

Full Length Research Paper

The problem of solid waste management and people awareness on appropriate solid waste disposal in Bahir Dar City: Amhara region, Ethiopia

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The problem of solid waste management (SWM) and its implications to health and environmental problems has become increasing. The issue of SWM in Bahir Dar city appeared to be one of the problems that need a great improvement. The principal results show that institutional, economic and social factors hinder SWM service in Ethiopia with particular focus on Bahir Dar city. Also, the results of the study reveal that most of the respondents have low awareness towards appropriate SWM. Purposive sampling was used to sample kebele (Kebele is the smallest administrative unit (administrative neighborhood units) of Ethiopia similar to a ward or peasant association) whereas random sampling technique was employed to select sample households. Data were collected from the respondents using questionnaire, key informant interview and observation. It is recommended that government should encourage the private service providers through clear institutional structure and create community awareness about the disposal systems of solid wastes.

Key words: Solid waste management, appropriate waste disposal, people awareness.

INTRODUCTION

Waste management is an all-encompassing term which describes several distinct processes. It includes the elimination or reduction of waste, recycling of waste material, the treatment and distraction of waste, that is, physically destroying, chemically detoxifying or otherwise rendering waste permanently harmless and disposing or depositing the material into the air, water or land (Ward and Dubos, 1972). As urbanization continues, solid waste management (SWM) becomes a major public health and

environmental threat in urban areas. The daily life in industrialized nations can generate several pounds of waste per consumer, not only directly in home, but also indirectly in factories (Sarker et al., 2012). The problem for these societies, with their ever greater variety, amount and durability of refuse, is getting more serious. However, today, developed nations use solid waste as a multi dollar business and they can manage it to an acceptable level. On the contrary, third world countries face particular

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Table 1. Sampling distribution.

Sample <i>kebele</i>	Households number	Sample household	
		Frequency	Percentage
<i>Kebele</i> 04	5,951	44	29.3
<i>Kebele</i> 06	5,953	45	30
<i>Kebele</i> 17	8,452	61	40.7
Total	20,356	150	100

challenges in the management of solid waste, as in other aspects of environmental management (Eshun, 2002). Therefore, even though SWM is nowhere adequately executed and is a global problem, municipalities from the developing countries are highly faced with this problem.

As long as life has existed in this world, the disposal of waste has been a problem. Agrawal (2002) has argued that collection of solid waste in urban areas is difficult and a complex job because the generation of waste from different sources in a diffuse process complicate the collection task. Especially in under developed countries, the problem of disposal of waste is both difficult and unsolved which further leads to several illnesses caused by infectious and parasitic diseases. According to Forum for Environment (2010), one of the challenges that the Ethiopian towns such as Bahir Dar faces are the problem of sanitation in general and SWM in particular. In Ethiopia, among the well-known cities, Bahir Dar is one of the fast growing tourist destination cities. It is also a center of industrial and commercial activities. Adjacently, the daily waste generation rate in the city is also increasing from time to time (Forum for Environment, 2010). But the current waste collection capacity and disposal system is not matching with the rapid expansion of the city and its corresponding waste generation. It encounters problems like shortage of containers, road side waste bins, public toilets and the absence of proper and well prepared disposal site (FUPI, 2006). Hence, the people give no or little attention to SWM and they dump wastes along the roads and in open spaces. In addition, most of the industries and health centers in Bahir Dar did not start treating and/or reusing their waste properly.

In this regard, a few surveys and studies have been carried out by city administration on the solid waste generation rate and on the assessment of SWM systems. But the assessments made did not consider the attitude of people towards waste disposal and the problems of SWM. Thus, to address this situation, this study has been selected to know about the cause and the problems of SWM.

Specifically, this study will address the following research questions:

1. What are the factors that strongly hinder proper SWM in the city?
2. To what extent the community is aware of appropriate solid waste disposal system?

