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Urban households' demand for improved solid waste management service in Bahir Dar city: A contingent valuation study

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Abstract: Primary data from 350 households were collected to assess the solid waste management system of Bahir Dar city, to elicit urban households' willingness to pay for improved solid waste management service and to analyze factors affecting urban households' willingness to pay. The survey result indicated that 22% of the respondents were satisfied with the existing waste management service. Whereas, only 29% of the sample households received solid waste management services based on weekly plan of the city municipality. The contingent valuation result revealed that the mean willingness to pay is 13 ETB per month which is higher than the monthly flat fee of urban households. The model result demonstrated that education level of household head, monthly aggregate income, access to solid waste management service, disease outbreak, number of children and quantity of waste generated per week had statistically significant positive effect on households' willingness to pay. But sex of the household head had statistically significant negative effect on households' willingness to pay. The implications of the findings are that the municipality of Bahir Dar city should consider the demand of households for improved solid waste management service and these significant variables to design and implement improved solid waste management services.

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PUBLIC INTEREST STATEMENT

Solid waste management has become a major issue in urban areas of Ethiopia though only 2% of the population received solid waste collection services. A total of 144.6 tons per day of solid waste is generated from Bahir Dar city; only 51% was properly collected and disposed. So, inefficient solid waste management increase environmental pollution, disease transmission and damage ecosystem services. Therefore, the need for adequate solid waste management service is unquestionable. So, households are required to pay a monthly flat fee of 8 ETB for solid waste management service. But this revenue is not sufficient to cover all costs of solid waste management because the affordability and willingness to pay of the urban households that are supposed to be served has been ignored. Consequently, the revenue streams need to be increased based on the demand of urban households so as to cover the cost of solid waste management service.

Subjects: Urban Studies; Economics; Environmental Economics

Keywords: contingent valuation; double bounded; ordered probit; open ended

1. Introduction

Solid waste management is more prominent in middle- and low-income countries where there is rapid population growth and urbanization (Alam & Ahmade, 2013; Damtew & Desta, 2015). The booming growth of cities of the developing world has created limited financial resources of municipalities to deal with the provision of solid waste management services (Birke, 1999). This is because the rate of generation of solid waste increases with the increase in population, technological development and the changes of the life style of the people (Ali, 2015; Monavari, Omrani, Karbassi, & Raof, 2012; Sankoh, Yan, & Tran, 2013; Seadon, 2006). Even though developed countries generate greater quantity of solid waste than developing countries (Solomon, 2011), the problem of solid waste management in developing countries is more acute than developed countries (Zerbock, 2003). Most of the municipalities in developing countries spend 20–50% of their budget on solid waste management which covers less than 50% of the total population (Henry, Yongsheng, & Jun, 2006; Memon, 2010).

Municipal solid waste management has become a major issue of concern for many developing nations (Bartone, 2000). The overall goal of solid waste management is to collect, treat and dispose of solid waste generated by all urban dwellers, 30–60% of all the 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 increase disease transmission, contaminate ground and surface water, create greenhouse gas emissions, damage ecosystem services, discourages tourism and other business activities (Alam & Ahmade, 2013; Chinasho, 2015; Ejaz, Akhtar, Nisar, & Naeem, 2010; Thanh, Matsui, & Fujiwara, 2011). Due to this, solid waste management is becoming a major public health and environmental concern in urban areas of Ethiopia though only 2% of the population received solid waste collection services (Kassa, 2010). In Ethiopia, solid waste management is mainly the responsibilities of municipalities, which resulted in inadequate service provision (Bewketu, 2013; Hagos, Mekonnen, & Gebreegziabher, 2012). Because of the existing poor waste management systems in Ethiopia, cities have neither adequate nor acceptable levels of practice in waste handling and disposal systems (USAID, 2015).

Bahir Dar is one of the highly expanding and rapidly growing cities in Ethiopia (Chinasho, 2015; UNEP, 2010a) with the current annual population growth rate of 6.6% continues, the city population will double in 11 years (Fenta, 2017; UNEP, 2010b). The daily waste generation rate in the city is also increasing from time to time (UNEP, 2010a). A total of 144.6 tons per day of solid waste is generated from Bahir Dar city in 2016 (Fenta, 2017; UNEP, 2010a). From the total waste generated, only 51% was properly collected and disposed (UNEP, 2010b). This implies that small proportions of the urban dwellers are served and large quantity of solid waste left uncollected. Thus, the need for adequate solid waste management is unquestionable (Mekete, Atikilt, & Hana, 2009). From this, we can conclude that the problem of solid waste management cannot be solved only by mere effort of municipal government because these interventions that aim to improve the coverage and quality of waste management services are not demand oriented. For example, households who have water bill are required to pay a monthly flat fee of 8 ETB for solid waste management service together with water service. Scholarly literatures indicated that the payment rate is reported as being low because only 50% of the households pay the collection fee (Lohri, Camenzind, & Zurbrügg, 2014). This indicates that the affordability and willingness to pay of the urban dwellers that are supposed to be served has been ignored. Due to this gap, the revenue collected from households is not sufficient to cover all costs of solid waste management services (staff salary, transport, maintenance, and other operational expenses) (USAID, 2015). So, the revenue streams need to be increased so as to cover the cost of solid waste collectors. Therefore, assessment of the urban households' for improved solid waste management service plays a great role to find sustainable solution for this inefficient solid waste management service. But a study about urban households' demand for improved solid waste

