

**ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
DEPARTMENT OF BIOLOGY**



**Municipal solid waste management practice in Sabata town, Special Zone in
Oromia Regional State, Ethiopia**

**A thesis submitted to the School of Graduate Studies of Addis Ababa
University in partial fulfillment of the requirements for the degree of
Masters of Science in Biology (M.Sc.)**

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Addis Ababa, Ethiopia

DECLARATION

I declare that **Municipal solid waste management practice in Sabata town, Oromia special zone surrounding Finfine, Oromia, Ethiopia** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

Name of Candidate

Signature

Date

DEDICATION

I dedicate this work to my late brother, Lelissa Chalchisa who laid the foundation for my education.

ABSTRACT

The objective of this study was to assess and examine the current status of municipal solid waste management practices in the city of Sabata, Oromia Special Zone, surrounding Finfine in Oromia Regional State of Ethiopia. Descriptive research method was employed to explore the current status of solid waste management in the study area using both primary and secondary data sources. In doing so, 167 households were selected in three Kebeles of the town by applying both probabilities (systematic random sampling) for sample households and non-probability (purposive) sampling techniques for focus group discussion (FGD) with pairwise ranking and key informant interviews. The three Kebeles were selected judgmentally based on the activities taking place in the surrounding market, transport, service giving and other activities. The data collection instruments comprised of questionnaires, key informant interview, FGD, field observation and documented data. The collected data were analyzed using SPSS software. Results of the study indicated that solid waste management practice of the community; particularly, at source was poor and feeble relationship of institutions. In addition to this, the municipality of the town was not able to provide adequate solid waste management service. This was because of some factors related to financial constraint, very poor institutional coordination, weak enforcement of rules and regulations, socio-cultural factors and lack of awareness among the community. The findings of the study conclude that the key elements of solid waste management system in the town such as waste handling and processing, waste collection and disposal practiced was ineffective and inadequate. The study thus recommends that the community has to be provided with adequate education and develop awareness on how to handle its solid wastes at home and about the consequences of improper solid waste disposal.

Key Words: *Municipal solid waste management, Solid waste, Household, Sabata town*

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ABBREVIATIONS AND ACRONMYS

AACGSBPDA Addis Ababa City Government Sanitation and Parking Development Agency

CSA Central Statistical Agency

CWB Community Waste Bin

FGD Focus Group Discussion

GHGs Greenhouse Gases

LFG Landfill gas

MES Micro and Small Enterprises

MMTCE Million metric tons of carbon equivalent

MSW Municipal Solid waste

MSWM Municipal Solid Waste Management

OUPI Oromia Urban Planning Institute

SBPDA Sanitation, Beauty, Parking and Development Agency

SFEDO Sabata Finance and Economic Development Office

SKAT Swiss center for Development Technology and Management

SPSS Statistical Package for Social Sciences

SWH Solid waste Handling

SWM Solid Waste Management

UNDP United Nations Development Program

UNEP United Nations Environmental Program

UNESCO United Nations Educational, Scientific and Cultural Organization

WHO World Health Organization

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1 INTRODUCTION

The rapid urbanization that has been taking place during the 20th century virtually transformed the world into communities of cities and towns facing similar challenges on environmental issues (Smith, 2010). Among those environmental issues, solid waste management is a critical one. With the current rate of urbanization and industrialization, solid waste collection, transportation and disposal has been a major problem of most municipalities of the developing countries. Consequently, municipalities are faced with the problem of effective solid waste management (UNEP, 1996).

Urban population in developing cities is estimated to be over one third of a country's total population (Eshuan, 2002). Besides, high birth rates, urban centers have attracted migration from rural areas due to "assumed" more work opportunities, better health and educational facilities. The author also showed informal settlement contributed to improper solid waste disposal ranges from ten percent in Cape Town and Buenos Aires to ninety percent in Addis Ababa and Luanda respectively. The situation is exacerbated in slums where households cannot make use of community waste bins. Besides, crunching poverty and crowdedness of the society, the major contributor to high morbidity and mortality among the urban poor is lack of basic solid waste disposal service (Zurbrug, 2003).

MSW generation rates are influenced by economic development, the degree of industrialization, public habits, and local climate (What is waste, 2012). Generally, the higher the economic development and rate of urbanization, the greater the amount of solid waste produced. Income level and urbanization were highly correlated and as disposable incomes and living standards increase, consumption of goods and services correspondingly increases, as does the amount of waste generated. Urban residents produce about twice as much waste as their rural counterparts. The volume of waste generated is also dependent on the economic status of the people.

Developing countries have solid waste management problems that differ from those found in fully industrialized countries. Indeed, even the very composition of their waste differs from that of 'developed' nations. Notwithstanding, in low-income countries, solid waste generation

rates average only 0.4 to 0.6 kg/person/day, as opposed to 0.7 to 1.8 kg/person/day in fully industrialized countries (Zerbock, 2003).

Solid waste collection system in many countries cannot cope with the increasing volume of solid waste. In general, the current waste collection capacity and disposal system are not matching with the growing solid waste generation rate in many developing countries. As a result, about 40 percent of solid waste which is dumped on the street and drainages contributed a lot to breeding insects, rodents, vectors and spread of disease (Zurbrug, 2003).

In several parts of Africa, thousands of tons of solid waste are generated daily. Most of this waste ends up in open dumps and wetlands, thereby contaminating surface and ground water and posing major health hazards (EGSSAA, 2009). The waste generation rates, available only for selected cities and regions, are approximately 0.5 kilograms per person per day—in some cases reaching as high as 0.8 kilograms per person per day (EGSSAA, 2009).

The population growth and the rate of urbanization are alarmingly increasing throughout the African continent (UNESCO, 2009). But the technology, technical knowhow, financial capacity, culture, and understanding of the community required to properly manage solid wastes are not adequately available. The management of solid waste in Africa is often weak due to lack of appropriate planning, inadequate governance, poor technology, weak enforcement of existing legislation and the lack of economic incentives to promote environmentally sound development (UNEP ,2005). Consequently, solid waste is not only increasing in quantity but also changing in composition from less organic to more paper, packing wastes, plastics, glass, metal wastes among other types, a fact leading to the low collection rates (Bartone and Bernstein, 1993).

In Ethiopia, the increase of solid waste generation is resulted from rapid urbanization and population booming. The amount of solid waste in Addis Ababa and other fast growing areas in the country has been increasing over time, largely attributed to rapid population growth rate (Dawit Walelign and Alebel Bahiru, 2003).

The current rate of solid waste generation is 0.252 kg /cap /day in the city of Addis Ababa (SBPDA, 2003) Other cities also generate solid waste at a rate of 0.277 kg/d in Mekelle, 0.22 kg/d of Bahirdar, and 0.227kg in Debre markos, 0.267 inAdama town compared to 0.233 kg/d in different east African cities developed by WHO cited in (Gebrie Kassa,2009), this finding is high.

In general, the solid waste management problems include inadequate waste collection, transportation systems and inadequate waste handling and improper final disposal results in urban environmental pollution. These problems are being aggravated by the growing waste generation rates associated with population growth change of composition of waste and economic condition of population (Tadesse Kuma, 2004; Degnet Abebaw, 2008; Getahun Tadesse, 2011).

1.1 STATEMENT OF THE PROBLEM

Sabata town is found in Oromia Special Zone, in Oromia Regional State of Ethiopia. It is located between 8⁰53'58.50''N_8⁰59'58.17''N latitude and 38⁰35'11.91''E_38⁰39'33.75''E longitude at 24kms in the South West of Addis Ababa. The total area that is covered by the current topographic map of the town is estimated to be 7.41 sq Km consisting of eight major *Kebeles* (CSA, 2010).

The population and housing census of CSA of 2007 projected that the total population of Sabata town to be 137,411. The high population growth is due to different pull and push factor. This include; reclassification of rural neighborhood previously administered under surrounding rural areas, as part of the city and migration as a result of huge investment in the town that creates job opportunities for migrants and town residents (Sabata office of Finance and Economic Development, 20106),

It is estimated that the town generates solid waste at a rate of 0.32kg/cap/day compared to 0.22kg/d (Debre Markos Town)-0.277kg/d (Mekelle Town) (Gebrie Kassa, 2009, and 0.4-0.6 kg /cap /day for developing countries (Medina, 2004). This indicates that the town generates

slightly higher solid waste than it can manage creating high load for the municipality. Continuous economic activities, rapid urbanization, population growth and the rise of living standards could accelerate the generation of MSW in Sabata town.

This necessitates accurate information with regard to solid waste to establish proper waste management system for regulatory, financial, and institutional decision making. Investigation of the existing management practices and factors that constrain these practices is believed to be important in order to gain understanding of the challenges and issues involved in municipal solid waste management. Thus, this research work was designed to investigate the key municipal solid waste management in the town such as the relationship between education levels of the household, household size, income, institutional involvement, solid storage system, infrastructure and solid waste management.

1.2 OBJECTIVES OF THE STUDY

1.2.1 General Objective

The purpose of this thesis was to examine municipal solid waste management practices in Sabata town.

1.2.2 Specific objectives

The study was geared to attain the following specific objectives:

- ❖ To describe and explain the current status of municipal solid waste management system and practices in the town.
- ❖ To identify the factors that influence municipal solid waste management system in the town.
- ❖ To identify environmental and health impact of municipal solid waste management in the town.
- ❖ To assess the attitude of the community towards solid waste management practices in the town

1.3 RESEARCH QUESTIONS

To achieve the intended objectives stated above, the following research questions were formulated.

- What do the current municipal solid waste management systems and practices of the town look like?
- What environmental and health impact can be identified regarding municipal solid waste management in the town?
- What is the level of awareness and attitude towards community participation in solid waste management?

1.4 SIGNIFICANCE OF THE STUDY

This study will have the following importance: Firstly, the study will contribute a better theoretical understanding of the overall features of solid waste and physical factors on the process of municipal solid waste management on the whole population; Secondly, the study will give some guide line information to policy makers, the town's municipality, solid waste managers, environmental protection agencies and researchers about the preexisting situation of municipal solid waste management in the town. Thirdly, it may also important in putting base line information to the next work who would like to conduct detailed and comprehensive studies in the town and other study area.

1.5 ETHICAL CONSIDERATION

All information was obtained on free will. No questionnaire involved too personal or sensitive questions whatsoever. This was confirmed by first explaining the objectives of the thesis and asking if each individual was willing or unwilling to answer each question, interview or focus group discussion. No individual declined.

2. REVIEW OF RELATED LITRATURE

2.1 DEFINITIONS OF MUNICIPAL SOLID WASTE MANAGEMENT

Municipal solid waste is defined as a material for which the primary generator or user abandoning the material within the urban area requires no compensation upon abandonment. This definition covers all urban solid wastes if it is generally perceived by society as being within the responsibility of the municipality to collect and dispose of (Cointreau, 1982). Some authors also define municipal solid waste (MSW) as material which is useless or unwanted material discarded as a result of human or animal activity. Most commonly, it is solids, semisolids or liquids in containers thrown out of houses, commercial or industrial premises (ESI Africa, 2004). The major type and source of municipal solid waste are food, paper, plastic, glass, metals and various other households' items including street sweepings and general refuse from households, commercial, institutional establishments and non-hazardous solid wastes from industries (Tchobanoglous et al., 1977; Bilitewski et al., 1977).

Solid Waste Management is also defined as the control, generation, storage, collection, transfer and transport, processing and disposal of solid waste consistent with the best practices of public health, economics and financial, engineering, administrative, legal and environmental considerations (Jamal, 2002).

2.2 NATURE AND CHARACTERISTICS OF WASTE IN DEVELOPED AND DEVELOPING COUNTRIES

There are several factors that set MSW management in developing countries apart from management in developed countries. First, the type of materials that composes the majority of the waste is different. In developing countries, there is a much higher proportion of organics, and considerably less plastics (Cointreau 1982). The large amount of organic material makes the waste denser, with greater moisture and smaller particle size (Cointreau 1982). A second difference is that technologies used in developed countries are often inappropriate for developing countries. Even garbage trucks are less effective because of the much heavier, wetter, and more

corrosive quality of their burden (Cointreau 1982). Other technologies, such as incinerators, are often far too expensive to be applied in poor nations. Third, developing countries' cities are characterized by unplanned, haphazardly constructed, sprawling slums with narrow roads that are inaccessible to collection vehicles (UNESCO 2009, Daskalopoulos et al. 1998). Finally, there is often a much smaller stock of environmental and social capital in developing countries. People are unaware or uncaring of cradle-to-grave solid waste management needs, being more concerned with more immediate problems such as disease and hunger.