RESEARCH METHODOLOGY

Description of the Study Area

Bahir Dar city has a flat plateau earth structure which is located at 11°36"North latitudes and 37°23"East longitudes. The historical foundation of Bahir Dar city is associated with the establishment of St. Kidane Miheret Church in the present site of St. Giorgis Church around the 14th century (Seltene, 1988). The naming of the town as Bahir Dar has connection with its near proximity to the two water bodies of Lake Tana and River Abay (Nile). Hence, literally Bahir Dar means a town situated on or very close to the shore of Lake Tana and Blue Nile. Today, it is one of the fast growing largest cities in the country.

In line with its growth, different service sectors such as education, health and transport and communication have grown. However, waste management and disposal service problems of Bahir Dar have been identified as the second and third priority issues next to housing and flood/drainage problems (Bahir Dar City Administration, 2010). The main types of solid wastes produced in the city are household, commercial, industrial, construction leftovers and agricultural waste. There are 220,000 inhabitants in the city and a bit more than half (53%) of the total municipal solid waste generated in Bahir Dar is household waste from residential areas. Another 27, 17 and 3% is from the commercial sector, institutions and street sweeping respectively (UNEP, 2010). However, 30 to 40% waste is left without any management, which are mostly disposed in open places, wetlands, around fences, along streets, channels and at the peripheries of water bodies. The town does not have a proper landfill site; rather it has a simple open dumping place where all types of wastes are dumped in and in the vicinities haphazardly (Metaferia, 2001).

Since 2009, all solid waste disposal and management activities were outsourced to a private firm known as Dream Light Private Limited Company (PLC). This PLC has started a door-to-door waste collection service. In this regard, Public Private Partnership (PPP) is established in the area of dry waste collection and disposal in the city.

Sampling procedure

An appropriate sampling design is important to any research as it will guide the process for collecting the desired data. Therefore, for this study, the residents and administrative personnel have been primarily identified as target population. In order to select respondents, the sample *kebeles* among 17 *kebeles* (now administered in 9 administrative centers) of the town were selected using purposive sampling based on population density, commercial activity and location. As a result, *kebele* 04 (commercial center), 06 (heavily populated), and 17 (city outskirts) were selected. Thirdly, a total of 150 sample households were selected randomly in proportion to the population size in *kebeles* (Table 1). In addition *kebele* officials, elderly people and the dream light PLC leaders were selected as key informants.

Data collection methods

The data for this research are obtained from both primary and secondary sources. The primary source of data was collected through questionnaire, interview and actual observation. Questionnaires (both open and close ended) was held mainly for households to assess their disposal system, their attitude and awareness towards waste generation and proper management, to identify types of wastes they produce and to identify the causes of SWM problem that they are facing. A key informant interview has been made with municipality officials, *kebele* leaders, dream light PLC leader and elders. It was designed to assess the current SWM system of the town, their contribution, to identify the factors that hinder them to make the town clean and to know the history of SWM service system in the city. In addition, the researcher has directly observed the SWM operations taking place at stakeholders, institutions, groups and individuals in Bahir Dar city.

Secondary sources of data were collected through reading and interpretation of documents, publications, annual performance reports and other related materials from city municipality library.

Data management and analysis

The study employs both qualitative and quantitative methods. Descriptive data was coded and analyzed in the light of the literature reviews. Quantitative data was introduced into excel and simple statistical measures such as frequencies, percentages and means were used to reduce the volume of data, making it easier to understand. In addition, maps, photos and figures have been used to analyze the data.

RESULTS AND DISCUSSION

The trend of SWM in Bahir Dar City

Solid waste treatment/management is simply the removal and transfer of waste (Wentz, 1989) which includes not only the gathering up of solid waste from various sources but also having these wastes transported to the location where the collection vehicle are emptied (Tchobanoglous, 1993). In this process the efficiency of SWM could vary based on the availability of resources, technologies and awareness level of the community in different time periods. According interviews made with stakeholders, Bahir Dar has gone through various SWM systems. In light of this, one of interviewed old man called Abahoy Tesfahun has explained the trend as follows:

“....during emperor Hailessilasie’s regime solid waste was collected by car which was rounding through all villages. But the car did not come daily to the villages. Until the car comes, the people were forced to store their solid wastes in their homes and when it comes, they dump the waste to the car and finally the waste was disposed off to landfill.

