Assessing The Current Status Of Solid Waste Management Of Gondar Town, Ethiopia

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Abstract: Ethiopia is facing rapid urbanization leading to overcrowding and the development of slums and informal settlements with poor waste management practices. Urban dwellers generally consume more resources than rural dwellers, and so generate huge quantities of solid wastes. This study is focused on the overall assessment of the existing MSWM service of Gondar town. The overall objective of this study was assessing the current solid waste management service of Gondar town. Both primary and secondary sources were used to achieve the objectives. The analysis of this study was carried out using both qualitative and quantitative techniques. The findings of this study revealed that the present system of MSWM in Gondar town entirely relied on the municipality which provided the full range of waste collection, transportation and disposal service. But, the provision of this service is not kept in pace with the town solid waste generation. Based on the findings of this study, the town households' dominantly produced biodegradable solid wastes with generation rate of 0.21kg/person/day. This made the daily total solid waste generation of households to be 8,140Kg. Together with other four solid waste sources the total daily solid waste generation of the town is about 11660 kg. So that MSWM of the town is found in very low status and spatial coverage. This poor status of MSWM is also intensified by three critical factors i.e poor institutional structure and capacity of Sanitation and beautification, limited participation and contribution of stakeholders and poor households' solid waste management practices. This study concluded that, there should be sustainable solid waste management systems (reuse, recycle, composting, and incineration) through awareness creation and training, improvement of SB institutional structure and capacity, and implementation of integrated MSWM approach which recognizes and comprises all stakeholders in the town.

Keywords: Incineration, Landfill, Municipal, solid waste, solid waste management, Waste, waste disposal

1. INTRODUCTION

Ethiopia is facing rapid urbanization per annum, leading to overcrowding and the development of slums and informal settlements with poor waste management practices. Urban dwellers generally consume more resources than rural dwellers, and so generate large quantities of solid waste and sewage (Tewodros ferede, 2011). Waste management in these areas is hampered by multiple land tenure system with many tenants not having a right to the land and therefore not able to manage waste domestically and also the urban authorities are overwhelmed by the sheer volumes if garbage generated (Frank Flint off, 1976). The consequence is that many towns and periurban settlements, drainage channels and roads are highly littered. Some people especially in crowded high density areas do not have access to garbage disposal skips and while private collectors are too expensive for these poor households hence forced to practice indiscriminately dispose off garbage in drainage channels, road sides and abandoned buildings (WHO, 1999). Littering of food and other solid wastes in medieval towns-the practice of throwing wastes into the unpaved streets, roadways, and vacant land led to the breeding of rats, with of solid wastes thus led to the epidemic of infection and caused many subsequent epidemics with high death tolls (WHO, 1999). As the generation of solid waste increase, the cost of its removal increases too. Solid waste management is not an isolated phenomenon that can be easily compartmentalized and solved with innovative technology or engineering (Cointreau -Levin, Sandra, 2007). It is particularly an urban issue that is closely related, directly or indirectly, to a number of issues such as urban lifestyles, resource consumption patterns, jobs and income levels, and other socio-economic and cultural issues. Given this situation there is need to promote complimentary alternatives such as community initiatives to manage garbage in a sustainable manner in addition to being a potential source of income for the poor. In lower-income countries, as well as poorer parts of middle-income nations such as Ethiopia, an estimated of 30 to 50% solid waste produced in urban areas is left uncollected. Some viral and other infectious diseases are associated with waste and also serve as habitat formation for breeding insects and mosquitoes. The major solid waste management processes start at solid waste production, storage and followed by solid waste collection, transportation and transferring. Over the last few years, many micro and small enterprises have been set up to carry out waste pre-collection service, receiving payment either from the respective beneficiaries or municipalities to collect waste and transport to the municipal waste containers, and helps to fill the created gaps in collecting and transporting wastes. These enterprises represent a good starting point for building private sector participation and realizing the associated benefits. The rapid and constant growth of urban population has led to a dramatic increase in urban waste generation, with a crucial socio-economic and environmental impact. Basically, municipalities are giving preferences only on the collection of the waste and dumping it, while the principle of 3R's (waste reduction, reuse and recycle), are not prioritized by the municipalities for a sustainable solid waste management. Increasing public awareness to the necessity of clean environment for good health, at both local and national governments are facing public pressure to the proper management of the municipal waste (Solomon cheru, 2011). The Federal Democratic Republic of Ethiopia has ratified several international conventions that have meaningful implication to solid waste management in the country (Solomon Cheru, 2010). The solid waste management proclamation (Solid waste management proclamation, 2007) gives emphasis of its essential in community participation in order to prevent the adverse effects and to enhance the benefits resulting from solid wastes. Like the other cities of developing countries, due to the lack of waste management information and implementation of the

