greater than that of developing countries. Although developing countries have a lower rate of waste generation compared to developed countries, their quantum of waste is high owing to their higher levels of population growth. This clearly shows impact of population size on waste generation rate (Ibid, 2004). On the other hand, people's attitude towards waste can also conditioned solid waste generation rate in the form of their pattern of material use and waste handling, their interest in waste reduction and minimization, and the degree to which they refrain from indiscriminate dumping and littering (Schubeler, 1996).

Therefore, an accurate knowledge of quantity and rate of solid waste generation in a given area is essential for preparation and implementation of appropriate MSWM. Because it provides information on human, financial and equipment resources required for collection and transportation of waste, to enact appropriate laws on waste reduction, and establish current and future needs for solid waste disposal sites (Abel, 2007).

**Physical composition:** refers to quantity of various material types in a particular waste stream. Just like waste generation rate, physical composition of solid waste is also extremely variable as a consequence different factors. The major once are of the following:

- a) *Economic level difference: higher income areas are usually produce more inorganic waste while low income areas produce relatively more organic waste.*
- b) *Demography (difference in amount of population for example, tourist places).*
- c) *Locations: includes abundance and type of regions natural resource, and socio-cultural factors which highly contribute for variation of waste in different areas.*
- d) *Season: for instance during certain season's yard wastes such as grass clippings and raked leaves add greatly to solid waste (web page accessed, august 25,2010).<sup>2</sup>*

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<sup>2</sup> Urban waste generation and classification. Retrieved from ([http://www.medcities.org/docs/3%20urban%20waste % 20 generation%20classification.p](http://www.medcities.org/docs/3%20urban%20waste%20generation%20classification.p)).web page accessed, august 25, 2010.

Unlike various composition of solid waste in different areas, process of defining waste composition is similar in each area i.e. by measuring mass percentage of each material group present in a sample. Conduct of waste composition studies by using this method has several importances. “Some of these are: for identification of potential resource recovery activities, facilitate collection, transport and processing equipment, taking essential health, aesthetic and environmental precautions, and for monitoring changes in waste composition over time and improving waste management system” (Gidarkos, Havas, and Ntzamilis, 2005,p.1). Therefore, composition study is core stone for successful planning and implementation of solid waste management.

#### **2.1.4 Functional Elements of Municipal Solid Waste Management**

In the course of municipal solid waste management there are six functional elements. Identification of these functional elements allows description of relationships involved in each element, and development of a framework. As a result, to handle a specific solid waste management it is obligatory to observe the following six elements in combination. These are:

##### **2.1.4.1 Waste Generation**

Waste generation encompasses activities in which materials are identified as valueless and either thrown away or gather together for disposal. This functional element is very important because all activities that lead to identification and understanding of solid waste generation rate, volume, composition, area specific variations of waste generation and their expected changes overtime are belong to this component solid waste management. So, this functional element is a vital stage for acquiring accurate information that is necessary to monitor existing management system and to make regulatory, financial and institutional decisions (Gebrie, 2009).

##### **2.1.4.2 On site Handling, Storage and Processing**

This functional element constitutes activities associated with handling, storage, and processing of solid wastes at point of generation.

*Waste handling involves activities associated with management of wastes until they are placed in storage containers for collection. It also encompasses movement of loaded containers to point of collection. Storage refers stock up of wastes as soon as they are generated. There are two types of storage activities at source. The first one is temporary*

*storage done at household level as a part of their hygiene. The second type is communal solid waste storage system on public solid waste containers prepared by municipality. While processing at source involves activities such as waste composting and separation of solid wastes for reuse and recycling. All of these components are important for protection of public health and aesthetics and environment (Web page accessed, august 27, 2010).<sup>3</sup>*

### **2.1.4.3 Collection**

Collection involves the process of picking up of wastes from collection points, loading them in to a vehicle, and transporting it to processing facilities, transfer stations or disposal site. In most municipal solid waste management systems, cost of collection accounts a significant portion of total cost. For instance, “in industrialized countries collection accounts about 60-70% of total cost, and 70-90% in developing and transition countries” (UNEP, 1996). Collection is structurally similar in developing, transition, and industrialized countries, but there are important technical and institutional differences in implementation. In most cases, industrialized countries have more efficiency and effectiveness than developing ones in terms of their approach of collection, role of municipal governments, private-sector participation, and demographic and social factors relevant to collection. In developing countries, collection often involves a face to face transaction between generator and collector. The level of service is low, and generators often have to bring their wastes long distances and place it in containers. As a result many collection activities in developing countries carried out by informal sectors (UNEP, 1996). In general, there are four basic methods of collection described by (Tchobanalous, et al 1993 cited in Ramachandra and Bachamanda, 2006):

- i. **Community bin**- they are placed in convenient locations where community members carry waste and throw it in. This method is comparatively cheaper than other methods, and most widely adopted method in western countries. For this method to be adopted it is important that bins are covered, aesthetic, attended regularly, kept clean, easy to handle, and separate bins are provided.
- ii. **Curbside collection** - homeowner is responsible for placing containers to be emptied at the curb on collection day and for returning empty containers to their storage location until the next collection.
- iii. **Block collection**- collection vehicles arrive at a particular place or a set day and time to collect waste from households. Households bring their waste containers and empty directly into the vehicle. This method requires a higher homeowner cooperation and scheduled service for homeowner collaboration.

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<sup>3</sup> Chapter 2 Principles of Municipal Solid Waste Management. Retrieved from ([http://urbanindia.nic.in/public\\_info/swm/chapter2.pdf](http://urbanindia.nic.in/public_info/swm/chapter2.pdf)) web page accessed, august, 27, 2010

- iv. ***Door to door collection-*** waste is placed at doorstep at a set time when waste collector arrives. In this method, collector of waste has the responsibility to collect waste separately. This method is very convenient for households, however requires homeowner cooperation.

#### **2.1.4.4 Transfer and Transport**

These activities are associated with transfer of wastes from public storage facilities to collection vehicle and the subsequent transport of wastes to disposal site. Transfer refers to movement of waste or materials from primary collection vehicle to a secondary, larger and more efficient transport vehicle. When location of final disposal site is at a long distance from points of collection, transfer stations may be used. With respect to transfer stations, “there are two basic modes of operation: direct discharge and storage discharge. In storage discharge refuse is first emptied from collection trucks in to a storage pit or to a large platform. While in direct discharge station, each refuse truck empties directly in to larger transport vehicles” (Meenakshi, 2005).

Transportation on the other hand covers all types of vehicles under operation to transport solid waste from its generation point to transfer station and then to treatment or disposal site. “All vehicles in operation are considered including manually driven small carts, mechanically driven sophisticated transportation vehicles, and special vehicles for hazardous, bulky, and recyclable wastes. Generally, a properly design transfer and transportation system highly reduces cost of collection” (Ibid, 2005).

#### **2.1.4.5 Processing and Recovery**

This functional element includes all techniques, equipments and facilities used both to improve the efficiency of other functional elements and to recover usable materials, conversion products, produce energy, and compost from solid wastes. In addition it also provides several advantages. First, it can serve to reduce total volume and weight of waste material that requires collection and final disposal. Volume reduction also helps to conserve land resources since land is the ultimate sink for most waste materials. On the other side, it also reduces total transportation cost of waste to its final disposal site (Uriarte and Filemon, 2008).

Solid waste processing and recovery has been carried out beginning from separation and processing of wastes at the source. But, separations of mixed wastes usually occur at materials recovery facility, transfer stations, combustion facilities and disposal sites. It often includes separation of bulky items, separation of waste components by size using screens, manual separation of waste components, and

separation of ferrous and non-ferrous metals. Then they enter in small and large scale industries for recovery activities. For example, organic fraction of MSW can be transformed by a variety of biological and thermal processes. The most commonly used biological transformation process is aerobic composting and, the most commonly used thermal transformation process is incineration (web page accessed, august 27, 2010).<sup>4</sup>

#### **2.1.4.6 Disposal**

This is final functional element in solid waste management system. Disposal activities are associated with final dump of solid wastes directly to a landfill site. Today disposal of wastes by land filling or land spreading is the ultimate fate of all solid wastes whether they are residential wastes, or residual materials from materials recovery facilities. “However, in most developed countries this method is officially banned allowing only sanitary landfill for final disposal. Because sanitary landfill is not a dump it is an engineered facility used for disposing of solid wastes on land without creating nuisances or hazards to public health and environment” (Techobanglous, 2002). “Though it is the most common technology around the world, conventional and environmental unfriendly methods such as open-burning, open-dumping, and non-sanitary landfill can still be used as disposal method” (UNEP, 2009).

### **2.1.5 Economically and Environmentally Sustainable Municipal Solid Waste Management Methods**

#### **2.1.5.1 Incineration**

Incineration is one option for sustainable solid waste management. It is defined as the process of burning solid waste under controlled conditions to reduce weight and volume of solid waste, and often to produce energy. This process is really waste reduction, not waste disposal, though following incineration ash must still be disposed. It is recognized as a practical method of disposing of certain hazardous waste materials (such as medical waste). Incineration can be carried out both on a small scale by individuals and on a large scale by industry.

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<sup>4</sup> Chapter 2 Principles of Municipal Solid Waste Management. Retrieved from (<http://urbanindia.nic.In/publicinfo/swm/chapter2.pdf>) web page accessed, august, 27, 2010.

This facility does not require much area so that it is common in countries like Japan where land is scarce (web page accessed, September 5, 2010).<sup>5</sup> Incineration has several advantages and disadvantages. These are summarized in table 2.1.

Table 2.1: Advantages and disadvantages of incineration

<b>Advantages</b>	<b>Disadvantages</b>
<ul style="list-style-type: none"> <li>• Requires minimum land</li> <li>• Can be operated in any weather condition</li> <li>• Produces stable odor free residue</li> <li>• Can generate electricity</li> <li>• Effective way for hazardous waste management</li> <li>• Reduce solid waste weight up to 70 % and volume up to 90 %</li> </ul>	<ul style="list-style-type: none"> <li>• expensive to build and operate especially for developing countries</li> <li>• high energy requirement</li> <li>• requires skilled personnel and continuous maintenance</li> <li>• emission of gaseous pollutants</li> <li>• If not carried out properly, incineration results air pollution</li> <li>• Difficult to site because of citizens opposition</li> <li>• Encourages waste production because it is output approach</li> </ul>

Source: (Miller, 2007)

Generally, according to UNEP (1996) there are considerations that we should keep in our mind when we want to choose incineration. These are:

- The necessary environmental controls are properly installed and maintained.
- The facility is properly sized and sited to fit well with other components of the MSWM
- The material to be burned is combustible and has sufficient energy content.

### 2.1.5.2 Composting

It is a process of allowing biological decomposition of solid organic materials by bacteria, fungi, worms, insects, and other organisms in to a soil for transforming large quantities of organic materials to compost (humus like materials). “The organic materials produced by composting can be added to soil to supply plant nutrients such as nitrogen, phosphorus, potassium, iron, sulfur, and calcium, slow soil erosion, make clay soils more porous or increase water holding capacity of sandy soils” (Enger and Smith, 2008).

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<sup>5</sup> Solid Waste Management Glossary. Retrieved from <http://www.gdrc.org/uem/waste/swm-glossary.html> web page accessed, September 5, 2010.

*There are three scales at which composting has been implemented; residential level, decentralized community level, and centralized and large scale municipality level. The larger the undertaking the more capital investment is required. Most developing countries which have found success with composting revealed that composting works best when implemented at household level, with some project doing well at community level as well. At municipal level financial commitment required to maintain equipment has resulted in wide spread failures (zerbock, 2003, p.15).*

Generally composting has many advantages; first it would reduce amount of waste requiring ultimate disposal and extending the life of landfills. When it done correctly the end result becomes a useful product, capable of being used at household or farm level to augment soil nutrient levels and increase organic matter in the soil, increasing soil stability. If the product has high enough quality and markets exist, it can be sold. Environmentally, process of composting is preferable than landfill processes. In a landfill, bacteria break down organics anaerobically (in absence of oxygen) and resulted in release of methane gas. However, in composting organic matter is decomposed using an aerobic process and produces no methane by product (zerbock, 2003). Contrary to the above benefits, composting has the distinction of being failed waste management system.

*In cities of developing countries, most large mixed waste compost plants have failed or operate at less than 30% of capacity. The problems most often cited for such failures include: high operation and management costs, high transportation costs, poor quality of product as a result of lack of sorting (especially plastic and glass fragments), poor understanding of composting process, and high competition from chemical fertilizers (which are often subsidized) (UNEP, 1996).*

### **2.1.5.1 Reuse and Recycle**

Reuse involves cleaning and using materials over and over. In other words, it means the use of a product more than once in its original form for the same or a new purpose. It relays on items that can be used over and over instead of throw away items. This method is used to decrease the use of matter and energy resources, cuts pollution, creates local jobs, and saves money (Miller, 2007). “Reusing is more efficient and better than recycling and composting methods because cleaning and reusing materials in their present form avoids the cost of energy for remaking them in to something else” (Cunningham,2008).

In addition to reuse, recycling is also an obvious solution of solid waste problem. It is an important way of collecting solid waste materials and turning them in to useful products that can be sold in the market place. Such materials can be reprocessed in two ways: primary and secondary. “Primary recycling is a process in which original waste material is made back in to the same material for example, newspapers recycled to make newsprint. In secondary recycling, waste materials are made in to different products that may or may not be recyclable for instance, cardboard from waste newspapers” (Miller, 2007).

*Recycling is both environmental and economical issue. Many people’s are motivated to recycle because of environmental concern i.e. it reduces pollution, it also save energy, space and resources, helps to protect biodiversity and reduce litter. Economically, it can save money for items like paper, metals and some plastics, and generally it is important part of economy. However there are also some critics forwarded on recycling dominantly on economic aspect of its benefits. Economists say that recycling does not make sense if it costs more to recycle materials than to send them to a landfill or incineration. They also forwarded that recycling is often not needed to save landfill space because many areas are not running out of it (Miller, 2007).*

## **2.1.6 Institutional Aspect of Municipal Solid Waste Management Service**

### **2.1.6.1 Relationships between Institutional Structures and Municipal Solid Waste Management**

It is a common perception that improving MSWM means making waste collection and disposal systems more efficient, raising public awareness and enforcing environmental MSWM laws. However, according to Antipolis (2000)in Obeng et al,(2008,p.1) “a prerequisite for all these factors is a well planned management, operating within an enabling institutional framework, and capable of generating the financial resources required to meet operating, maintenance and investment costs. Otherwise, poorly managed facilities lead to declining service levels, which in turn reduce the chances of good cost recovery in terms of both willingness to charge and willingness to pay” (Obeng et al, 2008,p.1). In addition, several studies also point out the strength of institutional structure as a key underpinning factor to sustainable solid waste management. For example, (Schubeler et al, 1996) stated key institutional structure issues associated with MSWM which are considered as the building blocks of an enabling institutional framework for MSWM. These are:

- Decentralization of responsibility of MSWM i.e. a corresponding distribution of powers.
- Private sector involvement and participation of communities and user groups. Private sector involvement in MSWM implies a shift in role of government institutions from service provision to regulation. As a result, create essential conditions for successful private sector.
- Capacity building measures for MSWM should give primary attention to strategic planning and financial management.
- The contribution of informal waste collection workers may be significantly improved through appropriate organizational measures (Schubeler et al, 1996).

### **2.1.6.2 Relationship between Institutional Capacity and Provision of Municipal Solid Waste Management**

First of all, Institutional capacity means “the ability of institutions to perform functions, solve problems, and set and achieve objectives in a sustainable manner” (UNDP, 2008 in Abeje, 2009). According to Hilderbrand & Grindle’s in Watson (2004) capacity of an institution to deliver municipal solid waste management is mainly depend on three factors. These include; 1) capacity of individuals to perform their job or tasks; 2) considerations of structure and culture characteristics of organization and its leadership; and 3) institutional context of public sector and expansion of the task network.

#### **A. The capacity of individuals to perform job or tasks**

Environmental capacity building initiatives have not only stressed the importance of organizational and institutional strengths, but also the abilities of agents, the role of human capital, technical expertise and functional skills needed to carry out environmental protection measures. In relation to solid waste management, “the capacity of an individual is expressed based on the will and ability to set MSWM objectives and achieve them using one’s own knowledge and skill, linguistic competence, expertise, will and sense of responsibility” (JICAIC, 2005). “Strengthening the efficiency of environmental protection through capacity building has therefore focused increasingly on improving the skills of individuals through various forms of training because sustainable policy implementation capacity cannot be achieved without strengthening the ability of institutions and employees to carry out policy initiatives” (Hirschman, 1993cited in Watson, 2004,p.5).

## **B. Structure of the organization and task networks**

For the purpose of evaluating institutional capacity for MSWM, it is more important to examine the present level of cooperation between government agencies charged with waste management responsibilities; the present state of solid waste management policy; efforts undertaken for its implementation and the level of cooperation between its implementing agencies; and the level of municipal government financial and decision-making autonomy for determining appropriate waste management options for their area (Hirschman,1993cited in Watson,2004).

Specifically, organizational capacity for MSWM can be viewed in terms of, human aspect (human resource in the engineering, management, and planning sections in MSWM, including the development of such resources), physical assets(facilities, equipments, land, fund, and capital all required to provide MSWM), intellectual assets (expertise in MSWM system; statistical information including waste flows, literature; manuals; and research data, organization forms, management, leadership, and ownership that can put these assets to good use, and also a shared awareness with in organizations (JICAIIIC, 2005).