Later, the car system was changed into public storage container system during the Durg era. At that time, the containers were placed in communal open places nearby villages and the residents disposed of their daily waste in this container. As the container gets full, it was picked up



Figure 1. Dream Light PLC workers segregate and dropout wastes from a car.

by the municipality. I remember that when the waste overflows, unpleasant smell disturbs the surrounding. Today, it has been replaced by the door-to-door collection system. The households only pay a service fee which actually varies according to the amount of solid wastes they produce. The problem what I am facing today is that my waste is not picked up quickly. Generally, even though wastes are dispersed everywhere in the city and pollutes the environment there is an improvement in the system”.

Lohri et al. (2014) has shared the idea that the SWM system of Bahir Dar has undergone some major organizational and institutional changes in the past years. In last of 2008 the municipality of Bahir Dar outsourced the main municipal solid waste management activities (collection and transportation to the dumpsite) to a private waste management company. The interview made with municipality officers has also confirmed that currently household wastes are collected from door-to-door which is done by Dream Light PLC. Primarily, the residential solid waste is stored at the household level whereas street, commercial and organizational wastes are collected in some stations by the employed workers. Dream Light PLC workers collect these wastes from areas suitable for loading to the vehicle/car and finally the car picked up the waste to the landfill (Figure 1). According to Dream Light PLC manager, recently they are trying to segregate wastes before dumping. But it is not more than testing. In addition, he said that they did not give full service to the whole city which worsens the problem of SWM.

Therefore, we can understand that different SWM



Figure 2. Dumped waste at open place and channel.

systems have been established in the history of the city. The households had participated directly and indirectly to keep their city clean. Nowadays, the responsibility of households and other waste generators in Bahir Dar is to accumulate their solid waste carefully within receptacles and wait till the collectors come and take away the garbage. On the other hand, the discussions made with the stake holders revealed that SWM problem still significantly exists in Bahir Dar city.

Constraining Factors of SWM in Bahir Dar city

As literatures read, not more than half of the solid waste is properly collected and disposed of to the final disposal site in Bahir Dar. Both the key informant interview and field observation indicated that the problem of SWM in Bahir Dar city appeared to be largely a result of short comings of the responsible bodies; particularly the city administration, Dream Light PLC and the community. On one hand, the Dream Light PLC is not in a position to provide a satisfactory SWM service. On the other hand, the way communities handle residential solid wastes is not proper. Furthermore, the city administration could not give promotion and encouragement to the service providing body. Generally, these factors could be seen as institutional, socio-economic and administrative factors.

Institutional factors

The institutional problems that mainly hinder SWM

include organizational structure, man power and facilities of SWM in the city. The current organizational structure of SWM in Bahir Dar is very loss and unorganized. Usually SWM service is organized under the city municipality or given to non-governmental organizations. Likewise, in Bahir Dar city, it is run by one private company. But according to the discussion made with the sanitation-beautification and recreational development head, SWM service has been privatized to Dream Light PLC in 2001 without any tender. This absents other organizations which could provide better service. However, the problem is not only being organized and given the PLC; rather it is not completely given to this PLC. As the manager said, on one hand, the activity of collecting waste from households is given to Dream light PLC while the main streets and organizations are served by other workers. On the other hand, mini roads, channels and open places are left for no one. Moreover, Dream Light PLC manager stressed that while the responsibility was given to them, they have not been given power/permission to take measures on those who do not dispose their waste properly. As a result of these facts, instead of paying a service charge for waste collectors, the households prefer to dump wastes in open areas (Figure 2).

In addition to structural defects, the availability of inadequate man power in the system could be seen as an important hindering factor. According to the data taken from city municipality office, there are more than 142 permanent and temporary street sweepers; 100 are employed by city council and the remaining 42 are from the association named Million and his friends. Dream light PLC has 350 employees who give household door-

Table 2. Average waste collection days.

