

Municipal Solid Waste Management in Debre Berhan City of Ethiopia

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Abstract

This paper presents an assessment of municipal solid waste generation and composition in Debre Berhan city in Ethiopia, providing an overview of the current state of municipal solid waste management, an analysis of the current problems in MSW collection, transportation, recycling and disposal, and few suggestions for improving the MSW in the coming years. Currently, waste composition in Debre Berhan is dominated by a high organic content, since the concentration of food and kitchen waste in urban solid waste makes up the highest proportion of the waste stream. The study revealed that only 25 % of the households have access to waste collection and transportation services as city municipality is under capacity to provide waste collection and transportation service. 98% of the respondents reported that recycling is not being practiced in the town. So, the potential of recycling and related activities is yet to be exploited. 75% of the urban dwellers dump the waste produce illegally and there exists no well designed dumping or landfill site, consequently urban dwellers are vulnerable to surface and groundwater pollution. Urgent and immediate improvement in building the capacities of the municipality is necessary to meet the current demand for improved municipal waste management and a number of recommendations are made aimed at improving the MSW management system.

Keywords: Ethiopia, Waste Collection, Waste Disposal, Municipal Solid Waste Management.

1. Introduction

Production of solid waste is not a new phenomenon and is as old as the human civilization. However, because of rapid population growth followed by economic development and urbanization majority of developing countries are experiencing difficulties in the management of municipal solid waste produced by the urban dwellers (Suocheng *et al.* 2001). In most of the cities of the developing countries, government and local city councils have a mandate for the proper management of the municipal solid waste from collection to disposal (Kassim and Ali, 2006). According to Collivignarelli *et al.* (2004) in recent years it has been reported that many developing countries have shown progress to improve their municipal solid waste management practices. However, because of limited technical capacities and low financial resources, adequate management of municipal solid waste is not achieved. Failure to provide proper waste management is causing serious environmental risk and poor urban governance. Improper management of municipal solid waste has been reported by several researchers in different cities of the developing countries like in Nigeria (Imam *et al.* 2008), in India (Sharholi *et al.* 2008), in China (Chung *et al.* 2008) and in Turkey (Berkun *et al.* 2005). Poor management of municipal solid waste may result to in consequences such as pollution, low aesthetic values and economic losses due to failures in recycling and composting valuable components of the municipal solid waste. According to Mor *et al.* (2006) improper management of municipal solid waste may result in serious urban, sanitary and environmental problems such as unpleasant odor, risk of explosion in landfill areas, as well as groundwater contamination because of leachate percolation.

Developed countries are able to manage the various types of waste to an acceptable level, contrary to developing nations like Ethiopia which are still struggling to deal with the problem of proper management of solid wastes. With the current rate of urbanization municipal solid waste collection, transportation and disposal have been a major problem of municipalities in most of the Ethiopian cities. Collection of municipal solid waste in most of the cities is difficult and complex because the generation of residential, commercial and industrial waste is a diffuse process that takes place in every house, every building and every commercial and industrial facility as well as in the streets, parks and even in the vacant areas available within the community. In addition to this hilly terrain of many cities, lack of manpower and equipments and financial constraints are factors which aggravate the problem (Beyene *et al.* 2009; Daniel *et al.* 2010; Mulu and Legesse. 2005 and Sharma *et al.* 2011). Though a few studies have been carried out in some Ethiopian towns however, no study till date is reported for the town of Debre Berhan. The present study will help to generate data and gather information on the municipal solid waste management in Debre Berhan town. Thus the study is hoped to provide some information to policy makers, donors, and environmental protection practitioners who are interested to assist financial, training and legal provision which in turn minimize the constraints of MSWM activities.