2.3 SOURCES AND TYPES OF SOLID WASTES

According to Medina, (2004) the three general categories of solid wastes are municipal waste, industrial waste and hazardous wastes.

Industrial wastes: are wastes arising from industrial activities. Industrial process wastes include a very wide range of materials and the actual composition of industrial wastes in a country will depend on the nature of the industrial base. Composition of industrial waste depends on the kind of industries involved. Examples of the wastes which may be found under this category are general factory rubbish ashes, organic wastes from food processing, packaging materials, plastics, papers, acids, and alkalis, metallic sludges, demolition and construction waste, hazardous waste and tarry residues.

Hazardous wastes: a waste or combination of wastes which because of its quantity, concentration, or physical, chemical or pathogenic characteristics may cause an increase in serious illness, morbidity and mortality.

Municipal solid wastes: urban solid waste Medina, (2004) also commonly referred as municipal refuse is defined as material for which the primary generator or user abandoning the material within the urban area requires no compensation upon abandonment. With respect to source from which solid waste emanates, Medina (2004) categorized municipal solid waste as household (residential) refuse, institutional wastes, street sweepings, commercial 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 Tadesse (2001) as follows and urban solid waste materials discarded in urban areas and generally viewed as municipal responsibility includes:

Household wastes: It is also referred to as residential refuse or domestic waste, this category comprises wastes that are the consequence of household activities. These include: food preparation, sweeping, cleaning, fuel burning and gardening wastes. It also include: old clothing, old furnishing, retired appliances, packaging and reading matter.

Commercial waste or refuse: This category consists of wastes from shops, offices, hotels, store offices, fuel service stations, warehouses, restaurants, etc. and typically consisting packaging materials, office supplies and food wastes. In developing countries, markets may contribute the major portion of these waste categories refuse.

Institutional waste: waste from schools, hospitals, clinics, and government offices, police, barracks, religious buildings, military bases etc., and comprise hospital and clinical wastes including potentially infectious and hazardous materials. Where the institution involves residents, such as in camps, the wastes are similar to those from households.

Street sweepings: This type of waste always includes dust, dirt, litter, soil, paper, etc. However, in developing countries it may also contain appreciable amounts of household refuse, street sweeping also include fruit and vegetable residues, household wastes dumped along roads, drain cleanings, human fecal, 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.

Heeramum (1995) considered solid waste as any unwanted solid material generated from human and animal activities that have been put aside. In broad terms, solid wastes are categorized into three main groups' namely municipal waste, industrial waste, and hazardous waste. According to him municipal solid waste can be classified into two broad categories. These are: Biodegradable or recyclable and non-degradable or non-recyclable. In other word municipal solid waste may be partly composed organic matter that would be easily degradable and those non-organic matters such as bottles, glasses, and papers among others that go through before degradable. The variation in nature of solid waste affects the level of solid waste handling.

The quantity of waste generated is increasing because of rapid population growth, economic development, urbanization and improved living condition in cities and towns. However, in most developing countries like Ethiopia the increasing of solid waste generation is resulted from rapid urbanization and population booming. This has outpaced financial and man power resource of municipalities to deal with provision and management of service solid waste. In most cities of the developing world inappropriate handling and disposal of municipal solid waste is the most visible cause of environmental degradation, which means air pollution, soil contamination, surface and ground water pollution, etc. resulted from improper disposal of MSW (WHO, 1996).

Table 2.1 Municipal solid waste characteristic for low, middle and high income countries

Composition (% by weight)	Low income Countries	Middle income Countries	High income Countries
Paper	1-10	15-40	15-40
Plastics	1-5	2-6	2-10
Metals	1-5	1-5	3-13
Glass, ceramics	1-10	1-10	4-12
Leather, Rubber	1-5	-	-
Wood, bones, straw	1-5	-	-
Textile	1-5	2-10	2-10
Vegetables/organic matter	40-85	20-65	20-50
Miscellaneous	1-40	1-30	1-20

Source: Cointreau (1992).

Developing countries have 40-85 percent waste made up of household's organic matter with a high density of 450-500 kg/m³ with a high proportion of moisture content (40-80 %) and small particle size ranging between 5-35 percent(Cointreau,1992). From table 1 it can be concluded that density of waste as reflected in humid weight is high in developing countries and low in developed countries.

2.4. MUNICIPAL SOLID WASTE GENERATION RATE

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. 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, et al., 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 Afon, 2007).

2.5 SOLID WASTE MANAGEMENT IN DEVELOPING COUNTRIES

Urbanization is increasing both in developed and developing world. The rapid urbanization which occurred in developed world in the late 19th and 20th centuries is now underway in developing world. In Asia, Africa, and Latin America cities are growing rapidly caused by larger rural to urban migration and natural increase within the cities. However Asia and Africa are relatively less urbanized, they have very large urban populations and rapidly growing cities (Hardoy, et al., 2001). As Economic Research Unite of the Indian Statistical Institute (2003) states the increasing of solid waste is, now days, a serious problem in urban areas of the world. High rate of population growth and increasing per capita income have resulted in generation of enormous solid waste posing a serious of threat to environmental quality and human health. This is more in developing countries where large quantities of solid wastes are dumped haphazardly thereby, putting pressure on scarce land and water resources, and at the same time adversely affecting the health of human beings mostly that of the poor who have greater exposure to it.

The changing economic trends and rapid urbanization complicate solid waste management in developing countries. Consequently, solid waste is not only increasing in quantity but also changing in composition from less organic to more paper, packing wastes, plastics, glasses, metal wastes, among other types, a fact leading to low collection rate. In addition the problem of

municipal solid waste management in developing countries include mixing of waste, collection and storage of waste, transportation of waste, indiscriminate burning of waste and illegal disposal of waste (Zerbock,2003).

Urbanization in the third world implies the expansion of slum areas and the creation of new ones structure in many cities already overburdened with the provision of urban services most level world cities lack the resources to meet the demand for services such as water, sanitation and solid waste management. The sufficiency of services results in deterioration of the urban environment in the forms of air, water and land pollution that passes risks to human health and the environment (Medina, 2004).

Solid waste management in developing countries has received less attention from policy makers and academics than that paid to other environmental problems, such as air pollution, waste water treatment. Nevertheless, the improper handling and disposal solid waste constitutes a serious problem; it contributes to high morbidity and mortality rate in many developing country cities (Medina, 2004).

Currently, collecting, transporting and disposing of MSW represent a large expenditure for cities of developing countries: waste management usually accounts for 30-50 percent of municipal operational budget. Despite these high expenses cities collect only 50-80 percent of the refuse generated. In India for instance about 50 percent of solid waste, 33 percent in Karachi, 40 percent in China and 50 percent in Cairo and 60 percent in Addis Ababa was the only amount of solid waste that was collected in 2000 (Medina, 2004; SBPDA, 2003).

Usually in low income community residents tend to gather and dump their garbage at the nearest vacant lot public space, near river or simply burn it in their surroundings. These uncollected wastes may accumulate on the street and blocked drains when it rains which may cause flooding (Medina, 2004; Eshuan, 2002). Thus, if these wastes are not collected, treated and disposed of properly health, psychological, aesthetic and environmental conditions will further deteriorate in developing countries. Various measures have been implemented in order to extend refuse collection, upgrade disposal facilities and diminish the risk to human health and the environment associated with inadequate waste management. The measures which are

proposed to the problem in SWM in these countries have socio-economic, demographic, and institutional features.

Although production of solid waste is minimal, environmental problems are possible to occur due to improper handling and lack of service that result from different characteristics of solid waste in developing countries. Besides, collecting, transporting and disposing, solid waste requires high expenditure which is still scarce in the developing world. Even though small amount of solid wastes are produced in the developing countries, responsible authorities do not properly handle and dispose their solid waste (Hogland, 1996). Thus, an adverse effect of improper solid waste handling brings about health and environmental problems in most developing countries.

2.6 SOLID WASTE HANDLING SYSTEM

Solid waste handling includes not only the gathering up of solid waste from various sources but also the hauling of these wastes to the location where the content of the collection vehicle are emptied (Tchobanoglous, et al., 1993). Solid waste handling practices includes the process of collection, transfer, reuse, composting and incineration.

Collection involves the process of picking up of wastes from collection points, loading them into 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).

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). Most major cities in Africa have established municipal waste collection system. In the case of Ethiopia in particular Addis Ababa, there are three basic types of collection equipments: Human powered, Animal powered and engine powered (AACGSBDA, 2005).

Human powered collection equipment: This includes pushcarts, pedal tricycles, wheel barrows, and two wheel donkeys with baskets. In general these equipments require some sort of smooth surface on the cones to be effective.

Animal powered collection equipment: animals powered collection equipment either takes the form of drawn carts or animal may be directly backed with containers such as basket. This type of collection is applicable in the cities where there is no much traffic.

Engine-powered collection equipment: This includes all motorized collection equipment. There exist three broad types refuse collection systems namely door-to door, block on communal collection that are facilitated by three types of collection vehicles that means side load truck, closed compacting type trucks and containers lift trucks, and these ways of collections are used in Addis Ababa solid waste collection systems.

Door to-door collection: the side loading and compacting trucks are usually served for door- to-door collection systems where container transfer stations are lacking and road accessibility is not limited, in such collection system the disposing people and the truck along accessible street collection points met at a defined time.

Block collection: It consists of large refuse containers from 0.1-8 cubic meters located at the premise of the blocked houses or buildings.

Container system: The public at large gets collection services through a transfer station in a container collection system, which is composed of refuse containers of large capacity located at accessible sites of community and where generation assumed.

In order to manage the growing volume of wastes collected in various ways proper policies need to be performed and implemented. For instance in the developed world the approach to waste management regarded as the most compatible with the environment and sustainable development. Environmentally sustainable approach of solid waste handling reduces pollution, seeks to maximize recovery of reusable and recyclable materials and protect human health and the environment. Integrated waste management aims to socially desirable, economically visible and environmentally sound approach in the process of waste handling (Medina, 2004).

2.6.1 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 into a storage pit or to a large platform. While in direct discharge station, each refuse truck empties directly into 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.

2.6.2 Waste Disposal

This is a 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, et al., 1993). “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).

2.6.2 Economically and environmentally sustainable Municipal Solid Waste Management Approaches

Environmentally sustainable approach of solid waste management has the following structure:

Waste prevention: this is a preventive action that seeks to reduce the amount of waste that individuals and other organizations generate. By not creating waste fewer collection vehicles, and fewer number of refuse collectors would be needed; smaller waste handling facilities would

be required and ultimately it would extend the life of the land fill (Tchobonoglous, 2002, Medina, 2004; SKAT, 2005)

Reuse: 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 into something else” (Cunningham,2008).

Recycling: 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 into 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 into the same material for example, newspapers recycled to make newsprint. In secondary recycling, waste materials are made into different products that may or may not be recyclable for instance, cardboard from waste newspapers” (Miller, 2007).

Composing: it is the process of decomposition of organic waste material considering the high proportion of organic matter in waste generated composting can be an option to reduce the amount of wastes that are land filled. Composting is usually applied to solid or semi-solid materials and can be carried out under either aerobic or anaerobic conditions. When composting is conducted under controlled condition, it reduces the cost of waste disposal does not produce odor produce a clean and readily marketable finished product. Composting also increases nutrients by returning them back to the soil (Martin, 2004; Zurburg; 2002).

Landfill: - landfill is a method of solid waste disposal that functions without creating a nuisance or hazard to public health or safety. Engineering principles are used to confine the waste to the smallest practical area and volume, and cover it with a layer of compacted soil at the end of each day of operation, or more frequently if necessary. This covering of the waste makes the sanitary landfill “Sanitary”. The compacted layer effectively denies continued access to the waste by insects, rodents, and other animals. It also isolates the refuse from the air, thus minimizing the amount of surface water entering into and gas escaping from wastes. Land filling is necessary

for municipal solid waste disposal but every landfill has its own finite capacity. The most common approach to extending the life of landfills is to introduce recycling, composting, and incineration into the solid waste disposal system (Chang and Nishat, 2005).

Incineration: Incineration refers to the controlled burning of wastes at a high temperature, sterilizers and stabilizes the waste in addition to reducing its volume, and may be used as disposal option or means when land filling is not possible and the waste composition is highly combustible. Incineration (mass burning with a Temperature of 900-1000⁰c) is the term used for the combustion of solid wastes. In properly designed and operated incinerator, there is a substantial reduction in the volume of waste material. Thus, equipment for reducing the size of irregular objects is normally a prerequisite at most incinerator plants (World Bank, 1999).