<i>Kebele</i>	Collection /picking days	
	Mean	Standard deviation
04	6	± 5.1
06	5	± 7.1
17	11	± 9.3

Source: Own field survey (2014).

to-door waste collection service. Therefore, taking this number in account and analyzing to what extent the SWM service is smug becomes not surprising.

In addition to being small in number, the workers are not proportionately distributed to *kebeles*. About 71% of the respondents agreed that the problem of SWM is associated with the imbalance between the workers and population size in *kebeles*. The PLC manager also admitted that though the villages do not have equal population size, their workers have been equally distributed to each *kebele* and this causes wastes left uncollected for long in *kebeles* having large population number. This also makes outskirts areas (such as *kera serfer* found in *kebele* 17) with no car passing road to be uncovered by the service. Especially, during holiday when wastes increased in volume and type, the picking up period will become longer.

The other significant problem that considerably affects SWM service is the dis-satisfaction of workers on their work. Providing solid waste collection service is considered as cultural taboo and hence the workers are not seen as a healthy person in the community. Besides, they are low paid workers. They are paid 20 to 25 US dollars or 400 to 500 Ethiopian birr per month (1 US dollar is approximately equivalent to 20Ethiopian birr (as of 2014).). Due to these, they are not morally good and they do not worry about how they perform efficiently which in turn highly affects the quality of the service.

According to scholars like Hoornweg and Thomas (1999), Medina (2002) and Zerbock (2003), waste should be collected on a daily basis from the vast section of the municipal area and then taken to the dumping site. However, this is a typical problem for developing nations around the world. Likewise in Bahir Dar, due to the limited availability and low capacity of cars, the waste is taken to dumping site after long delay. In addition, it was observed that the waste is transported in open trucks and has the tendency to fall off at every bump or pothole on the road. Table 2 shows that the household waste of *kebele* 04 is picked up within an average of 6 days while in *kebele* 06 wastes is picked and transported within 5 days. In *kebele* 17, the wastes are picked and taken to the landfill after much delay than the two *kebeles*. Its mean indicates that the waste is collected (picked) within 11 days (Table 2).

In another additional view, within institutional or

administrative factors, the inactiveness of rules and regulations could take the front step that hinder SWM. The Federal Democratic Republic of Ethiopia has ratified several international conventions that have meaningful implication to SWM in the country such as the Basel Convention, Kyoto Protocol and Stockholm Convention (Forum for Environment, 2010). However, even if there are specific SWM rules and regulations at federal and regional level, their implementation seems very weak and the nature of their implementation is general.

According to the sanitation, beautification and recreational development office director, Bahir Dar city has its own SWM rules and regulations. These rules include the measures that should be taken on illegal waste disposers. For example, the regulation number 14/2008 part 2 and number 8/2008 part 4 state the ways to protect illegal solid waste storage, collection and disposal. However, the *kebele* leaders explained that no measure has been taken. In addition, according to the Dream light PLC leader, since they took the service in contract form for 10 years, they do not have any power to force households to dispose their waste properly and to punish illegal waste disposers but are only responsible to pick up wastes. Hence, members of the community are less aware about the rules and regulation of SWM in the city and some are acting irresponsibly.

Economic factors

Economic factors such as inadequate budget and low income level of the households are the major SWM problems in Bahir Dar city. Before 2009, municipal SWM had been financed by city administration. But currently, the budget has been obtained from different sources. According to the Dream Light PLC manager, the direct source of their budget is the community/waste generator. According to his explanation, they have collected 10 to 50 birr per month from households and 50 to 1000 birr from institutions and hotels based on amount of solid waste and distance from the transfer stations. Fee collection system is not income threshold based, rather it is decided in negotiation between the household head and the collector but it could not be less than 10 birr. However, he boldly underlined that the service charge is not sufficient to cover all service costs and it is very challenging to them to employ additional workers and purchase equipments to give satisfactory SWM service in the city. Coincides to this, the research conducted in Ivory Coast and Bolivia by Ambat (2003) has identified that SWM service is influenced by the willingness to pay, way of payment, availability of sanctions and persons collecting fees. Lack of sanctions and a lack of legal obligations to pay are often the cause of fee collection problems.