## **C. Institutional context of the public sector and expansion of the task network**

Institutional context refers to the environment and conditions necessary for demonstrating capabilities at the individual or organizational level, including the decision making process, systems and frame works necessary for the formation, implementation of policies and strategies that are over and above an organization. As a result, for better provision of solid waste management service it is necessary to have the following capacities;

- *Formal legal framework, laws, decrees and ordinances that define wastes and clarify where the responsibility for waste management lies. And formal regulations and standards on management, treatment and disposal of wastes; standards on waste generation rates, environmental standards; and legal force.*
- *Articulated solid waste management policies, policy objectives.*
- *Social infrastructure for solid waste management services, social organizations involved in solid waste management (CBOs), NGOs, formal and informal recycling markets and industries.*
- *partnership designed to ensure that the opinions of local residents and communities are taken account of good governance, involving a partnership between all stakeholders in MSWM, Social ownership of the implementation of solid waste management (public feeling, consensus or willingness to work together, etc (JICAIIIC, 2005, p.7).*

## 2.2 Municipal Solid Waste Management in Developing Countries

The rapid extent and nature of urbanization in developing countries made MSWM as a major issue of concern in those countries. “In the next 35 years, the urban population of world is expected to be double to more than five billion people, and from this 90% of growth is taking place in developing countries” (World resource institute, 1997; in Ahmed and Ali, 2002,p.468). As a result of this, the existing MSWM of developing countries fail to catch up with the rapid increase of solid waste production in these countries. To show this situation, UNCHS (1996) cited in Schertenleib and Meyer (1992,p.1) report identified “one third to one half of solid waste generated with in most cities in low and middle income countries are not collected, rather it ends up as illegal dumps on streets, open spaces, and sewerage systems, and contribute to spread of diseases”. Furthermore, MSWM schemes generally serve only part of the urban population. For instance, “in Kenya -Nairobi municipal solid waste collection service is mainly concerned in central business district and more affluent communities. As a result, in poor suburban zones indiscriminate disposal of solid waste at riversides, roadsides, and other open spaces are common” (Henry et al., 2005 cited in Gebrie, 2009, p.22).

*Transport of waste from households, commercial areas, institutions and other generation sites is also a growing problem in developing countries. The transport of waste becomes longer and more time consuming, and hence, more expensive and less efficient. In developing countries many sources of waste might only be reached by roads or alleys which may be inaccessible to certain methods of transport because of their width, slope, congestion, and surface. This is especially critical in unplanned settlements such as slums or low income areas. In addition to this vehicles that serve for waste transports are also outdated, poorly maintained and frequently out of action (zerbock, 2003, p.4).*

The operational inefficiency of MSWM in developing countries is also further reflected in resource recovery. Although the material recovery from the waste stream has a great potential in economic as well as environmental point of view, municipality and formal private sector contribution in this activities is minimum. Besides this, waste disposal is also a neglected area in many low income countries and causes for environmental health hazards. Most of municipal solid wastes in developing countries are dumped on land in a more or less uncontrolled manner. These dumps make very uneconomical use of the available space, allow free access to waste pickers, animals and flies and often produce unpleasant and hazardous smoke from slow-burning fires (Zurbrugg, 2003).

## **2.2.1 Constraints of Municipal Solid Waste Management in Developing Countries**

As it is noted earlier a typical solid waste management system in a developing country displays an array of problems including low collection coverage and irregular collection services, and crude open dumping and burning without air and water pollution control. These problems are caused by various factors which constrain development of effective municipal solid waste management systems. They can be categorized into technical, financial, institutional, social constraints, and awareness and attitudes (Ogawa, 2002). Each of these constraints is discussed below.

### **2.2.1.1 Human and Technical Constraints**

In most developing countries, there is lack of human resources and technical expertise both at national and local levels. Many officers in charge of municipal solid waste management, particularly at the local level, have little or no technical background or training in engineering or management (Ogawa, 2002). This is a main reason for lack of comprehensive waste management planning in developing countries. Furthermore, collection and analysis of solid waste data are generally not given sufficient attention. As a result, there are few opportunities for waste management administrators to become experts and to formulate and implement waste management plans that are tailored to the actual situation in their country. This in turn makes it extremely difficult to license or develop technologies that are best suited to the local conditions (web page accessed, September 9, 2010).<sup>6</sup>

Moreover, research and development activities in municipal solid waste management have often low priority in developing countries. This lack of research and development activities in developing countries leads to selection of inappropriate technology in terms of local climatic and physical conditions, financial and human resource capabilities, and social or cultural acceptability. “Several guides or manuals on appropriate solid waste management technologies in developing countries are available in the literature, and selection of technology could be made sometimes based on these guides. However, in most cases these guides must be modified to local conditions prevailing in the country, and therefore local studies are normally still needed” (Ogawa, 2002).

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<sup>6</sup> Chapter 1 Characteristics of Solid Waste Problems in Developing Countries. Retrieved from <http://www.jica.go.jp/english/publications/reports/study/topical/waste/pdf/waste02.pdf> web page accessed, 14, 2010.

### **2.2.1.2 Financial Constraints**

MSWM is given low priority in developing countries; as a result, very limited funds are allocated to the sector by government. This problem is acute at the local government level where local revenue collection system is inadequately developed and financial base for public service including MSWM is weak. In addition to limited funds, many local governments in developing countries lack good financial management and planning. For instance, “in a developing country town over 90% of annual budget provided for solid waste management was used up within first six months. Lack of financial management and planning, particularly cost accounting depletes limited resources available for the sector even more quickly and causes solid waste management services to halt for some periods, thus losing trust of service users” Zurbrugg (2003) in Gebrie (2009,p.22).

### **2.2.1.3 Institutional Constraints**

*The waste management regime in developing countries is seldom integrated, and there is often no clear assignment of responsibilities and schedules among the organizations involved. Furthermore, there is often no umbrella organization to coordinate overlapping responsibilities for waste management that involve more than one agency. This situation not only hinders effective implementation of waste management operations, but also produces confusion in relation to technical cooperation and assistance projects among donors. Along with these organizational and structural problems, lack of an effective legal system and technical standards constitute a major constraint. Legal provisions related to solid waste are often incorporated as fragmented elements in disparate laws, such as laws for public hygiene, local administration, and environment protection. Generally speaking, there is no integrated legal framework to deal with waste management in developing countries (web page accessed, September 9, 2010).<sup>7</sup>*

### **2.2.1.4 Social Constraints**

Social status of solid waste management workers is generally low both in developed and developing countries, but more severe in developing countries than developed countries. Such people's perception leads workers to disrespect their work and in turn produces poor quality of their work. At dump sites, transfer stations, and street refuse bins, waste picking or scavenging activities are common scenes in developing countries. People involved have not received school education and vocational training to obtain knowledge and skills required for other jobs. They are also affected by limited employment opportunity available in formal sector. The existence of waste pickers

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<sup>7</sup> Chapter 1 Characteristics of Solid Waste Problems in Developing Countries. Retrieved from [http://www.jica.go.jp/english/publications/reports/study/topical/waste/pdf/waste\\_02.pdf](http://www.jica.go.jp/english/publications/reports/study/topical/waste/pdf/waste_02.pdf) web page accessed, 14, 2010.

(scavengers) creates often an obstacle to the operation of solid waste collection and disposal services. However, if organized properly their activities can be effective in waste management system. Such an opportunistic approach is required for sustainable development of solid waste management programs in developing countries (Ogawa, 2002).

#### **2.2.1.5 Awareness and Attitudes**

Public awareness and attitudes to waste can affect the whole municipal solid waste management system. All steps in municipal solid waste management starting from household waste storage, to waste segregation, recycling, collection frequency, willingness to pay for waste management services, and opposition to siting of waste treatment and disposal facilities depend on public awareness and participation. Thus, lack of public awareness and school education about the importance of proper solid waste management for health and well-being of people severely restricts use of community based approaches in developing countries and also crucial factor for failure of a MSWM service in developing countries (Zurbrugg, 2003).

### **2.2.2 Municipal Solid Waste Management in Ethiopia**

Solid waste management is becoming a major public health and environmental concern in urban areas of Ethiopia. In Ethiopia, like developing countries, increase of solid waste generation is resulted from rapid urbanization and population booming. “The average solid waste generation rate is about 0.221kg per person per day and it is also estimated that only 2% of the population received solid waste collection services” (Zebenay, 2010, p.39). This shows that the operational condition of MSWM service and efforts made to change the situation are low. As a result, small proportions of the urban dwellers are served and large quantity of solid waste left uncollected. “The public sector in Ethiopia is unable to deliver services effectively, as result illegal dumping of solid waste along road sides and open areas is a common practice due to inadequate supply of waste containers and longer distance to these containers” (web page accessed, September 8, 2010).<sup>8</sup> The involvement of private sectors are also very limited, but currently a number of micro and small scale enterprises are emerging to participate in primary solid waste collection i.e. collect garbage at source from households and transport it to the municipal waste containers and transfer points. To sum up the real

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<sup>8</sup> The Cycle of Waste in Addis Ababa, (1999). Addis Ababa, Ethiopia. Retrieved from <http://www.globnet.org/preceup/pages/ang/chaptire/capital/transver/ethiopia.htm> web page accessed, September 8, 2010.

situation of MSWM in Ethiopia indicates that the problem of solid waste cannot be solved only by mere effort of municipal government, there should be large involvement of the private sectors in general and participation of micro enterprises and community in particular (Abebe,2006).

## **CHAPTER THREE**

### **3. BACK GROUND OF THE STUDY AREA**

This chapter describes historical, physical (location, topography, and climate) and socio economic back ground such as demography, social and physical infrastructures, and economic activity of Dessie town.

#### **3.1 Historical Background of Dessie Town**

Dessie town, which is considered as the principal urban settlement in Wollo, is one of the relatively older towns in Ethiopia. It came in to being in 1886 following Nigus Michael's selection as a seat of power. Several factors were responsible for the rise of Dessie as a political powerhouse of Nigus Michael. The first reason was Dessie is very strategically situated at the heart of Wollo. The last quarter of the 19th century saw that the ruling houses of Ethiopia were trying their best to consolidate and expand their feudal domains. Thus, for Michael, who was one of the main actors of this historical drama, Dessie's commanding position was vital importance. There was also an economic factor which encouraged Nigus Michael to make Dessie as political center of wollo. Dessie was a well-placed site through which the flourishing Tigray-Shewa trade route passed. The availability of water, fire-wood and grain also contributed to selection of Dessie as Michael's seat of power. Thus, in 1886 Nigus Michael established his palace at "Ayteyyef"- a strategic site southeast of the town and became the nucleus of the town. The land between the present days Medhane Alem church through the left side of "Arada" up to "Silk Amba" was allotted to his guards and came to be known as "Zebegna Sefer". The next step taken by Nigus Michael was to distribute land to his chiefs and their retainers.

However, the newly-founded town of Dessie showed no significance growth until the late 1890s. This was mainly because the chiefs of Michael were not certain about the stability of their position and as a result they were reluctant to construct permanent structures on the land allotted to them. It was in the post-Adwa period that Michael's retainers began constructing their domed houses in their respective quarters. Their retainers, too, began to construct their huts around their Nigus residence.

As a result several residential areas evolved bearing the name of Michael's chiefs such as Dejjach Yazew Sefer, Dejjach Yimer Sefer, etc. In such conditions the town of Dessie resumed its south-north elongation (web page accessed, October 12, 2010).<sup>9</sup>

The town was occupied by Italians 15 April 1936. Dessie became an important administrative center under Italian occupation. In a decree of 1942, Dessie is listed as one of the six "Schedule A" municipalities in Ethiopia, while there were about a hundred in "Schedule B". It was an administrative, military, and commercial center. Dessie has an important marketplace dealing in animal skins and agricultural products. The local handicrafts industry is also a significant economic activity (web page accessed, October 15, 2010).<sup>10</sup>

The town continued in importance as the capital of the province of Wollo until the province's abolition in 1995. Following the severe civil war, in October 1990 Dessie was totally captured by Ethiopian people's revolutionary democratic front (EPRDF). Currently, the town serves as the capital city of South Wollo zone of Amhara Regional State (Draft Strategic plan of Dessie, 2009 cited in Abebe, 2010).

## **3.2 Physical Background of Dessie Town**

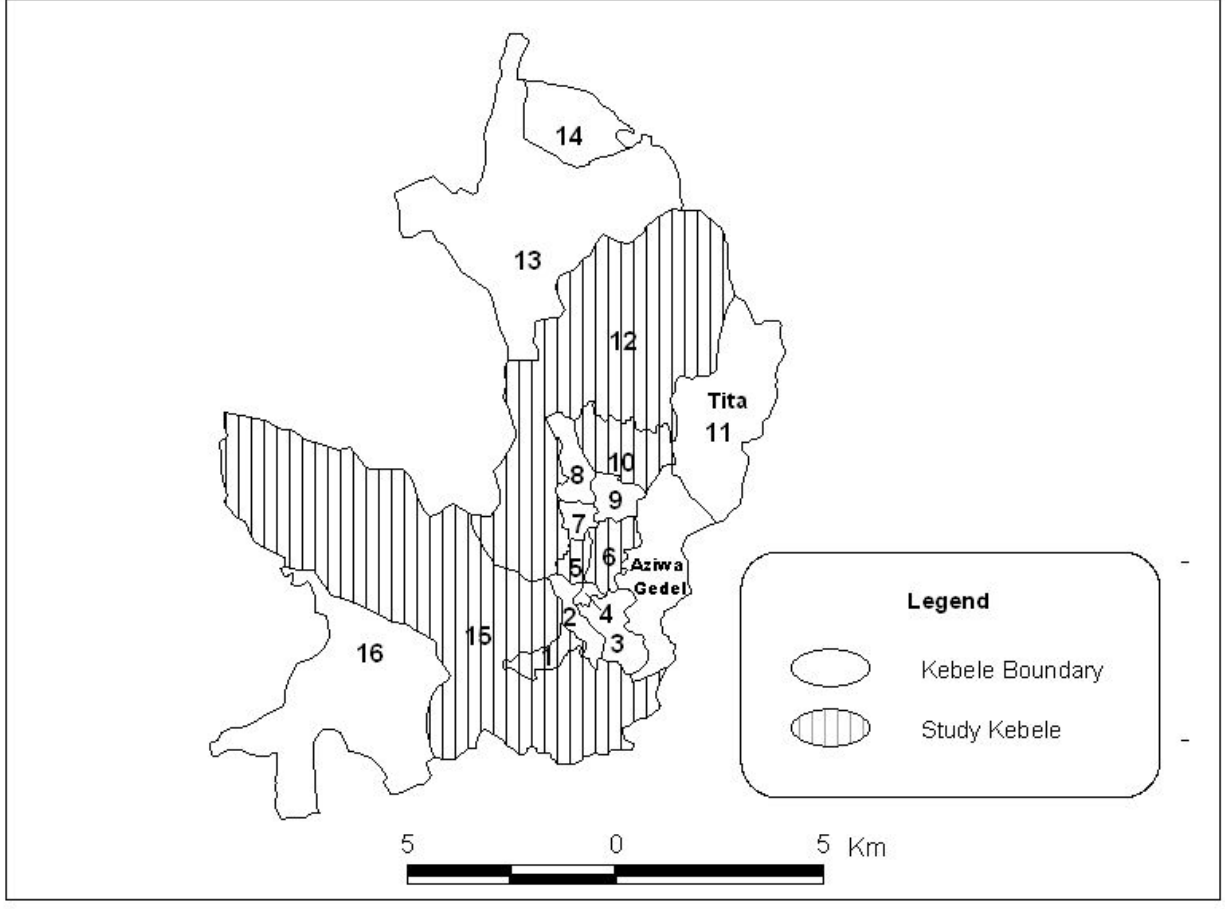
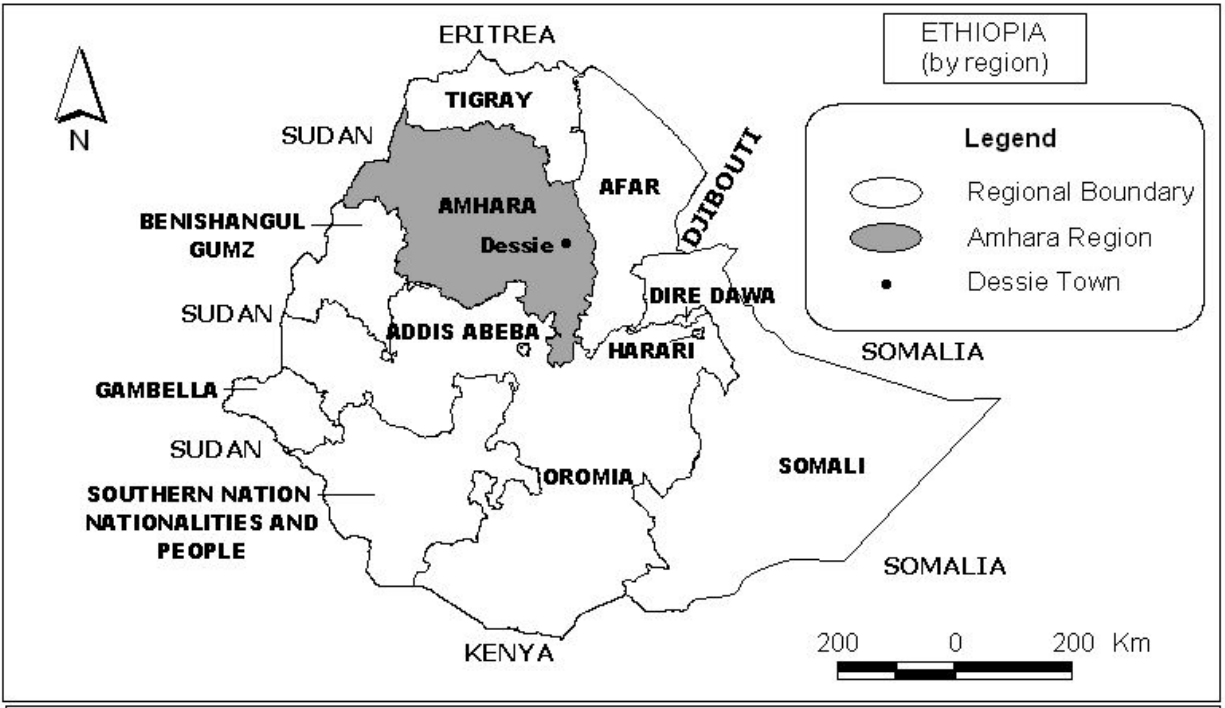
### **3.2.1 Location, Topography and Climate**

Dessie town is found in south Wollo zone, eastern margin of Amhara regional state and in north-central part of Ethiopia at a road distance of 401km from Addis Ababa. Astronomically, the town lies on the intersection of 11°8'N 39°38'E. It is surrounded by imposing Tossa Mountain that overlooks the town in west and rises to 3000 meters. The eastern side of the town is hilly with an average elevation of about 2400 meters and constitutes a series of ridges of eastern escarpment of the north-western highlands of the country. Out of the total area of the town, flat plain covers 10 %, while 30 % is plateau, and the remaining 60 % is mountainous. Administratively, the town is subdivided to 16 kebelles. From this 10 are urban kebelles while the remaining 6 are rural kebelles of the town (Dessie town administration office magazine, 2009).