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proclamation most of the towns of Ethiopia are suffering from the adverse effects of the plastic materials (Zebenay Kassa, 2010)). Although, Ethiopia ratifies solid waste management on plastic bags, the proclamation doesn't clearly indicate the adverse effects of plastic water bottles after their use.

1.1. Statement of the Problems

Solid waste management has been a big challenge to both the developed and developing countries all over the world. Gondar town is characterized by rapid population growth caused by natural increase and migration from rural area. Such rapid increase in population together with rapid development of the town has produced increasing volumes of solid waste and in turn it induced greater infrastructural demand, institutional setup and community participation for its management. But, the town sanitation and beautification (SB) which runs the solid waste management activities of the town could not fulfill the above requirements. For instance, currently sanitation and beautification (SB) has practice its activity by supplying not using more truck for collection, transportation and disposal of the town solid waste. Most of solid wastes that are generated in the town remain uncollected and simply dumped in open areas, road sides, river courses, gullies. The disposal method that the town used is also open dumping type which widely practiced in many developing countries and has hazardous effect on health and the environment. As a result, municipal solid waste management in Gondar has not been carried out in a sufficient and proper manner. The environmental and sanitary conditions of the town have become more serious from time to time, and people are suffering from living in such conditions. So that critical need of efficient municipal solid waste management (MSWM) on one hand and steady growth of solid waste problem on the other side are still the main features of the town.

1.2. Objectives of the Study

1.2.1 General objective

The overall objective of this study is assessing the current solid waste management service of Gondar town.

1.2.2. Specific objectives

- To investigate the generation rate and physical composition of solid waste from different sectors in the town.
- To identify the different solid wastes from different sectors in the town.
- To examine the existing status and spatial coverage of solid waste management service in the town.
- To assess present institutional arrangement and capacity of solid waste management of the town.
- To assess the job opportunity that creates by solid waste management activities in the town.
- To assess the current condition of the dumping site Gondar town
- Identify and suggest possible public policy recommendations, technological innovations, delivery methods and further research.

2. Materials and methods

2.1. Description of the study area

2.1.1. Geographical location

This study was conducted in Gondar town, which is the capital city of North Gondar zone and it is located 747 km North West of Addis Ababa and 180km North East of Bahir Dar. It is located at 12^0 30' North and 37^0 20' East (Ethiopian Mapping Agency, 1981). The town limits of Gondar enclose an area of 48.27 km^2 (CSA, 1998) and standard altitude is 1966m above sea level.

2.1.2. Topography

The topographic characteristic of Gondar is made up of sloping terrain dissected by a number of rivers that start from the mountains west of the town and drain towards south east before joining the Angereb River. The notable rivers that drain the town include the Angereb, keha, Dimaza and Shinta. Generally, scattered hills, valleys and eroded land comprise a major portion of the town's topography. Elevation within the town ranges from 1800m.a.s.l around Keha River to 2200 m.a.s.l at Goha Ridge (Planning and Economic Development Department for NGAZ, 1999). The nature of the topography of Gondar has a great influence on the development of the town. First it partly determines the natural direction of the town's expansion to be along the left side of the main asphalt road that extends from Gondar to Addis Ababa. Second, although the town extends from north east to south west in a linear strip along the main route from Addis Ababa to Gondar, the settlement is disjointed at least at four places due to its topographic features. The first is the Core Gondar, which comprises nearly three fourth of the total area of the town. The second is the Addis Alem area, which is separated from the Core area of Gondar by a relatively steep slope. The third and the fourth refer to the Azezo area which is further divided in two places. The Azezo area is separated from the Core Gondar by the ridges of Mt. Maraki and Mt. Genfo Quch.

2.1.3. Climate

The average annual temperature is 19.1 degree centigrade and an average annual precipitation is 1161 mill meter (Ethiopian meteorological service, 2012).