management service in Bahir Dar city is totally nix. So, this study was conducted to assess Bahir Dar city solid waste management system and elicit households' willingness to pay for improved solid waste management services using double bonded contingent valuation method and analyze factors that affect households' willingness to pay for improved solid waste management services using ordered probit model.

2. Material and methods

2.1. Description of the study area

Bahir Dar city is located in the north western part of Ethiopia which is the capital city of Amhara region (UNEP, 2010a). Bahir Dar city is located at 11°36″ North latitudes and 37°23″ East longitudes (Kassie, 2016) (Figure 1). 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) and estimated number of 321, 319 in 2016 (Fenta, 2017; UNEP, 2010a, 2010b). Today, sewage discharge into Lake Tana has become a serious and highly visible problem (UNEP, 2010a). At the same time, Bahir Dar city is converting more and more land into streets, parking lots and hotels. This increases the amount of solid and liquid wastes disposed to the environment. Household, commercial, industrial, construction leftovers and agricultural wastes are the main types of wastes produced in the city. Household waste accounts 53% of the total municipal solid waste generated (Kassie, 2016). Even though waste management and disposal service problems of Bahir Dar have been identified as the priority issues next to housing and flood/drainage problems, 30–40% waste is disposed in open places, wetlands, around fences, along streets, channels and at the peripheries of water bodies (Fikreyesus, 2011; Kassie, 2016; UNEP, 2010a).

2.2. Sampling procedure

Multi stage random sampling technique was employed to address the objective of this study. In the first step, Bahir Dar city was selected because of three major reasons: lack of background information about households' solid waste disposal practices, current solid waste management system and its challenges; the increment of solid waste disposal induced problems in the city and the presence of high rate of migration from rural areas in all directions, and these increases pressure to manage

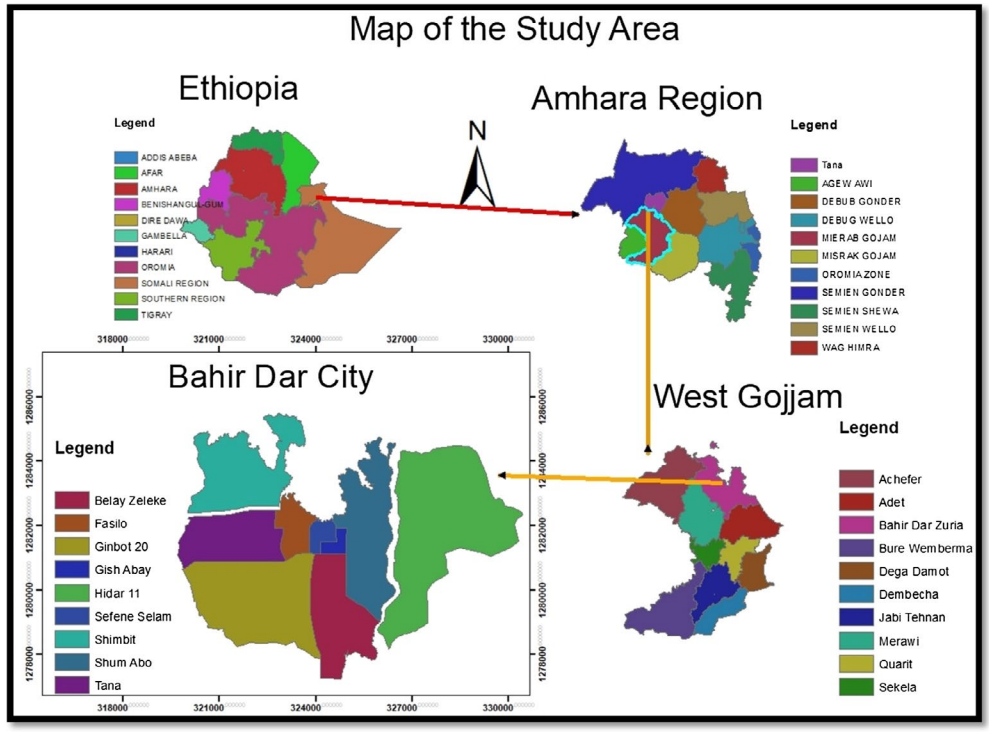

Figure 1. Map of the study area.