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<sup>9</sup> History of Dessie town, retrieved from (<http://www.ethiopedia.com/index.php?title=Dessie>, web page accessed, october12,2010

<sup>10</sup> History of Dessie town retrieved from Answer. Com, web page accessed, October 15, 2010



Map 3.1: Location of Dessie town in Amhara National Regional State of Ethiopia

The average elevation of the town ranges from 2400 to 2800 meter above sea level. The town is bounded and squeezed by a series of ranges and escarpments with rugged surfaces between the cliffs of Tossa and Azuwa, and Borkena River divides this basin in to two parts. Dessie falls within “Dega” agro climatic zone with an average monthly minimum and maximum temperature of 12.370c and 26.270c respectively. As a result, it has cooler temperature and higher precipitation. According to the metrological data record at kombolcha station (which is 10km air distance from Dessie) in Dessie there are two rainy seasons: spring (march-may) and summer (July-September), of which summer season has the highest rainfall. The average annual rainfall for the period between 1994 and 2001 were calculated to be 1070mm (Solomon, 1993 cited in Sileshi, 2004).

### **3.3 Socio-Economic Background of Dessie Town**

#### **3.3.1 Demographic Characteristics**

According to 1994 national census report Dessie town has a total population of 97,314 of whom 45,337 were males and 51,977 were females. While in 2007 national census it was 151,094 with growth rate of 3.38% /annum which is almost doubled in the past 13 years. The town has an estimated area of 15.08 square kilometers, which gives the town a density of 11,213.79 people per square kilometer.

#### **3.3.2 Settlement Pattern and Housing Condition**

According to the information gained from municipality office, the total numbers of plots that have been distributed during the last five years for residential purpose were 2062 at an average rate of about 412 per year. However, the places which are favorable for urban development have already reached as a saturation point during the past three decades (between 1964 and 1994). Consequently, in recent years the new settlement areas have been developed in different directions of the town. Development of settlements on steep gradients has already aggravated the problem of surface run off and thereby causing the concentration of landslides on the weakest part of an area (Dagnachew etal., 1996 cited in Sileshi, 2004).

### **3.3.3 Social and Physical Infrastructures**

In 1957, Dessie had one of 9 provincial secondary schools (excluding Eritrea) in Ethiopia, named after Woizero Sehine the daughter of Negus Mikael. But now, Dessie has a number of governmental and private educational institutions ranging from kindergarten to higher education levels. According to the Dessie town education office report of 2010, there are 29 kindergartens, 36 general primary, 11 secondary and preparatory, 8 higher education institutions (colleges) and 1 university currently functioning in the town (Dessie Town Education Office Report,2010). On the other hand, according to the information obtained from Dessie town health office (2009), the health coverage of the town has now reached to about 44.5 percent. The town has five hospitals, 4 diagnostic and regional laboratory, 7 higher clinics, 11 junior clinics, 2 whole services of pharmaceutical products, 21 pharmacies and drug stores, 7 health centers and 8 developing health posts. This shows that the provision of health service coverage is found in a good manner and also gives service for the neighboring zones and region like Oromiya zone and Afar region. In addition, the participation of private investors on this sector is great since they cover 62% of such health facilities.

With respect to transportation, electricity and telecommunication services, the town also has such services. In the town there are 108 km of roads out of which 33.4 km are asphalt while the remaining are gravel roads. Owing to this, the town is known for its high traffic flow in addition to its high commercial and communication centers. The town also gives transportation service to different areas using many public buses. Dessie shares airport with neighboring Kombolcha. On the other dimension, Dessie has postal service beginning from 1920s and telephone service from at least as early as 1954. At present, the telephone service is reached to 16,240 fixed line and 11,897 mobile telephone connections and Postal services serve for about 1,600 customers. Among these telephone services, there are 14,046 and 13,450 fixed line and mobile customers/beneficiaries respectively. Moreover, 420 internets and 123 public phones booths are also at services. Besides this, the town has also electrical power since at least 1963 when a new diesel-powered electric power station with a power line to Kombolcha was completed. Today, the town serviced with 24 hours of electricity (Dessie aown administration office magazine, 2009).

### **3.3.4 Economic Activities of Dessie Town**

Currently, Dessie has exhibiting promising improvements in almost all areas of development activities in general and local economic development in particular. Owing to its strategic location on the main north-south transportation route, Dessie is an important trade and transport center for the north eastern part of the country. As a result, the town's economy is largely characterized by diversified trade activities particularly involves collection and distribution of agricultural and industrial commodities and provision of catering services (Dessie town administration office magazine, 2009).

## **CHAPTER FOUR**

### **4. ANALYSIS OF THE CURRENT STATUS AND SPATIAL COVERAGE OF MUNICIPAL SOLID WASTE MANAGEMENT SERVICE OF DESSIE TOWN**

#### **4.1 Introduction**

Dessie town is one of the oldest, populous, and fast growing towns of Ethiopia. It is also known by being a trade and communication center, junction point for different towns of the northern part of the country, and varied topographic features. Unlike these features of the town, municipal solid waste management service provision for its residents was a recent phenomenon beginning from 1997. In paradox with this recent duration of MSWM service delivery, solid waste generation of the town was continues to grow for many years and currently it reaches to 32188 m<sup>3</sup>/annum (SBPDD report, 2009). As a result of this huge generation of solid waste, town residents considered MSWM as a necessary and vital urban service. For instance, from total 239 sample households of the town around 167(69.87%) of them are regarding this service as a burning urban service just like road, water and electricity. This is because absence of qualified and efficient municipal solid waste management service exposed them to various health, aesthetic and environmental impacts. On the other hand, respondents are also asked to evaluate the effort made by municipality to provide efficient municipal solid waste management service compared with other services of the town. And majority 229(95.82%) of them responded that municipality has made weak effort. For this reason, this chapter briefly discusses and evaluates the existing condition of MSWM service in general and household solid waste management practice in particular.

#### **4.2 Socio Economic and Demographic Characteristics of Sample Households**

Because solid waste generation and its handling shows a great variation related with difference in background characteristics of households, in this study the researcher tried to constitute different sample households with various socio economic and demographic characteristics. In this study the questionnaire survey was conducted among 239 households with a response rate of 97.55%. Among those sample respondents more than half (65.27 %) of them are females. This was due to the fact that most of the time females stay and work inside their house rather than working outside. Such dominance of women is appreciated and important for this research since women have better

knowledge than men about their residence solid waste property and its handling. This is because most of such kind of activities are routinely done by women and children. Besides this, out of the total respondents about 76.57 % of sample respondents are belong to adult age group (20-50 ages). This is also contributed for the accuracy of information gathered from such respondents.

Table 4.1: Socio economic and demographic characteristics of respondents

<b>Variables</b>	<b>Category</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Sex</b>	Male	83	34.73 %
	Female	156	65.27 %
	Total	239	100 %
<b>Age</b>	15-19	42	17.57 %
	20-30	77	32.22 %
	31-40	61	25.52 %
	41-50	45	18.83 %
	51-60	14	5.86 %
	Total	239	100 %
<b>Educational level</b>	No formal education	27	11.3 %
	1-4 grade complete	16	6.69 %
	5-8 grades complete	22	9.21 %
	9-12 grades complete	75	31.38 %
	Certificate	24	10.04 %
	Diploma	39	16.32 %
	First degree	30	12.55 %
	Second degree and above	6	2.51 %
Total	239	100 %	
<b>House ownership condition</b>	Kebelle rental house	50	20.92 %
	private rental house	69	28.87 %
	private house	120	50.21 %
	Total	239	100 %
<b>Family size</b>	1-3	85	35.56 %
	4-6	122	51.05 %
	7-9	29	12.13 %
	10 and above	3	1.26 %
	Total	239	100 %
<b>Average monthly income</b>	Less than 500	77	32.22 %
	501-1000	48	20.08 %
	1001-1500	37	15.48 %
	1500-2000	40	16.74 %
	Greater than 2000	33	13.81 %
	Not mentioned	4	1.67 %
	Total	239	100 %

Source: Survey data, 2011

Furthermore, with respect to educational level greater numbers of respondents (31.38 %) have educational level of 9-12 grades complete. Next to this diploma (16.32 %) has relatively great share.

These educational characteristics of sample households also resulted positive impact to get brief and different perceptions. Finally, income level of participated households' also illustrated in table 4.1. Households were categorized into five groups based on their monthly household income. Thus, dominant (32.22 %) number of sample households' average income is grouped in the first category who earns less than 500 birr per month. But the least number of households (13.81 %) are clustered in category five that earn greater than 2000 birr.

### **4.3 Characteristics of Municipal Solid Waste of Dessie Town**

One of the basic services that are currently receiving wide attention in many towns of Ethiopia is municipal solid waste management. This is mainly because solid wastes that are generated in most towns of Ethiopia are not appropriately handled and managed. However, it is possible to minimize and solve these problems through strictly planning and implementing different municipal solid waste management components. The first and the most prerequisite step for provision of efficient MSWM is began by identification of major sources, and determination of generation rate and composition of municipal solid waste. This is because these elements are considered as a baseline for the rest of municipal solid waste management components. Therefore, for appropriate management of municipal solid waste of Dessie town, reliable and accurate data about these elements is very decisive. Despite this, Dessie town sanitation, beautification, and parks development department (SBPDD) gave less attention. For instance, regarding the town residential solid waste composition and generation rate, there has been lack of frequent and ongoing surveys opposed to frequent variation characteristics of it. Furthermore, those available data are also scattered and unorganized. In order to fill this gap a researcher investigates household solid waste generation rate and physical composition since the majority of solid waste constituents of the town are comes from households.

#### **4.3.1 Municipal Solid Waste Sources and Their Solid Waste Generation**

Municipal solid waste consists of highly heterogeneous mass of discarded materials from urban residences, commercial establishments, institutions, street sweepings, and light industrial activities. Similarly, according to Dessie town SBPDD report (2009) there are five major sources of MSW of the town. These are residential areas, commercial areas, street sweeping, institutions, and small scale industries. Based on this report, the daily total solid waste generation of these sources is around  $88 m^3$ (32560kg) and annually it reaches to  $32188 m^3$  (11,909,560 kg).<sup>11</sup>

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<sup>11</sup>  $1m^3 = 370 kg$

Table 4.2: Major solid waste sources and their daily and annual generation in 2011

Source of solid waste	Solid waste generated per day(in $m^3$ )	Solid waste generated per annual (in $m^3$ )	Percentage share
Residential areas	52.8	19312.8	60 %
Commercial areas	16.72	6115.72	19%
Street sweeping	9.68	3540.68	11%
Institutions	7.04	2575.04	8 %
Small scale industry	1.76	643.76	2 %
Total	88.00	32,188	100 %

Source, SBPDD report, 2009

Table 4.2 revealed that the lion share (60%) of solid waste of Dessie town is generated from residential areas. Even if massive amount of solid waste of the town is generated from this source, the town SBPDD does not gave much weight for it in planning and implementation process of MSWM. For example, in order to make plan to the town solid waste management, SBPDD has used daily and annual household solid waste generation of  $52.8 m^3$  (19536 kg) and  $19312.8 m^3$  (7145736 kg) respectively using 0.12kg/day generation rate as constant. However, based on this study the daily and annual generation rate of household of the town is much greater than the above estimation of the department. For making this survey researcher identified 36 households who are not involved in any type of business activities. Based on their monthly income, ownership status of household residence and housing condition, they were categorized in to higher, middle, and lower income groups. After this researcher gave plastic containers for each household and measure their solid waste for seven consecutive days. The findings of this survey are summarized in table 4.3.



Picture 4.1: Partial view of daily household solid waste generation and composition measurement.  
Source: field survey, 2011

Table 4.3: Solid waste generation rate of households in 2011

Income groups	No of sample HHs	Family size	Qt/HH/week(kg)	Qt/HH/day(kg)	Generation rate of a group Qt/day/person(kg)
Higher	6	36	71.3	10.186	0.283
Middle	12	59	101.6	14.514	0.246
Lower	18	88	123	17.572	0.2
Total	36	183	295.9	42.272	<b>0.231</b>

Source: field survey, 2011 (for detail understanding of result see appendix 4)

Daily total solid waste generation of residential areas of the town is calculated as total population of the town (161,633) times per capita household solid waste generation rate. Based on the updated per capita household generation rate of 0.231kg (0.000624  $m^3$ ) indicated in table 4.3, daily total solid waste generation is 37337.223kg (100.91 $m^3$ ). The annual total generation of solid waste is also 100.91 $m^3$  times 365 days i.e. 36832.15 $m^3$ (13627895.5kg). When 0.231 kg/d generation rate of Dessie town is compared with other Ethiopian towns such as 0.277 kg/d of Mekelle, 0.22 kg/d of Bahirdar, and 0.227kg of Debre markos, 0.267 of Adama town and 0.233 kg/d for east African cities developed by WHO cited in (Gebrie,2009), this finding is consistence and reliable. However, when this generation rate is compared with the town SBPDD existing capacity to handle this amount of solid wastes it is very high and create high load for the department.

### 4.3.2 Composition of Municipal Solid Waste

As it is indicated in review of literature part of this research municipal solid waste is a term usually applied to a various mixtures of solid wastes produced in urban areas. But commonly urban wastes can be subdivided into two major components called biodegradable and non biodegradable. The biodegradable component of urban solid waste constitutes organic wastes such as food waste, garden waste, and agricultural waste which undergo biological degradation under controlled conditions and can be turned into compost or organic fertilizer. While non biodegradable wastes includes inorganic materials which can't be decomposed and degraded. Likewise, from my own observations in disposal site, illegally dumping areas and in residential areas, Dessie town physical composition of municipal solid waste is also composed from both biodegradable and non degradable components. The dominant types of biodegradable solid wastes are food leftovers, vegetable peelings, onion, seed coats, grasses, kitchen and garden wastes, animal wastes, ash, dust, leaves, scarp of chat, market place wastes (vegetable and fruit wastes), papers, wood scraps, bones, straw, dead animals, cardboard, cartons and paper packaging materials etc. Whereas non biodegradable wastes of the town includes different types of plastics(like plastic bags or “festals”, broken pieces of plastic materials, plastic packaging materials), cables and useless electronic materials, pieces of ceramics, glass, cans, pieces of metals, textile scraps, discarded old shoes, packaging materials, etc.



Picture 4.2: Partial view of biodegradable and non biodegradable solid wastes generated. Source: field survey, 2011

Apart from these, construction and demolition waste that is generated during the course of repair, construction, and destruction activities constituting sands, soil stones, nails, cement concrete, wood, and so forth are also observed in the town. This is due to high construction activities of the town and such wastes are not stored by waste generator within their compound rather they deposited just outside in streets and open areas. Different types of medical waste such as syringes, gloves, glucose materials etc from hospitals, clinics, and other health care establishments are also detected in different disposal areas of the town. But such wastes should be managed carefully and separately from the above types of solid wastes because of its hazardous health impacts.



Picture 4.3: Partial view of medical solid wastes. Source: field survey, 2011

Though the town municipal solid waste is comprised from the above listed solid waste fractions, it is dominated by organic waste streams generated from households, markets and commercial areas. The main reason behind this is about 60 % of MSW of the town arises from residential areas and this source is dominantly characterized by biodegradable solid wastes. To reach this conclusion the researcher made measurement on major solid waste composition of households by sorting and weighting it for seven continuous days from 36 houses in conjunction with solid waste generation rate measurement.

Table 4.4: Composition of residential solid waste in 2011

Category	Type of solid waste	Qt/day/person in Kg	percentage share
Biodegradable waste	Ash and dust	0.1027	44.5%
	Food waste	0.072	31.1%
Non biodegradable	Grass, leaf, straw, paper, cardboard, and wood scarp	0.0242	10.5%
	Plastic, textiles and leathers	0.0152	6.6%
	Glass, ceramics and metals	0.0169	7.3%
Total		0.231	100%

Source: field survey, 2011 (for detail understanding of result see appendix 5)

As it is expected in developing countries around 75.6% of households solid waste stream of Dessie town is covered by biodegradable waste such as ash and dust (44.5%), and food waste (31.1%). This is because majorities of the population have mud houses that frequently generate dust, and uses wood as energy source. Food wastes also generate from house cooking, food slip and fruits. This condition dictates that the most appropriate and sustainable method for management of Dessie town solid waste is composting. In addition to this, there should also be an activity of reuse and recycle for those inorganic materials even if their proportion seems insignificant. Otherwise, in the long run those solid wastes may deteriorate the human health and the town environment.