2.7 THE IMPACT OF SOLID WASTE ON HUMAN HEALTH

Serious public health problems arise due to uncollected solid waste and waste often leading to many infectious diseases including water borne diseases such as cholera and dysentery. Such incidence of diseases puts additional burden on the scanty health services available in resource poor developing countries. The U.S. Public Health Service identified 22 human diseases that are linked to improper solid waste management (Hanks, 1967 in Hoornweg et al., 1999). The most immediate health threat due to solid waste in developing countries is to the waste workers, rag pickers and scavengers. Waste workers and rag pickers in developing countries are seldom protected from direct contact and injury. The co-disposal of hazardous and medical wastes with municipal wastes pose serious health threat. Exhaust fumes from waste collection vehicles, dust stemming from disposal practices, and open burning of waste also contribute to overall health problems (Hoornweg, et al,1999).

The magnitude of the health problems due to solid waste in case of developing countries are particularly alarming where the proper collection and disposal of solid waste is impeded by paucity of funds and technological capacity. The areas, which are not serviced, are left with clogged sewers and litters which create serious health problems for the resident population (Khawas, 2003). Crowding and unsanitary conditions are important amplifiers of the transmission of infectious diseases. Many infectious diseases thrive where there is a lack of

water, and inadequate drainage, sanitation and solid waste removal (Mcmichael, 2002). Chang et al. (2001) recognized seven different ways, through which pollutants can transport back to affect human health.

- Waste → soil → human.
- Waste → soil → plant → human.
- Waste → soil → plant → animal → human.
- Waste → soil → atmosphere → human.
- Waste → soil → surface runoff → surface water → human. Waste → soil → vadosezone → groundwater → human.
- Waste → soil → animal → human, waste → soil → airborne particulate → human

Hence, improper handling waste will eventually move back into the system and cause further harm to human health through the biomagnifications of toxins.

2.8 ENVIRONMENTAL PROBLEMS

The impacts of solid waste on environment is immense, from release of harmful greenhouse gases (GHGs) to contamination of ground water. Improper solid waste can cause havoc on the environmental health. The most serious environmental problem in terms of solid wastes is the emission of GHGs. The waste management sector represents 4% of total anthropogenic GHG emissions and landfills contribute the largest anthropogenic source of methane, contributing 90% to the total GHGs release from the waste sector in the United States (Thorneloe, et al; 2002). Methane is a primary constituent of landfill gas (LFG) and a potent greenhouse gas when released to the atmosphere.

LFG is created as a natural byproduct of decomposing organic matter, such as food and paper disposed of in these landfills and it consists of about 35-50 % methane and 35-50 % carbon dioxide, and a trace amount of non-methane organic compounds. Each day millions of tons of municipal solid waste are disposed of in sanitary landfills and dump sites around the world. According to Methane to Markets Partnership (2004); “globally, landfills are the third largest anthropogenic (human influenced) emission source, accounting for about 13 percent of global methane emissions or over 223 million metric tons of carbon equivalent” (MMTCE). The status of solid waste management system thus considerably influences the problems associated with

climate change and global warming. Figure 2.1 identifies some of the countries with significant methane emissions from landfills.

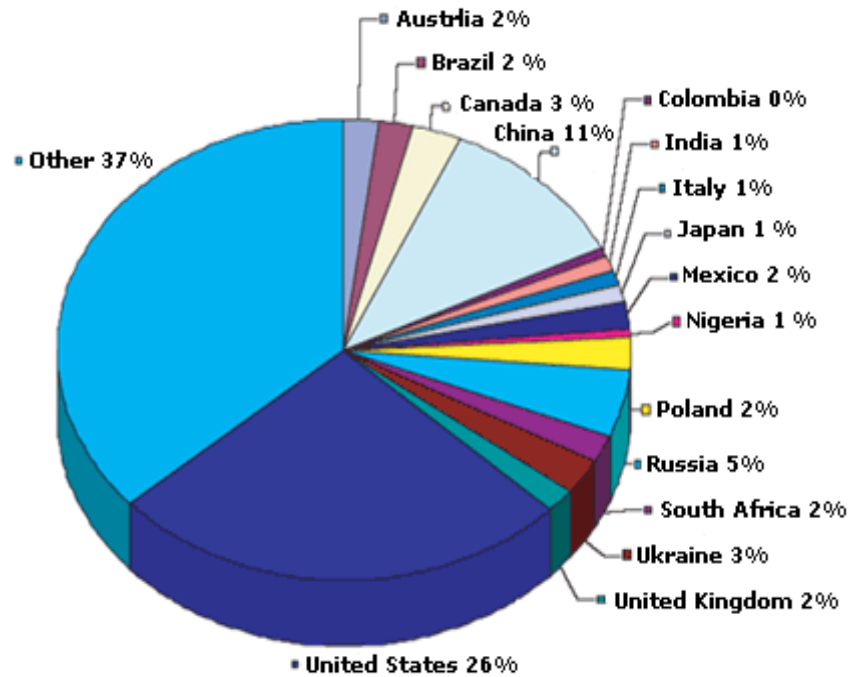


Figure 2.1 Global landfill methane emissions in 2000 (MMTCE).

Source: Methane to Markets Partnership (2004).

It is to be noted that global landfill methane emissions are more prevalent in developed countries as compared to the developing countries. Further, it has been observed that the major factors driving landfill gas emission levels are the amount of organic material deposited in landfills, the type of land filling practices, and the extent of anaerobic decomposition (Jokel, et al. 2002). The higher the organic content, the higher is the level of methane emission; considering the fact that the wastes generated in developing nations have high organic content, the potential for environmental damage is immense. Although methane can be trapped and used as alternative energy source (Jokela, et al. 2002), the lack of technology and finance impedes the trapping of methane in the developing nations.

Besides the emission of GHGs, solid waste cause ground and surface water contamination; as water filters through any material, chemicals in the material may dissolve in the water, this process is called leaching and the resulting mixture is called leachate (McMichael, 2002). As water percolates through solid waste, it makes a leachate that consists of decomposing organic

matter combined with iron, mercury, lead, zinc, and other metals from rusting cans, discarded batteries and appliances. It may also contain insecticides, cleaning fluids, paints, pesticides, newspaper inks, and other chemicals. Contaminated water can have a serious impact on all living creatures, including humans, and the ecosystem as a whole.

Generally in developing countries, dump sites are managed by indiscriminately burning the wastes. Burning causes heavy metals like lead, toxic gases and smoke to spread over residential areas. The wind also carries waste, dust and gases caused by decomposition. Air pollution due to burning of waste and spreading of toxic fumes causes large number of damage to both environment and human health (Medina, 2002). Putrefaction of waste in sunlight during daytime results in bad smells and reduced visibility and it ruins the ambience of the place.

2.9 INSTITUTIONAL PROBLEMS

The most serious impediment for a sustainable solid waste management is that, there is a wide range of individuals, groups and organizations that are involved with waste as service users, service providers, intermediaries and/or regulators (Zerbock, 2003). The interests, agendas and roles of these actors form a complicated web, which defines and designs the prevalent waste management system in any developing nation (Sudhir, et al. 1997). Collection and disposal of refuse within an urban area has been traditionally perceived as the responsibility of the local municipal government (formal public sector). However, in a developing country scenario the provision of waste management system by the local government is generally inadequate, centralized, top-down and in most cases inefficient (Cointreau, 1982). Following which, many developing nations have a dynamic informal sector that has evolved around wastes, which supports the livelihood of a large number of the urban poor. The most common occupations are informal refuse collection and scavenging, which are undertaken by unemployed, women, children, recent migrants, etc. for their sustenance and livelihood (Median 2002). The informal sector consists of many “actors” such as waste-pickers, itinerant-buyers, small scrap dealers, and wholesalers. In India, the informal sector is attributed with recycling about 10– 15% of the solid waste generated in the cities (Sudhir, et al 1997). Though a formal private sector (private companies dealing with all aspects of waste management) is emerging

strongly in many developing countries, however, it is yet to be an alternative to the current formal public sector. In many cases it has been seen that private sectors are generally motivated by the idea of profit maximization; the poorer section of the society in many developing countries lack the financial resources to subscribe to the services provided by private waste management companies (Sudhir, et al.1997). The interactions between these formal and informal sectors design the existing waste management system in most of the developing countries.

2.10 DETERMINANTS OF MUNICIPAL SOLID WASTE MANAGEMENT

Globally, the per capita amount of MSW generated on daily basis varied based on many factors. Population distribution, mobility, age structure, rate of growth, and other factors affect the environment. These factors affect resource utilization, where, when, how and what extent solid waste to be handled and conserve the environment. Changes in population size results in a change in the amount and composition in solid waste which ultimately affect the system of solid waste handling. Many cities are facing disposal crises as population growth simultaneously produces more solid and use the available land for dumping.

The inefficient status of SWH in every country may lead to a potential pollution of the environment, water, air and even agricultural products. Parallel to this point (Berry, 1997) points out that there are three SW problems, those of generation, proper handling and disposal of which potential pollution by solid waste is by images what would accumulate. If collection system were not operating in many cities today this is the handling problem due to industrialization and urbanization (Berry, 1997). One can think from this saying that in the case of Sabata, there will be obvious problem due to uncollected solid waste in the town.

2.10.1 Income and solid waste management

The services of collection, transfer and disposal of solid waste in the urban area of developing countries are either sparse or ineffective and/or the wastes are often improperly disposed. Available studies on this notes that about 30 percent to 50 percent of solid waste produced in

urban areas in the lower income as well as poorest parts of middle income countries is estimated to be left uncollected. The same sources indicate that it is less than 30 percent of the urban population have access to proper and regular garbage disposal and estimated less than 20 percent of the waste produced in developing countries is treated (Rushbrook, 1999; Zerbock, 2003).

Income is the major factor, which determines the magnitude of solid waste management at large and solid waste handling in particular. The level of economic is an important determinant of the volume and composition of wastes generated by residential and at the same time the effective demand for waste management service. The willingness and ability to pay for a particular level of service is also influenced by income level of the residents of the country (Kumar, 2002).

There is a positive relationship between community's income and the amount of solid waste generated and capacity to remove (Medina, 2004). Economic development plays a key role in SWM. Obviously an enhanced economy enable the community to allocate more for the removal of solid waste, provide a more sustainable financial base.

2.10.2 Household Educational level and solid Waste handling

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 municipal solid waste management service in developing countries (Zurbrug, 2003).

People's attitude influences not only the characteristics of waste generation, but also the effective demand for waste collection service. People's attitude towards waste may positively affect their interest and willingness to pay for collection service (UNDP, 1996). In addition, through awareness campaigns and educational measures attitude may be positively influenced and in

turn it can change the negative impact of inadequate waste handling with regard to public health and environmental conditions.

Therefore, awareness campaigns should be coordinated with improvements in waste collection, reuse, recycle, composting and other integrated approach. Whether adopted handling systems are similar or not, peoples waste handling patterns are influenced by their neighbors yield significant environmental impacts if most households in an area participate in the improvement. Thus, besides general awareness campaigns improved local waste management depends up on the availability of practical option for waste handling and a consensus among neighbors (Berry, 1997).

Solid waste handling by the community is a function people's attitude and thus the reflection by their socio- economic characteristics. The activities of the society towards solid waste and their and patterns of material use and SWH, interest in solid waste reduction and minimization degree to which they refrain from indiscriminate dumping and littering (SKAT,2005).

Therefore, attitude towards solid waste may be positively influenced by public information and awareness measures. At the same time improved SWH patterns can't be maintained in the absence of knowledge. However, even practical knowledge is maintained, some individuals either due to negligence or dissatisfaction of the existing service delivery system in a town may take opposite action towards solid waste handling. To conclude, in this literature review it is assessed that solid waste generated in developing countries differs from that of developed countries, in respect to amount, composition, moisture content and density. As a result its handling approaches varied according to nature and characteristics of the waste; moreover, influencing factors of SWH such as income, household size, educational level and distance of CWB from houses have a significant negative or positive impact on solid waste handling.