In addition to the inadequacy of the budget, low income level of the community has a greater impact on the full implementation of SWM service. Figure 3 indicates that 35.3% of the respondents have a monthly income

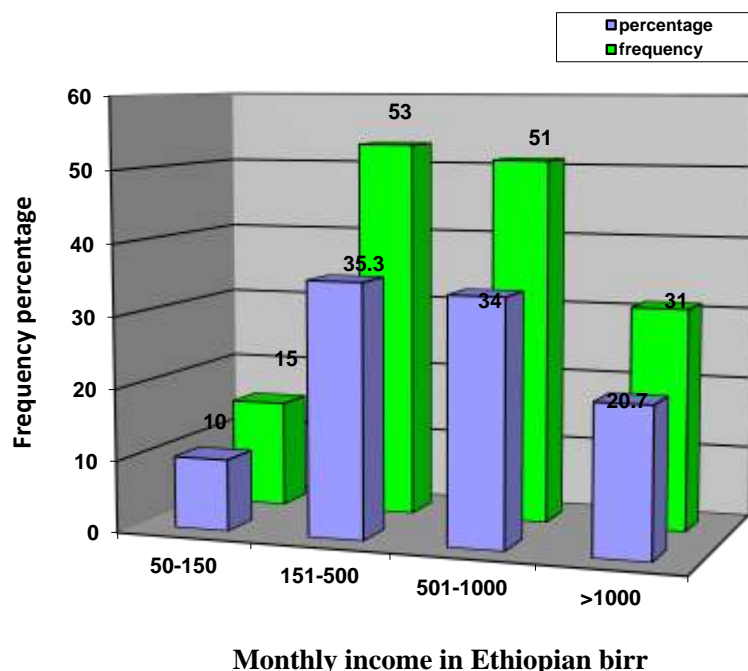


Figure 3. Monthly income of the respondents. Source: Own survey, 2014.

ranging from 151 to 500 birr which is a low level income. About 34% of the households have a monthly income ranging from 501 to 1000 birr whereas about 10% have extremely low (50 to 150 birr) income per month. Thus, based on the current inflation in which the price of one kilo Teff, which is a fine grain widely consumable food crop that is indigenous to Ethiopia and Eritria is above 20 birr, it may be difficult to think that these people are able to pay 10 birr per month for SWM service. The PLC manager has also added that since not being able to pay for the service, low level income households dump their waste on road sides and open areas at night. Forum for Environment and Development (2003) confirmed that in Mali, the micro-enterprise has faced this challenge when they wanted to collect cost covering fees from households. They found that not all service levels are affordable for low income community and it appeared that they could not afford the required fees.

In connection with their low income, poor housing facility of a household has also a significant impact on waste management. The facilities used to properly manage solid waste at the household level include latrine, kitchen and safe communal cooking home. However, the household survey indicated that 42% of the respondents do not have their own kitchen and among them about 30% are cooking their food in open space. The remaining 12% use kitchen by sharing with others. In addition, 31.4% of the households do not have their own latrine and 24.7% of them excrete on open spaces and

Table 3. Household facility.

Cooking place	Respondents	%
Own Kitchen	87	58
Sharing with others	18	12
on open place	45	30
Latrine facility	F	%
Yes	103	68.6
No		
Use public latrine	10	6.7
Use open place and canal	37	24.7

Source: Own survey, 2014.

channels while only 6.7% use public latrine (Table 3). In the same token, the *kebele* officers admitted the fact that most of the public latrines are removed to use the place for construction and hence a household without its own latrine may use toilet in open areas. Therefore, it should be noted that even though low income households produce wastes, they cannot afford the management costs and thus they dispose illegally.

Awareness of households on appropriate SWM

A critical component in any waste management program is public awareness and participation in addition to appropriate legislation, strong technical support and

Table 4. The attitude and awareness of respondents.

