Original article

Liquid waste management: The case of Bahir Dar, Ethiopia

Fesseha Hailu Mekonnen

Abstract

Background: Human beings pollute the environment with their industrial and domestic wastes. In Bahir Dar Town there is no conventional municipal waste water collection and treatment system.

Objective: The aim of this study was to describe the liquid waste disposal practices of the residents of Bahir Dar Town and to assess the performance of waste water disposing institutions.

Methods: Data were collected from 270 households and 16 experts working in liquid waste management institutions. Different closed and open ended structured questionnaires were prepared to collect the data from the samples.

Results: Sixty-four percent of the respondents discharge their waste water in to the streets and open fields. The inadequacy of sanitation services resulted in defecating in open fields and discharging of raw waste water into inappropriate places and these, in turn, have created serious environmental problems.

Conclusion: There is a weak implementation of the regional sanitation regulations in Bahir Dar. Controlling offenders through strict enforcement of the regulations should be encouraged. Skilled environmental health workers should be assigned at each *kebele* and sub-city to implement sanitation regulations and coordinate the sanitation efforts at the grassroots levels. [*Ethiop. J. Health Dev.* 2012;26(1):49-53]

Introduction

Waste water results from human and animal activities that are unwanted or hazardous. Humans pollute their environment with industrial and domestic wastes. In this case, whenever people do their daily activities, they bring negative effects on the environment. Environmental pollution increases as the density of people increases. Unsanitary environments are favorable for the outbreak and spread of different types of communicable diseases. Most of the disease-causing agents that contaminate water and food come from human and animal wastes. Without proper management, they result in communicable diseases (1). More than half of the population of less developed countries does not have access to sanitation and more than 80% of the waste water generated is directly discharged into surface water bodies (2). In Ethiopia, the sanitation facility coverage gap remains unacceptably large and lack of space for the construction of latrines is one of the reasons (3). The habit of open field disposal of liquid waste is one of the main causes of soil and water contamination and consequently a cause of many communicable diseases (4).

This study was conducted to examine the disposal of liquid waste in Bahir Dar Town. The Town was established during the Italian occupation of the 1930s (5). High population growth rate and rapid rural to urban migration contributed to the growth of the town and currently, Bahir Dar has more than 183,000 inhabitants (6). The Town is located on the shores of Lake Tana (1883 meters above sea level). It is built on a relatively flat land. In the rainy seasons, water accumulates on the surface in many areas the Town. There are no conventional waste water collection and treatment systems in the city, and this creates a high prevalence rate of waterborne diseases. The city is divided into 17 *kebeles*, each of which is subdivided into zones (which represent the lowest administrative units of the urban structure). There is a marked difference in population density between the downtown and suburbs of the city. The downtown has large population with crowded housing units and small urban land holdings compared to the suburbs.

Data from an unpublished report of the Bahir Dar Special Zonal Health Department indicate that significant proportion of outpatients in the Region as being treated for water-borne diseases (7).

Based on the above background, this study has three objectives: to describe the major variables that determine liquid waste management practices of the community; to assess the performance of institutions in waste water disposal; and to evaluate the status of regional sanitation regulation implementation in Bahir Dar Town.

Methods

A cross-sectional study with quantitative and qualitative tools was conducted in March 2008 in Bahir Dar. Respondents were selected with stratified multistage sampling. Three *kebeles* (two from the downtown and one from the suburbs) were randomly selected in the first stage. Six out of the ten zones from the downtown *kebeles* and three out of the five zones of the suburb *kebeles* were randomly selected in the second stage. Finally, a systematic random sampling method was applied for selecting study households in each of the chosen zones.

To determine the sample size, a population proportion sampling procedure was used. To get the maximum sample size, $p = 0.50$ was used as there were no previous estimates available. The researcher allowed the

Bahir Dar University, Department of Geography, P.O. Box 79, Mobile 0918782199, Email fesseha2005@yahoo.com

maximum errors to be ± 6% of the population proportion. The 95% degree of confidence was used. Therefore, sample size was determined to be 270 households. Sixteen experts from Felegehiwot Referral Hospital, Bahir Dar City Sanitation and Parking Office, Bahir Dar Special Zonal Health Department, and the Amhara Regional Health Bureau were also included. The other sources of data were Bahir Dar University, Bahir Dar Prison, and Bahir Dar Textile Factory.