#### 4.4 Solid Waste Storage Facility and Its Handling in Dessie Town

This functional element of MSWM constitutes an activity that is carried out both by solid waste generators and solid waste managers of a town. It encompasses an action of storing solid waste in a certain kind of material or equipment as soon as it is generated and safe control of it until it is permanently disposed. Accordingly, studying solid waste storage facilities and their handling has significant impact for betterment of municipal solid waste management activity. This is from the point of identification of type and quantity of storage material to be used, appropriate location (sitting) of it, deciding the collection method to be used, and avoidance of health, environment and aesthetics impacts of storage materials (G/tsadkan, 2002). As a result of this, the researcher collects information about solid waste storage and handling practice of Dessie town and briefly explains in two categories. The first category constitutes primary or temporary storage facility of households,

while second category comprises secondary or communal storage facility of a town which includes public solid waste container and dustbins. The detail examination of both of these storage facilities is described in the following sections.

#### 4.4.1 Primary Solid Waste Storage Facility and Its Handling

Residents of Dessie town used different type storage materials in their compound which is stationary like pit and portable like sack. In order to assess type and quantity of storage materials of residents, around 239 households were asked. The result has shown that 78.24 % have one storage material, while the remaining 21.76 % have two storage materials. But, on the type of storage materials used by households there is high variation. This is mainly because the nature of storage material of households is depend on characteristics of solid waste (rate of generation, physical and chemical composition, moisture content of waste etc.), collection frequency and types of collection equipment, space available for placement of the storage materials, and economic power of solid waste generators (Techobanglous, 1977 and 1993 cited in G/tsadkan, 2002). The concrete evidence of this situation is shown in the following figure 4.1.

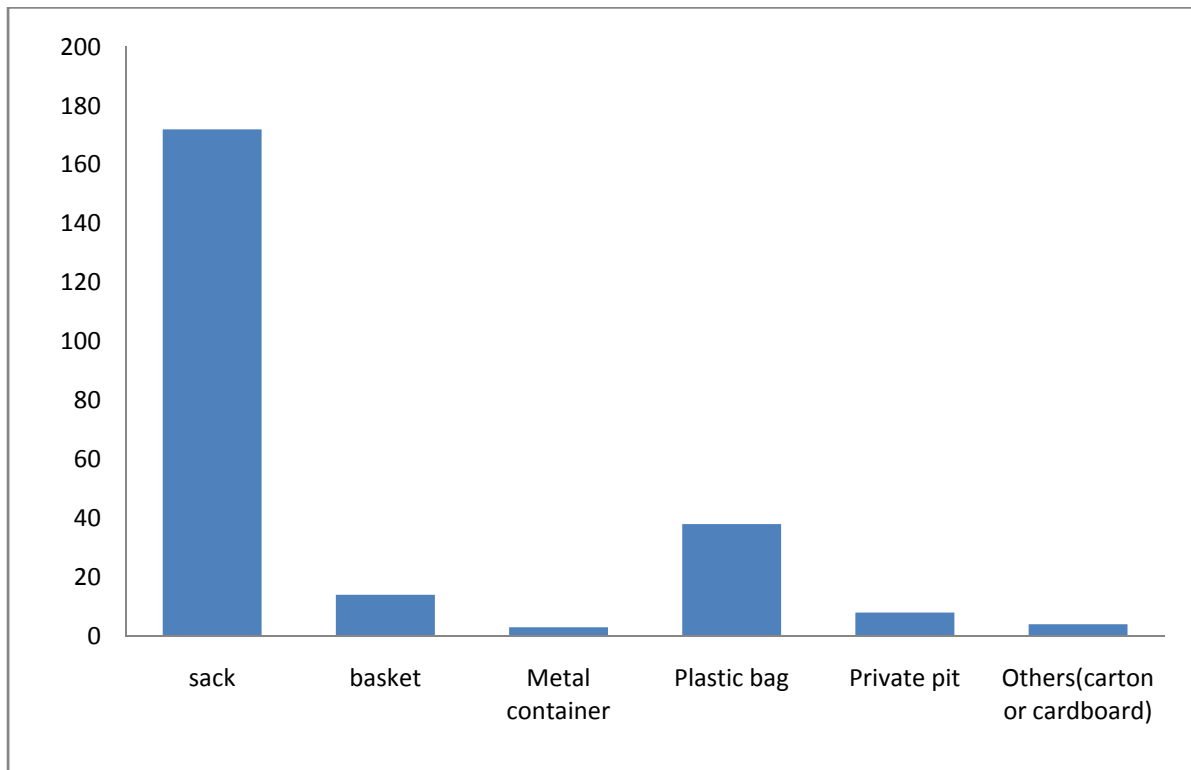


Figure 4.1: Types of primary solid waste storage materials of households. Source: field survey, 2011

As it is clearly observed in figure 4.1, the majority of households (71.97%) stock up their solid waste in sack (“Madaberiya”). This is highly related with the least cost of sack, easily availability in the market, its suitability for holding large volume of solid wastes, and low frequency and spatial coverage of door to door solid waste collection service of the town. Next to sack, about 15.89 % of households use plastic bag followed by basket (5.86 %) because of their frequent but low generation of waste and economical power to utilize replicable storage materials such as plastic bags. Following these there are households that use private pit (3.35 %) and cardboard (1.67 %) as storage material of solid waste in their home. This is due to availability of space in their compound and households need to prepare fertilizer for vegetable growing. But, the least used storage material is metallic container (1.26 %). This is essentially because of its difficulty for transportation, high cost and low access in market.



Picture 4.4: Partial view of solid waste storage materials of households. Source: field survey, 2011

However, different from preparation and usage of storage material, most of the residents do not have well established handling practices and give low attention for it. The storage materials of households are characterized by unpleasant feature resulted by inappropriate handling, and drop out of solid waste around storage material. Majority of households are also located it very near to houses especially in condominium houses storage materials are placed inside the house due to absence of space.

#### **4.4.2 Secondary solid waste storage facilities and their handling**

Secondary storage facilities refers to different types of solid waste containers which involve keeping solid waste generated from different households at a common or central point from where collection vehicles can pick it and transport to final disposal site(Zebenay, 2010). These facilities are provided by municipality which is responsible for management of the town solid waste. Until early 2010 Dessie town SBPDD put 21 public solid waste containers in different areas of the town where frequent illegal dumping of waste was mostly occurred, and in areas where high population density is assumed to exist. But this operation caused odor and dust problems. Residents around those containers were highly exposed and attacked by different solid waste caused diseases. This is mainly due to lifter truck being out of service, absence of frequent collection of those public solid waste containers, and misuse of the society. As a result, the town SBPDD was forced to collect those public solid waste containers instead of serving the intended purpose.

However, for solving problem of secondary storage facility, the town SBPDD prepared 9 communal solid waste accumulation sites called transfer stations. Presently, these are located in:

- Arada (kebelle 03)
- Around Catholic high school (kebelle 10)
- Behind Kidame Gebeya high school (kebelle 07)
- In front of Memhir Akale Wold preparatory school (kebelle 09)
- Near Hotie high and preparatory school (kebelle 06)
- In front of Zemagel primary school (kebelle 09)
- In front of Fasika hotel (kebelle 05)
- Behind Gion hotel (kebelle 05)
- Nearby W/o Sihine TVT college (kebelle 05).

These sites are found at the edge of main roads in order to make such places accessible for transportation. However, in many cases those transfer stations are not well designed, not protected from rain and sun. They are just road side open dumps without any health and aesthetic impact considerations and optimum travel distance of beneficiaries. So, those sites are created bad smell, unsightly urban picture, and deterioration of the neighborhood.

According to interview made with SBPDD head, those transfer stations give service only to MSSE workers who collect solid waste from households, institutions and commercial areas. The reason behind this is the regulation made by SBPDD. It stated that in order to use transfer stations one should have to accumulate waste by using sack and also he/she should load his/her accumulated waste by waiting municipality truck until it comes. Because of this regulation, communities and informal sectors are not allowed to use this transfer stations.



Picture 4.5: Typical solid wastes transfer stations and their respective users (MSSE solid waste collectors). Source: field survey, 2011

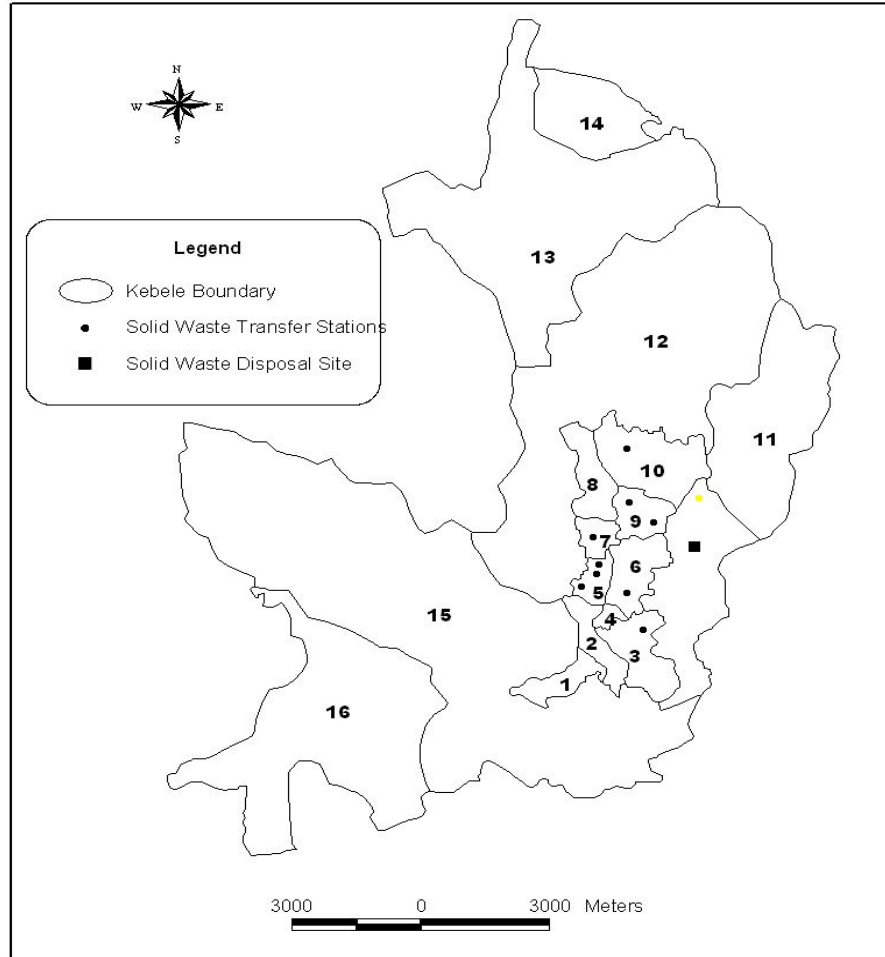
However, in some transfer stations such as in front of Zemagel school, around Catholic school, behind Kidame Gebeya school, and near Hotie high and preparatory school residents indiscriminately dispose waste without storing it by sack or any other storage material. As a result of this, it is common to observe accumulated solid wastes in such transfer stations of the town.



Picture 4.6: Partial view of solid wastes transfer stations which are characterized by indiscriminate disposal of HHs. Source: field survey, 2011

Besides this, those nine transfer stations are also characterized by uneven distribution both in terms of distance from beneficiaries and kebele specific locations. When we go far from the center, the

numbers of transfer stations are decreased in relation with low solid waste collection service of MSSE and municipality truck. On the contrary, distance between each transfer stations and illegal disposal of solid waste are increased as we go out of the center to the periphery of the town.



Map 4.1: Kebele specific distributions of solid waste transfer stations of Dessie town. Source: field survey, 2011

As it is indicated in map 4.1, majority of transfer stations (about 5 of them) are situated in kebelles which are located close to the center (kebele 05, 06 and 07), while the rest are placed in middle kebelles of 03, 09 and 10. But in periphery and rural kebelles there are no transfer stations at all. Map 4.1 also reveals that variation is not only existed between those three groups of kebelles but also between individual kebelles of each group. From 5 transfer stations of central kebelles, more than half (3) of transfer stations are found in kebele 05. And also from 4 transfer stations of middle kebelles 2 of them are located in kebele 09. This situation clearly shows that there is very low spatial coverage of secondary solid waste storage facilities in the town.

Apart from transfer stations, there are also dustbins which used to collect pedestrians' solid waste like napkins, pieces of paper, and remains of fruits such as banana, orange etc. Nevertheless, according to the interview taken from SBPDD head, there were around 60 dust bins that were located at the major roads, recreational areas, institution and market areas, but all of them are stolen and currently there is no dustbin in the town. The main reason behind this was placement of dust bins were not cemented in to ground rather they placed in electric and telephone poles. This type of placement accelerated theft of those bins since it is easy to move and pick.

#### **4.5 Solid Waste Separation, Processing and Recovery Activities in Dessie Town**

In this study solid waste separation, processing and recovery activities at source and by municipality refer all activities or efforts of separation of recyclable, reusable, compostable wastes to sell or to recover resources by themselves. Practicing these types of activities is very important to waste generators as well as municipality since it minimizes cost of disposal, generates revenue, and prolongs lifespan of disposal site. This is one of the reasons why solid waste managers in many parts of the world are now exploring ways to reduce flow of biodegradable and recyclable materials to landfill sites. However, in the case of Dessie town such activities are found at a very grass root level without any significant outcome and progress. Generally, in the following sections we will see the separation, processing and recovery activities both at the households and SBPDD level of the town.

##### **4.5.1 Solid Waste Separation, Processing and Recovery Activities of Households**

###### **A. Solid waste separation**

As the researcher tried to observe households solid waste separation activities in the town, only solid wastes that are sellable to Quraleos, exchangeable to Liwach, and to some extent organic wastes are separated. Supporting to researcher's observation, response of sample also shows that about 62.76% of them are separately store solid wastes which are sellable to "Quraleos" and exchangeable with "Liwach". According to those respondents the dominant types of such wastes include: textile and old shoes (37.58 %), tin and metals (26.67 %), plastics (18.78 %), glass, bottles, and can (13.33 %), and electronic wastes (3.64 %). Households' awareness about usefulness of such discarded wastes for Quraleos and Liwach together with their low economic performance led households to separately store such wastes and generate income and new equipments to their house.

However, beyond such solid wastes, separation of other types of solid wastes in different dwellings of the town is very low, only 33 (13.81%) of sample households are currently separating. Some of solid wastes that are separated by such small number of households are:

- ash, dust, agricultural waste, and food wastes for the purpose of using it as home garden
- grass, leaf, waste of sugarcane, waste of cattle's(after dried by sun), wood scrap, waste of chat to use them as fuel
- used papers are reused as toilet paper by family
- plastic, paper and other burnable solid wastes for reducing the volume of waste by burning, makes throwing convenient and contributing to environmental protection.

## **B. Resource recovery activities**

In order to assess resource recovery activity of residents the researcher used recycling, reusing and composting activities as a baseline and tried to collect the responses of sample households. Accordingly, it is found that participation of the society is still very low even as it is compared to separation of solid waste. From the very beginning the number of respondents who have awareness about the concept of recycling, reusing, and preparation of compost are low (47.28 %). This fact demonstrates that there is lack of awareness about sustainable solid waste management practices within the society since reusing, recycling and composting concepts are considered as pillars of sustainable solid waste management.

Aside from awareness of the society, the numbers of respondents who are currently practicing such activities are also very insignificant in number. About 30 (12.55 %) of them are carried out reusing. The major types of materials which are reused by the society are glasses, bottles, metallic materials, plastic materials, textiles, and umbrellas with accompanying some sanitation and maintenance activities by themselves or through taking it to maintenance experts. In terms of recycling, none of the respondents are practicing this task. The main reason behind low recycling and reusing activities of the society is their less interest and very low economic feasibility of recycled materials. Even though few people have interest to practice such activities, lack of technical ability, financial capacity, material and space, and absence of support from their family and society discouraged them.

On the other dimension 17 (7.11 %) respondents are presently preparing compost. But, based on the response of those respondents and my own observation most of compost preparation activities of households are failed due to lack of technical skill of compost preparation.



Picture 4.7: Partial view of households composting activity. Source: field survey, 2011

#### **4.5.2 Solid Waste Separation, Processing and Recovery Activities by SBPDD**

Even though the rapid pace of urbanization of Dessie town and parallel increment of its solid waste volume are adding burden to SBPDD of the town , the existing waste composition of the town which carries a high potential for composting create a better chance to municipality for undertaking environmentally as well as economically viable solid waste management. SBPDD understands this potential resource and included it as one strategic plan of the department. However, contrary to their strategic plan SBPDD is not carried out any type of composting activity. Towards recycling and reusing the department does not also made any attempt, rather it totally engaged in collection, transfer, and final disposal of solid waste as the only means of municipal solid waste management. This is attributed to lack commitment, finance, material, and manpower resource.

Furthermore, to fill this gap the department did not also play any role in organizing, encouraging, and giving incentives to different stake holders such as informal workers, private investors, NGOs, and communities to participate in such activities. For instance, in the town there is a recycling activity held by hand crafts through scavenging recyclable materials using informal waste collector

called Quraleos. They located in Arada (kebelle 03) and used metal, tin, cans, oil containers, etc to produce a variety of materials like container, fuel saving stove which is called ‘laketch’. But, there is no recognition and support given by SBPDD.