2.11 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 other 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 Kassa, 2010). 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 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 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 Tegegne,2006)

2.12 Conceptual Framework for Analysis

Based on the above review of related literature, the following conceptual framework (Figure 2.2) was developed for the purpose of analysis. As stated above, municipal solid wastes are generated from different sources such as from industries, institutions, commercials, households and the like. This particular study was emphasized on municipal solid waste management system at Sabata town. All in all, the main focus and scope or boundary of this study is summarized on the following conceptual framework.

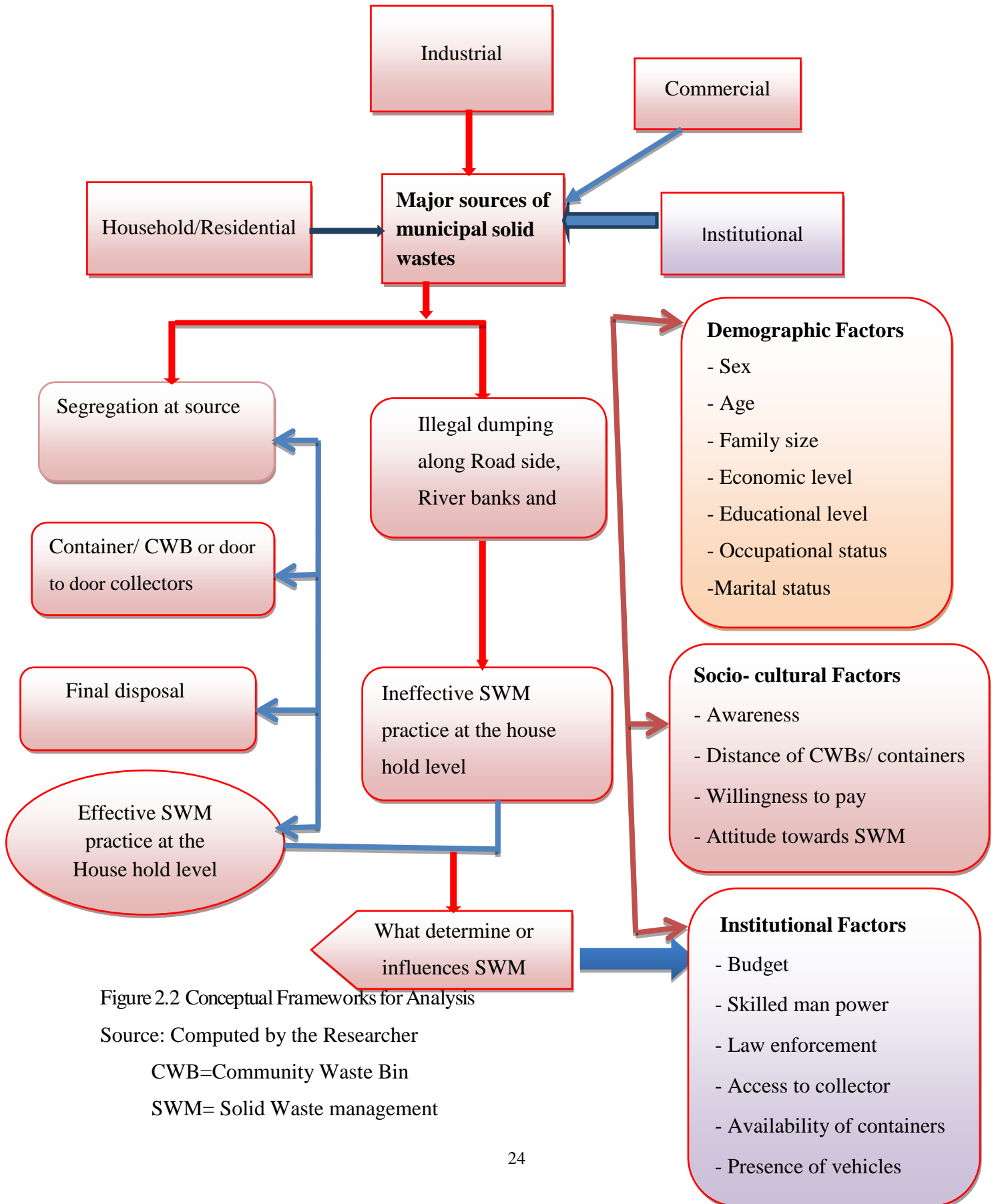


Figure 2.2 Conceptual Frameworks for Analysis

Source: Computed by the Researcher

CWB=Community Waste Bin

SWM= Solid Waste management

3. RESEARCH METHODOLOGY

3.1 Location of the Study Site

With regard to relative location, Sabata shares common boundaries with Addis Ababa in North, North East and East, Burayu town in the North, and rural villages of Sabata Awas district to the South and West. The total area that is covered by the current topographic map of the town is estimated to be 7.41 sq Km (CSA, 2010). The present Sabata town consists of eight major *Kebeles* including Sabata (01), Alemgana (02), Walate (03), Furi (04), Dima (05), Dalati (06), Roge Atebela (07) and Gara Bolo (08) (SFEDO,2016).

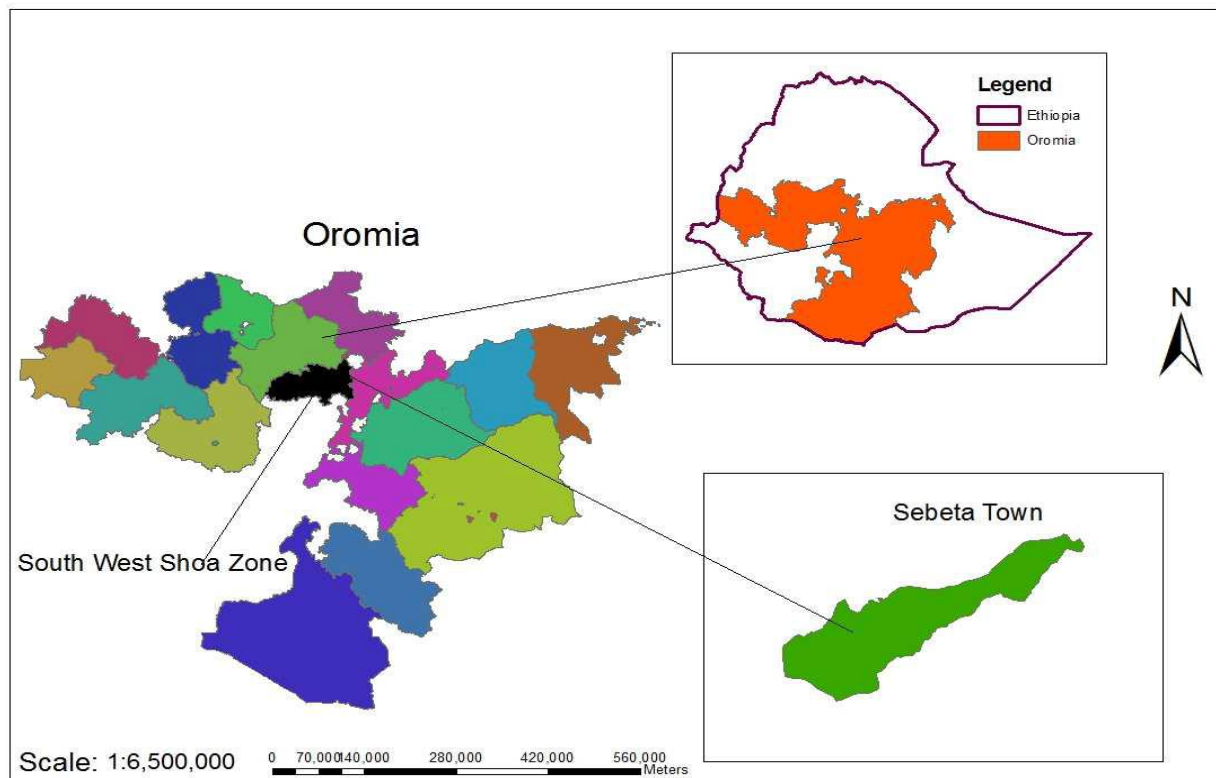


Figure 3.1 Local map of the study Area

3.2 Topography and climatic condition

Sabata town has favorable and highly moderated climatic condition. It has an altitudinal range of 2060 to 2670 meters above mean sea level. The Northern part of the town is characterized by

mountain ranges land form having an altitude lying between 2600 to 2670 meters above mean sea level. However, the southern part of the town lies between 2060 to 2120 meters above mean sea level, showing that it is the lowest elevated part. As a result of this, vast area of Sabata is considered as flat and intermediate plateau that are highly recommended for expansion. Climatically, the town is classified within temperate (locally named Badda daree/ Weyna dega) zone that has the same general climatologically characteristics as that of Addis Ababa. The majority of rainfall in the area is obtained during the Ethiopian Summer time (Ganna/Kiremet) i.e. June, July, August and September which covers 76.4% of the total annual rain fall. The minimum rain fall records are in the months of December, January, and February with other short rain during March and April. The average annual rain fall varies between 783.6 to 1422.7mm. The temperatures of Sabata area lay in the temperate (Badda daree/ Weyna dega) climatic zone with a temperature range of 12.7⁰c to 24.4⁰c.

3.3 Background features of the study population and demographic characteristics

The population and housing census of CSA of 2007 estimated the total population of Sabata town to be 49,331 with male 24,356 and Female 24,975. On the other hand according to the projection of population made from the 2007 census by Oromia Finance and Economic Development Bureau, the total population of Sabata town in the year 2013 was 137,411. The high population growth is due to different pull and push factor. According to information from Sabata office of Finance and Economic Development, the high population growth of the city is mainly due to the following reason: Reclassification of rural neighborhood previously administered under surrounding Woreda Sabata Hawas as part of the city and migration as a result of huge investment in the town that creates job opportunities for migrants and town residents in addition to natural growth rate. This high population growth has implication for infrastructure development.

According to the municipality annual report, currently the municipality solid waste collection and transfer is conducted by two skip loader tracks, 25 containers, (8m³), about 10 carts and 2 tractors. The skips were serving for 8 *Kebeles*. But the regularity of the skips differs according to population density and waste generation rate. Solid waste collected by the municipal skip loaders

openly dumped at Daleti, Southern part of the town near the right side of the road to Butajira. The dumpsite was located at 2.5km from the Daleti *Kebele*.

3.4 Socio economic characteristics of the town

Sabata town is a home for almost all Nations and Nationalities in the country, and the Oromo ethnic groups are the majority as a whole. Most of the residents of the town engaged in different trade activities and others were employed in different governmental organizations and factories. Agriculture is also another economic activity in the peri-urban area of the town. In contrary to this, there are unplanned, congested and dirty housing conditions, which present physical and psychological discomforts to their inhabitants (Sabata Town report, 2015).

3.5 RESEARCH DESIGN

3.5.1 Sources of Data

The data were collected from both from primary and secondary sources. The primary data were collected from household respondents, field observation, focus group discussion and key informants. Secondary data were also another important source of information for the study. The secondary data for this research were gathered from related published and unpublished materials, books, journals, manuals, various research papers and government publications which were found in the library, website and report from the environmental protection and health station.

3.5.2 Sampling Technique

For this study, purposive sampling and stratified random sampling were taken from households from residential areas in three selected *Kebeles* (the smallest administrative unit) based on geographical location, population density and availability of different infrastructures. The kebeles were; 01 *Kebele* from the commercial center, 02 *Kebele* from residential areas of the town and 07 *Kebele* from the periphery (rural *Kebele* of the town)

For the purpose of the survey, from lists of households of the selected *Kebeles* systematic samplings were used to select respondents. There are 11,651 households resided in these three

selected *Kebeles* of the town according to office of finance and economic development of town. Hence, by dividing total household population of selected for sample size $(11,651/167) = 69.76$. Therefore, 69 is k and the first household was selected based on simple random sample and fall on the 10th household. Therefore, the rest households were selected by adding k which is 69 on the consecutive households from the lists of households from the three *Kebeles* which are 69, 79, 89 and etc.

3.5.3 Determination of Sample Size

To make the sample representativeness and data quality, reasonable number of representatives as a sample from the total population has been taken. The target populations of the study area *Kebeles* were relatively ancient *Kebeles*, which has different industries such as textiles and food, institutions/stakeholders. The residents of these *Kebeles* could give intended information about this solid waste management in the city administration.

Based on the data obtained from Sabata town Finance and Economic Development office; the household of the three *Kebeles* by the year 2013 was 11,651 (keble 01=5396, *Kebele* 02=3555 and *Kebele* 07=2700). These were the target populations of the study. For the population greater than or equal to 10,000; Kothari (2004) developed an equation to yield a representative sample for proportions. Therefore, the following statistical sample size decision formula to a population size (N) that is greater than or equal to 10,000 was used. The sample size was determined by using the following formula (Kothari, 2004).

