

Evaluate of Municipal Solid Waste Management System in Wolkite City, Ethiopia

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Abstract

Municipal solid waste management is one of the major challenge problems in wolkite city. Improper management of municipal solid waste causes hazards to inhabitants and creating problems to public health and the Environment. In this study, I attempt has been made to provide a comprehensive review of the characteristics, generation, collection, transportation, and disposal practiced in wolkite. From the interview conducted with MSE (Micro and Small Enterprise) workers and illegal solid waste disposal in open spaces is common practice in the study area and some of the main reasons raised by the respondents were the insufficient number of transfer stations and communal containers. The frequency of waste collection from sample respondents reveals that 46% of the respondents have been collecting users waste in two weeks interval. While respectively 37%, 3% and 14% of the respondents has conducted waste collection service once a week, twice a week and daily and results of experimental analysis of waste compositions showed high contents of food waste (43.45%) and low content E-waste (0.09%). The study is concluded with a few fruitful suggestions, which may be beneficial to encourage the competent researchers to work towards further improvement of the present system.

Keywords: Waste generation; Waste disposal; Solid waste; Waste hazard; Waste collection; Waste transformation; Waste characterization

Introduction

The management of solid waste is one of the challenges facing any urban area in the world. An aggregation of human settlements has the potential to produce a large amount of solid waste; the collection, transfer and disposal of that waste has been generally assumed by municipal governments in the developed world. The format varies, however in most urban areas, Garbage is collected either by a government agency or private contractor, and this constitutes a basic and expected government function in the developed world. Municipal Solid Waste (MSW) management has become a major issue of concern for many under-developed nations; especially as populations increase [1]. The problem is compounded as many nations continue to urbanize rapidly, 30%-50% populations in many developing countries is urban and in many African

countries the growth rate of urban areas exceeds 4%. Urbanization is not necessarily a new phenomenon on the continent of Africa, as shown by urban centers like Addis Ababa and Cairo. Municipal Solid waste is, therefore, broadly defined as including non-hazardous industrial, commercial and domestic refuse including household organic trash, street sweepings, hospital and institutional garbage, and construction wastes; generally sludge and human waste are regarded as a liquid waste problem outside the scope of MSW [2]. Also, the threat of toxic waste being present in industrial garbage often leads to it being treated separately, although this is not always the case. The overall problem of MSW is obviously multi-faceted; many organizations, including the United Nations (UN) and various Non-Governmental Organizations (NGOs) advocate an integrated approach to MSW management by identifying key stakeholders, identifying specific issues which comprise important stumbling blocks, and making recommendations based on appropriate technologies, local information, and pressing human and environmental health concerns [3]. Waste management is referred to as the proper and correct handling of waste products at the lowest cost and with minimum destruction and pollution to the environment. Improper management of waste has caused numerous cases of contamination of surface and soil water and the atmosphere and threatens the health of the exposed populace. There is therefore need to manage waste to reduce the threat to the environment and to the populace like developing countries, in Ethiopia.

The increase of solid waste generation is resulted from rapid urbanization and population booming. The same authors indicated that from the total solid waste released by the population the City, about 50%-60 % was collected and the rest was unattended. Wolkite like many towns in the country has many sanitary problems of which the bigger one is solid waste. It is very common to see bagasse and piles of waste on the streets; riverbanks, besides individual houses, available open areas, and market areas [4]. In these areas where generators throw wastes illegally, it is observed that flies and rodents" bread and also dogs, goats and sheep scatter the wastes. The poor housing condition of the town is characterized by lack of toilet, kitchen and proper sanitation. Besides above 70% of the existing houses are owned by the government that makes regular maintenance and renovation impossible. This shows that one of the most important problems of wolkite town is municipal solid waste management. In-adequate municipal solid waste management

in the town has resulted in the accumulation of waste on open lands, in drains and in the residential areas, causing a nuisance and foul-smelling pools, environmental pollution through leachate from piles and burning of waste, clogging of drains [5]. This situation is believed to result in poor environmental conditions, which in turn present a formidable threat to health. There is thus a need for improved waste management system of the town. Information on the characteristics, the composition, the volume and weight of waste generated and collected in wolkite town is limited. In the case of characterization, no research has been taken place on the wolkite municipal solid waste, so that such study of domestic solid waste management is required and taken place for further study and well organized management options. Demographic dynamics, socio-economic changes and consumption patterns are the main factors that affect the municipal solid waste generation in general and domestic solid waste in particular, and composition, which in turn affects the waste management system. Therefore, conducting studies on generation rate, characteristics and composition of solid waste at the present demographic and socio-economic conditions is very critical [6].