A structured questionnaire was designed to collect information on socio-demographic factors and waste water management practices by the sample households. Semi-structured questions were used to collect information from experts and waste water disposing institutions. Bahir Dar University students administered the questionnaires. To ensure data quality, completed questionnaires were reviewed by senior university staff members. In-depth interviews were made with three informant experts. The researcher had also observed, for seven consecutive days, how different institutions and housing units in the sample *kebeles* managed the waste water they generated.

Data were analyzed using descriptive statistics for comparison of proportions using x^2 and p-values. Regression analysis was also used to analyze the effect of the various factors on latrine availability.

Operational definitions

Waste water is defined as liquid waste from household sinks, showers, laundry and baths.

Ethical Considerations

Ethical clearance was obtained from Bahir Dar University and Bahir Dar City Service Administration Office to conduct this study.

Results

Results from the quantitative survey

A total of 270 respondents were interviewed at the household level, of whom 81 (30%) were males and 189 (70%) were females. Ninety three (34.4%) of the respondents were illiterates while 177 (65.6%) were literates (Table 1). One hundred eighty eight (69.6%) of the households were getting a monthly income of less than ETB 500. One hundred ninety five (72%) of the households had no space in their compound to dispose of the wastewater they generated. Availability of empty land directly affects the collection and safe disposal of waste water. Only seventy five (28%) of the housing units used septic tanks to collect and treat the generated wastewater. Among the total respondents, who had no space in their compound for waste water discharge, 64.3% discharged the waste water they generated into streets. In this study, 80% of the respondents had access to latrines, while 20% used open fields.

Table 1: **Distribution of latrines availability by education, monthly income (in Birr) and space availability in Bahir Dar**

	Latrine availability		Total	X^2	P-value
	Yes	No			
	No (%)	No. (%)	No (%)		
Educational status	**(n=270)**				
Illiterate	78(29.0)	15 (5.5)	93 (34.4)	0.84	P<0.001
Literate	139(51.5)	38 (14.0)	177 (65.6)		
***Monthly income**	**(n=270)**				
Less than 500	139(51.5)	49 (18.1)	188 (69.6)	10.3	P<0.001
501 – 750	39 (14.4)	3 (1.1)	42(15.6)		
751 – 1000	19 (7.0)	1 (0.4)	20 (7.4)		
Above 1000	18 (6.7)	2 (0.8)	20 (7.4)		
Space availability	**(n=270)**				
Have space	66 (24.5)	10 (3.7)	76 (28.1)	3.9	P<0.001
Have no space	148(55.8)	46 (17.0)	194 (71.9)		

Chi square test was performed to assess the association of the various factors related with availability of latrines. Education, income and vacant land availability were statistically significant factors ($x^2 = 0.84$; $p < 0.001$, $x^2 = 10.3$; $p < 0.001$ and $x^2 = 3.9$; $p < 0.001$, respectively) associated with availability of latrines (Table 1).

Logistic regression was performed to assess the impact of a number of factors on the likelihood of availability of latrines. The result indicated that education and space availability were not statistically significant with latrine availability at 0.133, P<0.05 and 0.065, P<0.05 respectively. Income was statistically significant with latrine availability at 0.029, P<0.05. From the income category the group between ETB 500 to 750 was also statistically significant with latrine availability at0.020, P<0.05.

Table 2: **Logistic regression predicting likelihood of reporting for availability of latrine, March 2008, Bahir Dar**

	B	S.E.	Wald	df	Sig.	Exp (B)
Education						
Illiterate	(Ref)					
Literate	0.526	0.350	2.258	1	0.133	1.693
Space availability						
No	(Ref)					
Yes	0.751	0.407	3.398	1	0.065	2.119
Income						
Income group			9.024		0.029	
Less than 500 Birr	(Ref)					
500 -750	-1.466	0.629	5.435	1	0.020	0.231
751-1000	-1.730	1.051	2.709	1	0.100	0.177
More than 1000	-1.016	0.775	1.718	1	0.190	0.362
Constant	-2.001	0.462	18.733	1	0.000	0.135