2.2. Data sources

Both primary and secondary data were used to do this research project. The primary data were obtained from the site and the secondary data were obtained from different sources such as published and unpublished materials, internet, books, journals, articles, and report papers.

2.3. Methodology

2.3.1. Research area determination

Gondar town is purposely selected for this research because of the presence of high accumulation of solid waste and accessibility of data about solid waste management.

2.3.2. Sampling Techniques

Simple random sampling method was used to take samples. The study uses the descriptive research method and employed survey in determining the current solid waste management practices and extent accumulation of solid waste. Some sets of questionnaires were used as tools in data gathering from the waste generators and implementers of

the solid waste. The methodology and procedures used to estimate the extent of waste were simple step by step procedures.

2.3.3. **Stratification of the Study Area**

In order to collect primary data from Gondar town, we classified the town in to kefle ketemas. Gondar town is classifying in to twelve kefle ketema. In order to reduce the cost of time and energy, four kefle ketemas were randomly selected namely, Chirkos, Gebriel, Azezo Demieza and Arbegnoch and one kebele from each kefle ketema and their household number as a representative sample randomly in the following way were selected respectively.

Table 2.1: *Representative selected kebeles of Gondar town*

Representative kebeles	No of house holds	5% of the house holds
Kebele 07	700	35
Kebele 14	900	45
Kebele 20	1000	50
Kebele 04	800	40
Total representative house holds		**165**

The 5% of the households that used to design for collection of data from households on their solid waste management practice, and their attitude towards MSWM practice of the town is 165 households. Additionally to examine the institutional arrangement and capacity of the town sanitation and beautification that is responsible for town solid waste management's, institutions and factories which generates solid wastes and from them we asked the responsible bodies or heads of each factories, institution, and sanitation and beautification bureau purposely. The rate and quantity of solid waste production of households is a direct reflection of their income level or economic performance.

2.4. Methods of data collection

2.4.1. Questionnaire survey

Data gathered from randomly selected individuals in Gondar town by oral interview and questioner to assess the solid waste management in Gondar town.

2.4.2. Observational study

A direct method of solid waste accumulation and the level of solid waste management program assessment were carried out by visualizing the area and photos were taken.

2.5. Data analysis

All data that generated from the respondents of Gondar town were analyzed by using simple descriptive statistics such both qualitative and quantitative techniques. Quantitative methods include percentages, graphical maps, and tabular form. Qualitative techniques were cause and effect relationships, and also the data that collected from direct physical observation or visualization was analyzed by describing the phenomena using personal judgment and supported by photographs.

3. Results and discussion

3.1. The current status and spatial coverage of municipal solid waste management service of Gondar town

In Gondar town, the solid waste generation of each household averagely was currently reaches to 76.65kg /annum (Abebe Tegegne (2006). As a result of this huge generation of solid waste, town residents considered MSWM as a necessary and vigorous urban service. For instance, from total 165 sample households of the town around 15(9.09%) of them are regarding this service as a burning urban service just like road, water and electricity. This is because absence of qualified and efficient municipal solid waste management service exposed them to various health, aesthetic and environmental impacts. On the other hand, respondents are also asked to estimate the effort made by municipality to provide efficient municipal solid waste management service compared with other services of the town. And majority 125(75.5%) of them responded that municipality has made weak effort.

3.2. Characteristics of Municipal Solid Waste of Gondar Town

Solid wastes that are generated in most towns of Ethiopia are not correctly handled and managed. Therefore, appropriate management of municipal solid waste of Gondar town, reliable and accurate data about these elements is very decisive. In spite of this, Gondar town sanitation and beautification (SB) gave less attention. For instance, regarding the town residential solid waste composition and generation rate, there has been lack of frequent and ongoing surveys opposed to frequent variation characteristics of it. Furthermore, those available data are also scattered and unorganized. In order to fill this gap examining household solid waste generation rate and physical composition since the majority of solid waste constituents of the town are comes from households.

3.3. Municipal Solid Waste Sources and their Solid Waste Generation

Municipal solid waste contains highly heterogeneous mass of discarded materials from urban residences, commercial establishments, institutions, street sweepings, and light industrial activities. Similarly, according to (Abebe Tegegne, 2006), there are five major sources of MSW of the town. These are residential areas, commercial areas, street sweeping, institutions, and small scale industries. Based on this report, the daily total solid waste generation of these sources is around 11660kg and annually it reaches to 41976290 Kg.