Methodology

Description of the study area-Wolkite city

Wolkite is the capital city of Guraghe zone in SNNP regional state Ethiopia. It is located in the southern region of Ethiopia which is 152 km from Addis Ababa. It has experiencing the prevalence of high temperature in which the maximum temperature increases as high as 29 °C. According to 2007 of the population census, 220,344 inhabitants are living in wolkite city. The urban population accounts 180,094 and the rural people constituted 40,250.

Materials and instruments

During the study time the following listed materials and equipments were used Hand protective plastic gloves, to protect hand from direct contact with dirt, mouth and nose mask to protect one from bad smells and inhalation of any fumes, Plastic sheets to ensure no loss of waste during sorting, audio and video cameras for recording capturing pictures of the working process [7].

Methods

Evaluate municipal solid waste generation: Waste generation is, at present, an activity that is not very controllable. In this case we can studied waste generating sectors, waste composition, distribution of waste production among the waste streams and waste generation rate in wolkite city by collecting data's from different source, like dream light.

Waste handling, sorting, storage, and processing at the source: The second steps that we were followed to do this thesis were evaluate the Waste handling and sorting activities associated with management of wastes until they were placed in storage containers and the movement of loaded containers to the point of collection by collected data from users, government

officials, MSEs managers and workers through interview, questionnaires and direct observation.

Municipal solid waste collection: The 3rd step that we were followed to done this thesis were evaluate the municipal solid waste collection system in wolkite city by collected primary data from users, government officials, MSE managers and workers through interview and direct observation and gathered secondary data by reviewing different concepts, theories and related previous studies from books, journal articles, on SWM and offices reports relevant national policies, laws and documents [8].

Sorting, processing and transformation of municipal solid waste: After evaluating the collection system we were studied the recovery of sorted materials, processing of solid waste and transformation of solid waste that occurs primarily in locations away from the source of waste generation.

Transfer and transport of municipal solid waste: The functional element of transfer and transport involves two steps:

- The transfer of wastes from the smaller collection vehicle to the larger transport equipment.
- The subsequent transport of the wastes, usually over long distances, to a processing or disposal site. The transfer usually takes place at a transfer station. For this reason we were evaluate the transportation system of municipal solid waste in wolkite city by collect data from different source and direct observation.

Disposal: The final step in the municipal solid waste management system is disposal. After evaluate transportation system of municipal solid waste we were known the disposal area known as wabai by ask workers and observe that area and studied the effect of waste on animal and human being that lives around wabai and environmental condition.

Results and Discussion

Municipal solid waste generated in Bahr Dar city

Due to our study municipal solid wastes were generated from many sources, such as

- Residential Wastes are generated by households such as organic wastes, recyclable, non- recyclable, hazardous waste.
- Commercial wastes are shops, hotels, garages and agricultural wastes.
- Street wastes.
- Institutional wastes are government and non-government bureaus, school, universities, colleges, training centers, churches, mosques etc. are waste sources.

Waste handling, sorting, storage, and processing at the source

Waste separation at source: According to interview conducted with the dream light managers, FGD held with users and the data analyzed from day to day observation of MSE workers reveal that there is no waste separation at source in

which 100% of the respondents replied that waste has been hardly separated at source [9].

Use of durable and closed storage materials by users: According to the data analyzed from waste collectors observation, the widely used waste storage materials of households are sacks (89%) and card boxes (11%), which are water porous materials during the rainy season. No respondents replied plastics and metallic storages. The respondents of waste collectors said that since the storage materials used by users are open, exposed to rain and easily permeable to water, it highly increases the weight of waste. Besides the addition of moisture in the waste creates a bad smell which seriously affects our health. It has exposed for coughing diseases (**Figure 1**).



Figure 1: Commonly used waste storage materials of users.