Results of the Qualitative Study

Services rendered to the residents

The City Service Administration Office is responsible for emptying septic tanks, disposing litter, administering parks and keeping generally the cleanliness of the streets. The Water Supply and Sewerage Service Office also empties septic tanks and provides potable water for the city. The two institutions together handle about 6,120 cubic meter of liquid waste in the year 2005/2006 (8). The waste water generation capacity of the city and the amount of disposed waste is not clearly known. However, most experts (62.5%) estimated that from the total generated waste water about 60-70% is properly removed. The City Service Administration and Water Supply and Sewerage Service Offices do not have adequate skilled manpower in the field or facilities to dispose of waste. The two institutions had only one vacuum truck each, which had 8,000 liters carrying capacity. There was no coordination between the two institutions in rendering service to their clients. They provide their services when the residents requested them to empty their septic tanks.

Wastewater handling practices of selected institutions

There is one dumping site on the outskirts of the city, 7 kilometers from its centre for both solid and liquid wastes. The site is a small, natural depression which fills with water during the rainy seasons. There is no further treatment at this site. The institutions selected for assessing their waste water handling practices are as follows:

Felegehiwot Referral Hospital

The hospital discharges its waste water through pipelines into Lake Tana. This discharge pollutes the environment and is damaging the ecosystem, especially the lake, even though the impact of this has not been properly studied.

Bahir Dar Prison

The effluent from the prison's septic tank is directly discharged into Lake Tana. Contents of the latrine also flow into the surface outside the fence of the prison compound and into the lake. These produce offensive smell to the surrounding. Waste water resulted from body washing and utensil-cleansing also directly flow into the lake. There is one bio-gas digester, but it cannot digest all the waste generated by the institutions; as a result it did not contribute much to minimizing the pollution of the environment. The problem of this pollution has not also been given due attention by environmental protection authorities.

Bahir Dar University

Waste water from the students' cafeteria is directly discharged towards Abay (Blue Nile) River and this produces an offensive smell. The environment seems highly polluted and has not yet been looked into by the sanitation authorities of the city.

Bahir Dar Textiles Factory

This factory treats water from Abay (Blue Nile) River for its consumption, but the liquid wastes and other used waters are directly released back to the river. In the absence of a primary treatment plant, the waste water pollutes the river as well as the nearby environment.

Sanitation regulations

The Amhara National Regional State has established the Regional Hygiene and Environmental Executive Committee which has issued regional environmental sanitation regulations. As per the regulation, residents of the region and establishments/institutions must: construct and use latrines; not release liquid waste to flow onto roads, public places, running waters, wells, lakes, ponds and the like; not use open fields (instead of latrines); and not wash clothes and other similar things in unauthorized places (8). The environmental health inspectors, frontal health workers, and sanitation agents are give the power to ensure full implementation of these regulations. However, a significant portion of the experts (37.5%) engaged in liquid waste disposal activities, as well as 73% of the respondents did not know these regulations. As a result, there was no strict control on the discharge of waste water in the city. Fifty eight percent of the residents interviewed responded that there was no control on waste water discharge to the streets and sidewalks of the city.

Discussion

In this study, it was found that one out of five households do not have access to latrines, using open fields and disposing waste water into the available open spaces. Because of the lack of latrines, waste disposal sites and poor collection practices, only 35% of the city's liquid waste was being collected (9). In the absence of a city sewerage system, the overall drainage in the town is a problem aggravated by the plain geographical terrain and rapid urban growth. The same situation was reported in the City of Addis Ababa where less than 3% of the population has access to a sewerage network and 75% of the pit latrines used to be discharged into open drains (3). Waste water generation potential increases with increasing use of flush toilets, which in turn requires increased wastewater treatment plants (4). This implies the ever-growing Bahir Dar Town with modern buildings using flush toilets will produce more waste water that should be treated. This calls for due attention to the waste water management system of the Town.

In this study, 80% of the respondents had access to latrines, which is higher than the urban households of the region (3). The availability of latrines is also better when compared to the situation in 2007/8 when only 29% of the total households in Amhara Region had access to toilets (10).