Picture 4.8: Partial view of handicrafts recycling activity in Dessie town. Source: field survey, 2011

#### **4.6 Solid Waste Collection and Transportation Systems in Dessie Town**

Collection and transportation of solid waste involves the process of picking up of waste from place of generation, taking it to nearby public solid waste containers or transfer stations, and finally dumping it to disposal site. This functional element is very decisive and mandatory component of municipal solid waste management because productivity and efficiency of this service is highly determined by it. Currently, in Dessie town there are two methods of waste collection such as door to door and transfer stations collection.

##### **4.6.1 Door to Door Solid Waste Collection and Transportation Systems**

This method is largely implemented for collection of solid waste from residential areas. It is provided by MSSE and informal waste collectors, and rarely by municipality collection truck. But the service of MSSE is reached to very small number of residents. Currently in Dessie town there are 5 MSSE which engaged in deliver of solid waste collection service to the town residents. According to SBPDD head interview, in each 10 urban kebelles of the town there are one MSSE organized under micro and small enterprise office of the town, but presently 5 of them are not working due to material and financial shortage. So, the remaining 5 MSSEs, namely Addis tesfa, GT, Lewute

legodana, kale, and Abyssinia are functioning now. All of them are males who work under their organization leadership integrated with the city municipal. Most of them are established in 2010, only Addis tesfa and GT are organized in 2007. Apart from these, there is also one women association consisting 35 women. They give solid waste collection service to some commercial districts that located in “Arada”, “Shelf Tera” and “Buna Tera”. Normally, both 5 MSSEs and one women association are participated only on door to door solid waste collection from individual house, commercial areas and institutions to transfer stations. While sorting, recycling and composting were not carried out by them.

Table 4.5: Overall characteristics of MSSE solid waste collectors in 2011

List of MSSE	No of client		Average service charge		No of equipment	No of man power
	HHs	Hotels and institutions	HHs	Hotels		
Addis tesfa	630	9	10-15		4	22
GT	560	35	10-15	30-50	3	10
Lewute legodana	62	3	20-30	30-50	1 cart	6
kale	150	6	5-15	50-300	1	5
Abyssinia	95	2	10-15	50	-	8
Total	1497	55			9	51

Source: field survey, 2011

According to the personal interviews with MSSE leaders, they have around 1497 clients and they charged 10-30 birr per month from households and 30-300 birr for institutions and hotels based on amount of solid waste and distance from the transfer stations. They collect solid waste from residents with one week interval. When this figure is compared to total household size of the town (37590) it only covers 3.98% of them. This is largely attributed to small number of MSSEs and their less human and material capacity. But, according to 67.64 % of SBPDD workers and 20% of sample households’ appreciate MSSE effort and give fair price to them. Related with this, the researcher also observed that they are being operating and contributing to the cleanness of the town. Nonetheless, due to multidimensional challenges they are not optimally utilized their efforts. Those challenges are:

- ❖ Scarcity of equipments. For instance Abyssinia MSSE has no any type of collection equipment and they simply collect solid waste by human power, while Lewute legodana and kale only have 1cart for each. General all MSSEs have 51 members but their total number of cart 9 i.e. 1cart for 6 workers. As a result of this they can't do full day rather they are working by shift.
- ❖ Lack of support from different stakeholders such as kebele, SBPDD, NGOs, MSSE office etc apart from municipality collection truck and 1cart from Mechane Iyessus church. The MSSE office of the town refused to give credit to them for purchasing equipments and collection vehicle.
- ❖ Shortage of collection car and transfer stations together with weak controlling mechanism of municipality for time wastage and absents of the truck. For instance, the Addis tesfa leader told me that even though their association has got additional 400 numbers of household clients and can collect around 4500 birr per month, because of lack of transfer stations around them and small collection coverage of the municipality vehicle they lost them.
- ❖ Lack of respect from the community as well as municipality and unwillingness of some households to pay for MSSE monthly collection fee after the use the service and lack of respect or demoralization. In addition community refused MSSE to use transfer stations around there surrounding.
- ❖ No training and protective material given to by municipality them when they enter to this work
- ❖ The undulating topographical feature of Dessie town (out of the total area of 7,200 hectares of Dessie town, flat plain covers 10 percent, while 30 percent is plateau, and 60 percent is mountainous (Dessie City Service, 2009)) also restricts spatial coverage of MSSE (since they have only 9 human pushing carts for collection) as well as municipality collection truck to be limited only to road side and flat areas.

In general from the above challenges of MSSE and personal observation of the researcher it is possible to conclude that MSSE are not well organized, not well equipped with solid waste collection materials and technologies, they suffer from lack of financial credit, technical and moral support. As a result this the participation of MSSE restricted to collect waste from roadsides residents, and centrally located kebelles. So, In order to solve the problem of the town MSWM the

municipality as well as the community should support them and should work a lot of activities to improve them.

Similar to MSSEs, door to door collection of municipality truck also reached only to very few residents (4.18 % of respondents) who are situated in central part of the town and along the main roads. To get this service, even those residents have to wait for unknown period for the truck to come and collect waste. People usually carry waste to the main road and wait for the truck. Due to unknown collection schedule people may wait for the whole day and finally they either deal with informal collectors or dump in illegal place.

Finally, these small contribution and very limited spatial coverage of MSSEs and municipality truck together with unwillingness and incapability of households to pay monthly charge of MSSE, lead large number of households turn their face to use informal collectors such as children, mentally retarded peoples, daily workers or laborers by paying 2-5 birr on average or through feeding them for picking waste once. As compared to MSSE informal collectors charge is low and also those individuals are easily available at any time. For these reasons the people who are using informal collectors accounts 60 (25.1%) of the total respondents. Although informal sectors are able to fill huge gap of solid waste collection, there poor way of handling waste resulted in undesirable environmental and health impacts. All of informal waste collectors simply dispose in unauthorized places without any sense of accountability and responsibility unlike to MSSE.



Picture 4.9: Partial view of informal sectors illegal solid waste disposal. Source: field survey, 2011

#### 4.6.2 Collection and Transportation of Solid Waste from Transfer Stations

According to the interview taken from head of SBPDD and my own field observations, in Dessie town there is only one lifter truck used for transportation of solid waste from transfer stations to final Membre Tsehay disposal site by loading metallic solid waste container. The vehicle carry only a single container with a maximum capacity of  $8 m^3$  (2960kg) at a time. On average, the vehicle make about four trips per day instead of making 9 trips in line with total number of 9 transfer stations. The driver told me that the collection of waste from these transfer stations is performed in accordance with the schedule prepared by SBPDD. The schedule is categorized in to three collection frequencies.

- daily collection from Arada (kebelle 04), nearby W/o Sihine TVT college (kebelle 05), and Fasika hotel (kebelle 05) transfer sites,
- three times in every one week collection for transfer stations located behind Gion hotel (kebelle 05), and in front of Memhir Akale Wold preparatory school (kebelle 09),
- Once in a week from the rest 4 transfer stations such as near Hotie high and preparatory school (kebelle 09), in front of Zemagel primary school (kebelle 09), around Catholic high school (kebelle 10) and behind Kidame Gebeya high school (kebelle 07).

Nonetheless, according to MSSE workers vehicle cannot work based on the above programs due to carelessness or low motivation of the deriver, low control and follow up of SBPDD, problem created on the truck, and unsuitability of roads particularly around disposal sites. They also told me that the vehicle does not work in Saturday, Sunday and holidays because there is no peridem payment for driver and other 5 workers of the truck. As a result, in many transfer stations of the town there is nothing more than an urgent need removal of accumulated waste when it becomes intolerable and complains raise. These situations make the town municipal solid waste collection and transportation to be very low. I.e. on the basis of 4 trips, total amount of solid waste which is daily collected and transported by municipality is  $32m^3$  or 11840kg ( $8m^3 \times 4trips$ ). But the actual daily generated solid waste from all solid waste sources of the town is  $136.11m^3$  or 50360.7 kg. Therefore, only 23.51% of municipal solid waste of the town is collected and transported. But the remaining 76.49 % ( $104.11m^3$ ) of solid wastes left is uncollected. This fact clearly indicates how the town municipal solid waste management is very poor and below expectation.

#### **4.7 Street Sweeping Activity in Dessie Town**

In addition to collection of solid waste from transfer stations, street sweeping is also included in municipal solid waste management service offered by SBPDD of Dessie town. The town has around 33.4 km asphalt roads. For cleaning these roads about 17 women sanitation workers are employed with contract by SBPDD. Street sweeping takes place every day since it needs to be done more frequently because of no street dustbins and regular generation of solid wastes like napkins, pieces of paper, residual vegetables and fruits such as banana, orange etc. The street sweepers are separately spaced on streets, and clean roads using brooms that gifted from the department. After cleaning they used wheelbarrows to collect piles of solid wastes from streets, and then most commonly they burn it in gullies around streets, load into municipality truck if it comes while doing their work, or else store it in sack and placed in transfer station that located in front of Fasika hotel.

However, from my own observation and interview made with SBPDD head there is serious shortages of manpower for street sweeping. The existing employees are not able to cover all streets and in many cases particularly newly constructed 11km roads remained unclean and unpleasant to see. Most of street sweeping takes place around the center of the town where streets are busy with many activities. Moreover, residents are very careless to clean their front yards and street and see it as the responsibility of the municipality. For example, about 77.41 % of respondents clean their houses in every day. But, annually most of residents (62.76 %) participated on cleaning campaigns of their surroundings on average 3-4 times. This clearly shows how communities give little attention to clean their surroundings. Much of the residents of the town are only stressed to protect their home but they do not care for others. Whatever the case may be, it is becoming a common problem both for local people and municipality.



Picture 4.10: Partial view of indiscriminately dispose solid wastes in streets. Source: field survey, 2011

## **4.8 Solid Waste Disposal Practices in Dessie Town**

### **4.8.1 Households' Solid Waste Disposal Practices**

As it is described earlier, door to door solid waste collection of the town is very insignificant both in spatial coverage and efficiency. As a result, the only solid waste option of majority households is restricted to two choices. The first one is simply burning, burying, or dumping of solid waste in their compounds. While the second option is throwing of solid waste at roadsides, open fields, nearby rivers, bridges and gullies. Hence in order to assess the routine method of solid waste disposal practices of households and to know the destination of uncollected solid wastes, the researcher asked sample respondents about their common disposal system. The survey result looks like the following.

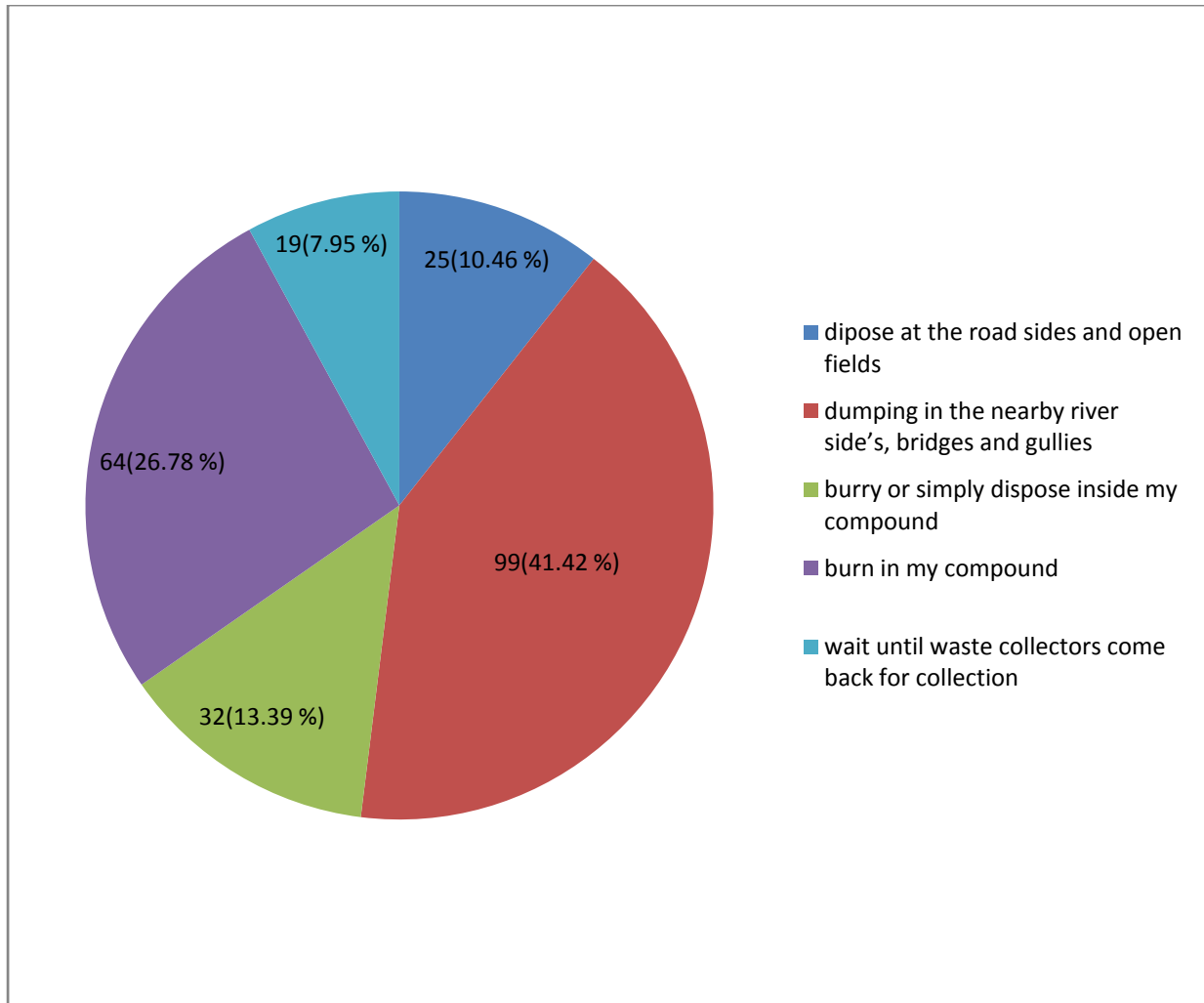


Figure 4.2: Households solid waste disposal practices. Source: field survey, 2011

As it is observed in figure 4.2, quit large numbers of households (51.88%) preferred improper and unauthorized solid waste practices. This confirmed that the destination of the majority of uncollected solid wastes of households are in roads, sewers ,river banks, valleys, gullies, bridges, and open areas. This improper disposal of solid waste exposed communities to different respiratory and water borne diseases. Dessie health office report also proved this. Health office report shows that there are high levels of diseases which are partly associated with solid waste.

Table 4.6 Dessie town administration health office 20 top disease in 2009

No	Diseases	% out of 20 tops	Rank
1	Acute upper respiratory tract infection	21.41	1
2	All other respiratory diseases	14.8	2
3	Other diseases of circulatory system	8.87	3
4	Gastritis and duodenitis	6.75	4
5	Other unspecified anemia	5.12	5
6	Other helminthes	5.07	6
7	Other unspecified malaria	4.53	7
8	Amoebiasis	3.98	8
9	Otitis external	3.17	9
10	Pneumoconiosis	3.12	10
11	All other diseases of skin	3.08	11
12	Bronchial asthma	2.76	12
13	Other diseases of the digestive	2.72	13
	All other infective & parasitic diseases	2.31	14
15	Infection of skin & subcutaneous tissue	2.31	15
16	Other unspecified dysentery	2.17	16
17	Inflammatory diseases of the eye	2.17	17
18	Broncho pneumonia	2.04	18
19	All other diseases of tooth & gums	1.9	19
20	All other diseases of genito urinary	1.72	20

Source: Dessie town health of report of 2009

As it is observed in table 4.6, From 20 top diseases the majority of them are partially caused by inappropriate solid waste handling activity of residents.

On the other hand, illegal solid waste disposal of residents also closed and damaged sewerage systems and force liquid waste stagnant in street sides. Typical views of this damage are shown in the following pictures.



Picture 4.11: partial view of impacts of improper solid waste disposal. Source: field survey, 2011

As it is observed in picture 4.11 uncollected domestic waste is the most common cause of blockage of drainage channels. It also covers pavements and other walk ways as well as filling the open spaces. Households' liquid waste also remains stagnant in the open street-side sewers and tends to be

a breeding ground for insects as well as being attractive to vermin. Therefore, the participation of the whole community in the MSWM program of the town is very essential and highly expected to bring changes on the existing low status of MSWM. However, irrespective of the above responsibilities and expectations, the current role of community is poor and they are rather exacerbating the problem.

The major reasons behind this illegal disposal of solid waste of residents are lack of clear and adequate awareness about proper solid waste management system, cultural constraint which forces the society to give low emphasis to sustainable solid waste management, lack of door to door solid waste collection service, and absence of public solid waste containers. Based on the response of 29 SBPDD (90.63%) workers most of the town residents do not have a clear and adequate knowledge about different components of solid waste management and their appropriate practice. For instance, at the HH level residents are responsible for storing waste in a proper way and disposing it in right and authorized manner using either MSSE, municipality vehicle or burning and burring, but the HH not actively participate in using such activities rather most of them handle and dispose improperly. In support of this from the total respondents' large number of (62.76%) sample household also do not have taken education and training about solid waste management by responsible body of the town. But, around 94.14% of them are interested to learn more about solid waste management, environmental impact of waste, and various ways of minimizing and treating the waste stream. The method to receive the education by those respondents preferred is dominantly on solid waste management campaign (29.71%), door to door education, and meetings (15.48%).

