

Assessment of Solid Waste Management Practices in Bahir Dar City, Ethiopia

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ABSTRACT: Even though solid waste management has become a major public health and environmental concern in urban areas of Ethiopia, only 2% of the population receive solid waste management services. The primary objective of this study is to assess solid waste management practices of Bahir Dar City. The technique of multistage random sampling has been employed to draw 350 households for this study, with both quantitative and qualitative primary data put into good use. Finally, the quantitative data has been analyzed by means of descriptive statistics with the results indicating that 78% of the respondents feel that the current solid waste management service is far below the required level; whereas, 22% of the respondents show satisfaction with the existing waste management service. The municipality has planned to provide solid waste management service for the residents once a week, but the survey results demonstrate that only 29% of the sample households received solid waste management services weekly, indicating that the performance of solid waste management service is low. Among 350 households, a sum of 66.6% practice illegal solid waste disposal with the remaining 33.4% waiting until solid waste collectors come to the area to take the waste away. Therefore, participation of urban households, micro and small enterprises, and governmental and non-governmental organizations plays a great role to upgrade the existing low status of solid waste management services.

Key words: Challenge, Municipality, pollution, urban, transfer station

INTRODUCTION

Economic growth in developing countries has led to massive immigration of people from rural areas to urban ones (Dimitre, 2011). As a result, the number of people, added to the urban population of developing countries, indicates the challenges faced by governments, urban planners, non-governmental service providers, and urban residents (Abdullah, 2009, Damtew and Desta, 2015). Consequently, urbanization and population

growth are solely responsible for the rapid increasing rate of solid waste disposal (Alam and Ahmade, 2013, Monavari *et al.*, 2012, Sankoh *et al.*, 2013). The rate of solid waste production is increasing with population growth, technological development, and changes of people's life style (Ali, 2015, Seadon, 2006, Monavari *et al.*, 2012). Although developed countries produce greater amounts of solid waste than the developing ones (Solomon, 2011), the problem for the latter is further complicated by rapid population growth

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and urbanization, greatly adding to the volume of waste being produced as well as the demand for waste retrieval service in municipal areas (Pradhan, 2009, Rezaei *et al.*, 2010). This implies that the problem of solid waste management in developing countries is more acute than the developed ones (Zerbock, 2003). To solve the problem, most municipalities in developing countries spend 20–50% of their budget on solid waste management, though it covers only less than 50% of the total population (Henry *et al.*, 2006, Memon, 2010).

In developing countries, improper handling and disposal of solid wastes contribute to high levels of mortality and morbidity (Medina, 2002). In addition, improper municipal solid waste disposal and management causes all types of pollution, i.e., air, soil, and water pollution (Alam andAhmade, 2013, Rezaei *et al.*, 2010, Xiao *et al.*, 2007), indicating that human health and ecosystem service is threatened by improper solid waste management (Pradhan, 2009, Rezaei *et al.*, 2010, Giusti, 2009). Even though the overall goal of urban solid waste management is to collect, treat, and dispose solid waste, produced by all urban dwellers, 30-60% of all urban solid wastes are uncollected, and less than 50% of the population is served (Monyoncho, 2013). As a result, inefficient municipal solid waste management system increases disease transmission, contaminates ground and surface water, causes greenhouse gas emission, damages the ecosystem, and demotes tourism along with other business activities (Alam andAhmade, 2013, Ejaz *et al.*, 2010, Chinasho, 2015, Thanh *et al.*, 2011, Giusti, 2009).

Municipal solid waste management has thus become a major concern for many developing nations (Bartone, 2000, Noori *et al.*, 2010). Accordingly, solid waste management is becoming a major public health and environmental concern in urban areas of Ethiopia with only 2% of the

population receiving solid waste collection services (Kassa, 2010).