waste effectively in order to avoid outbreaks of diseases. In the second stage, 17 kebeles' of Bahir Dar city was stratified based on geographical location, i.e. inner (kebele close to the center of the city), middle (kebele located in the middle distance to the 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 selected. In the fourth step, 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.

2.3. Source and method of data collection

This study utilized both primary and secondary data. Household survey (face-to-face interview), key informant interview and focus group discussion were undertaken to collect the required data for this study. Household survey was conducted using well structured questionnaires with 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 to solid waste management practices and households' willingness to pay for improved solid waste management service. Focus group discussion is another method of gathering qualitative primary data. As a result, 10 focus group discussions were made with 8–12 homogeneous members to gather nuanced information about solid waste management system of Bahir Dar City, the experience of households in relation to waste disposal practices and to order households' willingness to pay (low, medium and high). The questionnaire for household survey was designed in two parts. The first section incorporates socioeconomic characteristics of respondents and the second section contains contingent valuation scenario and household's willingness to pay for improved solid waste management services. Pretest with open-ended questions provides some information on the bounds of respondents' WTP (Hoyos & Mariel, 2010). As a result, 20 households were randomly selected for pretest before the actual survey. As the result indicated, the willingness to pay of the respondents ranges from 0 to 40 ETB per month for improved solid waste management services. Depending on the result of preliminary survey, initial bids were determined using open-ended contingent valuation format (Belhaj, 2003; Fentahun, 2014; Gebremariam, 2012; Kasaye, 2015; Tilahun et al., 2011). As a result, 6, 12 and 18 ETB per month followed by open-ended questions were randomly assigned to 350 sampled households in the final survey (Ayenew & Meride, 2015; Fentahun, 2014; Gossaye, 2007; Marta-Pedroso, Marques, & Domingos, 2012). Finally, the cross-sectional data were collected using carefully designed contingent valuation survey questionnaire.

2.4. Method of data analysis

Descriptive statistics and econometric model were used to analyze the data to discover useful information, suggest conclusions and support decision-making. Hence, the collected data were analyzed using statistical software (SPSS version 23.0 and STATA 13). Descriptive statistics such as percentage, mean, frequency and tables were used to summarize and present the data in a manageable form. Whereas, the choice of econometric model depends on the nature of the dependent variable, i.e. nominal, ordinal, interval, and/ratio scale. So, the dependent variable of this study is households' willingness to pay which takes 1 for low, 2 for medium and 3 for high. This implies that the dependent variable has order responses. To do this, consecutive focus group discussions were made with selected individuals to order sample households willingness to pay for improved solid waste management. Based on the discussion, municipal solid waste management fee (8 ETB per month) and mean willingness to pay of households (13 ETB) were used as a cut of point to categorize their willingness to pay, i.e. $0 < WTp < 8$, low; $8 \leq WTp < 13$, medium and $WTP \geq 13$, high. As a result, ordered logit and probit models are the right econometric models to analyze ordered response dependent variables (Wooldridge, 2002). How do logit models differ from probit models? This question is answered by (Park, 2015). The core difference lies in the distribution of the error term. In the logit model, error term is assumed to follow the standard logistic distribution; whereas, probit model is assumed to follow the standard normal distribution. With this minor difference, ordered probit model was employed to analyze determinants of households' willingness to pay for improved solid waste management services. Following(Wooldridge, 2002), the model is specified as follows:

$$y = j \text{ if and only if } \alpha_{j-1} \leq y^* \leq \alpha_j \; j = 1, \ldots\ldots, J$$

$$y = 0 \text{ if } y^* \leq \alpha_1$$
$$y = 1 \text{ if } \alpha_1 \leq y^* \leq \alpha_2$$
$$\ldots$$
$$\ldots$$
$$y = j \text{ if } \alpha_{j-1} \leq y^* \leq \alpha_j$$

$$y^* = \beta_0 + \beta_i \sum_{i=1}^{n} X_i + \varepsilon$$

Where α_{j-1} *and* α_j are threshold parameters

β_0 = constant term,

β_i = coefficients of explanatory variables,

X_i = Explanatory variables, and

ε = Error term

Based on review of previous empirical studies (Aklilu, 2002; Amfo-Otu, Debrah, Adjei, & Akpah-Yeboah, 2012; Hagos, Mekonnen, & Gebreegziabher, 2013; Nkansah, Dafor, & Essel-Gaisey, 2015; Thirumarpan & Dilsath, 2016), household socioeconomic characteristics and attributes of solid waste management which are hypothesized to affect urban households' willingness to pay for improved solid waste management service were identified (Table 1).