Table 3.1: *Major solid waste sources and their daily and annual generation of Gondar town in, 2013*

Source of solid	Solid generated averagely per day(kg)	Solid waste generated averagely per annual(kg)	Percentage share
Residential areas	8140	2930400	69.8%

Commercial area	1672	601920	14.3%
Street area	968	348480	8.3%
Institutions	700	252000	6%
Small scale industries	180	64800	1.5%
Total	11660	4197600	100%

Source, SB report, 2013

Table 3.1 presented that the share (69.8%) of solid waste of Gondar town is generated from residential areas. Even if huge amount of solid waste of the town is generated from this source, the town SB does not gave much weight for it in planning and implementation process of MSWM. Therefore, the daily and annual generation rate of household of the town is much greater than the above estimation of the solid waste source. This is graphically represented as follow:

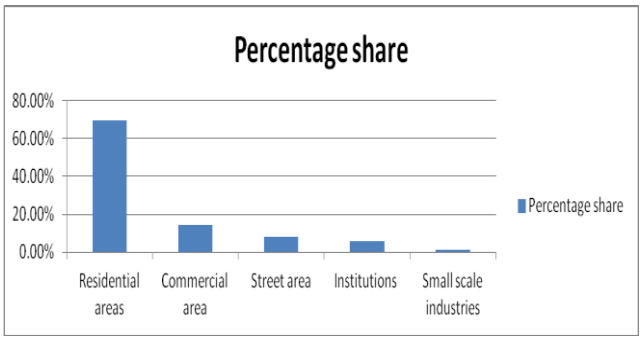

Figure 1: *Major solid waste sources and their generation in 2013*

3.4. Composition of Municipal Solid Waste

Urban solid wastes can be segmented into two major components called biodegradable and non-biodegradable. The biodegradable component of urban solid waste constitutes organic wastes such as food waste, garden waste, and agricultural waste which undergo biological degradation under controlled conditions and can be turned into compost or organic fertilizer. While non-biodegradable wastes includes inorganic materials which can't be decomposed and degraded (cited by Solomon cheru, 2011). From our own observations in disposal site, illegally dumping areas and in residential areas, Gondar town physical composition of municipal solid waste is also composed from both biodegradable and non-degradable components. The construction and demolition waste that is generated during the course of repair, construction, and destruction activities constituting sands, soil stones, nails, cement concrete and wood are also observed in the town. This is due to high construction activities of the town and such wastes are not stored by waste generator within their compound rather they deposited just outside in streets and open areas. Different types of medical waste such as syringes, gloves, glucose materials etc. from hospitals, clinics, and other health care establishments are also detected in different disposal areas of the town. But such wastes should be managed carefully and separately from the above types of solid wastes because of its hazardous health impacts (Source: field survey, 2014).

Table 3.2*: Components of solid waste*

Though the town municipal solid waste is comprised from the above listed solid waste fractions, it is dominated by organic waste streams generated from households, markets and commercial areas. The main reason behind this is about 69.8 % of MSW of the town arises from residential areas and this source is dominantly characterized by biodegradable solid wastes.

3.5. Solid Waste Storage Facility and Its Handling in Gondar Town

Studying solid waste storage facilities and their handling has significant impact for betterment of municipal solid waste management activity. This is from the point of identification of type and quantity of storage material to be used, appropriate location (sitting) of it, deciding the collection method to be used, and avoidance of health, environment and aesthetics impacts of storage materials (G/tsadkan, 2002). As a result of this, we collected information about solid waste storage and handling practice of Gondar town and briefly explain in two categories. The first category constitutes primary or temporary storage facility of households, while the second category comprises secondary or communal storage facility of a town which includes public solid waste container and dustbins. The detail examination of both of these storage facilities is described in the following sections.