Bahir Dar is one of the highly expanding and rapidly growing cities of Ethiopia (UNEP, 2010a, Chinasho, 2015). With the current annual population growth rate of 6.6% continuing, the city population will double in 11 years (Christian *et al.*, 2014, Fenta, 2017, UNEP, 2010b). Therefore, the need for adequate solid waste management is unquestionable (Mekete *et al.*, 2009). According to UNEP (2010a), one of the challenges that Ethiopian towns such as Bahir Dar face, is the problem of sanitation, in general, and solid waste management in particular. As much as 98.8 tons of solid waste is daily produced in the city of Bahir Dar; however, the city municipality collects and disposes only 58% of this amount (Fikreyesus, 2011). This implies that small proportions of the urban dwellers are served and large quantity of solid waste is left uncollected, from which, we can conclude that the problem of solid waste management cannot be solved only by mere efforts of municipal government. Hence, this issue needs research and development to figure out the possible challenges of the municipality for providing better solid waste management service and to understand urban households' practices of solid waste disposal as well as the current solid waste management systems of the city. But there are almost no studies to address such issues. As a result, the present study attempts to assess solid waste management practices of Bahir Dar City, particularly aiming at assessing current solid waste management systems of Bahir Dar city, households' solid waste disposal practices, and challenges of Bahir Dar's municipal solid waste management.

MATERIAL AND METHODS

The city of Bahir Dar is located in the north western part of Ethiopia, being the capital city of Amhara Province (UNEP, 2010a). Bahir Dar is located at 11°36" North latitudes and 37°23" East longitudes (Kassie,

2016). Literally, Bahir Dar means a town situated on or very close to the shore of Lake Tana and Blue Nile (Fenta, 2017). It has a total population of 220,344 in 2007 (CSA, 2007), estimated to be 297,749 in 2014. Today, sewage discharge into Lake Tana has become a serious and highly visible problem (UNEP, 2010a). At the same time, Bahir Dar is converting more and more land into streets, parking lots, and hotels which increases the amount of solid and liquid wastes disposed to the environment. Wastes from the household, commercial and

industrial activities, construction leftovers, and agriculture are the main types of wastes produced in the city. Household waste represents 53% of total municipal solid waste produced (Kassie, 2016). Even though waste management and disposal service problems of Bahir Dar have been prioritized, next to housing and flood/drainage problems, 30% to 40% of the waste is still disposed in open places or wetlands, around fences, along streets, in channels, and at the peripheries of water bodies (Kassie, 2016, Fikreyesus, 2011).

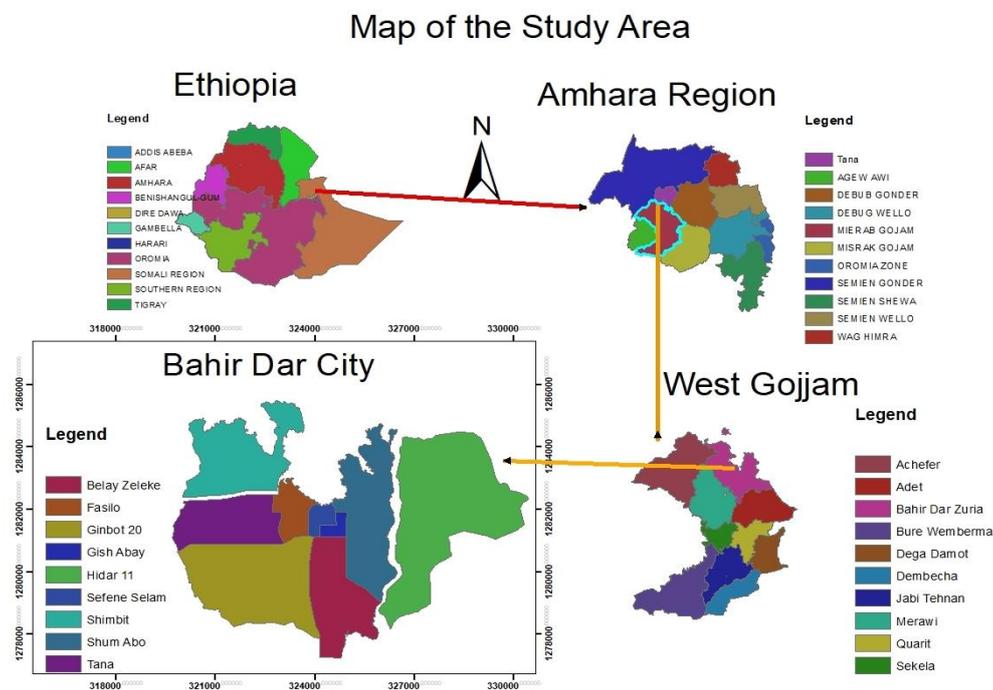


Fig. 1. Map of the study area

Multi-stage random sampling technique was employed to address the objective of this study. In the first step, Bahir Dar was selected, thanks to three major reasons: 1) no background information about households' solid waste disposal practices, 2) current solid waste management system and its challenges, and 3) the exacerbation of the problems, related to solid waste disposal in the city, and a high rate of immigration from rural areas to all directions, which intensifies the pressure for effective waste management in order to avoid outbreaks of diseases. In the second stage, 17 kebeles' of Bahir Dar got