No.	Statements	Agree		Disagree		Not sure	
		F	%	F	%	F	%
1	Having a clean environment is vital to health	150	100	-	-	-	-
2	All waste is unwanted or useless	81	54	60	40	9	6
3	Segregating garbage would do well for management	45	30	102	68	3	2
4	It is important that I should know about the SWM program of Bahir Dar	132	82	27	18	-	-
5	It is important that I should know about the SWM rules and regulations of Bahir Dar	79	52.7	67	44.7	4	2.6
6	I am willing to practice waste collection	26	17.3	118	78.7	6	4
7	I am busy; I do not have time to participate in SWM Program	74	49.3	59	39.3	17	11.3
8	Properly disposing wastes in to container or landfill is the job of waste collectors	82	54.7	65	43.3	3	2.1
9	It concerns me if I see garbage scattered anywhere in the city	33	22	112	74.75	3.3	
10	My practice in waste segregation, collection, reduction and reusing will not amount to any significant contribution to the SWM Program in the city	86	57.3	49	32.7	15	10

Source: Field survey, 2014.

adequate funding. Hasan (2004) has explained that waste is the result of human activities and everyone needs to have a proper understanding of waste management issues without which the success of even the best conceived waste management plan becomes questionable. A person who has poor awareness about the impacts of wastes is of opinion that living with the wastes, nothing will happen if they continue likewise and this constrains the proper management efforts.

As literatures argue according to EPA (2007) and Tchobanoglous et al. (1993), awareness of SWM is measured in terms of behavioral change towards what the people perform. Based on this assumption, to assess the awareness level of household respondents, the study employs likert scale analysis: 1-agree, 2-disagree and 3-not sure.

The analysis shows that all (100%) of the respondents have agreed that clean and healthy environment is vital for life. This indicates that they have good attitude to have clean environment. However, 54% of the respondents perceive that all wastes are useless and 68% believed that segregation has nothing to do with waste management and hence 57.3% of them agreed that their participation in segregating, collecting, reducing, reusing, etc of solid wastes may not amount a significant contribution to the SWM process. These infer that the majority of the respondents have low awareness about SWM mechanisms such as recycling and reusing and they may not be aware that segregation is the first step for proper waste disposal.

Willingness of the respondents to participate in waste management process is also low. About 78.7% of the respondents disagree to participate in waste management, 49.3% thought that they are busy and they have no time to participate and further 54.7% believe that

Table 5. Sampled household response about their knowhow of rules and regulations of SWM.

Rules and regulations	Respondent frequency	Percent
People know	67	44.7
People do not know	83	55.3
Total	150	100

Source: Field survey, 2014.

properly disposing wastes is the work of waste collectors. In addition, about 74.7% responded that it does not concern them if they see garbage scattered anywhere in the town (Table 4). Hence, the figures indicated that households put the responsibility of SWM service on the shoulder of the service providing company only and they are not well aware about how, when and where they could participate and manage their waste. But every person can participate in SWM in many ways like paying for the service, properly disposing own waste to the respective receptacle at home, educating others, etc.

On the other hand, 82 and 52.7% of sampled households responded that they agreed to know about the SWM program and its rules and regulations respectively. This may not necessarily mean that they actually know, rather it shows their good will to know. Likewise, the survey data (Table 5) indicated that 83% of respondents do not know about the rules and regulations of SWM in Bahir Dar city. This indicates that they dispose waste and the methods they use to dispose suit them but which may not actually be suitable to the environment.

According to the Dream Light PLC leader, the low awareness of the community could be due to the absence of training and their low educational level. Table

Table 6. The training of SWM.

Attained training	Frequency	Percent	Level of training	Frequency	Percent
Yes	33	22	Very much adequate	2	6.1
No	117	78	Moderately	9	27.3
Total	150	100	Scarcely	21	63.6
-	-	-	Was not	1	3

Source: Field survey, 2014.

6 also confirmed that 70% of the respondents have never got a chance to attend SWM awareness creation trainings and among the trained respondents, 63.6% of them are not satisfied and they level it under scarcely adequate training. However, it is discussed that awareness creation activity requires appropriate approach with continuous effort (EPA, 2007; Tchobanoglous et al., 1993). The approach may vary according to the different backgrounds of stakeholders like educational level, culture, language understanding, capacity of individuals, activities, interest, etc. On the other hand, although stakeholders know and want to act positively, the mechanisms may not be available to help them implement what is required.