3.6. Primary Solid Waste Storage Facility and Its Handling

Residents of Gondar town used different types of storage materials in their compound which is stationary like pit and portable like sack. In order to assess type and quantity of storage materials of residents, 165 households were asked. The result showed that, 130 (78.78%) had one storage material, while the remaining 21.22 % had two storage materials. But, the types of storage materials used by households are different. This is mainly because of the nature of storage material of households that depends on the characteristics of solid wastes (rate of generation, physical and chemical composition, moisture content of waste etc.), collection frequency and types of collection equipment, space available for placement of the storage materials, and economic power of solid waste generators (Techobanglous, 1977 and 1993 cited in G/tsadkan, 2002). As it is clearly observed, the majority of households put up their solid waste in sack. This is highly related with the least cost of sack, easily availability in the market, its suitability for holding large volume of solid wastes, and low frequency and spatial coverage of door to door solid waste collection service of the town. The storage materials of households are characterized by unpleasant feature resulted by unsuitable handling, and drop out of solid waste around storage material. Majority of households are also located it very near to houses especially

Types of waste	Bio-degradable	Non bio-degradable
	Food waste	Bottle
	Garden waste	Tin
	Agricultural waste	Can
	Grass waste	Electric material waste
	Ash	Syringes

in condominium houses storage materials are placed inside the house due to absence of space.
Source: field survey, 2014

3.7. Secondary solid waste storage facilities and their handling

Secondary storage facilities refers to different types of solid waste containers which involve keeping solid waste generated from different households at a common or central point from where collection vehicles can pick it and transport to final disposal site(Zebenay, 2010). These facilities are provided by municipality which is responsible for management of the town solid waste. Gondar town SB put 140 public solid waste containers in different areas of the town where frequent illegal dumping of waste was mostly occurred, and in areas where high population density is assumed to exist (SB, Gondar town director, 2014). Residents around those containers were highly exposed and attacked by different solid waste caused diseases. This is mainly due to lifter truck being out of service, absence of frequent collection of those public solid waste containers, and misuse of the society. As a result, the town SB was compulsory to collect those public solid waste containers.
However, for solving problems of secondary storage facility, the town SB prepared different communal solid waste accumulation sites called transfer stations. Presently, these are located in:

Table 3.3: *Transfer station of municipal solid waste of Gondar town*

No	Kifle ketama	Transfer site	Remark
1	Cherikos	Mayimok, Mogne mekomia, Etan meshecha and abomedaresha	
2	Azezo Demiaza	Condominium, Hamus gebeya and Buluket sefer	
3	Gabriele	Auto garage, Nuor clinic and 17 makel	
4	Arbegnoch	Hiberet temert bet, near to public library and gulit gebeya (kebele 03)	

Those transfer stations are not well designed, not protected from rain and sun. They are just road side open dumps without any health and aesthetic impact considerations and optimum travel distance of beneficiaries. So, those sites are created bad smell, ugly urban picture, and deterioration of the neighborhood. According to the interview with SB head, those transfer stations give service only to MSSE workers who collect solid wastes from households, institutions and commercial areas. It stated that in order to use transfer stations one should have to accumulate wastes by using sack and also he/she should load his/her accumulated waste by waiting municipality truck until it comes. Apart from transfer stations, there are also dustbins which used to collect walkers' solid wastes like napkins, pieces of paper, and remains of fruits such as banana, orange etc. Nevertheless, according to the interview taken from SB head, there were around 120 dust bins that were located at the major roads, recreational areas, institution and market areas, but some of them are stolen and currently there is only some dustbin in the town.

3.8. Solid Waste Separation, Processing and Recovery Activities in Gondar Town

In this study solid waste separation, processing and recovery activities at source and by municipality refer all activities or efforts of separation of recyclable, reusable, compostable wastes to sell or to recover resources by themselves. Practicing these types of activities is very important to waste generators as well as municipality since it minimizes cost of disposal, generates revenue, and prolongs lifespan of disposal site. Additionally it creates job opportunity for 24 persons that separate bio-degradable and non-bio-degradable and for five guards that protect the dumping site. Generally it creates job opportunity for 60 persons.