stratified, based on their geographical locations, i.e., inner (Kebele close to the center of the city), middle (kebele located in middle distance from the city center), and periphery (kebele located far from center of the city). In the third step, a total of three kebeles (one from each stratum) were chosen, while in the fourth, 350 randomly-selected urban households were allocated to the sample kebeles, using probability proportional to sample size. Finally, systematic random sampling was applied to draw sample respondents from each stratum.

Table 1. Sample respondents, selected from sample kebeles, based on the proportion of total households

| Stratum | Sample kebele | Total number of households in each sample kebele | Number of sample households |
|-----------|---------------|--|-----------------------------|
| Inner | 04 | 1904 | 124 |
| Middle | 17 | 1910 | 125 |
| Periphery | 11 | 1539 | 101 |
| Total | 32 | 5353 | 350 |

The study utilized both quantitative and qualitative primary data. Household surveys (face-to-face interviews), key informant interviews, focus group discussions, and field observations were conducted to collect the required data for this study. For household surveys, well-structured questionnaires were employed which had both open and close-ended questions. Head departments, staff members from the city municipality, and micro and small enterprise leaders were incorporated as a key informant interviewee to generate better information regarding solid waste management practices as well as its challenges. Focus group discussion is another method of gathering qualitative primary data. As a result, ten focus group discussions were made, each having 8-12 homogeneous members, to gather nuanced information about solid waste management system of Bahir Dar City as well as households' experience in relation to waste disposal practices. Field observations, with regard to the method of solid waste accumulation sites (open spaces, road sides, gullies, drainage channels, collection containers, etc.) were conducted too, in order to support the findings of this study. Finally, the collected data were analyzed, using descriptive statistics such as frequency, percentage, and graphs. On the other hand, qualitative data were utilized in narrative form.

RESULT AND DISCUSSION

Currently, the municipality of Bahir Dar collects solid waste by employing five waste management companies, known as Micro and Small Enterprises (MSEs) as well as one private limited company, called Dream Light PLC. The micro and small enterprises have

334 employees in total (38 males and 309 females) with 36 hand carts and no truck, while in Dream Light PLC there are 13 employees in total (4 males and 9 females), equipped with 16 hand carts and 5 trucks (Table 2). The loading capacity of the trucks ranges from 4m³ to 18.5m³, which on average enables the trucks to load 10m³ of solid wastes. In contrast, average loading capacity of hand carts is a tiny amount of 0.5m³ with a minimum of 0.25m³ and a maximum of 1m³. Engaged in door to door collection of wastes once per week, they bring the gathered waste to communal solid waste accumulation sites, called transfer stations, which are found at the edge of main roads in order to make them accessible for transportation. Those transfer stations give service only to MSE workers who collect solid waste from households, institutions, and commercial areas. However, in many cases those transfer stations are not well-organized to protect the collected waste from rain and sun, being just road side open dumps without any health and aesthetic impact considerations. The companies are paid by the municipality, based on the population and housing units they serve along with the performance of their activities. Bahir Dar municipality pays 392,500 Ethiopian Birr (ETB) per month (\$16,802.23) for solid waste management services, while it receives 335,000 ETB (\$14,340.75) from the residents, which covers 85.4% of the total costs of solid waste management services. All companies provide house to house solid waste collection services as well as transportation of the collected wastes to the landfills. The operational modes of primary collection include hand cart system by all MSEs and

Dream Light PLC, manual adult labour (own force and hired), street sweepers, and wheel barrow system. There are many problems in relation to the collection and disposal of solid wastes in the city. According to personal interviews with MSEs Leaders (one from each company), there is a one-week interval for collection of the solid wastes from the residents.