If N is greater than 10,000 ($N > 10,000$) using the formula of:

$$n = \frac{Z^2 pq}{d^2}$$

Where, n= Desired sample size

N= Population size

Z = the standard normal variable at the required confidence level or Z statistics (93%)

P= Estimated characteristics of target population

q = 1 - p, non-estimated characteristics of the target population

d = Level of statistical significance or margin of error (7%)

The researcher used the above formula to get the desired sample size (n) when $N > 10,000$ with 93% confidence level, if there is no estimated characteristic of target population, 50% used then, $P = 0.5$ and $q = 1 - p = 0.5$. And the Z statistics is 1.81 (93% confidence level) and the desired accuracy at the 0.07 level of significance. Therefore, based on the above explanation the sample size is computed as follow:

$$n = \frac{(1.81)^2 (0.5)^2}{(0.07)^2} = 167$$

3.6 METHODS OF DATA COLLECTION

3.6.1 Data Collection procedure and Instruments

3.6.1.4.1 Questionnaires

The main instrument used for data collection was a structured questionnaire designed to address specific objectives of the study. Pre-test of the questionnaire was conducted prior to household survey. The pre-test was done in the three *Kebeles* with similar conditions to the study area. The purpose of pre-testing was to check the validity of the instrument. Based on the results of the pre-testing, the questionnaire was adjusted accordingly. Open and closed ended questions were included in the household questionnaire. Data were collected from 167 respondents as representatives of the residents in the study area (Appendix 1).

To collect data on municipal solid waste management system, questionnaires were distributed to the 167 randomly selected households in the three *Kebeles* of the town (Appendix 1). Regarding to educational background, from 167 respondents 17 respondents have filled the questionnaires with the help of the enumerators or research assistance. In addition to this, relevant information were collected from different stakeholders selected from municipality, health offices, environmental offices, *Kebele* administrators and sanitary committee through Key informant interview and focus group discussion (FGD).

3.6.1.2 Field Observation

The observation method was the most commonly used technique in collecting primary data. The main advantage of this method is that subjective bias was eliminated and the information obtained under this method related to what is currently happening; it was not complicated by either the past behavior or future intentions (Kothari, 2004). Thus, this technique was employed for understanding 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 'hotspot' waste dumping sites, and illegal SWM community/HH practices across the town.

3.6.1.3 Focus Group Discussion

Focus group discussions were conducted after carrying out individual interviews. Groups of ten members (five male groups and five female groups) for each stakeholder based on gender and age were used. The purpose was to obtain more clarification and details of the collected data from the respondents. A checklist (Appendix 4) was used to guide the discussions as per specific objectives.

Table: 3.1 Interviewer and FGD respondents

Key informant interview			
No	Organization	Role	Number
1	Sanitation and beatification core process owner	Process owner	1
2	Sanitation and beatification core process owner	Sanitation team leader	1
3	Environmental office	Office head	1
4	Environmental office	Monitoring and evaluator of SWM	1
5	Health office	Communicable disease control expert	1
Total			5
FGD			

No	Organization	Role	Number
1	Sanitation and beatification core process owner	Sanitation and beatification designer	2
2	Sanitation and beatification core process owner	Sanitation experts	2
3	Environmental office	Awareness creation expert	1
4	Environmental office	Environmental prolusion control expert	1
5	Micro and Small Enterprise	Members	2
6	Municipality	Solid waste collectors team leader	2
Total			10

3.6.1.4 Key informant Interview

Five key informant interviewers were conducted for gathering information from the sanitation and beatification core process owner, environmental office and health office. Interview schedule was selected because of its advantages like chance of obtaining in depth data related to the problems.

3.7 METHOD OF DATA ANALYSIS

The collected data was processed, analyzed and interpreted in both qualitative and quantitative methods. In the qualitative method, the existing situation of the problem was organized, summarized and explained thematically for the comparison and analysis of attributes. The quantitative data was analyzed and interpreted by using different statistical techniques like descriptive statistics ((frequencies, percentages, means, graphs, charts, etc.). Finally conclusion and recommendation was formulated based on the finding.

4. RESULTS AND DISCUSSION

4.1 Socio-economic and Demographic Characteristics of Sample Households

4.1.1 Sex of the respondents

Figure 4.1 showed that out of the total 167 respondents 78 (46.7 %) were males while 89 (53.3%) were females. It is established that sex of households has an influence on the process of municipal solid waste management in that most of the time females were engaged in the residential waste collection and disposal.

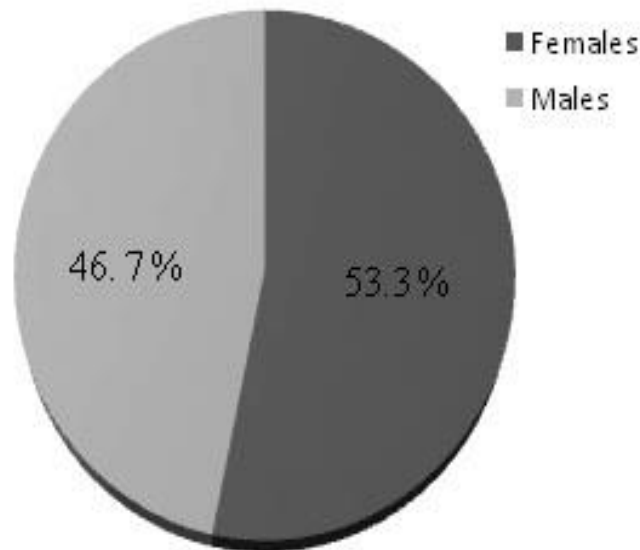


Figure 4.1 Distribution of respondents by sex

4.1.2 Age category of the respondents

Age is an important demographic variable and is a primary basis of demographic classification in vital statistics, censuses and surveys (URT, 2005c). Table 4.1 showed the different age groups that participated in solid waste management ranging from 20 to 70 years and above. Accordingly, about one third (35 %) of respondents were in the age group between 40 – 49 years followed by 24 % in the age group of 30- 39 years and 22 % of the age group of 50-59

years. In general, the age group structure indicates that high proportions of the respondents were found in the age of 40 to 49 years, reproductive age they have even high potential for high population. This indicates most of the age groups were within the active age groups of 20-50.

The results also showed that the mean age of respondents was 46.6 years, indicating that adults contributed more in solid waste management. They were more experienced and had access to new technologies/ ideas (Adesina and Baidu, 2003). This finding was similar to the report that showed the age group of 26 – 57 years is the active and creative labour forces that participate in many social and economic activities (URT, 2005c).

Table 4.1 Age category of respondents

Age category (Years)	Frequency	Percentage
20-29	9	5
30-39	40	24
40-49	59	35
50-59	37	22
60-69	16	10
≥ 70	6	4
Total	167	100.0

Source: Field Survey, 2017

4.1.3 Household size of the respondents

According to the respondents, the household size of the Sabata town was in the range of 1-11 people (Fig 4.2). 26 (15.6 %) of the households had equal or less than two members (≤ 2), whereas 75 (44.9%) contained 3 to 5 members, 45 (26.9%) of the households had 6 to 8 members. Likewise, 19 (11.4%) of the households were characterized with 9 to 11 members and 2 (1.2%) had greater than or equal to 12 household members. This indicates that about 44.9 % of the households were with average size of three to five people which was similar to the average households of the census of the country (CSA, 2007).

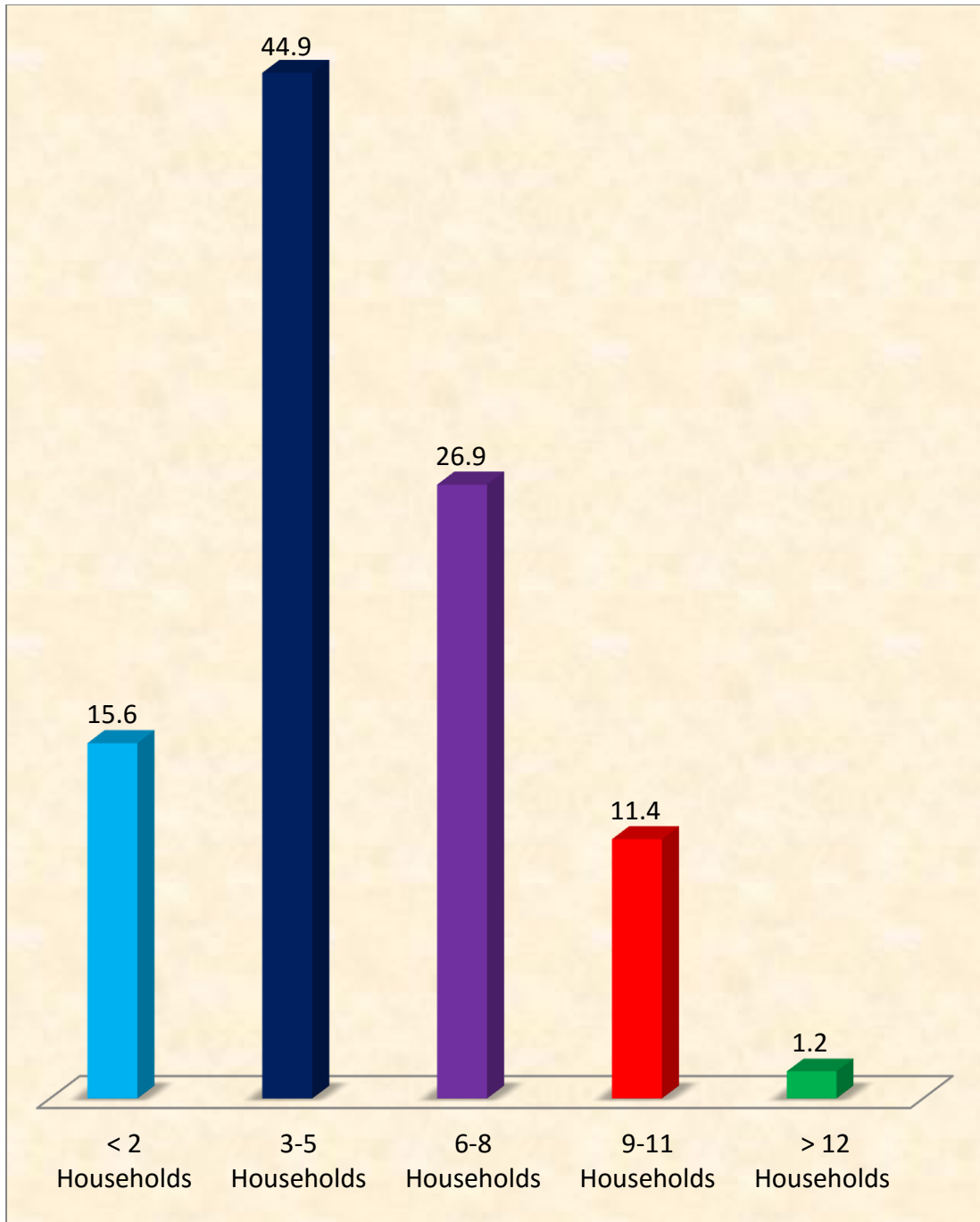


Figure 4.2 Distribution of respondents by household size

Source: Field Survey, 2017

4.1.4. Educational background of the respondents

Education is always valued as a means of deliverance from ignorance and enables one to perform effectively to any given task within a specified period (Kasanga, 2005). Results in figure 4.3 indicated that the majority of the respondents 60 (35.8 %) had attained primary school education whereas 17(10.2 %) of the respondents had no formal education. Those who had certificate and diploma level of education constituted about 32 (19.2 %) and the remaining 33 (19.8 %) had first degree and above, respectively. This suggests that the majority of community members had basic education and therefore likely to adopt new practices and ideas. Most of the respondents in the study were therefore expected to actively participate in solid waste management in their communities.