The discharge into Lake Tana and Abay (Blue Nile) River and the health hazards of such inappropriate waste water discharge should get due attention by the health inspectors and the residents. Lack of space for waste water collection and treatment seems to be the most important problem especially in the downtown. On the other hand, lack of awareness and carelessness on the part of both the public and sanitation workers and the weak control or absence of punishment of offenders seems to result in the degradation of the environment in the Town.

The waste water management practices of the major institutions of the Town are not also environment friendly. These institutions do not have their own wastewater treatment and management systems. Their waste water disposal provisions are not different from that of individual housing units in the Town. They also discharge waste water into Lake Tana and Abay (Blue Nile) River through tubes and open ditches. Such discharges pollute the environment and create offensive smell and aggravate the conditions for the spread of communicable diseases. Similarly, waste water disposal has been reported to be a major problem in the City of Addis Ababa, where 90% of the industries directly discharge their untreated waste into the nearby rivers and water bodies (11). In less developed countries more than 70% of industrial wastes are dumped, untreated into water bodies (2). Waste water management requires collaboration and coordination among stakeholders including planners, public health officials, waste managers and developers (2). In Bahir Dar, however, there was no well organized coordination among the concerned bodies regarding waste water management.

Conclusion

This study did not attempt to measure the amount of waste water generated, the degree of environmental pollution, or its impact on underground water and the soil. The study also may not be adequately conclusive to refer the result to similar settings other than the study area as it lacks design effect considerations during sample size determination.

Nearly two-thirds of all households in Bahir Dar discharge waste water into streets and flood water drainages. There is a poor level of awareness about existing regulations on sanitation among the experts as well as the public. The City Service Administration Office authorities did not seem to give due attention to waste water management in the Town. There is weak implementation of the regional hygiene regulations. In addition, space availability is an important factor affecting waste water management at household level in the city.

Therefore, the following measures need to be taken to reverse the adverse outcomes: increasing public awareness about waste management; controlling the offenders through strict enforcement of regulations; assigning qualified environmental health workers to each *kebele*/sub-city to enforce the sanitation regulations and coordinating the efforts at the grassroots level. The urban health extension program should also take measures to mitigate the problems.

Finally, a more comprehensive systematic study should be conducted on the impact of waste water that is generated in the Town into Lake Tana and Abay (Blue Nile) River.

Acknowledgements

This research was conducted with the help of a grant from Bahir Dar University for which I am grateful.

I would also like to express my great appreciation to my staff members for all their suggestions and encouragement.

References

1. Mehlers V. Municipal and Rural Sanitation. New Delhi: Tafa McGraw-Hill Publishing Company 1976.
2. UN HABITAT. Sick water? The Central Role of Wastewater Management in Sustainable Development. [Accessed 20 May 2008]. Available from: www.unhabitat.org.
3. Mengesha A, Mamo W, Tesfaye T. Sanitary survey in Gondar Town. *Ethiop Med J* 2004; 18(1):39-43.
4. Nanda R. Human Relations and Primary Health care Delivery in Rural Nepal: The case of Deurali.

Journal of Professional Geographers 1988;40(2):17-23.
5. Melkamu B. The need for real Estate Management in Urban Ethiopia: The case of Bahir Dar City [Accessed 1 April 2008]. Available from: http//:www.enhr2007rotterdam.nl/documents/w17.
6. Central Statistical Authority. Statistical Abstract. Addis Ababa: 2007.
7. Bahir Dar Special Zonal Health Department. Report of health services for the year 2004/2005. Unpublished, Bahir Dar, Ethiopia.
8. The Hygiene and Environmental Health Executive Committee Regulation No.16/2000, Bahir Dar, Ethiopia, 2000.
9. Debora K, Tadesse E. Deepening Decentralization in Amhara national Regional State and Tigray National Regional State and Restructuring of nine local urban Governments [Accessed 5May 2008]. Available from: www.urban.org.
10. Global Sanitation Collaborative Council. Sanitation Sector Status: Ethiopia. [Accessed 20 Sep 2009]. Available from: http//wsscc.org/sites/default/files/gsf ethiopia_sector_review.
11. Woineshet M. Integrated Housing Development programs for Urban poverty alleviation and Sustainable urbanization (The case of Addis Ababa). [Accessed 20 June 2008]. Available from: www.enhr2007rotterdam.nl.