The cleanliness of the environment depends on regular collection of wastes by the municipality. The results of the present survey indicate that the respondents are not satisfied with the existing solid waste management in Bahir Dar. From all sample

households, about 273 (78%) feel the current services are far below the required level, while 77 (22%) of the respondents are satisfied with the existing waste management services. Although the municipality has planned to regularly provide services to the residents once a week, through the MSEs and Dream Light PLC, the survey results show that only 29% of the sample households received weekly solid waste management services. To add insult to injury, 25% of sample households never received any solid waste services as long as this interview was being made (Figure 2).

Table 2. Background information of Micro and Small Enterprises and Dream Light PLC solid waste collectors in Bahir Dar

| N ^o | Name of small & microenterprises | Year of establishment | Number of staff | | | Services sites | Equipments | |
|----------------|---|-----------------------|-----------------|--------|-------|--------------------------------------|------------|-------|
| | | | Male | Female | Total | | Hand cart | Truck |
| 1 | Dream light Plc | 2002 | 4 | 9 | 13 | Sefene selam, Tana, Fasilo, Gishabay | 16 | 5 |
| 2 | Yifestemal Qalu | 2005 | 10 | 50 | 60 | Hidar 11 | 7 | |
| 3 | Sira Lehiwote | 2005 | 8 | 39 | 47 | Shimbit | 6 | |
| 4 | Green Vision | 2005 | | | | Shumabo | 3 | |
| 5 | Diresse, Tigiste and their friend SWM Cooperative | 2005 | 12 | 44 | 56 | Ginbote 20 | 3 | |
| 6 | Emenat, Guadie and their friends cooperative | 2005 | 8 | 32 | 40 | Belay Zeleke | 3 | |
| 7 | Street sweeping | | - | 131 | 131 | Streets | 14 | |
| | Total | - | 38 | 309 | 347 | 9 | 52 | 5 |

Source: field survey, 2017

Primary waste collection is done by the residents inside their home premises and for this they use various types of bins like baskets, empty oil drums, paper cartons, plastic bags, or simply a pit they dig in their compounds. To estimate weekly solid waste generation of a household, the study used a plastic shopping bag ('Kurtu'), familiar to almost all respondents. The results of the assessment revealed that the average solid waste, generated by a household in a week, was 1.25 Kurtu with a minimum of 0.25 'Kurtu' and a maximum of 3 'Kurtu'. Among 350 households, 328 (93.7%) had a solid waste storage receptacle, used to store solid wastes, and 22 (6.3%) did not have any.

These storage receptacles are not standardized, being made up of various inputs, but they are used for private solid waste collection services. The respondents were also asked the type of storage materials they used for waste collection. Among 328 respondents, 301 (86%) households had one storage material, while the remaining 27 (7.7%) had two and more storage materials. Majority of the households (72%) stocked up solid wastes in sacks; whereas, 16.6%, 7.5%, 2%, and 1.9% of them used plastic containers, baskets, private pits, and metallic containers as a storage material of solid waste in their houses, respectively.

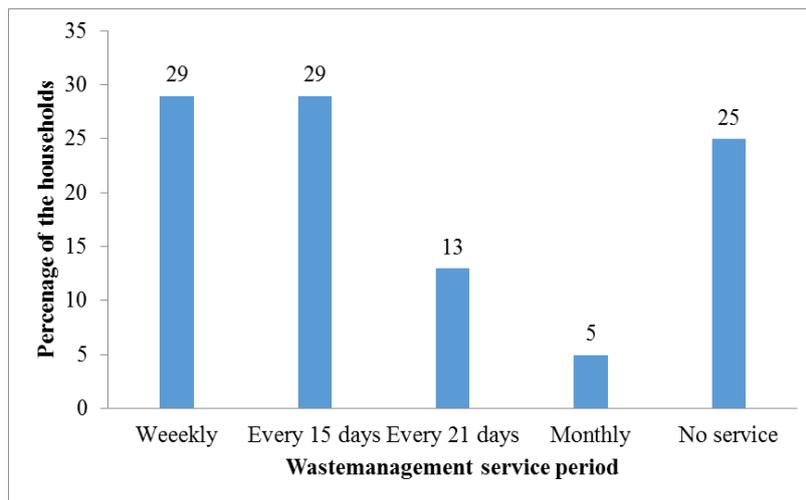


Fig. 2. Percentage of households' solid waste management services delivered by Bahir Dar municipality; source: field survey results, 2017