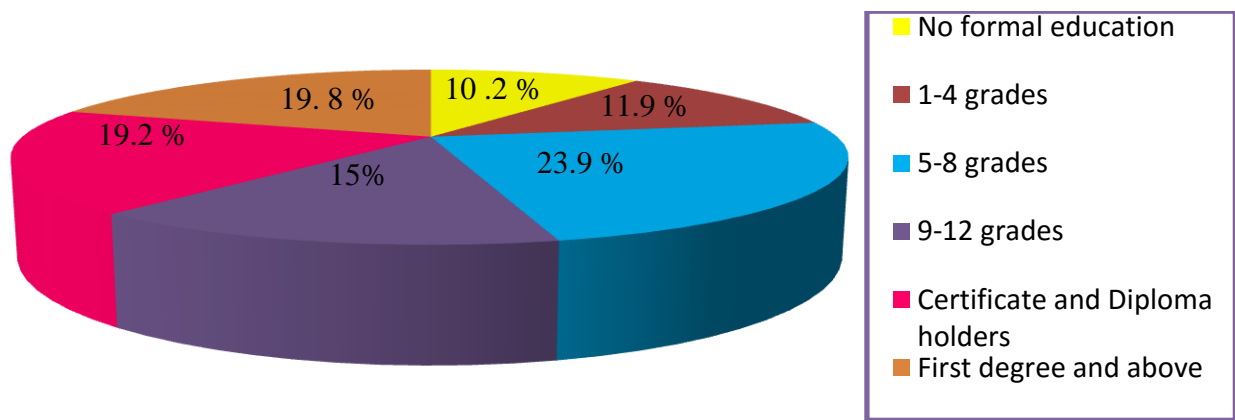


Figure 4.3: Distribution of respondents by level of education

Source: Field survey, 2017

4.1.5. Households occupational status of the respondents

The questionnaire study also showed that household respondents had different occupations. These include trading, farming, civil servants, laborers and others (fig 4.4). Accordingly, out of the total 167 households, the highest number of people 78(47%) were civil servants or government employers and 27(16%) were traders, 24(14%) were farmers and 17(10%) of

respondents were laborers. The remaining 21(13%) of the respondents were engaged on other different economic activities.

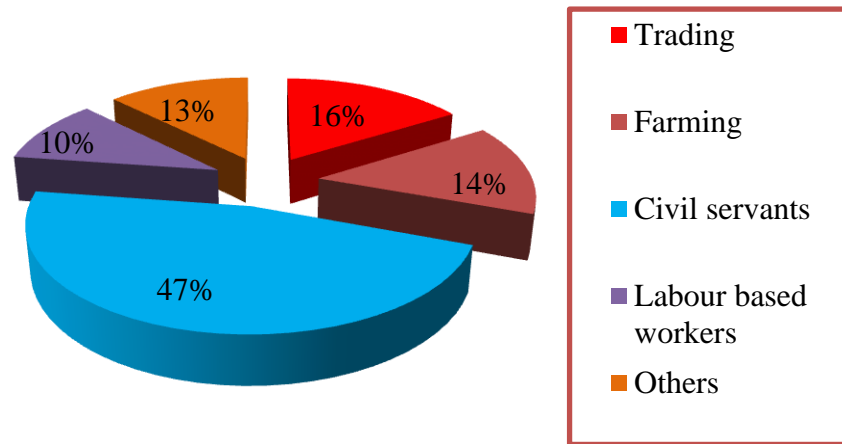


Figure 4.4: Main occupation of respondents

Source: Field Survey, 2017

4.1.6 Marital status of the respondents

The marital status of the household respondents showed that about 61 % of them were married, 17.4 % single, 8.4 % divorced, 7.2 % separated and 6% were widowed (Fig 4.5). Phillip and Abdillahi (2003) reported that married couples showed a high level of participation in community development.

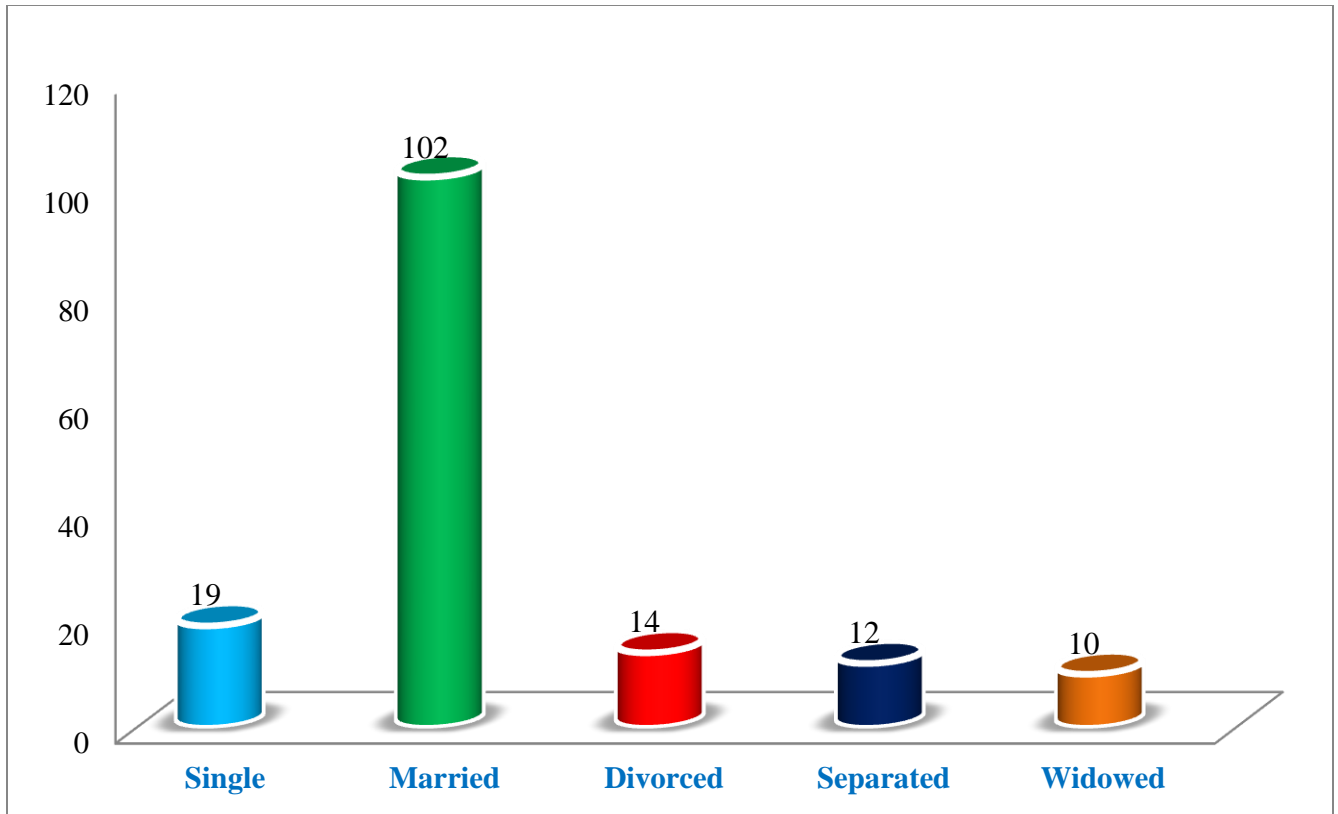


Figure 4.5 Marital status of the house hold

Source: Field survey, 2017

4.1.7 Households average monthly Income

It is well known that annual income of the household had an impact on municipal solid waste management. Table 4.2 shows that majority of the respondents 44(26%) earned between 601-1500 birr per month and 41(24.6%) of them earned between 2001-3000 birr. About 31(18.8%) of the respondents earned 1501-2000. While, 27(16.2%) of them were included under those who earned greater than 3000 birr and 19(11.4%) earned less than 600 birr. The remaining 5(3%) did not disclose their monthly income.

Table 4.2: Average monthly income of the households

No	Household monthly Income(ETB)	Frequency	Percentage
1	Less than 600	19	11.4
2	601 – 1500	44	26
3	1501 – 2000	31	18.8
4	2001 – 3000	41	24.6
5	Greater than 3000	27	16.2
6	Not mentioned	5	3
	Total	167	100

Source: Field Survey, 2017

4.2 Current MSWM of the town and their limitations

4. 2.1. The Current SWM Practices

Based on the data gathered through observation and from secondary sources, the SWM practice setup, i.e., the solid waste collection and disposal operation in the town is shown in Figure 4.6.

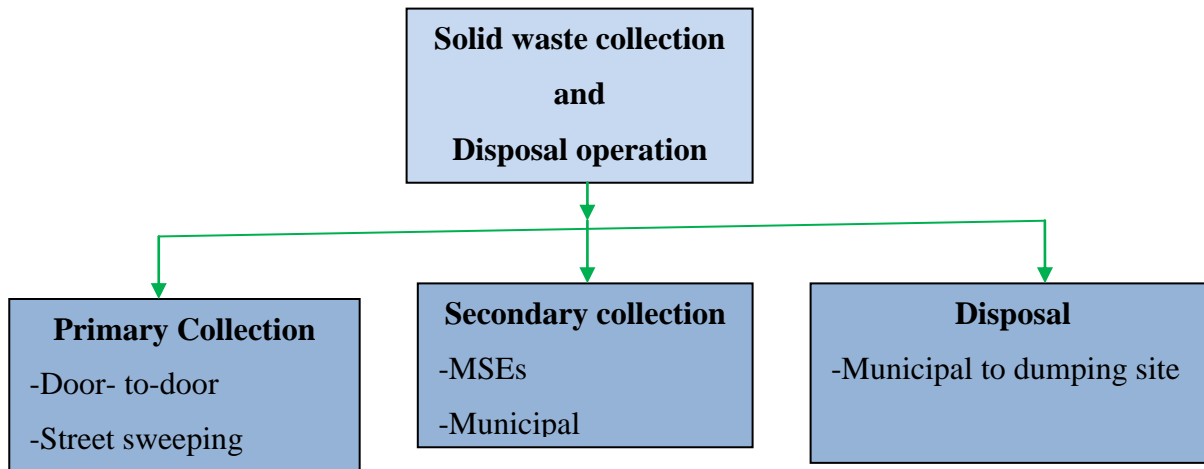


Figure 4.6 Hierarchy of SWM in the town.

According to Figure 4.6, households and other organizations have two options: either disposing waste into a nearby container or having contract agreement with MSEs to dispose it into the container using hand pushed carts. Most households and low income families preferred the first option that did not incur cost on them. Some middle and high-income households preferred the second option. In some cases the municipality provides street sweeping services once in a day for a total of 18kms. The mode of the service is provided by MSEs using facilities such as straw brooms, wheel barrow and shovel.

4.2.2 MSW generation and Composition

Table 4.3 indicates the major compositions of domestic solid wastes from the studied households. As can be seen from the Table, organic wastes constitute 60.20 % of the total household wastes by weight. Paper waste is being generated from 13.5 % of the surveyed households. Studies also showed that large portion of solid wastes of developing countries is organic wastes (Tchobanoglous et al., 1993). For example, organic waste accounts 59.17 % by weight of the total wastes in Arada Sub-city, Addis Ababa (Yitayal, 2005), 36% in Makurdi-Nigeria, (Sha’Ato et al., 2006), 40.7% in Guadalajara, Mexico (Perez et al., 2001).

Table 4.3 Instant Survey waste composition of Sabata town

No	Waste composition	% by Weight
1	Organic or vegetables	60.20
2	Paper	13.50
3	Glass, ceramic, textiles and others	12.40
4	Plastics	6.40
5	Metals	5.40
6	Inert materials (e.g. Ash, sand, soil)	2.10

Source: Sabata Municipality report, 2016

Solid waste handling

Most of the solid waste at the study area was not collected properly because of lack of proper management. Most of the respondents indicated the problems of waste collection and storage before disposal. Table 4.4 shows how the respondents handle household solid waste.

Table 4.4 How to handle household Solid Waste

No	How to dispose household solid	Frequency	Percent
1	Burning inside compound	45	27
2	Burying inside compound	12	7.2
3	Spreading inside compound	3	1.8
4	On open fields and road sides nearby	23	13.8
5	Into river courses or canals	38	22.7
6	Into municipal collection containers	46	27.5
	Total	167	100

Source: Field survey, 2017

According to the table 4.4, 46 (27%) of respondents disposed solid waste into municipal collection container and 45(27%) burned solid waste inside compound. On the other hand, 38(22.7%) respondents disposed solid waste into river course or canals and 23(13.8 %) disposed solid waste into open fields and road sides and 12 (7.2%) disposed by burying inside compound and the remaining 3 (1.8%) spread waste inside compound.