Conclusion

This study has tried to investigate the factors of SWM problem and people awareness in Bahir Dar city. The results of the study showed that the major factors that influenced SWM service include institutional, economic and social factors. The city municipality does not have a well-organized and accountable SWM structure. Lack of adequate budget, low economic status of households and low attitude given to solid waste workers and to the job are identified as hindering factors of appropriate SWM service in the city. The study also reveals the current door to door SWM service delivered by Dream Light PLC is not satisfactory. The households dispose their waste like they did in the past and they are not fully aware about how waste should appropriately be disposed of. It is recommended that government should strengthen the private sectors to participate in SWM service. It would also be better if the government establish a well-defined institutional structure that could take the *kebele* administrators, private organizations and households into the SWM system. These encouragements would enhance the initial efforts of waste management and bring the SWM service to the mainstream of Bahir Dar city development plan.

Conflict of interests

The authors hereby declare that no conflict of interest

exists among them.

REFERENCES

- Agrawal A (1995). Indigenous and Scientific Knowledge: Some Critical Comments," Indigenous knowledge And Development Monitor. PhD Dissertation, Montreal University of Technology and management, Canada.
- Ambat B (2003). Study of the Attitude and Perception of Community towards Solid Waste Management; a Case Study of Thiruvananthapuram. City-phase 2. Kerala Research Programme on Local Level Development, Centre for Development Studies, Thiruvananthapuram.
- Bahir Dar City Administration (2010). Integrated Solid Waste Management Plan, Strategic Action Plan (Draft).
- Environmental Protection Agency (EPA) (2007). Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2007, Washington, DC.
- Eshun JK (2002). Coordinating informal settlement solid waste management in to municipal waste system: the case of Accra city. MA Thesis, Netherlands.
- Forum for Environment (2010). Assessment of the Solid Waste Management System of Bahir Dar Town and the Gaps Identified for the development of ISWM Plan. Available at: <http://ekh.rrcap.ait.asia/?q=node/2766>.
- FUPI-Federal Urban Planning Institute and Bahir Dar Metropolitan City Administration (2006). Executive Summary of Bahir Dar Integrated Development Plan (bdidp).
- Hasan S (2004). Public awareness is key to successful waste management. Center for Applied Environmental Research, Department of Geosciences, University of Missouri, Kansas City, USA.
- Hoorweg D, Thomas L (1999). Sources and Types of Solid Wastes. Urban Development Sector Unit, Working Paper Series No. 1.
- Lohri CR, Camenzind EJ, Zurbrugg C(2014). Financial sustainability in municipal solid waste management—Costs and revenues in Bahir Dar, Ethiopia. Waste Manage. 34(2):542-552.
- Metaferia (2001). Upgrading the city of Bahir Dar: Action Plan for Flood Control and Drainage Final Design Report". Metaferia Consulting Engineers and Devecon Architects and Engineers, Ethiopia.
- Sarker BC, Sarker SK, Islam MS, Sharmin S (2012). Public Awareness about Disposal of Solid Waste and its Impact: A Study in Tangail Pourashava, Tangail.
- Seltene S (1988). A History of Bahir Dar Town. MA Thesis, Addis Ababa University, Addis Ababa.
- Tchobanoglous GH (1993). Solid Waste Management Engineering Issue Principle and Management Issue.
- UNEP (2010). Assessment of the Solid Waste Management System in Bahir Dar Town and the Gaps identified for the Development of an ISWM Plan. Forum for Environment, June 2010.
- Ward D, Dubos R (1972). Only one Earth, the Care and Maintenance of a Small planet. London, Penguin.
- Wentz AC (1989). Hazardous Waste Management: Chemical Engineering series. Argone national laboratory.
- Zerbock O (2003). Urban Solid Waste Management: Waste Reduction in Developing Nations. Michigan Technological University.