We tried to observe household's solid waste separation activities, finding out that solid wastes, capable of being sold to *Quraleos* or exchanged with *liwach*, and to some extent organic wastes were separated. Similarly, responses from sample households revealed that about 85 (24.29%) of them were separately store solid wastes, capable of being sold to *Quraleos* or exchanged with *liwach*. According to those respondents, the dominant types of such wastes included textile and old shoes (17.65%); tin and metals (29.41%); plastics (1.2%); glass, bottles, and cans (29.41%); broken electronic gadgets (16.47%), and other types of wastes (4.50%). Households' awareness about usefulness of such discarded wastes for *Quraleos* and *Liwach* together with their low income led them to separately store such wastes in order to make some money and purchase new equipments. In Bahir Dar, there is no mechanized thenology to convert solid wastes into recycled materials, but handcraft is more common in the process of converting solid wastes into recycled items for local use such as *wesfie*, *phermelo*, *zenezena*, and *ambassador shoe*. The information obtained from craftsmen and craftswomen indicated that the average

price of recycled materials were 21.30 ETB (\$0.91), ranging from 6ETB to 40 ETB.

Additionally, 33(13.81%) of sample households are currently separating solid wastes for compost and alternative sources of energy. Some of the solid wastes, separated by such a small number of households, include agricultural and food wastes to be used for home gardens and grass, leaf, sugarcane wastes, cattle waste, and wood scraps to be used as fuel. Out of the total sample, 265 (75.71%) households did not practice solid waste separation due to lack of spaces, incapability to afford separate bins, and lack of ready market for recyclable materials.

The report obtained from the head of SBPDD indicated that the city has around 78 km asphalt and 102 km cobblestone roads. For cleaning purpose, about 131 street sweepers are employed with contract only to cover 58 km asphalt and 35 cobblestone roads. These street sweepers are separately positioned on streets to clean the roads, using brooms. After cleaning, they use wheel barrows to collect piles of solid wastes from the streets, which they most commonly burn in gullies around the streets, load into municipality trucks if it they are nearby, or store in sacks and take to transfer stations.

Street sweeping mostly takes place around the center of the city, where the streets are very crowded. Moreover, residents are very careless to clean their front yards and street. They simply consider it a responsibility of the municipality. For example, about 82.3% of the respondents clean their houses every day, yet annually only 14% of the households participate in cleaning campaigns of their surroundings once or twice on average. This clearly shows how communities pay little attention to their surroundings. Much of the residents of the city are only concerned to protect their homes, yet they do not care about the outside environment.

According to the interviews with the head of SBPDD as well as field observations in Bahir Dar, the functional element of collection includes not only the gathering of solid wastes and recyclable materials, but also the dispatch of these

materials into transfer stations. Only respective city authority is responsible for collecting wastes from secondary points and transferring them by motorized vehicles/trucks. After these companies collect wastes from the sources, the city municipality takes the responsibility to transport the collected wastes to the transfer station (Figure 3).

Sanitation, Beautification, and Parks Development Department (SBPDD) of municipality has set up the time schedule and fixed the vehicles for waste collection and transfer. Generally, collection vehicles such as dump trucks, normal trucks, open trucks, tipping trucks (container carriers), dislodging vacuum tankers with tractors, and power tillers with trolleys stay by the road close to the transfer station for operation. Staff workers are assigned with each vehicle to collect and dispose, though municipality does not have the required number of vehicles and staff to perform the task fully.



Fig. 3. Solid waste transportation and disposal to Bahir Dar transfer station via trucks

By itself, solid waste collection and transportation is not an end for solid waste management process. Proper solid waste management also requires proper disposal of the waste in an appropriate place. Safe and reliable long-term disposal of solid wastes is an important component of solid waste management. In addition to site observation, interview with the head of SBPDD revealed that there is no controlled sanitary landfill in Bahir Dar. The site is situated in and around

the city areas as low-lying open spaces, unclaimed lands, and roadsides. There is currently one open dumpsite, where all collected wastes are disposed. Established 15 years ago, it is known as Sebatamite municipal solid waste disposal site, which is in south eastern part of the city, about 6.5 kilometers away from the city center (Figure 4). With an area of 3-4 hectares, the dumping site is a common place for disposal of all types of solid wastes.