Current solid waste collection system

From the interview conducted with MSE workers and data taken from it became clear that before the waste service has been privatized, a container system was the main waste collection method in the city. Since the containers were not emptied regularly, inhabitants obliged to dispose and throw their waste just around the container areas. As a result, there was unpleasant smelling up to certain distance from the containers. To alleviate the shortcomings of the previous system, currently the solid waste collection services has been delivered through a door to door collection system in which waste collectors of MSE knock on each door and take away the stored waste from each user. There is no communal container system in the city and all the community bins have been removed. Adopting the current door-to-door collection system, which started through Dream Light private limited company, the current MSE have also implemented and promoted this system by taking a legal agreement with BDM. During the starting of an MSE waste collection service, the agreement was like a franchise system in which the MSE deliver the service and directly collect their service charge from users. This method was too difficult because at the time there was no enforcement mechanism

designed to enforce the service users in order to pay the service fee [10].

Currently, the type of contractual agreement is arranged in a contract system, where the municipality collects the service fee and monthly pays to MSE according to the contract. The service fee is collected with other utilities payments such as the water and electricity bill by the municipality. So now, the responsibility of MSE is just provision of waste collection service to all citizens, regardless of checking whether users pay for the service or not. Primarily the service fee was determined based on water consumption. However, the application of this system resulted in high complaints from users, particularly users such as local beer producers consume high amounts of water resources, hence setting the service fee related to water consumption, but that was unfair for households [11]. Besides to the information obtained from BDM and the two MSE managers the solid waste collection and transport service of the MSE is not limited to high income groups but serve all citizens. Even though there are people in the city which cannot pay for the service due to economic reasons, the MSE deliver the service including these individuals. The frequency of waste collection from sample respondents reveals that 46% of the respondents have been collecting users waste in two weeks interval. While respectively 37%, 3% and 14% of the respondents has conducted waste collection service once a week, twice a week and daily. According to FGD held with users the frequency of waste collection was their main issue as it is not satisfactory. Users complain the service because of their waste has not been collected on time.

Sorting, processing and transformation of municipal solid waste

Data's that we were taken from indicates that an important composting practice has been started by one of the sample MSE. Since this MSE has small farm workers have been using the compost for their fruit farm. But the Green vision MSE have not their own trucks, it has been difficult to transport waste for this purpose and this limits the amount of compost to be produced. Dream light also started selling used papers to paper recycling industries [12]. Another important process that we observe MSE workers has started to collect some recyclable materials like plastics and metallic substances. However, according to the workers, since there is no separation of waste at source by the users, they have faced great difficulties to get the usable materials after the waste has been mixed.

Transfer and transport

Availability of waste transfer site: The study findings show that there is no temporary transfer site prior to final disposal and instead the MSE workers simply collect in any free space until the waste is transported to its final disposal. The problem is when the vehicles are not available, the waste stays there for a week resulting in unpleasant smelling around the area. According to the interview held with the MSE workers this causes a consequent or even conflict between waste workers and inhabitants of the area. As per field observation workers have collected the waste from users and stored almost on the

foot path, which is really creating difficulties for the people to pass along the road. This is because no specific site or temporary stations are delineated in the city to collect the waste until its final disposal (**Figure 2**).



Figure 2: Partial view of the solid waste disposal site.

Transportation: As per field observation all the waste transport truck are open types without any cover, this will lead to dropping of waste during transportation. Moreover, since the vehicles are of a general purpose type, they are not convenient for loading and very risky for the health of workers. Because the trucks are not standard types specifically designed for this work. As the trucks are small in size and not the standard type [13].

- The frequency of trips to and from the disposal area is large and not cost effective.
- Since the trucks are not closed types, wind disperses wastes to the surrounding area while transportation.
- All the waste is transported without segregation.

Availability of proper final disposal site: In the study area, the final dumping site is not well protected, it has no fence. During field observations animals like cattle simply entered to the disposal site and according to inhabitants their cattle and sheep are affected by plastics while grazing. Due to this impact, farmers around the area highly complain over the site.

Factors that influence the sustainability of WCT

Technical sustainability factors

We developed criteria to assess the technical sustainability of MSE WCT service. These are the type of equipment used locally or imported opportunities for maintenance and availability of spare parts for the equipment, accessibility of the area for WCT equipments and fitness to the local situation, availability of sufficient WCT equipment's, use of separate storage bins and availability of compartment containers in the vehicle.

Waste collection equipment type: According to data collected from respondents and the fields observation most of the waste collection and transport equipment's used by the MSE workers are locally produced and more labor-intensive. All the respondents confirm that they mostly use locally made equipment's like hand push carts, shovel, and wheelbarrow etc. in their daily waste collection activity.