Figure 4.7 waste dumped openly that forms unsightly condition (beside Sabata River and Condominium site)



Figure 4.8 Solid waste dumped in front of resident house

4.2.3 Solid Waste Storage

When requested about the use of temporary storage for solid waste and sorting at the source, almost all respondents responded that they stored their waste in temporary storage. The types of equipment or container used by households to store solid waste in their respective home are listed on figure 4.9. It was observed that majority of the households (55.1%) used sacks (*madaberiya*). This is followed by plastic bags (17.9 %) and local baskets (13.2 %) while others (8.4%) of the respondents claimed to use nothing for solid waste storage. They either dump it in nearby rivers, along road street or open spaces. In general, the equipment used for solid waste storage were of poor quality. These containers were not properly covered as a result they served as good breeding sites for insects and released bad smell.

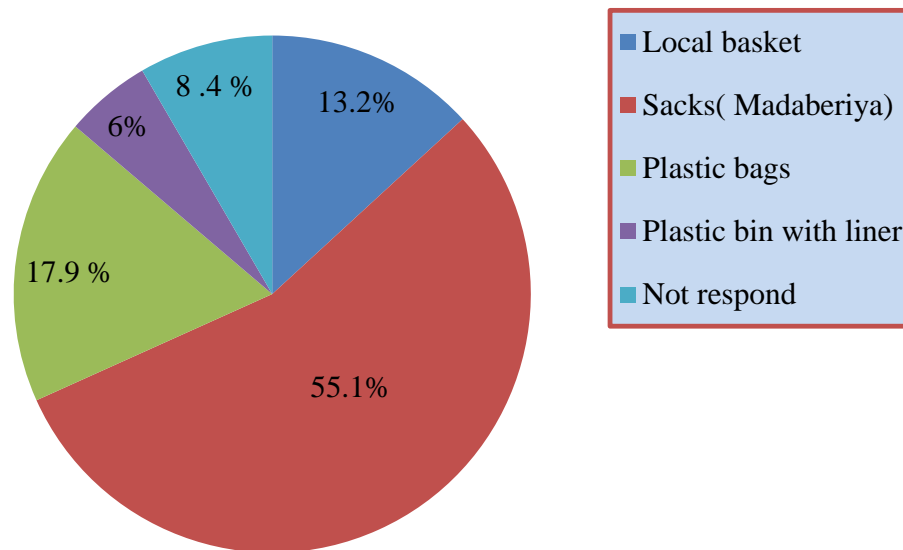


Figure 4.9 Type of solid waste container storages used by HHs at sources of generation

Source: Field Survey, 2017

The length of time solid wastes remained at home in the temporary storage before disposal was also important variable to appraise the solid waste handling system of the residents. Regarding this, the majority of the respondents indicated that their solid wastes could stay at home for about a week to ten days.



Plate 4.1 some examples of solid waste storage materials from residential areas

Source: Field Survey, 2017

Focused group discussion results (Table 4.5) indicated that the residents of the study areas currently generate large volumes of solid waste far beyond the management capabilities of the existing waste management system. These results are consistent with results in Table 4.6 which indicate that the municipality is able to collect and dispose off only 58 tons out of 167 tons per day which is equal to 34.5 %. The rest 109 tons (65.5%) used on site disposal methods, which include open dumping, disposal pits and incineration (Sabata town report, 2016). These findings are consistent with those of Kironde and Yhdego (1995) which indicated that most of the solid waste generated in urban and peri-urban areas is left unattended

According to the annual report of the municipality, solid waste collection and transfer was conducted by two skip loader tracks, 25 containers, ($8m^3$), about 10 carts and 2 tractors. The skips were serving for 8 *Kebeles*. But the regularity of the skips differs according to population density and waste generation rate. Solid waste collected by the municipal skip loaders openly dumped at Daleti, Southern part of the town near the right side of the road to Butajira. The dumpsite was located at 2.5km from the Daleti *Kebele*. Consequently, most parts of urban areas were not easily accessed to refuse trucks, where 60 - 70 % of the urban population lived in the town (Sabata Municipality report, 2016). This means that, the remaining solid waste has to be

managed by other means like disposal pits, and disposal in open spaces. Plate 4.2 show wastes dumped in an open space near residential area.

Table 4.5 Pairwise ranking of major practices of solid waste management in the town

	Collected by municipality	Disposal pits	Open dumping	Incineration	Composting	Scores	Rank
Collected by municipality	X	Collected by municipality	Collected by municipality	Collected by municipality	Collected by municipality	4	1
Disposal pits		X	Open dumping	Disposal pit	Disposal pit	2	3
Open Dumping		X	Open dumping	Open Dumping		3	2
Incineration			X	Incineration		1	4
Composting				X		0	5

Source: Focus group discussions

In general, results from focused group discussion indicated that the majority of residents in the study area perceived that the overall process of solid waste management is a serious problem in Sabata town. Most of the municipal authorities have very low capacities of waste collection and disposal. Recent studies in major urban centres in Africa have shown that the problem of waste management has become serious that has aborted most efforts by city authorities to collect and dispose the generated solid wastes (Onibokun, 1999).



Plate 4.2 Solid wastes dumped in an open space near residential area

In general, Table 4.6 indicated the reasons for insufficient collection and disposal of solid waste in the Town that include; inadequate collection trucks, inadequate budget, and shortage of staff, poor urban planning /infrastructure and lack by-laws enforcement, inadequate collection points and refuse trucks against the increasing urban population and generation of solid waste. This is similar with the study of Onibokun (1999) who observed that, due to rapid urbanization, the population increase inserts the pressure to local authorities on the management of solid wastes.

Table 4.6 Pairwise ranking on major reasons for inefficient collection and disposal of solid waste by municipality

	Inadequate trucks for SW	Shortage of staff	Poor urban planning	Poor infrastructure	Inadequate budget	Score	Rank
Inadequate trucks for SW collection	X	Inadequate trucks for SW collection	Inadequate trucks for SW collection	Poor infrastructure	Inadequate trucks for SW collection	4	1
Shortage of staff		X	Inadequate trucks for SW collection	Poor infrastructure	Inadequate budget	0	5
Poor urban planning			X	Poor urban planning	Inadequate budget	1	4
Poor infrastructure				X	Poor infrastructure	3	2
Inadequate budget					X	2	3

Source: Focused group discussion

4.2.4 Waste Collection Methods

With regard to solid waste collection of the study area, households had two options. The first option was that households themselves took their solid wastes and dropped it into a transfer container nearest to their home. The second option was contract agreement with six micro and small enterprise associations (pre-collectors) (MSE's). From Figure 4.10, it can be seen that most households prefer the first option. This is because of less cost that most households especially low income families preferred.

Few of the low income, most of middle and high income households preferred to use the second option (per-collectors), and this accounted for only 40 (24%). These two options were mostly

available at the centers and main roads; the peripheries disposed their wastes at ditches, river banks and open spaces. But during this study time the truck was in garage so that most of the containers were full. Some *Kebeles* did not have containers at all and some residents did not know where the containers were located. Even in some areas residents were not allowed to dispose their wastes in the containers while it was empty.

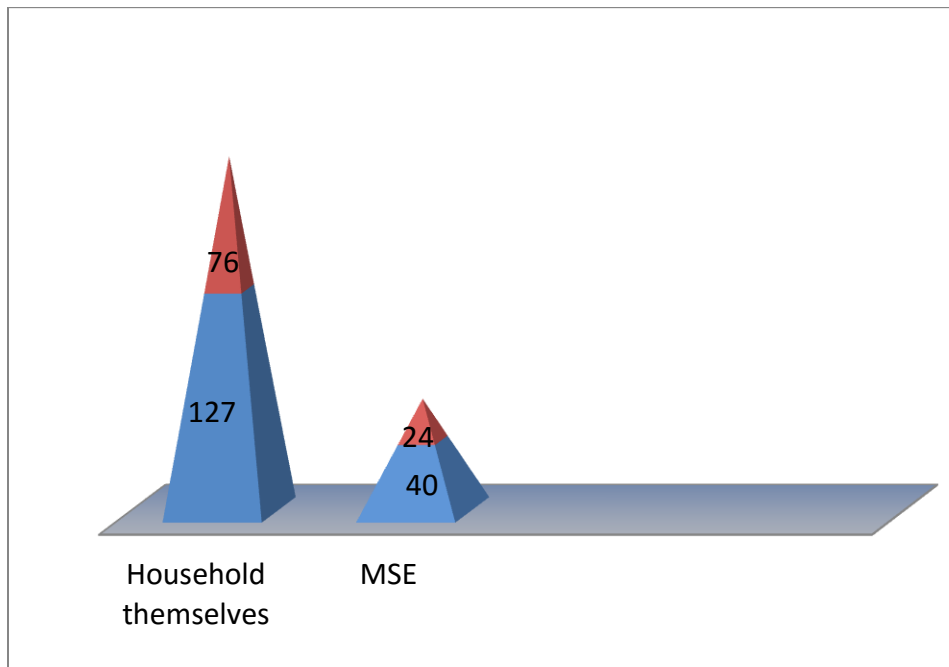


Figure 4.10 Pre-collection practices

Source: Field survey, 2017

The MSEs were small scale enterprises that collect waste door to door in Sabata Town. They had 41 members that collected waste and dumped into municipality's container (Table 4.7)

Table 4.7 Micro and small scale enterprises engaged in waste handling in Sabata Town

No	Name of MSE	Kebele	Number of members		Total
			Male	Female	
1	Abdi Boru	02	3	3	6
2	Sifsin	02	4	0	4
3	Siraj, Rukiya and Friends	08	4	1	5
4	Darara	03	6	2	8
5	Wondimamach	07	10	0	10
6	Mawudad	01	6	2	8
Total			41		

Source: Secondary Data from Sabata Municipality Report, 2016

According to the above data, there was less number of MSE and with low number of workers. When they were interviewed, the MSE members stated that service fee was inadequate to cover the service cost. They added that they collected from house hold 15-20 Birr per month. Due to long distance of transfer station, they said that they could not address the demand of their clients properly.

Moreover, due to lack of standardized solid waste transfer station, all wastes were transported without segregation. According to the team leader of sanitation work, the challenges were, lack of support and supervision, lack of horizontal and vertical integration, sources of solid waste increase from time to time because of low awareness among community and lack of professional man power and logistic were already identified.

4.2.5 Field observation on solid waste management

During field observation the following gaps related to solid waste collection and transportation were noted:

- Lack of fixed collection system like container
- Lack of support for house to house solid waste collection MSE
- Very smaller number of transfer station and skips
- Lack of maintenance of small vehicles (tractors)
- Lack of periodic emptying of skips by the municipality
- Small number skip loaders
- Low number of MSE and with low number of workers
- Insufficient machinery and equipment
- Lack of sanitary supervisors for each *Kebele*
- Solid waste collection does not cover all solid waste generators (low coverage)
- No standard solid waste transfer station
- Service fee is inadequate to cover the service costs
- No routing map for the collection system
- All the waste is transported without segregation



Plate 4. One of the Skip Loader Dumping Solid Waste at Daleti *Kebele* Disposal Site

Source: Field Survey, 2017

4.2.6 Waste Disposal

With regard to waste disposal at transfer station, the study identified that almost all solid waste generated in households was indiscriminately disposed together i.e. there was no habit of sorting organic from inorganic waste at the household level. The result also showed a number of households disposed the waste into a river/ stream, drainage system and any open place. Regarding improper waste disposal at a transfer stations, respondents blamed the rarity of inspection on the waste management condition of the households, loose management action for punishment and lack of accountability of the community members.

Windblown waste was scattered all over the site all the way to the near *Kebeles* and farmlands, while ashes and fine sands were blown in the area. In addition, both human and animal scavengers were observed at the disposal site (Plate 4.4).



Plate 4.4 Dump Site of Sabata Town

Source: Field Observation, 2017

Generally, the following are some of the gaps identified related to the existing solid waste disposal practices of the town:

- ✚ Open field disposal (no sanitary landfill).
- ✚ No restriction for animal entrance to the site
- ✚ The disposal sites are neither demarcated nor fenced.
- ✚ Waste isn't covered with soil.
- ✚ No action for waste reduction at site
- ✚ No action for run-off control.
- ✚ No action for generated gases.
- ✚ Insufficient action for hazardous wastes.
- ✚ No restriction for light waste spreading around

- ✚ Air pollution because of wastes burning
- ✚ Unfavorable odors at site
- ✚ Nuisance and health hazard for people living nearby
- ✚ No consideration for leachate control
- ✚ No action to control of insects, rodents, and other vectors
- ✚ There is no any machinery (compactor or graders) that regularly works at disposal site.