The municipal solid waste is dumped on land, more or less in an uncontrolled manner. It is an open field disposal, close to rural settlements, and is not covered with soil daily, which causes nuisance and health hazards for the people living nearby. Moreover there is no leachate containment or treatment protection at the bottom by a geomembrane nor any required infrastructure. Also the site features no rainwater drain off, no odor or vector control, and no fence which can easily result in blowing of the litters as well as spreading of wastes outside the site, on the surrounding. There is no machinery (compactor or graders) to

regularly work in the disposal site. This uncontrolled burning of solid wastes releases smoke and other types of air pollution.

In the disposal site, leachate may percolate and contaminate surface and ground water as this site is not designed for leachate containment protection. The sources of ground and surface water may be contaminated by these percolated wastes. People use this type of water for different purposes like bathing, washing, drinking, and farming. Also, contaminated water is harmful for fish and aquatic lives as the amount of dissolved oxygen in the water is reduced.

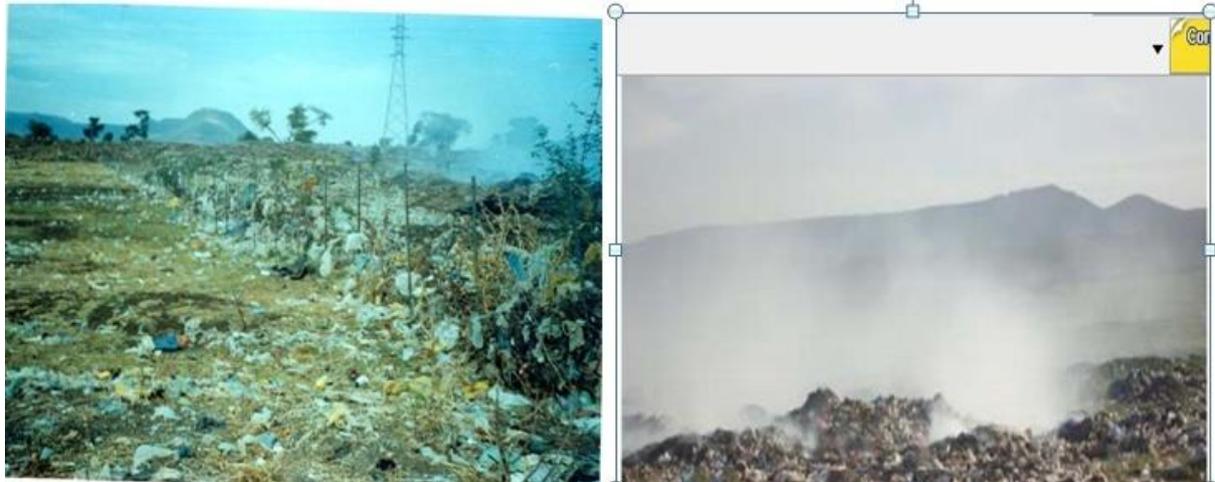


Fig. 4. Sebatamite municipal solid waste transfer station of Bahir Dar

The house to house solid waste collection of the city is insignificant in terms of both spatial coverage and efficiency. Results from the survey show that 25% of the households never received solid waste management services provided by the municipality. As a result, the only solid waste disposal options of such households are limited to two choices: either to simply burn, bury, or dump solid wastes in their compounds or to throw away solid wastes in roadsides, open fields, nearby rivers, bridges, and gullies. The households practicing illegal waste disposal practices, do so because they are not properly served based on the plan of the municipality (i.e., once a week for residents, once a day for higher level

hotels, and once every three days for cafes and restaurants).