Table 4.7: Households' choice of methods to receive education on solid waste management

<b>Methods of educating households</b>	<b>Frequency</b>	<b>Percentage (%)</b>
Meeting	37	15.48%
Brochures distributed to residents	23	9.62%
Solid waste management campaign	71	29.71%
door to door education	57	23.85%
Educational programs newsletter and magazines	11	4.6%
Educational programs in radio and television	20	8.37%
Through community organizations	20	8.37%
Total	239	100%

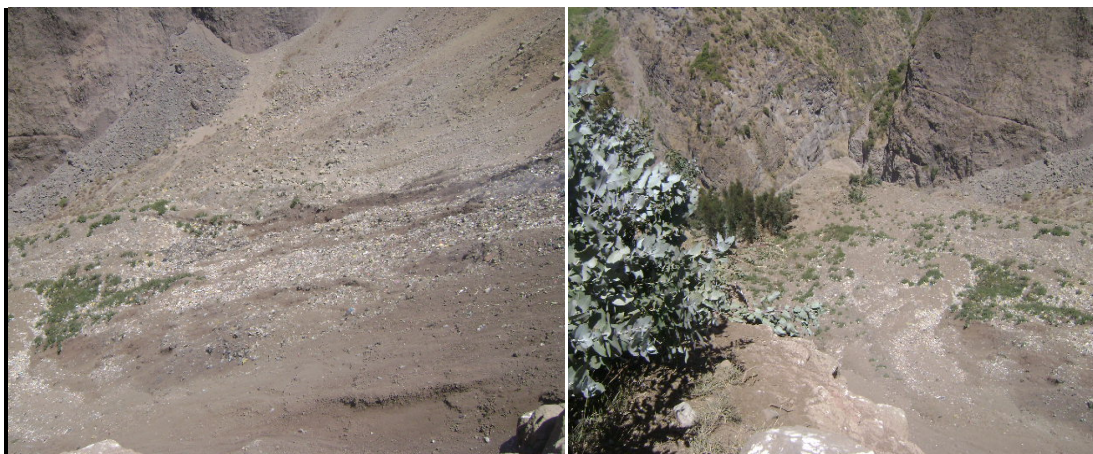
Source: field survey, 2011

#### **4.8.2 Existing Situation and Management of Solid Waste Disposal Site**

Solid waste collection and transportation is not an end to solid waste management. Proper solid waste management also requires proper disposal of waste in a proper place. In sight of this Dessie town solid waste disposal site and its management is inadequate and below the standard. The site called Membere Tsehay is located at 2 km far from the center and generally described as open and unsanitary landfill site. Under such condition the site has been functioning for the last 14 years.

Landfill site selection involves proper study of the site in relation to its topography, slope, permeability, hydrology, accessibility, distance from incompatible land uses and acceptance by the local community. In this regard, Membere Tsehay landfill site qualifies none of the above criteria except being a low lying ground (naturally created gorge). The site is also characterized by poor road infrastructure; especially in rainy seasons the problem is highly intensified. The site on average receives about 32 m<sup>3</sup>solid wastes with normal daily truck trip. The bottom line here is that the site has various health and environmental problems. Some of the major problems associated with this unsanitary open landfill include:

1. Indiscriminate solid waste disposal posed serious environmental and health risks especially hazardous medical wastes of hospitals and health care units.
2. Due to high methane gas in the site, there is frequent fire which is a threat to human safety and cause of air pollution.
3. Odor is also another problem at the disposal site which diminishes the quality of fresh air in the surrounding area and causes residents be affected by different respiratory diseases.
4. There is high leachate generation from the site which has high potential for soil and ground water as well as surface water contamination. For example, the site is bounded by Borkena River in the southern direction and the leachate is directly flow and joins in to this river. In addition, dumped solid waste of the site also goes to this river by water and wind erosion. As a result of this, health of the surrounding residents and inhabitants is highly affected. Especially those households who living at the lower part of the river are subjected to different health problems since they use the river for agricultural as well as washing purpose.
5. The site is open to human scavengers and animals like monkey, dogs, goats, and sheep. This situation caused solid waste scattering to the surrounding and posing health risk on the local community.



Picture 4.12: Partial view of Membere Tshehay solid waste disposal site. Source: field survey, 2011

## **4.9 Institutional Arrangement and Capacity of Municipal Solid Waste Management Service of Dessie Town**

It is a common perception that improving solid waste management means making waste collection and disposal systems more efficient, raising public awareness and enforcing solid waste management laws. However, a prerequisite for all these factors are a well planned management operating within an enabling institutional framework and capable of generating financial resources required to meet operating, maintenance, and investment costs Antipolis (2000) in Obeng et al,(2008). So in order to build an acceptable and satisfactory level of MSWM service, the responsible institution primarily need to have well organized management that functions within an adequate institutional arrangement, skilled manpower and financial resources, appropriate rule and regulation, short and long term strategy, and good cooperation with different stakeholders. Otherwise, if one or more of the aforementioned resources and frameworks are missing, then MSWM remains unattainable. This is one key reason why MSWM of Dessie town is very poor in terms of status as well as spatial coverage. Therefore, before trying to find any solutions to this problem, first of all it is important to do detail assessment and get better understanding about the fundamental characteristics of the institution which is responsible for delivery of MSWM in the town. Hence, in dealing with institutional arrangement and capacity of MSWM service of Dessie town the researcher is focused on organizational structure, strategic goal and objective, institutional mandate, human, material and financial resources, enforcement of rules and regulations, and inter organizational and stakeholders linkage.

### **4.9.1 Organizational Structure of Sanitation, Beautification and Parks Development Department**

It is obvious that for sound municipal solid waste management of any town, there should be well arranged and capable institution. The opening pace towards building of this type of institution is began from building clear, short and efficient organizational structure of responsible institution of the town's solid waste management. In line with these issues, Dessie town municipal solid waste management system is organized under a jurisdiction of municipality in one of the eight work process called Sanitation, Beautification, and Parks Development Department. Before it is considered as one work process and gains the present structure, it was named as Dessie town sanitation and parks office. But after the implementation of BPR nationwide, it obtained the current

SBPDD structure with constituting solid waste management, liquid waste management, town beautification and parks development together. The town SBPDD is directly accountable to Dessie town municipality office. Its internal arrangement constitutes one work process manager and five different case teams but one case team is still not operational because of lack of expert on that position. Structurally, the internal arrangement of the town’s SBPDD looks like this.

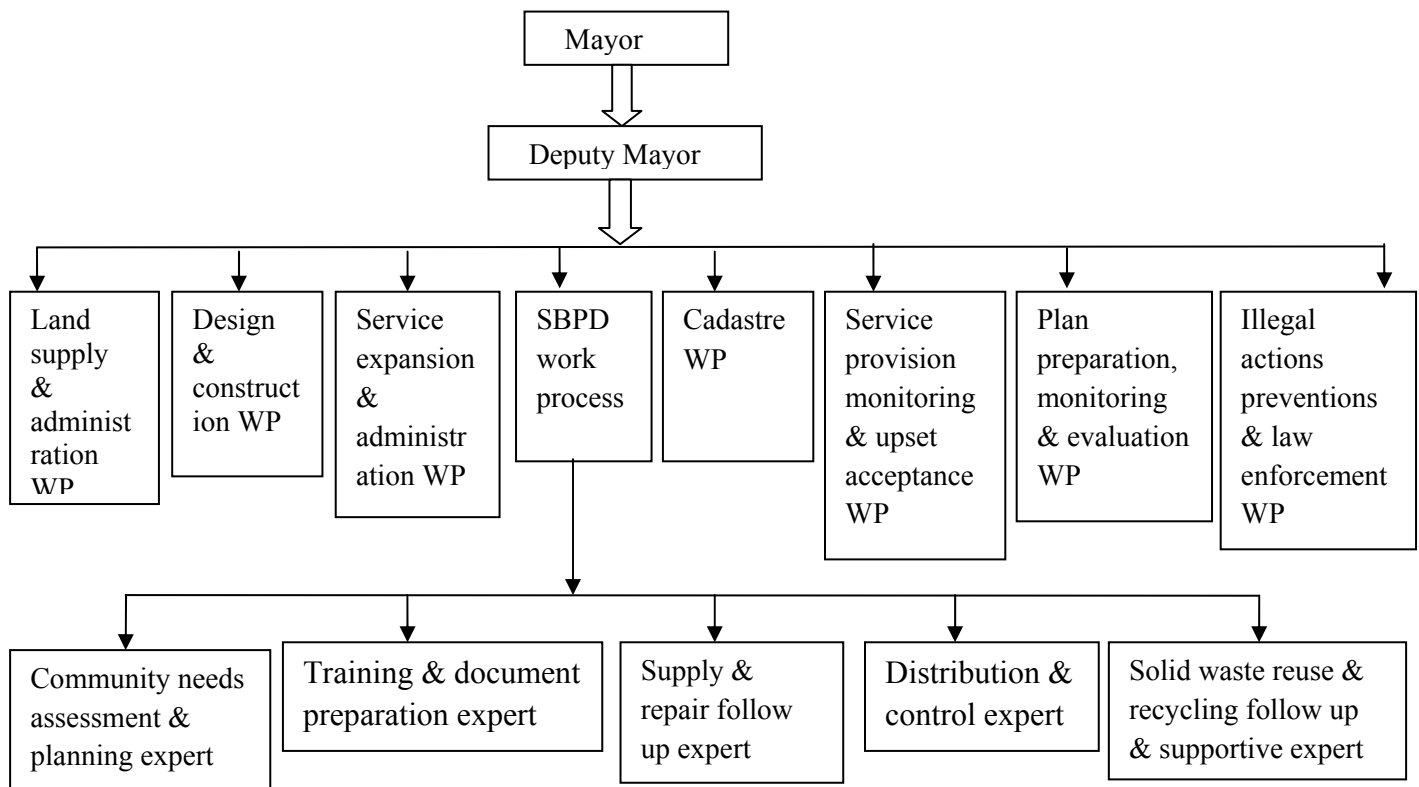


Figure 4.3: Dessie town SBPDD organizational structure in 2011

As it is observed in figure 4.3 the new structure of work process seems interesting on the base of minimizing bureaucracy and classification of works to different case teams. Despite this significant and appreciated modification, there are still a lot of weaknesses which contributed for the present inefficient MSWM of the town. The first and the most significant weakness is lack of practical applications of such structures and their respective works since the department can’t avoid delay of work process at ground level. The interview which was made with SBPDD workers and department head also verify this. They told me that there is great holdup in decision making and implementation process on municipal solid waste management due to long bureaucracy and low concern of higher officials to SBPDD as compared to other eight work processes. Besides this, real decentralization of functions and responsibilities between higher and lower officials is not existed.

The existing work process is also exposed to high burden of work with three significant services called liquid waste management, town beautification, and park development and solid waste management. Accordingly, inadequate and improper distributions of resources (capital & equipment) among these work processes are observed and the share of solid waste management became low as compared to others based on the interview made with department workers. Furthermore, the department has not also kebele specific sanitation teams which used to create a two way communication between community and SBPDD. So that by observing the above organizational weaknesses of the department, one can easily realize that the department has not in a position to provide a satisfactory solid waste management service.

#### **4.9.2 Strategic Goal and Objectives of Sanitation, Beautification and Parks Development Department**

Following the new organizational structure execution, SBPDD of Dessie town sets its goal and objective in its strategic plan. Accordingly, the goal that the department has set is ‘to make Dessie clean, beautiful and hospitable town for residence as well as work’ and its objectives constitute:

- cleaning areas which are characterized by illegal solid waste disposal and change them to greenery and parks
- improving the status of MSWM by outsourcing it to private sectors
- practicing reuse, recycle and compost preparation
- prepare sanitary landfill for permanent solid waste disposal
- encouraging the participation of community and other stakeholders through giving training and support

However, these objectives are simply put for paper value rather than for practical problem solving. For instance, from the above strategic objectives of the department three of them i.e. preparation of sanitary landfill, giving training to the community and other stakeholders, and practicing reuse, recycle and composting are not totally put in to operation. With regard to outsourcing of MSWM to private sectors, the department has made a bid and gets one private investor who has the capacity to collect the town’s solid waste using four vehicles. However, this effort was not successful due to allegation of corruption in the process of selecting the appropriate winner of the bid. Therefore, this case is still undecided. On the other hand, the department has done little on mobilizing various actors to involve in solid waste management through community participation and partnership creation.

### **4.9.3 Institutional Mandate of Sanitation, Beautification and Parks Development Department**

Contrary to the crucial goal and objectives of SBPDD, the mandate given to the department is only limited to MSWM service provision i.e. collection, transportation and disposal of town's solid waste. But, other related critical mandates are given to the town's law and order enforcing office and health office according to the new organizational structure and 2000 hygiene and environmental health regulation of Amhara regional state. For instance, law and order enforcing office has the responsibility to control illegal solid waste disposal and penalize dwellers when they throw wastes in unauthorized places. Whereas health office has the following mandates:

- formulate rules and regulations related to solid waste management
- undertake public awareness creation programs
- monitor and supervise town sanitation service,
- contact municipality to pick waste frequently, and to construct solid waste infrastructures for those who do not have such facilities

Nevertheless, because of loose cooperation and low emphasis of those organizations, this type of work process created a great weakness on the town's MSWM. According to the department manager explanation this situation resulted additional burden of collecting illegally dumped solid waste to SBPDD.

### **4.9.4 Rules and Regulations of Municipal Solid Waste Management, and Its Status of Enforcement**

Since Dessie town SBPDD has no mandate to prepare its own rule and regulation, it follows solid waste management related rules and regulations derived from hygiene and environmental health regulation of Amhara regional state adopted in 2000 and 2002. These rules and regulations are largely emphasized on solid waste handling responsibilities and obligations of persons, establishments, and institutions. It didn't include specified rules which are focused on institutional issues of SBPDD, different stakeholders' participation, and sustainable solid waste management system. Apart from this there is also low enforcement of those existed rules and regulations

according to 143(61.09%) response of samples and my own field observation. Furthermore, there is no awareness creation activity to community about rules and regulations. There was a question forwarded to the respondents on whether they know the rules and regulations of solid waste management of the town or not. In response to this, more than  $\frac{3}{4}$  (76.57%) of sample households did not know the town's rules and regulations related with solid waste management. Therefore, the absence of regulatory framework and low enforcement of rules and regulations hindered effective solid waste collection, storage and disposal system of the town at large.

#### **4.9.5 Inter-Organization Linkage of Sanitation, Beautification and Parks Development Department**

Inter organizational linkage refers to a multi dimensional interactions between two or more institutions on the basis of their organizational principles and expected responsibilities to perform their respective roles. So, enhancing inter organizational integration is very important to improve MSWM through creating functional interdependences such as experience sharing, and supportive activities. This collaboration can also facilitate information exchange between them and initiate organizations to actively taking part in solid waste activities in particular and promoting public health and environmental protection in general.

Based on the strategic plan of SBPDD of Dessie town, there are several organizations which are identified for cooperation in solid waste management of the town. These are town administration office, health office, law and order securing office, urban agricultural office, micro and small enterprise office, information and communication office, and kebele sanitation agents. Based on this strategic plan, all the above organizations have their own responsibilities which are expected to play in sanitation, beautification and park development of the town. Nevertheless, according to the majority (67%) responses of SBPDD workers, health office, law and order securing office, micro and small enterprise office and kebele sanitation agents are the only organizations which have been involved in solid waste management activity of the town.

Table 4.8: List of organizations and their expected aspect of involvement in solid waste management

<b>List of organization</b>	<b>Expected aspects of involvement</b>
Town administration office	Creation of suitable conditions including good governance and due emphasis to sanitation, beautification and parks development.
Health office	Protect health of the society through controlling and supporting solid waste management of the town like supervision and awareness creation.
law and order enforcing office	They have the power and responsibility to penalize and control illegal dumping of solid waste.
Urban Agricultural office	Give support to development of different areas, work with different stakeholders about compost and other related works
Information and Communication office	Documentation of several SBPDD activities and communicating it to the society and other actors in order to upgrade their participation
Kebelle sanitation agents	organize society for sanitation campaign and also supervise and control illegal solid waste disposal in each kebelles
Micro and small enterprise office	Organize MSSE solid waste collectors

Source: SBPDD strategic plan, 2011

Despite the importance of inter organizational linkages, SBPDD lacks well integrated linkages among different offices and institutions which are vital for effective and efficient way of handling solid wastes in the town. About 87% of SBPDD workers revealed that there is no strong linkage among different bodies at grass root level. If there are some linkages it is at high level and very formal and too bureaucratic to be operational. Furthermore, lack of clearly stated duties and responsibilities among different offices has made the situation more complicated and led to fragmented actions by different offices.

#### **4.9.6 Effort of Sanitation, Beautification and Parks Development Department to Participate Different Stakeholders on MSWM**

For many services that are delivered in many urban areas of the world, stakeholders' participation is regarded as a backbone because delivery of one big service by one actor makes the service very difficult and complex. However, the involvement of various stakeholders with their specialization can make the service provision easy, satisfactory and efficient. Similar to this, for proper management of MSW of a given town and to keep its sustainable functioning, participation of

stakeholders also plays determinant and irreplaceable role. Those stakeholders of MSWM comprise community and community based organizations (CBOs), nongovernmental organizations and external support agencies, and formal and informal private sectors. In developed countries, all these groups and individuals do play an important role beginning from policy preparation to provision of waste collection, resource recovery, and supplying waste collection equipment. However, in developing countries, it is recently that some urban authorities have recognized these actors, and eventually integrated them in to their MSWM systems (Achankeng, 2004).