Figure 4.11 Solid waste dumping area near to liquid waste disposal area at Daleti *Kebele*

4.3 Institutional and Social Factors that Influence MSWM in Sabata Town

It is possible to see from the forgoing discussion that municipal solid wastes were poorly managed in the town. The service was clearly inadequate. A very small proportion of the solid wastes generated in the town was properly collected, transported and transferred to the final disposal site. This poor municipal solid waste management in the town was aggravated by poor institutional coordination, financial constraint, the socio cultural factor , lack of awareness, lack of rules and regulation.

4.3.1 Lack of institutional coordination

Poor institutional coordination was another challenge that led to poor solid waste management in Sabata town. As the researcher observed during the interviews with the institutional officials, there was very weak coordination between the municipality officials of the town and other stakeholders involved in the MSWM. According to the information collected from the vice manager of the municipality through key informant interview recently the linkages and coordination was established between the municipal administration, sanitation office, *Kebele* administrators and stakeholders on solid waste management.

4.3.2 Financial constraint

During the interview, municipal solid waste management was given low priority with very limited funds. Therefore, the factors that influencing municipal solid waste management in the town for the ineffective service delivery was the shortage of finance. Lack of financial management and planning, particularly cost accounting depletes limited resources available for the sector is a rampant problem in developing countries (Zurbrugg, 2003; Gebrie Kassa, 2009).

4.3.3 The socio cultural factor

The poor municipal solid waste management that was observed in the town was mainly because of the communities poor practice with respect to solid waste management. The poor practice of the community with respect to solid waste management was manifested mainly in three ways: dumping of solid waste illegally anywhere in the town, improper handling of waste at home, and improper use of community waste containers. Municipal solid wastes were generally poorly treated or handled at home, and this partly aggravated the problem of solid waste management in the town.



Plate 4. 5 Improper SWM practice in the study area

Source: Field survey,2017

4.4.4 Lack of public awareness and attitudes

Public awareness and attitudes to waste can affect the whole municipal solid waste management system. As shown in table 4.8, the majority of the households about (75%) reported that, they did not have any awareness and education concerning solid waste management.

The study also revealed that about 25 % of the respondents said that the involvements of the municipality as well as the community were very low and they were not satisfied with the current waste management system of the town. In addition to this, the respondents also confirmed that except in a few annual anniversary days there was no community mobilization and awareness creation activity done by the concerned body.

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 practice in developing countries (Zurbrugg, 2003).

Table 4.8 Frequency distribution of municipality and households on the involvement of MSWM practices.

No	Is there active participation of the municipality and community in MSWM in your town?	Frequency	Percentage
1	Yes	41	25
2	No	126	75
Total		167	100

Source: Field Survey, 2017

4.4.5 Lack of rules and regulation

The study also showed lack of adequate legislation made it difficult to assign clear mandates to different sectors connected with solid waste management. The rules and regulation and their implementation programme of the town was weak. 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.

5. CONCLUTIONS AND RECOMMENDATIONS

5.1 Conclusion

This study was meant to address municipal solid waste management practices in Sabata town. Accordingly, solid waste management in general and waste handling in particular was very poor, there was a problem of solid waste segregation, collection, reuse, recycling, composting and disposal.

The majority of respondents who lived along the borders of rivers disposed their solid wastes inside drainage channel, on the street and other vacant places. This study also indicated that Sabata town municipal solid waste management practice was very weak in terms of status, spatial coverage and solid waste management facility. Currently, in the town there were a few limited public solid waste storage containers.

The rules and regulations of the town with regard to municipal solid waste collection and disposal were not well known by the community. Mobilization and participation of the community in sanitation process was not well practiced. This was mainly due to low involvement of the town sanitation officials and the municipality itself. There were no awareness raising, training and provision to proper training of households with regard to residential solid waste management methods in the town. This has aggravated the waste management problems and challenges thus leading to public health, aesthetic and ecological concerns.

Income of the household was the first factor influencing municipal solid waste management. Based on the study, the higher the household income, the higher to pay for collection and disposal of solid waste, while the lower per capital income, the lower to pay for disposal of wastes which ultimately forced and lead to improper management of wastes.

Household educational background was the second variable that had a direct influence in the process of municipal solid waste management. Education improves the awareness and knowledge of SWM among residents of the town.

The location of CW storage was also another variable that strongly affected municipal solid waste management. Its association indicated that there was a negative relationship between CW storage location and solid waste management in the town. Therefore, awareness creation programs supported by community waste bin accessibility and allocation of capital enable proper handling of wastes. The study also indicated the major problems aggravating municipal solid waste management in the town which includes: lack of institutional coordination, insufficient and skilled man power, very low financial capacity, weak enforcement of rules and regulations, socio-cultural factors and lack of awareness among the community.

5.2 Recommendations

Based on the findings of the study, the following are recommended for efficient and effective management of solid waste in the study areas.

- Adequate dustbins and skips should be provided by municipality for waste storage.
- Efforts should be directed towards educating and sensitizing community members about their role in SWM activities. This will enhance their participation in SWM matters.
- Emphasis should be targeted to promote sustainable alternative approaches of managing solid waste such as composting and recycling through use of site specific groups.
- There should be regularity of waste collection by the municipality particularly in highly populated areas to avoid heaping of waste and over flowing of skips with solid waste.
- The waste management institutions should be adequately resourced to ensure efficient and effective waste management in the area.

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APPENDICES

Appendix 1

Questionnaire prepared for sample households in Sabata town

This Questionnaire is prepared for an academic purpose for the fulfillment of M.Sc. degree in General Biology. Specifically the objective of the study is to examine the solid waste management practices in Sabata town in order to develop a framework for sustainable solid waste management in future. 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 by selecting (circling) your answer from the given alternative choice or describing your opinion. Please be informed that your response is kept in confidential and you are not required to write your name. I would like to thank you for your cooperation.

Part one: Background information about the respondents characteristics

Instruction: In order to answer the following questions, please put a right sign (√) in the boxes that located in front of your choice.

1. Sex: Male Female
2. What is your age in years?
20-29 50-59
30-39 60-69
40-49 Above 70
3. What is the size of your house hold? Certificate and Diploma
 ≤ 2 9-10
3-5 ≥ 12 Firs
6-8
4. What is your level of education?
No formal education 9-12 grades
1-4 grades Certificate and diploma
5-8 grades First degree and above

5. Households occupational status of the respondents

- Trading
- Farming
- Civil servant
- Labour based workers
- Others

6. Marital status of the respondents

- Single Separated
- Married Widowed
- Divorced

7. Households average monthly income

- Less than 600 2001 – 3000
- 601 – 1500 Greater than 3000
- 1501 – 2000 Not mentioned

8. Kebele

Part two: Questionnaire prepared on existing situation concerning solid waste management in the town (generation, collection, storage, transportation, separation and final disposal)

9. What is the main type of generated solid waste in your household?

- A. Vegetable and food remains
- B. Plastics/bottles/cans
- C. Leaves/grass
- D. Others (Specify)

10. Is the solid waste collected from your house?

- A. Yes
- B. No

11. Does your household have a storage facility for storing household solid waste?

- A. Yes
- B. No

12. What type of solid waste storage material do you use in your house to store solid waste

Produced from your dwelling?

- A. local basket
- B. sacks (madaberiya)
- C. plastic bags
- D. plastic bin with line
- E. Not respond

13. How do you dispose wastes after collection/storage?
- A. Burying inside compound
 - B. Burning inside compound
 - C. Spreading inside compound
 - D. On nearby open fields and road sides
 - E. into river courses or canals
 - F. Into municipal collection containers
14. Do you have a communal collection center/ point in your area?
- A. Yes
 - B. No
15. Are there any by-Laws, rules and regulations which govern community participation in SWM?
- A. Yes
 - B. No

Part three: Community awareness on solid waste management

16. What do you understand by solid waste management?
- A. Collection of solid waste by Local authority
 - B. Incineration
 - C. Dumping wastes in landfill
 - D. Collection of garbage in open places
 - E. Proper collection, recycling and disposal of solid waste
17. Does the municipality provide training, guidelines or awareness on community participation in solid waste management? (Tick one).
- A. Yes.....
 - B. No.....

Part Four: Community as a key stakeholder

18. Do you know that you are among of the key stakeholders in enhancing the success in solid waste management in your community?
- A. Yes, I know.....
 - B. No, I don't know.....
19. If yes in Qn 18 what are your main responsibilities?

20. Are those key stakeholders participating fully particularly in mobilization of community to Participate in solid waste management?
- A. Yes.....
 - B.No.....

Appendix 2

Interview questions prepared for Sanitation and Beautification Department workers of Sabata town

Dear respondent this interview is conducted for an academic purpose for the fulfillment of M.Sc. degree in General Biology. Specifically the objective of the study is to assess municipal solid waste management practices in Sabata 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.

Part one: Background information about the respondents

1. Job title in your department _____.
2. Employment condition
Permanent contract
3. Educational level
No formal education Certificate
1-4 grade complete Diploma
5-8 grades complete First degree
9-10 grades complete Second degree and above
11-12 grades complete
4. Work experience _____
5. Monthly salary _____
6. Family size _____

Part two: structured Questions prepared for investigating MSWM System 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 at regional/ national level?
2. Does your institution give incentives, promotions and salary increment to you?
3. If your answer for question no 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 SB department work with other government and non-government organization in 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 SBDS? Does such arrangement have any problem on the efficient performance of your division?
7. Do you feel your organization has efficient capacity to handle MSWM responsibilities?
8. Do you think the controlling mechanism of municipality is effective? If your answer is "no", what do you think the reasons?
9. Do your collection, transportation and disposal service cover all parts of the town?
If not covered, please specify the major reasons?
10. Are you provided with medical care, safety wares, and other materials that are necessary to keep your health?
11. Do you think residents of Sabata have clear and adequate awareness about solid waste management systems?
12. What do you think should be done to improve the situation of MSWM of the town in general?

Appendix 3

Interview questions prepared for head of SB Department of Sabata town

Dear respondent this interview is conducted for an academic purpose for the fulfillment of M.Sc. degree in Biology. Specifically the objective of the study is to assess municipal solid waste management practices in Sabata 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.

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 Sabata town?
5. Does Sabata 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. 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.
7. Briefly discuss Polices, Strategic plans, and its Implementation and monitoring mechanisms that have been proposed by your department for efficient practice of municipal solid waste management in Sabata town.
8. Does your department collect charge from the residents of the town for its municipal solid Waste management service delivery?
9. Do you think that there is inadequacy of man power in your organization? If there is, what do you think the reason behind this?
10. 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.
11. 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.

I would like to thank you for your cooperation

Appendix 4

Leading Questions for Focus Group Discussions for house hold head

1. Are you aware about the concept of Municipal solid waste management?
2. How do you see the situation of solid waste management practices of the town?
3. Which solid waste management practices commonly used/introduced in the town? Rank them.
4. What are the reasons for inefficient solid waste management services in the town? Rank them
5. What do you think are main problems/limitations in managing solid waste at Household and community level? Rank them
6. Do you have any suggestions to improve the situation of community participation in solid waste management?
7. Please describe how your household handles, collects, stores, transports and disposed of the solid waste from your house.
8. What methods are used in order to solve the solid waste management problems of the town?
9. What do you think about for the municipals of solid waste management practices for the town
10. Can you think of any ways of reducing the amount of solid waste that your household must burn, bury, dump, or leave for the solid waste truck?

Thank you for participating and your concern

Appendix 5

Solid Waste Management Human Resource of the town

<i>No</i>	<i>Description</i>	<i>Education Level</i>	<i>Number</i>	<i>Remark</i>
<i>1</i>	<i>Sanitation and beatification core process owner</i>	<i>MA</i>	<i>1</i>	
<i>2</i>	<i>Sanitation team leader</i>	<i>MSC</i>	<i>1</i>	
<i>3</i>	<i>Sanitation Experts</i>	<i>12 complete to BSC</i>	<i>4</i>	
<i>4</i>	<i>Skip loader driver</i>		<i>2</i>	
<i>5</i>	<i>Assistant Skip loader driver</i>		<i>2</i>	
<i>6</i>	<i>Tractor operator</i>		<i>2</i>	
<i>7</i>	<i>Solid waste collector working on tractor</i>		<i>14</i>	<i>Each tractor has seven collectors</i>
<i>8</i>	<i>Road cleaner</i>		<i>83</i>	
<i>9</i>	<i>MSEs</i>		<i>6</i>	<i>Each MSE has 5-10</i>
Total			115	