2 Materials and Methods

2.1 Study Area

Debre Berhan City was established in 1454 by Emperor Zera Yaeqob. It is situated in Amhara National Regional State and currently, the city has been serving as the seat of Northern Shoa Zone Administration, Debre Berhan City Administration and Bassona Worana Woreda (district). The city is located at 130 kilometers northeast direction along Addis Ababa–Dessie-Mekele route. Astronomically, the city is positioned at 9°41' North latitude and 39°40' East longitude and characterized by cool temperate climate. The annual average temperature of the city ranges between 4°C in the coldest month (August) to 26°C in the hottest month (April). Average annual rainfall ranges between 814 to 1080 mm. Most of the built up areas of Debre Berhan City have an altitude of 2750 meter above mean sea level. Generally, the topography is classified as 86% flat, 10% sloppy and 4% mountainous. The total area of the city is 21169.95 hectares of land. The City Administration is further sub divided into nine kebele administrations (wards). The projected population of the city based on the 2008 national census is 79,832 of which 37,500 are women and 42,332 men (CSA, 2008). The dominant economic activities in the town are tanneries and blanket factories. Agriculture on the suburbs provides livelihood to a large section of society. In the town there exist one Government University, various colleges, schools, banks, hospitals both public and private, various clinics and higher secondary and preparatory schools (Debre Berhan City Five Year Strategic Plan, 2006).

2.2 Research Design

For the assessment of the present situation of solid waste management in Debre Berhan city, a well-structured questionnaire with both open and close ended questions was prepared. The questionnaire was prepared in English and then translated to native and national language Amharaic to ensure better understanding of the residents. There are 9 kebeles (wards) in the city and purposive sampling was employed to select 4 kebeles. From the inner zone of the city kebele number 2 and 3 were selected while kebele number 4 and 7 from the peripheral area of the city. Finally questionnaires were administered to the selected households from the four chosen kebeles. To pick representative households from the preferred kebeles systematic sampling based on the document prepared by the Works and Development Bureau of Amhara Regional State was used to pick representative households. The housing units were marked in each kebele in order of their serial number like house number 1, 2, 3 and so on. Hence, the said document was used for picking the representative households. The total number of housing units in the selected kebeles was 5031. To determine the total sample size, the common method adopted is to use 5% of the total population; hence, 252 households were systematically selected for the distribution of the questionnaire. Apart from questionnaire, interviews and focus group discussions were conducted with concerned municipal authorities of Debre Berhan City.

3. Results and Discussion

The current situation of solid waste management in Debre Berhan city, its challenges and recommendations by researchers for better management of municipal solid waste are being discussed in this section.

3.1. Current state of MSW management in Debre Berhan

Waste generation, waste handling and separation, storage and processing, collection and transport, and final disposal are some of the important practices done for sound solid waste management (Tchobanoglous *et al.* 1993). Under sub-sections current state of MSW management of Debre Berhan is discussed.

3.1.1. Generation and Composition of Municipal solid waste generated in City

In order to monitor and control existing waste management system and to make regulatory, financial and institutional decisions it is necessary to characterize the solid waste by its source, type and composition (Hoornweg & Laura 1999). It is clear from the table 1 that the selected households of Debre Berhan are producing all types of solid wastes.

Based on daily waste generation data of 7 randomly selected houses for one week, the waste generation rate in city was found to be about 0.55kg/capita/day. The generation rate is high as compared with other data of 0.35 kg/capita/day from Bonga city (Mulu and Legesse, 2005); 0.18 kg/capita/day from Debreziet city (Mebrate, 2005) and 0.43kg/capita/day from Gondar city of Ethiopia (Sharma *et al.* 2011)

Out of the total waste generated 80% is degradable, and 20% is non degradable but could be recycled. Maximum quantity of waste generated was vegetable peelings and leftover food that accounts for total 33% of the total waste generated. A high organic content has been reported by many authors in many different cities of most of the developing and underdeveloped countries such Indonesia (74%) (Walhi, 2001); India (42%) (Ahkolkar, 2001); Turkey (43-64%) (Metin *et al.* 2003); and Nigeria (52-65%) (Imam *et al.* 2008). Ash as a waste contributes 25%, and the main reason for this is that electricity and cooking gas have never been an important source of energy for larger proportions of the households instead urban dwellers prefer coal and fuel wood. Beyene *et al.* (1999) stated that firewood, charcoal, dung cakes are major sources of energy for cooking and heating the house premises. Therefore, the amount of ash and smoke produced from the combustion of these materials is immense. Dissemination and popularization of energy saving appropriate technology may have a tremendous role in reducing the amount of waste generated after using such products. Tchobanoglous *et al.*

(1993) stated that composition of MSW varies according to the cultural habits and economic status of the residents, urban structure, density of population, extent of commercial activity and climate. The practice of chewing chat leaves (*Catha edulis forsk*) to reduce physical fatigue in many parts of country contributed 2% of the related wastes of the studied households.