Even contrary to some urban authorities of developing countries, Dessie town SBPDD is characterized by absence of stakeholders' involvement in strategy formulation, and insignificant participation of MSSE, informal sectors, and community on actual operation of MSWM. On the other hand, although there are 138 well functional and socially organized local area associations called 'Iddirs', and 10 woman and 20 youth associations in Dessie town, none of these CBOs are participating in town's MSWM. Moreover, according to the interview made with head of SBPDD, there are also no NGOs and donor agencies, and formal private sectors that are operating in MSWM of the town. This too low participation of stakeholders is created by SBPDD, kebele officials, and health office of the town because of their failure to practice their responsibilities of:

- awareness rising activities
- financial, technical, material and moral support
- establishment of suitable institutional environment for motivating stakeholders towards solid waste management

Therefore, those governmental institutions should recognize their defect and give great emphasis to initiate stakeholders' participation. Because, at the very beginning efficiency of solid waste management service could be real if and only if stakeholders are aware of their responsibilities and tries to practice it with a higher level of commitment, otherwise the movement to provide MSWM service without holding them is considered as clapping by one hand.

## **4.9.7 Institutional Capacity of Sanitation, Beautification and Parks Development Department**

Institutions play vital roles in guiding change, facilitating development and succeeding national socio economic and political goals if they are well equipped in terms of various types of resources. These dominant resources which determine an institutional capacity are: human, material, and financial resources. Otherwise, they can cause for failure of designed goal since the management of an institution with a relatively low capacity has its own impact on its effectiveness. With this intention, in order to manage solid waste properly the capacity of institution that is delegated with MSWM of the town also needs to be raised to a higher level with adequate budget, man power, technical skills and equipment used. But, status of the existing institutional capacity of MSWM in Dessie town is basically inadequate arising out of insufficient manpower, financial, and material resources.

### **4.9.7.1 Human Resource Capacity of SBPDD**

The most important factors that have influenced level and quality of operation of solid waste management services related with manpower of resource are actual size and required size, job requirement and actual qualification of staff, recruitment qualification, payment system, staff management activities like incentives and promotional opportunities, adequacy of waste management training and technical assistances, and moral aspiration of workers. As a result, to gain a better understanding of the human resource capacity of SBPDD of Dessie town, questionnaire which focused the above factors was prepared and distributed to all solid waste related workers and an interview with the head of the department was made in addition to secondary data received from the department.

According to the work process manual of the SBPDD, the present arrangement of the department was prepared in order to hold 160 workers. Among this, around 90 workers ( i.e. except 2 water supply pipeline stretching and repair workers,4 liquid waste drivers and his assistance, 12 truck assistants, 52 beauty development workers) are involved in provision of solid waste management in Dessie town. However, as it is clearly observed in table 5.1, currently the department continues its function using only 34 (37.78%) manpower but the remaining 39(62.22%) workers are not

employed. From this it is possible to conclude that the department has very weak manpower and this condition can be considered as a major problem for the existing MSWM activity of the town. Based on the information obtained from interview made with the manager, the reason behind this inadequacy of manpower is lack of budget and low attention given by the department as well as higher officials to employ. On the other hand, with respect to qualification of workers most of them are assigned in appropriate position with reference to the department manual except 3 official workers.

Table 4.9: SBPDD existing human resources and required number of workers related with solid waste management task in 2011

<b>Job title</b>	<b>Recruitment type</b>	<b>Required no of workers</b>	<b>Existing no of workers</b>	<b>Vacant positions</b>
WP manager	Permanent	1	1	-
WP assistant (secretary)	Permanent	1	1	-
Community need assessment & planning expert	Permanent	5	4	1
Training & document preparation expert	Permanent	3	-	3
Solid waste reuse & recycling follow up & supportive expert	Permanent	2	2	-
Distribution & control expert	Permanent	2	2	-
Supply & repair follow up expert	Permanent	1	-	1
Town sanitation workers	Contract	25	5	20
Driver( Solid waste collection vehicle)	Permanent	2	1	1
Assistant( Solid waste collection vehicle)	Permanent	2	1	1
Street sweepers (one person for 500 meter square)	Contract	46	17	29
<b>Total</b>		<b>90</b>	<b>34</b>	<b>56</b>

Source: Dessie town SBPDD WP manual, 2011(for detail understanding of this survey see appendix6)

In addition to shortage of manpower, failure to address fundamental need of workers such as salary increments, incentives, recruitment type, and promotion opportunities are also considered as second main reason that contributed to low MSWM of the town. For instance, for many tasks of solid waste management the department depends on contractually employed workers. From the total workers of the department only 21.11% of them are permanent employees where as the remaining 78.89 % are employed in contract. Although these workers registered a good experience (i.e. 87 % of them are above 5 years) on these positions and carried out the most risky type of work, the department is not willing to change them to permanent workers. Accordingly, all of those workers response and field observation revealed that they are less motivated at work.

Besides this, the contractual workers are also extremely upset by their low salary as well as absence of salary increment. Specifically, the monthly salary of these staffs is 390 birr for street sweepers, 366 birr for town sanitation workers and 1165 birr for driver. Genuinely speaking, this amount of salary is not matching with their difficult task, present inflation of money and high living expense. Related with this the workers stated that they are found in a big and difficult situation together with their family. In addition to this, these workers are also required to work around 8 hours in every day without any monthly or annual vacation or leisure time including Saturday, Sunday and holydays. In such type of wok loads over time payment is the only means of compensation but SBPDD workers do not receive any form of over time payment. The department is not also fulfilling its responsibilities of provision of appropriate health protection gears like gloves, shoes, clothes etc and health insurance. As a result, most of the department workers are motivated to leave their jobs. Currently, there are three workers that resigned from their jobs. This shows that the department will face a more severe job retention problem.

#### **4.9.7.2 Financial Resource Capacity of SBPDD**

Finance is a very decisive factor for any public service delivery in any town or country. On the other hand, an environment which is safe and healthy for human beings is also a requirement for any town or country. Therefore, one country or town should provide adequate finance to conserve and manage its environment in general and its solid waste in particular because solid waste is one of the problems which damage the urban environment. Different from this, in Dessie town the provision of adequate funding for MSWM is a sever challenge which causes the town environment to be deteriorated. It is

characterized by poor budget for service delivery, insufficient funding for building infrastructures and absence of appropriate cost recovery mechanisms.

At present, the budget of SBPDD of Dessie town together with other eight service sectors of municipality is released from finance and economic development office (FEDO) under the jurisdiction of municipality. Because, the total budget that needs to provide to the MSWM is covered only by the municipality as part of its yearly budget. This made the town supply of MSWM service to be highly dependent on the town municipality capacity to ensure adequate municipal revenue. And this finally results very weak financial performance of solid waste management service of the town since the municipality cannot collect adequate annual revenue to run all work processes. For example, in the last 3 years the total budget allocated for municipal office and sanitation and beautification department was around 135,678 birr in 2007, 148,456 birr in 2008, and 180,417.60 birr in 2009 with an increasing rate related with an increase in total municipal budget.

Table 4.10: Total budget of SBPDD compared to total budget of municipality in 2009

<b>Year</b>	<b>Total budget of municipality</b>	<b>Total budget allocated to SBPDD</b>	<b>Percentage share of SBPDD</b>
2007	58,530,948	135,678	0.23 %
2008	58,748,832	148,456	0.25 %
2009	61,479,672.95	180,417.60	0.29 %
Total	178,795,452.95	464,551.60	0.26 %

Source: Dessie town FEDO, 2009 report

However, when the total budget for SBPDD (464,551.60 birr) is compared to the total municipality budget of 178,795,452.95 birr, it only covered an insignificant part of it (0.26 %). From this situation one can understand that the municipality's budget allocation to these eight sectors has not been carried out based on the requirement of fund for service provision but simply it is based on the available fund since the budget is most often inadequate due to low revenue collection performance of the municipality. Head of the SBPDD is also share this idea and he told me that for releasing the actual budget to the eight sectors the municipality asked them to present their future plan. Then the distribution of budget in each sector is mainly under taken with respect to the higher office emphasis given to each sector without considering the proposed budget request of each sector. On the basis of

this inequitable distribution of funding across sectors, the majority of financial resource was allocated to those sectors which have given greater emphasis by the higher officials of the municipality. Whereas sectors like SBPDD received very low budget as it has obtained little attention by higher officials. To validate this, he also showed me the gap of 2010 plan of the department and actual implementation due to lack of budget.

Table 4.11: Solid waste management related plan of SBPDD for 2010

List of solid waste facilities	Measurement	Plan	Actually implemented	
			Number	Percent (%)
Preparation of new disposal site	Number	1	0	0
Purchasing solid waste storage basket	Number	144	0	0
Purchasing public solid waste containers	Number	30	5	16.66%
Preparing permanent place for public SW containers	Number	30	5	16.66%
Purchasing public SW container nets	Number	3	0	0
Purchasing SW collection vehicles	Number	1	0	0
Total	Number	209	10	4.78%

Source: Dessie town SBPDD report, 2010

As one can easily see from table 4.11, most of listed plans of SBPD are not implemented because of adequate fund. Specifically, from around 209 different solid waste management equipment requests of the department only 10 (4.78%) were purchased which is far below from adequate level. According to the department manager, this very low financial capacity of the department is also be a big barrier to perform the future solid waste management projects successfully.

Table 4.12: Solid waste management related five year (2011-2015) plan projects

List of projects	Measurement	Quantity	Time table					Estimated cost
			2011	2012	2013	2014	2015	
Building sanitary landfill	Number	1		√				12,000000
Purchasing solid waste lifter truck	Number	1	√					2,000000
Purchasing Door to door SW collection truck	Number	3	√	√				1,200,000
Building transfer stations	Number	4	√	√				400,000
Appropriate Solid waste disposal	m <sup>3</sup>	180,000	36000	36000	36000	36000	36000	
Purchasing public solid waste container	Number	35	15	15	5			600,000
Total								16,200000

Source: Dessie town SBPDD strategic plan, 2011.

As table 4.12 indicates, in order to put projects in to operation and make the town solid waste management efficient and sustainable, municipality needs around 16,200,000 birr. But with the previous budget experiences of the department it is quite difficult to implement these plans. So, the best way to contribute for enhancing the department financial capacity is to give opportunities for involvement of private sector in service delivery and tied to collect charge from the service users as well as private sectors.

To a great extent, the immediate cause for all financial constraints is inefficient methods of revenue collection of municipality together with lack of financial decentralization (i.e. absence of financial autonomy between each sector particularly in determining their own expenditures). For instance apart from the municipality budget, the SBPDD has not other revenue means even if there are a lot

of revenue generating mechanisms like introducing user charges, treatment plants and hazardous waste disposal, penalties for persons who illegally dispose waste, resource recovery (composting, energy recovery) etc. According to the work process manager, the main reason behind this is not due to lack of knowledge or information about those cost recovery mechanisms but it is lack of power to collect such revenues. For instance, solid waste collection service fee (around 3 Ethiopian birr per household) in the last year was undertaken by the municipality even though currently it is not practiced. Waste fees like any fees of other municipal services were considered as a municipal source of income by the municipality and compiled as municipal budget for improving other sectors of the town rather than allocation of it to MSWM service improvement. In addition to this, the power of penalizing persons who illegally dispose their waste given to health office and security office, the only role of SBPDD is giving service to the residents and reporting illegal activities of citizens to those bodies. Therefore, more power should be devoted to the department, and legal responsibilities should be made to match the required financial resources, so that the department can effectively perform the duties assigned to it. Otherwise, solid waste management in the town will continue to suffer with shortage of financial resource since it is very difficult for waste management system to be effective without generating its own efficient and sustainable revenue base. More than this it is also very difficult to successfully perform the future five year solid waste management projects which require around 16, 200,000 birr.

#### **4.9.7.3 Municipal Solid Waste Management Equipments**

In the process of municipal solid waste management there are various facilities/infrastructure that should be accomplished for providing efficient and effective service to citizens. But this facilities are highly correlated with the economic performance and good institutional concern of a given town or country. For instance, it is possible to observe developed countries which give high concern or attention to solid waste management and used different sophisticated technologies for managing it. Opposed to this, in developing countries solid waste management is mainly under taken by very inefficient equipments and technologies due to low level of economic development and low attention given to this service. The situation of MSWM infrastructures or facilities in Dessie town is also not different from the rest of developing countries. Currently, the SBPDD of the town runs this service with supplying only one solid waste collection, transportation and dumping truck. Besides this, the department has one disposal site 2 km away from the center of the town. Obviously these amounts of

equipment or facilities are not sufficient to convey the service when we compared with the rapid expansion of the town and the level of increasing waste generation rate of the society. In addition to shortage of equipment, the problem of MSWM in the town is also exacerbated by poor quality of truck and frequent break of it. For instance, we can take the old car which served for around 14 years. Because of this the average frequency of collection of the car is inadequate on average it is limited to 4 trips per day. This low service of the truck, it also exposed the department to a lot of expenses for fuel, tyre, filter, spare parts and maintenance.

Table 4.13: Amount of employees and vehicle related expenses in the year 2010.

<b>Types of expenditure</b>	<b>Expenditure (birr)in 2010</b>
Employees related expense	23691
Vehicle related expenses	
Fuel	62830
Tyre	14730
Spare parts	9108
Oil and filter	3180
Total	89,848
Grand Total	113539

Source: SBPDD annual report, 2010

Table 4.13 revealed that in 2010 department spends around 89,848 birr for such vehicle related expenses. Vehicle running cost on average consume almost 4 times of the total expenses for the department workers even if the MSWM service of the town is dominantly labor intensive and workers are the major resources who work with other technologies or facilities.

Apart from this, absence of public storage facilities such as public storage containers and dust bin is also another problem area that greatly minimizes the performance of MSWM service of the town and it is regular to observe accumulated solid wastes like plastics, papers, food wastes etc on different parts of the town like the street, open areas, rivers etc. On the other hand, the problem on implementation of the proposed plan of the department which aimed to improve the facilities through purchasing different equipments is worsening the low efficiency of SWM the town.

## CHAPTER FIVE

### 5. CONCLUSION AND RECOMMENDATIONS

#### 5.1 Conclusion

This paper has attempted to analyze the status and spatial coverage of municipal solid waste management service of Dessie town in general. In particular, the study explored households' solid waste physical composition and generation rate, household's solid waste management practice, and institutional structure and capacity of sanitation, beautification and parks development department (SBPDD) of the town. These investigations were addressed by employing questionnaires, field observation, field measurement, semi structured and unstructured interview with head and workers of SBPDD, and reviewing published and unpublished documents. Finally, on the basis of qualitative and quantitative analysis of data, the findings of this study are summarized as follows.

The principal sources of municipal solid wastes in Dessie town are residences, commercial areas, street sweeping, institutions, and small scale industries. However, the considerable amount of solid waste of the town (60%) is generated from residential areas. Though this source has such large dominance, the town's SBPDD didn't make frequent and ongoing inspections on its solid waste composition and generation rate. But, this study found out solid waste generation rate of household, it is about 0.231kg/person/day. This made the daily and annual total solid waste generation of residential areas of the town to  $100.91m^3$  (37337.223kg) and  $36832.15m^3$ (13627895.5kg) respectively. Furthermore, according to this study about 75.6 % of residential areas solid waste is composed of biodegradable solid wastes such as ash, dust, and food waste. This composition is very suitable to make compost. This is the best way of sustainable solid waste management both in terms of economic and environmental value. But, there is no activity made by the town SBPDD, as well as other actors towards application of this potential resource.

This study also indicated that Dessie town municipal solid waste management service is very weak in terms of status, spatial coverage and solid waste management facility. Presently, in the town there are no public solid waste storage containers and road side dust bins. As substitution of these facilities there are 9 communal solid waste transfer stations that give service only to MSSE waste collectors.

Those stations are located at the edge of main roads, and they are not well designed. Simply they are road side open dumps without any health, aesthetic and environmental impact considerations. Besides this, those transfer stations are also characterized by uneven distribution both in terms of distance from beneficiaries and kebele specific locations. Furthermore, municipal solid waste collection and transportation activity of the town is carried out by two types of collection methods such as door to door and transfer stations solid waste collection. Door-to-door collection system is provided by MSSE waste collectors and rarely by municipality collection truck. It is largely implemented for collection of solid waste from residential areas to transfer stations. But, the status and spatial coverage of this service is very unsatisfactory, only covers residents who are living in the center of the town and along accessible streets. Whereas the transfer stations collection method is directly performed by the SBPDD using its collection truck. Based on average trip of a truck, the total amount of solid waste which is daily collected and transported by the municipality is calculated as  $32m^3$  or 11840kg but the actual daily generated solid waste from all sources of the town is about  $136.11m^3$  or 50360.7kg. Therefore, only 23.51% of the municipal solid waste of the town is collected and transported to Member Tshehay disposal site of the town. As a result of this, huge amounts of uncollected solid wastes are indiscriminately disposed in unauthorized areas. In addition to poor solid waste collection and transportation practice, the town disposal site is also found in unacceptable and very risky situation. Because, it is simply naturally created gorge rather than manually prepared solid waste dumping through environmental, economical and social impact considerations.

Finally, this research investigated three main factors which are exacerbating the existing poor status of municipal solid waste management service of Dessie town. These are:

1. Very weak institutional arrangement and capacity of sanitation, beautification and parks development department.

Structurally, SBPDD is twisted by: long bureaucracy and delay in implementation of activities, lack of practical decentralization of power and regular interference of higher officials, absence of kebele specific structure of the department, and high burden of work with three significant services (liquid waste management, town beautification and park development, and solid waste management). In terms of capacity, very poor institutional capacity of the department is arising out of:

- very low financial capacity
- absence of cost recovery mechanism and financial autonomy
- insufficient manpower resource
- low motivation and productivity of workers due to failure to address fundamental need of workers
- scarcity of solid waste management facilities
- weak enforcement of rules and regulations
- fragile networks and linkage of the department with other sectors and organizations
- mandate restrictions of the department

## 2. Very poor solid waste management practices of the town households

The first weakness of households is poor handling of temporary storage material of their house. I.e. they drop out solid waste around it. They also exposed it to rain and light, did not well covered, and placed near to residence. Second, the greater part of the town households didn't separately store solid wastes other than salable and exchangeable with Liwach and Quraleos. They did not also carry out sustainable solid management activities such as recycling, reusing and composting. Apart from this they regularly apply illegal solid waste disposal. Moreover, they have also low emphasis to clean their surrounding area and nearby road.