Opportunities for maintenance of equipment: As mentioned in the above most of the equipment's used by respondents are

made locally by small manufacturing enterprises/industries organized in the city According to the interviewed workers of the two MSE, spare parts are easily accessible and maintenance is not a problem since they can be repaired by the local manufacturers.

Accessibility of the area and design of hand carts to the local situation: Adaptability of equipment's to the physical and social environment is an important element for technical sustainability of the service. The accessibility of the area for waste collection trucks is very essential. The waste collection truck has faced great difficulty and is unable to reach their waste collection site. The design of waste collection equipment should fit with the existing road and topography conditions. In this case we asked. Do the existing waste collection equipment, such as hand carts, fit with the existing road and topography conditions. They replay that on rough road and sloppy sites it was difficult to move hand push carts by a single person and it is required to push even by more than four workers. So this may have an impact on the efficiency of each worker.

Use of different storage bins and conducting separate collection: The economic value of waste can increase if waste is segregated at source and stored in separate storage materials. But based on workers day to day observation, the study findings revel that 78% of the respondents replied that users has stored their waste without separation and 22% of the respondents confirm that users waste has been poorly handled/dispersed. From our observation the main draw backs for separate waste collection is both lack of attention from BDM and low awareness of users [14].

Availability of compartment containers in the vehicle and its convenience for loading: The existence of compartment containers in the vehicle is helpful for separate collection and transport. Based on field observation the trucks that are currently used to transport waste do not have separate containers. They are general purpose trucks which transport and dump all types of waste materials together. In addition, they are not convenient for workers during loading.

Users cooperation: Users cooperation is an important factor for sustainability of the service. As per interview conducted with MSEs worker and data taken from regional environmental protection core process, users motivation for the service have been improved/increasing from time to time. They try to adapt holding their waste in their surrounding until the waste workers have visited and collected the waste.

Waste workers satisfaction and their safety: The findings from both MSEs respondents show that from the total 15 respondent's waste workers, 10 respondents are not satisfied due to very low payment, and very few respondents which account 2 and 3 respondents are not satisfied respectively due to the complexity of the job and poor safety of workers condition. If the payment is improved, the workers are interested and committed to the work, waste workers safety is another decisive factor. Workers should have enough protective equipment like foot wear, gloves and masks for safety.

Creating Job opportunity in the society: The findings in the study area reveal that the current SWM system has created job

opportunities particularly for the vulnerable groups in the society (youths, women). For example from the sample respondents 83% are women. This shows that there have been more employment opportunities for women.

Financial sustainability factors: Factors such as beneficiaries, willingness to pay, level of cost recovery and revenue generating mechanisms, availability of incentives and access to credit determine the financial sustainability of the MSEs service.

Beneficiaries' willingness to pay: Nowadays the service fee is revised and the MSEs have delivering the service and users are voluntary to pay for the service and have been collected with water bill *via* BDM. According to FGD held with users of Vision MSE, participants said that "We are already paying for the service but the problem is the collectors have come once in two weeks and sometimes they have come in three weeks interval.

Sufficient contract periods and conducive regulatory system: The availability of a sufficient and conducive regulatory system according to the local context is helpful for the sustainability of an institution. The investigation in the study area shows that the duration of the contract agreement between BDM and MSEs is for three months and renewed every three months, which is too short. The agreement does not allow working in flexible manner. Capacity building is crucial since it increases workers knowledge and skill for better waste management system [15].

Availability of reward systems: Employ evaluation and reward systems also help the workers to enhance their working capacity. In this case, according to the interviews conducted with both MSEs worker there is no reward mechanism until now for the existing workers.

Availability of supervision and monitoring system: Monitoring the actual implementation of the service is very crucial to establish and design mechanisms for effective PPP and feedback from those who implement waste collection service and users as well. The investigation in the study area indicates that 58 % of the respondents confirmed that no supervision has been conducted by BDM. Others, 29% and 13% respectively, replied that there has been very rarely and sometimes a supervisory function by the municipality.