Plastic, metallic and glass waste constitute near about 20% of the total waste. Resource recovery from the waste stream is desirable because it cuts down the transportation and disposal costs of municipal waste but recycling facilities are absent in Debre Berhan city. Even people don't have awareness about reuse and recycling as nearly 98% of the respondents reported that recycling is not being practiced in the city. So, the potential of recycling and related advantages are yet to be exploited. Sustainable solid waste management practices like recycling and composting helps in providing employment and income-generating opportunity for a significant number of people (Schubeler *et al.* 1996). As a limitation of study, due to unavailability of laboratory equipments, personnel protective devices and economic constraints, the solid waste collection was limited to only 7 houses and further moisture content was not analyzed for the collected wastes.

3.1.2. Collection and Transportation of Municipal solid waste

Currently, the solid waste management in Debre Berhan city relies entirely on municipality, which is expected to provide the full range of municipal waste collection, transportation and disposal services. City municipality with sporadic and inefficient collection system of MSW is currently providing its services only to 25% residents. However, collection containers have not been provided to the municipality. There is urgent need to increase the collection efficiency for effective management of MSW by the municipality. Poor institutional capacity, management problems and inadequate financing of the sector further aggravated the condition.

Primary collection of waste is done by residents within their home premises and for this they used various type of bins like baskets, buckets, empty oil drums, paper cartons, plastic bags or simply they dig a pit in their compound and start collecting the household wastes. Collection of waste continues until the bin is filled and then it is being either dumped illegally in other/different places or being transported to dumping site. Secondary collection is been done by municipality and collection service is just provided to the 25% of the total population. City's municipality owns only one truck for the transportation of the waste collected. Apart from collection of wastes, the truck is also being utilized for various other activities by the municipality like transportation of construction materials to various sites.

3.1.3. Disposal of solid waste

It has been observed and concluded that still open dumping of the waste is the most prevailing activity practiced by residents of Debre Berhan when it comes to final disposal of waste, making high probability of environmental pollution. Table 2 reflects the different methods of dumping of solid wastes practiced by the residents of the area.

From the table 2 it is clear that the majority of 75% population of Debre Berhan disposed waste illegally into public places, river and ditches. Fewer households (2.7%) reported that they practiced burning of the waste in some parts of the city to get exonerate the collected waste. Such practice poses high risk on the local environment. Improper solid waste management causes all types of pollution: air, water and soil. Indiscriminate dumping of wastes contaminates surface and ground water supplies (Mor *et al.* 2006). In urban areas, solid waste clogs drains, creating stagnant water for insect breeding and flood during raining season. Uncontrolled burning of waste contributes significantly to urban air pollution. Health and safety issues also arise from improper solid waste management. The U.S. Public Health Service identified 22 human diseases linked with improper disposal of solid waste (Hanks, 1967).

Collected waste from remaining 25% of the respondents is transported to dumping site by municipality. Only one truck is available for transportation of waste and that too is being engaged in various other activities of municipality. If the only available truck is assigned only for waste disposal by the municipality rather than other added activities, there are sure chances that area covered by municipality for collection, transportation and disposal of waste will significantly increase from the present 25%. Municipality is responsible for the transportation of collected wastes to dumping site, which is a plain land instead of landfill site. The MSW is dumped on land, more or less in an uncontrolled manner, as practiced in majority of cities in other developing countries (Zurbbrug, 1999). This dumping site is not fenced and nearby village children and stray animals, flies and vultures could be seen easily in and around the dumping site, producing an unaesthetic view.

3.2. Present problems and challenges linked with MSW management

Proper disposal and management of municipal solid waste is one of the challenging tasks faced by the municipality of Debre Berhan. The main factors for failure of solid waste management in accordance with the principle of public health, environmental protection, socio-economic and aesthetically are summarized below:

- According to officials of the Municipality, during the last few years urban population has been increasing and so the amount of waste generated. With growing urban population municipality fails to provide service to all urban dwellers, as a result currently municipality is facing challenges in providing efficient municipal solid waste management.