## 3. Very limited participation and contribution of stakeholders

The provision of municipal solid waste management of the town is dominantly performed by municipality with very limited contribution of MSSE, solid waste miners and handcrafts, and communities. Besides this, there is no involvement of CBOs, NGOs, and private sector.

## 5.2 RECOMMENDATIONS

Based on the findings of this study, the following measures are very important to overcome MSWM problems of Dessie town:

### 1. Education related measures

- The residents of Dessie town have low awareness and knowledge about solid waste management issues. This clearly indicates the need of wider public awareness creation activities. So that the SBPDD as well as health office of the town should deliver adequate training and awareness creation to residents about side effects of solid waste, and application of sustainable solid waste management practices. In this case, there is a need to give special attention to women who are the most powerful change agent.

### 2. Institution related measures

- ✓ Give majority of MSWM related mandates to SBPDD of the town since the fundamental part of MSWM activities are performed by this body.
- ✓ Prepare sound SBPDD institutional arrangement that is free from high interference of higher officials and bureaucracy, which have both horizontal and vertical integration and kebele specific teams, allows stakeholders participation, and characterized by real decentralization of tasks and authority.
- ✓ The town SBPDD should give priority to fulfill infrastructure facilities i.e. place back the public solid waste containers and introduce dust bins with a close supervision, frequent emptying of waste and even distribution.
- ✓ Organize efficient controlling mechanism and sanitation agent to prevent illegal solid waste disposal
- ✓ Increase SBPDD revenue through employing different revenue means like introducing user charges, penalties for persons who illegally dispose their waste, employing resource recovery activities, and government subsidies. But the department should also introduce cost accounting financial monitoring and financial evaluation.
- ✓ Improve solid waste collection by preparing permanent programs, increasing the number of collection trucks, by employing other methods of collection like block and curbside

collections, control and supervision field workers, increase human resource of the department, increase the number and strength of MSSEs.

- ✓ Improve the number and productivity of sanitation workers by giving reasonable salary increment, per diem payment, moral respect, training, promotion opportunities, changing their requirement type, and providing health insurance and health protection facilities
- ✓ Prepare specified rules and regulations that focused on local problems such as institutional issues about the town's MSWM service responsible body, stakeholder's participation and sustainable solid waste management options, and strictly enforce these rules and regulations under close supervision and inter-organizational linkage.

### 3. Stakeholder related measures

- ❖ SBPDD open its door to private sectors and also ensure their involvement in planning and implementation of municipal solid waste management activities.
- ❖ Promote and initiate communities and different CBOs of the town to involve in solid waste management. In addition, organize voluntary groups that work on MSWM through giving different incentives and providing necessary equipments that used for solid waste management
- ❖ SBPDD of the town create interaction with NGOs and donor agencies and watch these bodies as partner for delivery of MSWM, because they are one means to get financial support for purchasing different solid waste management facilities, managerial and technical skill building trainings. In addition, they can also provide awareness rising and skill building support to community based groups (Iddirs, youth, and women), informal sectors, formal sectors, and also to the SBPDD itself.
- ❖ Recognizing and encouraging the emerging role of handcrafts through reduction of taxes, and by providing space and equipments to produce recycled materials and creation of market for it.

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7. Kebelle \_\_\_\_\_

**Part two: Questionnaire prepared for investigating households solid waste management awareness, and practice together with their attitude regarding municipal solid waste management of the town.**

1. How often do you clean your house  
A. Every day                      B. with two days interval                      C. with three days interval  
D. with one week interval                      E. if others please specify it \_\_\_\_\_.
2. How many solid waste storage materials do you use to store solid wastes produced in your dwelling? \_\_\_\_\_
3. What type of solid waste storage material do you use in your house to store solid waste produced from your dwelling?  
A. sack    B. basket    C. metal container    D. plastic container ('festa')  
E. private pit              F. I don't use              G. if others please specify it \_\_\_\_\_.
4. Do you separately store solid wastes that are produced in your house and salable to "Quraleos" and exchange with "Liwach"?  
A. yes                                      B. no
5. If your answer for question **no 4** is 'yes', which of the following items do you separate for selling it to "Quraleos" and exchange to "Liwach" (possible to select more than one)?  
A. Metals,              B. Plastics              C. Glass, bottles, can etc.              D. Organic wastes  
E. Electronic wastes    F. textile and old shoes              G. if other please specifies it \_\_\_\_\_
6. Do you separate other solid wastes produced in your dwelling apart from solid wastes which are salable to "Quraleos" and "Liwach"?  
A. yes                                      B. no
7. If your answer for question **no 6** is 'yes', state the type of those solid waste?  
\_\_\_\_\_
8. If your answer for question **no 6** is 'yes', for what purpose do you separately store (possible to select more than one)?  
A. Using as fertilizer                      B. giving to other users                      C. to use as fuel                      D. to use as feeding animals  
E. to recover resources by using my own effort

F. for reducing the volume of waste, makes throwing convenient and contributing to environmental protection. G. if other please specify it \_\_\_\_\_.

9. Do you know the idea of solid waste recycling and reusing?  
A. yes B. no
10. If your answer for question **no 9 is 'yes'**, do you recycle or reuse solid wastes generated from your house? A. yes B. no
11. If your answer for question no 9 is 'yes', what type of materials do you reuse and recycle (possible to select more than one)?  
A. used Paper B. used glasses, bottles and glass materials. C. used metallic materials D. used plastics and plastic materials E. textile and used umbrellas  
F. if other please specify it \_\_\_\_\_
12. If your answer for question **no 9 is 'no'**, please describe your reasons.  
\_\_\_\_\_  
\_\_\_\_\_.
13. Do you know that compost can be prepared from solid waste?  
A. yes B. no
14. If your answer for question no **13 is 'yes'** do you prepare compost from solid waste produced in your house? A. yes B. no
15. Do you have access to door to door solid waste collection service delivered from the municipality solid waste collection vehicle?  
A. Yes B. No
16. If your answer for question **no 15 is 'yes'**, in how many days interval you get this service?  
A. 1-3 days B. 4-7 days C. 8-15 days D. 16-30 days E. above 30 days  
F. as available
17. Do you use MSE for door to door solid waste collection from your residence?  
A. Yes B. No
18. If your answer for question **no 17 is 'yes'**, in how many days interval you get this service?  
A. 1-3 days B. 4-7 days C. 8-15 days D. 16-30 days E. above 30 days  
F. as available





## APPENDIX 2

### Interview questions prepared for Sanitation, Beautification and Parks Development Department workers of Dessie town

Dear respondent this interview is conducted for an academic purpose for the fulfillment of MA degree in Geography and Environmental studies. Specifically the objective of the study is to assess the current practice, infrastructural and institutional capacity of municipal solid waste management service in Dessie town. Therefore, your response is very important for the success of the study because all information that you provide determines the analysis and conclusion of the research. Hence, you are kindly requested to give your response. Please be informed that your response is kept in confidential. I would like to thank you for your cooperation.

#### Part one: Background information about the respondents

1. Job title in your department \_\_\_\_\_.

2. Employment condition

Permanent

contract

3. Educational level

No formal education

1-4 grade complete

5-8 grades complete

9-12 grades complete

Certificate

diploma

First degree

Second degree and above

4. Work experience \_\_\_\_\_.

5. Monthly salary \_\_\_\_\_.

6. Family size \_\_\_\_\_.

**Part two: structured Questions prepared for investigating MSWM practice and capacity together with their attitude regarding households' solid waste management of the town.**

1. Have you ever been participated in solid waste management trainings or education given in our country?
2. Does your institution give incentives, promotions and salary increment to you?
3. If your answer for question n<sub>o</sub> 2 is 'yes', how do you evaluate the level of training, education, incentives, promotions and salary increment opportunities offered to MSWM workers?
4. Does your SBPD department work with other government and non government organization in its solid waste management operations? If your department works, please list the organization and their activities on solid waste management of the town.
5. How do you evaluate your institution status on interaction with other government and non government organizations regarding MSWM of the town?
6. How do you see the institutional arrangement of SBPDD? Does such arrangement have any problem on the efficient performance of your division? If it has please explain it?
7. Do you feel your organization has efficient capacity to handle MSWM responsibilities?
8. Do you think the controlling mechanism of municipality it is effective? If your answer is "no", what do you think the reasons?
9. Do you work on Saturday and Sunday per time? If you work, do you get over time payment?
10. Do your collection, transportation and disposal service cover all parts of the town? If it not covered, please specify the major reasons?
11. Are you provided with medical care, safety wares, and other materials that are necessary to keep your health?
12. Do you think residents of Dessie have clear and adequate awareness about solid waste management systems?
13. Municipal solid waste management in Dessie town? If any, please mention those kebelles together with its main reasons?
14. What do you think should be done to improve the situation of MSWM of the town in general?

**If you have any additional comments, suggestions, or would like to elaborate on any of your previous answers, please include it here, or attach a separate sheet.**

## **APPENDIX 3**

### **Interview questions prepared for head of Sanitation, Beautification and Parks Development Department of Dessie town**

Dear respondent this interview is conducted for an academic purpose for the fulfillment of MA degree in Geography and Environmental studies. Specifically the objective of the study is to assess the current practice, infrastructural and institutional capacity of municipal solid waste management service in Dessie town. Therefore, your response is very important for the success of the study because all information that you provide determines the analysis and conclusion of the research. Hence, you are kindly requested to give your response. Please be informed that your response is kept in confidential. I would like to thank you for your cooperation.

1. What types of solid waste collection methods does your department adopt?
2. Mention the types and total number of equipments that your department used for collection, transportation and disposal of municipal solid waste of the town?
3. Is there a mismatch between the amounts of municipal solid waste that regularly generated in the town and, total quantity of solid waste that is collected and disposed by your department? If there, please discuss the major reasons of a mismatch.
4. Explain the major reasons of why your department didn't place public solid waste containers and street bins at the major roads of Dessie town?
5. Does Dessie town sanitation, beautification and parks development department practice different types of resource recovery, waste minimization or waste treatment activities? If any, please describe those activities and, if not please mention the major reasons?
6. Did your department carry out the following surveys on disposal sites of the town in order to evaluate its suitability? If your department under take the survey, specify the outcomes. But if didn't carry out, please specify the major reasons.
  - A. Geological survey or study
  - B. Surface and ground study of the area
  - C. Environmental impact assessment
  - D. Surrounding land use assessment
  - E. Distance of Disposal sit versus future expansion of the town
  - G. Its appropriateness based on the master plan of the town.
  - H. Cost benefits analysis of the area.

7. Explain the overall institutional structure, mandate and functions of sanitation, beautification and parks development department and, the major positive and negative impact of these arrangement on the existing performance municipal solid waste management of the town.
8. Briefly discuss Policies, Strategic plans, and its Implementation and monitoring mechanisms that have been proposed by your department for efficient practice of municipal solid waste management in Dessie town.
9. Describe the total budget and revenue of municipal solid waste management related with their sources and the major challenges that faced your department about it?
10. Does your department collect charge from the residents of the town for its municipal solid waste management service delivery?
11. Do you think that there is inadequacy of man power in your organization? If there is, what do you think the reason behind this?
12. Do employees leave your department frequently? If yes, please specify their number, major reasons and your department response for it.
13. Do you think that your organization has sufficient autonomy from other levels of government in its every day decision making.
14. Does your department invited different stake holders of solid waste management to participate both in planning and implementation process of municipal solid waste management? If yes, please describe those actors and their significant activity.
15. Did your department give education to the community about solid waste management and prepared cleanup campaigns? If you did, for how many times and describe your method of delivery.
16. List challenges of your department.

**If you have any additional comments, suggestions, or would like to elaborate on any of your previous answers, please include it here, or attach a separate sheet.**

## APPENDIX 4

### Sample households' solid waste generation rate by income level in Dessie town, 2011

Income group of sample HHs	House no of sample HHs	Family size	Qt/HH/week (kg)	Qt/HH/day(kg)	Qt/day/person (kg)
Higher income group(>1501)	1809	7	12.6	1.8	0.257
	2251	4	5.7	0.814	0.204
	2779	5	14.2	2.029	0.406
	2090	6	9.3	1.329	0.222
	531	5	10.2	1.457	0.291
	1057	9	19.3	2.757	0.306
<b>Sub- total</b>	<b>6</b>	<b>36</b>	<b>71.3</b>	<b>10.186</b>	<b>0.283</b>
Middle income(801-1500)	181	6	8.5	1.214	0.202
	511	2	6.9	0.986	0.493
	296/1	2	5.3	0.757	0.379
	296/2	4	6.7	0.957	0.239
	296	4	12.1	1.729	0.432
	296/3	5	7.8	1.114	0.223
	241	6	8.9	1.271	0.212
	211	8	11.6	1.657	0.207
	163	7	9.3	1.329	0.190
	1067	5	6	0.857	0.171
	242	3	8.8	1.257	0.419
	182	7	9.7	1.386	0.198

<b>Sub- total</b>	<b>12</b>	<b>59</b>	<b>101.6</b>	<b>14.514</b>	<b>0.246</b>
Lower income group(<800)	181/1	3	3.8	0.543	0.181
	1062	4	5.7	0.814	0.203
	167	2	3.5	0.5	0.25
	012	3	6.8	0.971	0.324
	1590	7	10.3	1.471	0.210
	1520	4	7.5	1.071	0.268
	1121	3	4.1	0.586	1.195
	751	8	9.4	1.343	0.168
	193	6	7	1	0.167
	2063	5	7.4	1.057	0.211
	75	5	6.9	0.986	0.197
	127	4	7.1	1.014	0.256
	133	3	5.1	0.729	0.243
	412	8	8.6	1.229	0.153
	1560	6	8.7	1.243	0.207
	07	2	4.5	0.643	0.322
	35	6	7.3	1.043	0.174
526	9	9.3	1.329	0.148	
<b>Sub -total</b>	<b>18</b>	<b>88</b>	<b>123</b>	<b>17.572</b>	<b>0.2</b>
<b>Grand total</b>	<b>36</b>	<b>183</b>	<b>295.9</b>	<b>42.272</b>	<b>0.231</b>

## APPENDIX 5

### The Physical composition of solid wastes of Sample households' in Dessie town, 2011

Category	Type of solid waste	Qt/HH/week (kg)	Qt/HH/day (kg)	Qt/day/person (Kg)	Percentage share
Biodegradable waste	Ash and dust	131.68	18.811	0.1027	44.5%
	Food waste	92.02	13.147	0.072	31.1%
Non biodegradable	Grass, leaf, straw, paper, cardboard, and wood scarp	31.07	4.438	0.0242	10.5%
	Plastic, textiles and leathers	19.53	2.79	0.0152	6.6%
	Glass, ceramics and metals	21.6	3.086	0.0169	7.3%
Total		295.9	42.272	0.231	100%

## APPENDIX 6

### Dessie town SBPDD existing human resources and required no of workers related with solid waste management task on the basis of work process manual of the SBPDD of Dessie town,2011

Job title	Required educational level	Current educational level of workers	Recruitment type	Required no of workers	Existing no of workers	Vacant positions
WP manager	BA degree in Management	Degree	Permanent	1	1	-
WP assistant (secretary)	Diploma in secretarial science, management and related fields	Diploma	Permanent	1	1	-
community need assessment & planning expert	BA degree in social science(geography, sociology, economics and related fields), diploma in secretarial sciences, 10+2 or 12+1 in computer science and related fields, BSC degree in plant science	Diploma, degree, diploma, degree	Permanent	5	4	1
Training & document preparation expert	BSC degree or diploma in secretarial science with some year experiences, BSC degree in health officer or nursing and related fields, BSC degree in plant science and related fields	-	Permanent	3	-	3

Solid waste reuse & recycling follow up & supportive expert	12 grade complete and above	12+(Diploma), diploma	Permanent	2	2	-
Distribution & control expert	Diploma in management and related fields	diploma, diploma	Permanent	2	2	-
Supply & repair follow up expert	Diploma in management and related fields	-	Permanent	1	-	1
Town sanitation workers	1-4 grade complete and above	Four of them are 5-8 grade complete while the remaining are illiterate	Contract	25	5	20
Driver( Solid waste collection vehicle)	Driver	5 <sup>th</sup> driving license	Permanent	2	1	1
Assistant( Solid waste collection vehicle)	1-4 grade complete and above	-	Permanent	2	1	1
Street sweepers (one person for 500 meter square)	1-4 grade complete and above	11 of them are illiterate and the remaining 1,2,3 are 1-4 grade complete, 5-8 grade complete and 9-12 grade complete respectively	Contract	46	17	29
Total				90	34	39

Source: 2011

## Statement of declaration

I, the under signed, declare that the thesis is my original work, has not been presented for a degree in any other university and that all sources of material used for the thesis have been dully acknowledged.

Name                Solomon Cheru  
Signature            \_\_\_\_\_  
Date                    \_\_\_\_\_

This thesis has been submitted for examination with my approval as a university advisor.

Name                Yirgalem Mahiteme (Ph.D)  
Signature            \_\_\_\_\_  
Date                    \_\_\_\_\_