Conclusion and Recommendation

According to our study the increase of municipal solid waste generation is resulted from rapid urbanization and population booming in wolkite city. The main drivers for the municipality were organizing MSEs. The organization of MSEs is purposefully and legally initiated by the local government so as to create employment opportunities for the youths and poor people. In line with this, keeping the cleanliness of the city through them is the second main objective of organizing the MSEs. Currently they are providing a door to door waste collection service with low monthly payment rates for the workers and at a lower cost for the users. The factors that influence the level of sustainability of WCT are identified and discussed through assessing the main and sub variables of sustainability aspects based on the ISWM model. The variables are assessed and presented using relevant indicators in accordance with the findings in the research area as

follows. Technically, though the MSEs have started using locally produced technologies such as hand carts, according to the findings, 80% of the respondents disagree as they are not well fit with the existing road and topography conditions. Waste transport vehicles are general purpose types which are not convenient for loading and not suited for separate collection since they lack compartment containers. Moreover, the lack of sufficient WCT equipment, especially the lack of waste transport vehicles, highly impedes the waste collection activity in wolkite city. Besides because of low awareness of users and lack of attention from BDM waste is hardly segregated at source, the trend shows that almost every waste is stored in one storage material. Due to these main factors the service is not technically sustainable.

Environmentally; the absence of waste separation at source has impact on the collection of recyclable materials. The waste storage materials are not water proof and closed, in addition they are exposed to rain and sun which has resulted in bad odor and affects workers health. The frequency of the waste collection schedule is not short, rather largely scheduled in once a week and more of once in every two weeks which can create favorable conditions for the breeding of microorganism's and pollution. The waste transport is highly limited by the lack of an owned waste transport truck. Besides, the collected waste is not safely disposed in the area. There is no temporary transfer site prior to final disposal and instead the workers simply store in any free space, which results in health related problems and conflicts with inhabitants. All the waste transport vehicles used by MSEs are open types which have no any cover. This will lead dropping of waste during transportation. Further, the final dumping site is not well protected; has no fence. Due to this, animals like cattle simply enter to the disposal site and according to inhabitants their cattle's and sheep has been affected by plastics while grazing. This shows the dumping site by itself has an adverse effect on the surrounding environment. The inadequate monitoring and supervisory function worsen the situation so that it is environmentally not sustainable.

Socially, the service is partially sustainable. The MSEs have created job opportunity particularly for the vulnerable groups in the society and even for educated people. They are currently trying to provide the service for all citizens without discrimination. But workers satisfaction is low due to minimum payment rates their safety is not well kept. Besides they lack medical support. Due to these cases, the service is partly socially sustainable. Financially, the service payment from the BDM to MSEs is almost for the workers monthly subsistence which does not lead and encourage them being financially self- sustainable and to do further activities. Besides, the unfair users service payment system, unavailability of other revenue generating mechanisms and long bureaucracy of the financial institutions to provide credit further adds to the problem. Due to these main challenges the MSEs are financially not sustainable. Institutionally, the service is also not sustainable. This is because the duration of the contract agreement of MSEs is too short for cost recovery. Besides, to its limitedness in time, it does not allow the MSEs to work in a flexible manner. There is no reward system applied to the workers. On the other hand, the monitoring and supervision function is also weak. No customer

satisfaction survey has been conducted about the service of the MSEs. Generally, though the service is partly socially and politically sustainable most of others equally important factors or elements of sustainability are not achieved. The sustainability of the service is highly influenced or affected by a number of factors. Mainly, a serious shortage of waste transport vehicles which has a great impact on the frequency of waste collection, poorly designed hand carts, absence of waste separation at source, unsafe waste disposal methods, insufficient funding systems, inadequate monitoring and supervision and low enforcement of rules to implement activities as per the local context. Because of these challenges the current waste collection and transportation system is unsustainable.

It is justified that in the conclusion part the Municipal solid waste management system in Bahir Dar city is currently not sustainable for the various reasons mentioned above. But this does not mean that the Municipal solid waste management system cannot be improved. In order to improve and make the Municipal solid waste management system sustainable in the future the following recommendations are proposed. The existing hand carts should be modified to fit with the existing road, topography conditions and so as to easily push by the waste workers. The municipality in collaboration with the MSEs workers should encourage and promote waste separation at source. In order to avoid storing of waste in anywhere before final disposal and to minimize conflict there should be specified small transfer sites in the city. The selection of sites should be determined in consultation with waste collectors and users as well. The municipality should have a plan in the short run to minimize the current impact of the final dumping site at least through enclosing/fencing the site. In the long run, the municipalities has to take joint actions with interested as well as potential stakeholders on finding long term measures and funding possibilities in order to upgrade the final dumping site. The wolkite managements M should monitor and supervise regularly whether the waste is safely managed or collected by the MSEs.

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