- Inadequate economical, financial, technical and personnel capacity of the city's municipality is yet another important reason.
- Despite the legal provisions existing for proper handling and management of MSW there is lack of implementation.
- Societal lack of concern in (towards) solid waste management: efficient operational solid waste management depends on the active participation of both the municipal authorities and residents of the city. In Debre Berhan level of social input in waste management is critically absent. The municipality is entirely responsible for the management for the wastes. This approach neglects many social factors like participation issues in waste management in order to tackle wide range of problems associated with the management and finally to achieve socially and environmental solution of municipal waste management.

3.3. Recommendations for improving the current state of affairs of MSW management

The objective of the study was to assess the municipal solid waste management in Debre Berhan city. The following suggestions are made to improve the current situation:

- Awareness of residents must be increased towards Reducing, Reusing and Recycling of waste.
- Proper implementation and monitoring of suitable policies and legal framework.
- Capacity of Municipal body must be built in terms of economical, technical and personnel aspects. The municipality should increase its area of service for the effective collection of wastes.
- As 80% of total waste produced is biodegradable in nature, controlled burial, landfilling, composting and recycling facilities must be promoted within the city, so as to achieve the principle of integrated municipal waste management.
- People should be made aware about the health, socio-economic and other harmful impacts of improper municipal solid waste management.
- Residents should start separating the waste at source itself into valuable components of MSW like glass, metal and plastic and organic waste. So that recycling could be promoted and economic benefits could be achieved.
- Community participation, role of NGOs and concept of public- private partnership must be facilitated.
- The final disposal site must be properly fenced and there must be provision to keep the animals and village children away from the site.

In addition to all above recommendations social esteem of people engaged in solid waste management must be protected. Generally, due social respects is not given to people engaged in collection and transportation of waste. This thing must be checked and general awareness must be built for the same. So that, better cohesive environment must be provided to those who are working hard to make the city clean and making it a better place to live.

4. Summary and Conclusions

In developing countries, with an ever increasing population, municipal solid waste management is emerging out to be one of the serious problems. The improper municipal solid waste management poses a potential risk to water, air and land pollution and poses risk to human health. Majority of waste generated in Debre Berhan is of organic nature but, no composting facility or practice is being seen in/among the residents of the city. Waste types like glass, metal and plastic are not being recycled and as such the economic potential of recycling is yet to be explored in the city. The city municipality is not in position to manage the waste completely and properly. Municipality should increase its infrastructure and capacity in term of transportation vehicles and work force so that the present service area 25% by municipality can be increased accordingly. Peripheral urban area of city should also be given due importance by the municipality. The dumping site used for final disposal of waste is not a proper landfill but a plain land. No environmental consideration has been given for selection of this site. City administration should find a proper landfill site by taking all environmental, social, economical and political consideration. If proper land filling is not feasible, municipality should adopt other alternative of controlled burial of the waste away from the city.

Municipality of Debre Berhan is facing a number of challenges like lack of capacity in terms of financial, technical and personnel aspects. Proper budget is not allocated for municipal waste management. Municipal solid waste management is an integral part of good local governance and one of the most visible urban services influencing local perception of governance. But in Debre Berhan city administration gives less attention to the same. It is expected that city administration should work on the concept of public-private partnership and finally both print and electronic media should be used/enrolled for raising the awareness level of residents regarding proper reuse, disposal and management of MSW.

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Table 1: Composition of Municipal Solid Wastes in Debre Berhan city

S. No.	Type of Waste	Percentage of Waste (weight basis)
Biodegradable wastes:		
1	Vegetable and leftover food	33
2	Paper waste	20
3	Ash, wood and charcoal leftover	25
4	Chat leaves and sticks	02
Non-degradable wastes:		
5	Plastic waste	13
6	Metallic waste	04
7	Glass waste	03
Total		100

Table.2: Types of Disposal methods in practice in Debre Berhan city

S.No.	Disposal Methods	No. of Respondents		Remarks
1	Public open spaces	130	51.587%	Illegal
2	River and Ditches	52	20.635%	Illegal
3	Municipal carts	63	25%	Legal
4	Burning	7	2.77%	Illegal
Total		252	100%	