3.8.1. Solid Waste Separation Activities of Households

A. Solid waste separation

As we observed from households' solid waste separation activities in the town, only solid wastes that are sold to Quraleos, exchangeable to Liwach and to some extent organic wastes are separated. Response of sample respondents also showed that about 50 (30.30%) of them are separately store solid wastes which are sold to "Quraleos" and exchangeable with "Liwach". According to those respondents, the dominant types of such wastes includes textile and old shoes, tin and plastics glass, bottles, and can and electronic wastes. Households' awareness about usefulness of such discarded wastes for "Quraleos" and "Liwach" together with their low economic performance led households to separately store such wastes and generate income and new equipment to their house. Some of solid wastes that are separated by such small number of households are:

1. Ash, dust, agricultural waste, and food wastes for the purpose of using it as home garden
2. Grass, leaf, waste of sugarcane, waste of cattle's (after dried by sun), wood scrap.

3.8.2. Solid Waste Separation, Processing and Recovery Activities by Sanitation and Beautification.

Sanitation and Beautification is carried out some type of composting activities. Towards recycling and reusing the department does attempt it by collecting, transferring, and final disposal of solid waste as the only means of municipal solid waste management. To apply these activities there is lack of commitment, finance, material, and manpower resource UNEP (2009).

3.9. Solid Waste Collection and Transportation Systems in Gondar Town

Collection and transportation of solid waste contains the process of gathering of waste from place of generation, taking it to nearby public solid waste containers or transfer stations, and lastly dumping it to disposal site (UNEP, 1996). This functional element is very critical and compulsory component of municipal solid waste management because productivity and efficiency of this service is highly determined by it. Currently, in Gondar town there are two methods of waste collection such as door to door and transfer stations collection.

3.10. Door to Door Solid Waste Collection and

Transportation Systems

This technique is largely applied for collection of solid waste from residential areas. It is provided by medium and small scale enterprise (MSSE) (JICAIIC, 2005). But the service of MSSE is reached to very small number of residents. Currently in Gondar town there are 3 MSSE which have 3 kifle ketemas each to involve in deliver of solid waste collection service to the town residents namely Raeyi, Marsea, and Sarto melewet and the three (3) kifle ketemas covers by SB bureau. According to the personal interviews with MSSE leaders, they have collected 10-30 birr per month from households and 50-400 birr for institutions and hotels based on amount of solid waste and distance from the transfer stations. They collected solid wastes from residents with one weak interval. We also observed that they are being operating and contributing to the cleanness of the town. Nonetheless, due to multidimensional challenges they are not optimally utilized their efforts. Those challenges are:

- ❖ Scarcity of equipment
- ❖ Lack of support from different stakeholders such as kebelle, Sanitation and Beautification, NGOs
- ❖ Shortage of collection car and transfer stations together with weak controlling mechanism of municipality for time wastage and absents of the truck.
- ❖ No training , protective material and health care given to by municipality them when they enter to this work

3.11. Street Sweeping Activity in Gondar Town

In addition to collection of solid waste from transfer stations, street sweeping is also included in municipal solid waste management service offered by Sanitation and Beautification of Gondar town. Street sweeping takes place every day since it needs to be done more frequently because of there is only some street dustbins and regular generation of solid wastes like napkins, pieces of paper, residual vegetables and fruits such as banana, orange etc. The street sweepers are separately spaced on streets, and clean roads using brooms that gifted from the department (Degnet Abebaw, 2003). After cleaning they used wheelbarrows to collect piles of solid wastes from streets, and then most commonly they burn it in gullies around streets, load into municipality truck if it comes while doing their work, or else store it in sack and placed in transfer station. Most of street sweeping takes place around the center of the town where streets are busy with many activities. Furthermore, residents are very careless to clean their front yards and street and see it as the responsibility of the municipality. For example, about 140(84.8% of respondents clean their houses in every day. But, annually most of residents 25 (15.15%) participated on cleaning campaigns of their surroundings on average 3-4 times.

3.12. Solid Waste Disposal Practices in Gondar Town

3.12.1. Households' Solid Waste Disposal Practices

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

3.12.2. Existing Situation and Management of Solid Waste Disposal Site

Proper solid waste management requires proper disposal of wastes in a proper place (Cunningham, 2008). . In sight of this Gondar town solid waste disposal site which is Ayira and its management is inadequate and below the standard. Landfill site selection involves proper study of the site in relation to its topography, slope, permeability, hydrology, accessibility, distance from incompatible land uses and acceptance by the local community. Therefore, the Gondar town dump site which is ayira full fills all most those criteria.