Hence, in order to assess the routine method of solid waste disposal practices of households and to know the destination of uncollected solid wastes, sample respondents were asked about their common disposal practices. From the total sample, 233 households (66.6%) practiced illegal solid waste disposal. The remaining 97 households (33.4%), however, waited for solid waste collectors to come to the area and take the wastes away. Results indicate that the majority of sample households (40%) of Bahir Dar disposed wastes illegally at the road sides and open fields, 19.4% of households burned their collected wastes, 8.9% buried them inside their compounds,

5.1% disposed them in and around these compounds, 8.9% simply disposed the waste in the compounds, and the remaining 17.7% dumped them at river sides. Such practices pose high risk on the local environment. It was observed and concluded that open dumping of waste was still the most prevailing activity, practiced by the residents of Bahir Dar, increasing the probability of

environmental pollution, creating a breeding ground for insects, pests, and infectious diseases, and leading to the production of toxic gases. Therefore, it is very essential for the whole community to participate in municipal solid waste management programs of the city, highly expected to bring some changes to the existing low status of solid waste management services.



Fig. 5. Households solid waste collection container and solid waste collectors' transfer station of Bahir Dar; Source: field survey, 2017

Proper disposal and management of municipal solid waste is one of the challenges, faced by the municipality of Bahir Dar. To identify the main factors of inefficiencies of solid waste management services, focus group discussions were made with SBPDD staff members. The following main challenges are summarized based on these discussions' results:

- *Population growth:* With growing urban population, the municipality fails to provide solid waste management services to all urban dwellers. During the last few years, urban population has been increasing and so has the amount of the wastes, generated. Inadequate financial, technical, and personnel capacity of the municipality together with large population size worsens the problem of solid waste management service.
- *Scarcity of equipments and sites:* Almost all MSEs have few equipments

(all of which being hand carts) and they simply collect solid wastes by man power. Similarly, Dream Light PLC only has 16 carts for solid waste collection to cover 50% of the city residents, which is insufficient as well. All MSEs have 347 employees, in sum, yet total number of their carts is 52, meaning that there is only one hand cart for 7 solid-waste collection workers. Furthermore, with the exception of Dream Light PLC, managers of all other MSEs said that they did not have any proper vehicle to transfer solid wastes to their landfill. They simply wait for the municipality-contracted vehicle to do so, which delays waste collection and transportation activities.

- *Limited support:* Involvement of stakeholders such as Kebeles, NGOs, and small and micro enterprise offices in waste management activities is not encouraging. Especially, small and

micro enterprise offices of the city and financial sectors do not volunteer to provide credit for purchasing equipments and collection vehicles. Also, the municipality does not provide waste collectors with training and protective materials. In general, from the above challenges of MSEs and personal observations, it is possible to conclude that MSEs are not well organized and equipped with solid waste collection materials and technologies. As a result, the participation of MSEs is restricted to collect wastes from roadside residents. Thus, in order to solve the city's problem, MSWM, the municipality, the community, as well as governmental and non-governmental organizations should support these agents.

CONCLUSIONS

Municipality of Bahir Dar collects solid wastes through five waste-management companies, known as micro and small enterprises, along with one private limited company, called Dream Light PLC; however, according to the surveys made for this research, only 22% of the respondents were satisfied with the existing waste management services. This indicates poor quality of the services, delivered by the abovementioned waste collectors. Similarly, the municipality has planned to regularly provide solid waste management services to the residents once a week through the MSEs and Dream Light PLC, while only 29% of the sample households received solid waste management services weekly. To add insult to injury, 25% of sample households never received any solid waste services. All these points indicate that there is a gap in monitoring and evaluation of waste management service-provision, on one hand, and implementation of the plan, on the other. Among 350 households, 328 (93.7%) had solid waste storage receptacles, used to

store solid wastes, while 22 (6.3%) did not have any. Also, 72% of them stocked up solid wastes in sacks, whereas 16.6%, 7.5%, 2%, and 1.9% of the respondents said that they used plastic containers, baskets, private pits, and metallic containers to store solid wastes in their houses, respectively. Results indicated that the majority of sample households (40%) of Bahir Dar disposed their wastes illegally on road sides and open fields, while 19.4% burned them, 8.9% buried them inside their compounds, and 5.1% threw them away in and around their compounds. Such illegal practices pose high risk to local environment; therefore, it is better to recognize actively-participating households while creating public awareness about the impacts of illegal waste disposal practices. In general, urban households, micro and small enterprises, and governmental and non-governmental organizations should work together to upgrade the existing low status of solid waste management services.

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