3.13. Institutional arrangement and capacity of municipal solid waste management service of Gondar town

It is a common perception that improves solid waste management means making waste collection and disposal systems more efficient, raising public awareness and enforcing solid waste management laws (Obeng Peter, 2008). However, a precondition for all these factors are a well-planned management operating within a permitting institutional framework and capable of generating financial resources required to meet operating, maintenance, and investment costs (Antipolis, 2000). So in order to build an acceptable and satisfactory level of MSWM service, the responsible institution primarily need to have well organized management that functions within an adequate institutional arrangement, skilled manpower and financial resources, appropriate rule and regulation, short and long term strategy, and good cooperation with different stakeholders. Otherwise, if one or more of the above-mentioned resources and frameworks are missing, then MSWM remains unattainable Watson Adam, (2004) and cited by Solomon cheru, 2011). This is one key reason why MSWM of Gondar town is very poor in terms of status as well as spatial coverage. It is clear that for sound municipal solid waste management of any town, there should be well arranged and capable institution. The opening pace towards building of this type of institution is began from building clear, short and efficient organizational structure of responsible institution of the town's solid waste management. In line with these issues, Gondar town municipal solid waste management system is organized under a jurisdiction of municipality in one of the eight work process called Sanitation, and Beautification. The town Sanitation and Beautification is directly accountable to Gondar town municipality office **(**Meenakship , 2005).

3.13.1. Institutional Mandate of Sanitation and Beautification

Opposing to the crucial goal and objectives of Sanitation and Beautification, the mandate given to the department is only limited to MSWM service provision i.e. collection, transportation and disposal of town's solid waste Miller G. (2007). . For instance, law and order enforcing office has the responsibility to control illegal solid waste disposal and penalize dwellers when they throw wastes in unauthorized places (Solomon cheru, 2011)

3.13.2. Rules and regulations of municipal solid waste management, and its Status of enforcement

Gondar town Sanitation and Beautification bureau has no

mandate to prepare its own rule and regulation, it follows solid waste management related rules and regulations derived from hygiene and environmental health regulation of Amhara regional state adopted in 2000 and 2002. These rules and regulations are largely emphasized on solid waste handling responsibilities and obligations of persons, establishments, and institutions. Apart from this there is also low enforcement of those existed rules and regulations according to 98(59.39%) response of sample respondents and from our field observation. Furthermore, there is awareness creation activity to community about rules and regulations by some promoters. However, more than 161 (97.57%) of sample households did not know the town's rules and regulations related with solid waste management. As Enger and Smith (2008), mentioned, 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.

3.13.3. Inter-Organization Linkage of Sanitation and Beautification Department

Inter organizational linkage refers to a multi-dimensional interactions between two or more institutions on the basis of their organizational principles and expected responsibilities to perform their respective roles. So, enhancing inter organizational integration is very important to improve MSWM through creating functional interdependences such as experience sharing, and supportive activities , Dereje Tadesse (2001). This collaboration can also facilitate information exchange between them and initiate organizations to actively taking part in solid waste activities in particular and promoting public health and environmental protection in general (Kebede Faris *et al*., 1993). Based on the strategic plan of Sanitation and Beautification of Gondar town, there are several organizations which are identified for cooperation in solid waste management of the town. These are town administration office, health office, urban agricultural office, micro and small enterprise office, and kebele sanitation agents. According to SB head and workers explanation, there is no strong linkage among different bodies at grass root level.

3.13.4. Institutional Capacity of Sanitation and Beautification

Institutions play vital roles in guiding change, facilitating development and succeeding national socio economic and political goals if they are well equipped in terms of various types of resources. These dominant resources which determine an institutional capacity are: human, material, and financial resources. Otherwise, they can cause for failure of designed goal since the management of an institution with a relatively low capacity has its own impact on its effectiveness. With this intention, in order to manage solid wastes properly the capacity of institution that is delegated with MSWM of the town also needs to be raised to a higher level with adequate budget, man power, technical skills and equipment used (Edelman, 1997 cited in Tewodros ferede, 2011). But, status of the existing institutional capacity of MSWM in Gondar town is basically inadequate arising out of insufficient manpower, financial, and material resources.

3.13.4.1. Human Resource Capacity of Sanitation and Beautification

To gain a better understanding of the human resource capacity of Sanitation and Beautification of Gondar town, questionnaire which focused the above factors was prepared and distributed to all solid waste related workers and an interview with the head of the department was made in addition to secondary data received from the department. According to the work process manual of the Sanitation and Beautification, the present arrangement of the department was prepared in order to hold 60 workers who involved in provision of solid waste management in Gondar. Based on the information obtained from interview made with the manager, the reason behind this inadequacy of manpower is lack of budget and low attention given by the department as well as higher officials to employ.

3.13.4.2. Financial Resource Capacity of Sanitation and Beautification

In Gondar town, the provision of adequate funding for MSWM is a sever challenge which causes the town environment to be deteriorated, Melaku Tegegn (2008). It is characterized by poor budget for service delivery, insufficient funding for building infrastructures and absence of appropriate cost recovery mechanisms. Very weak financial performance of solid waste management service of the town since the municipality cannot collect adequate annual revenue to run all work processes. For example, the total budget allocated for municipal office and sanitation and beautification department was around 1.5 million.

3.13.4.3. Municipal Solid Waste Management Equipment

In Gondar town, solid waste management is mainly under taken by very inefficient equipment's and technologies due to low level of economic development and low attention given to this service, Gebrie Kassa (2009). Currently, the SB of the town runs this service with supplying only one solid waste collection, transportation and dumping truck. Besides this, the department has one disposal site which is 10 km away from the center of the town. Obviously these amounts of equipment or facilities are not sufficient to convey the service when we compared with the rapid expansion of the town and the level of increasing waste generation rate of the society. In addition to shortage of equipment, the problem of MSWM in the town is also worsened by poor quality of truck and frequent break of it.

4. Conclusion

This study has tried to investigate the status and spatial coverage of municipal solid waste management service of Gondar town in general. In particular, the study explored households' solid waste generation rate, solid waste management practice, and institutional structure and capacity of sanitation and beautification (SB) of the town. These inquiries were addressed by employing questionnaires, field observation, semi structured and unstructured interview with head and workers of SB, and reviewing published and unpublished documents. Lastly, on the basis of qualitative and quantitative analysis of data, the findings of this study were summarized as follows. The main sources of municipal solid wastes in Gondar town are residences, commercial areas, street sweeping, institutions, and small scale industries. However, the significant amount of solid waste of the town (69.8%) is generated from residential areas. However, this source has such large dominance; the town's SB didn't make frequent and continuing examinations on its solid waste composition and generation rate. But, this study found out solid waste generation rate of household, it is about 0.21kg/person/day. This made the daily and annual total solid waste generation of residential areas of the town to 8,140 to

4,197,600 respectively. This study also specified that Gondar town municipal solid waste management service is very weak in terms of status, spatial coverage and solid waste management facility. Currently, in the town, there are some public solid waste storage containers and road side dust bins. As replacement of these facilities, there are different communal solid waste transfer stations that give service only to MSSE waste collectors. Those stations are located at the edge of main roads, and they are not well designed. Simply they are road side open dumps without any health, aesthetic and environmental impact considerations.

Besides this, those transfer stations are also characterized by uneven distribution both in terms of distance from beneficiaries and kebele specific locations. Furthermore, municipal solid waste collection and transportation activity of the town is carried out by two types of collection methods such as door to door and transfer stations solid waste collection. Door-to-door collection system is provided by MSSE waste collectors and rarely by municipality collection truck. It is largely implemented for collection of solid waste from residential areas to transfer stations. But, the status and spatial coverage of this service is very unsatisfactory, only covers residents who are living in the center of the town and along accessible streets. Whereas the transfer stations collection method is directly performed by the SB using its collection truck. Based on average trip of a truck, the total amount of solid waste which is daily collected and transported by the municipality is calculated as 12,840kg but the actual daily generated solid waste from all sources of the town is about 11,660 As a result of this, huge amounts of uncollected solid wastes are indiscriminately disposed in unauthorized areas. In addition to poor solid waste collection and transportation practice, the town disposal site is also found in unacceptable and very risky situation. Because, it is simply naturally created gorge rather than manually prepared solid waste dumping through environmental, economic and social impact considerations. As a conclusion, this study investigated three main factors that aggravate the existing poor status of municipal solid waste management service the town. These are: weak institutional arrangement and capacity of sanitation and beautification, poor solid waste management practices of the town households and limited participation and contribution of stakeholders.

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