3. Result

3.1. Solid waste management systems of Bahir Dar city

Even though the municipality of Bahir Dar city collects solid waste using five waste picker cooperatives known as Micro and Small Enterprises (MSEs) and one private limited company called dream light Plc, only 22% of the respondents were satisfied with the existing waste management service. Similarly, the municipality is planned to provide solid waste management services for residents once per week in regular way by MSEs and dream light Plc, only 29% of the sample households received solid waste management services weekly. Contrary to this, 25% of sample households never received solid waste management services (Figure 2). This indicates that there is a gap in monitoring and evaluation of waste management service provision and implementation of the plan.

In addition to this, the house to house solid waste collection service of the city is insignificant both in spatial coverage and efficiency. As a result, the only solid waste disposal options of these

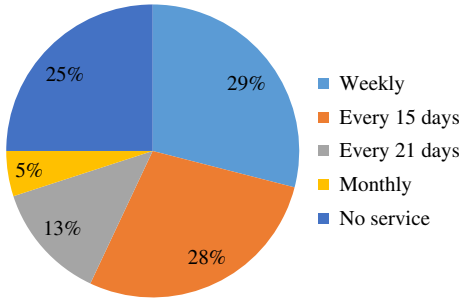

Figure 2. Households solid waste management services delivered by Bahir Dar city municipality.

Table 1. Definition, descriptive statistics, and expected sign of variables

Variable	Definition	Measurement	Descriptive statistics		Expected sign
			Percent	Mean	
SEXOFHH	Sex of household head	1 for male, 0 otherwise	47.1		−
AGEOFHH	Age household head	Year		49	−
MARITSTATUS	Marital status	1 married, 0 otherwise	80.9		+
EDUCLEVEL	Educational level	Year		7	+
JOBOFRES	Job of respondents	1employed, 0 otherwise	72		+
MONAGGRINC	Monthly aggregate income	Ethiopian Birr		1,564	+
DURRESIDENCE	Duration of residence	Year		17	+
ACCESSWAMGTS	Access to waste management service	1 user, 0 otherwise	75		+
QUANWGEN	Quantity of waste generated	Plastic bag (kurtu)		1.25	+
DISEOB	Disease outbreak	1 yes, 0 otherwise	94.9		+
NUMCHILD	Number of children	Number		2	−
RESPWMGT	Responsibility of waste manage-ment	1 responsible,0 otherwise	88.9		+
HEADST	Headship status	1 head, 0 otherwise	72.9		+

households are restricted in two choices. The first one is simply burning, burying, or dumping of solid waste in their compounds. While the second option is throwing of solid waste at roadsides, open fields, nearby rivers, bridges and gullies. As a result, 40% of the sample households disposed waste at the road sides and open fields; the remaining 60% of sample households practiced burning and burying of the collected waste in their compound. The survey result indicated that 328 (93.7%) households had solid waste storage receptacles used to store solid wastes and 22 (6.3%) did not have any storage receptacles. Among 328 households, 72% of them stock up solid wastes in sack; whereas, 16.6, 7.5, 2, and 1.9% of households use plastic container, basket, private pit, and metallic container as a storage material of solid waste in their home, respectively.

3.2. Households' willingness to pay

Double bounded contingent valuation method followed by open ended question was used for this study to elicit the households' willingness to pay for improved solid waste management services. The result indicated that 302 (86.3%) of sample respondents were willing to pay for improved solid waste management services; whereas, 48 (13.7%) of the respondents were not willing to pay anything at all. The willingness to pay of sample households ranges from 0 to 35 ETB per month for improved solid waste management services. The mean and mode of their willingness to pay is 13 ETB and 8 ETB, respectively. This implies that the respondents' average willingness to pay is much higher than the current solid waste management service charge (8 ETB per month).

In addition to this, low, middle and high income groups' willingness to pay were also analyzed. The result indicated that the mean willingness to pay of low income groups were 6.5 ETB per month. On the other hand, the mean willingness to pay for middle income and high-income groups were 13.25 and 16.75 ETB, respectively. This implies that the willingness to pay of households is different for

Table 2. Summary of households' willingness to pay by income group

WTP class boundaries	Total observation		Low income		Middle income		High income	
	No	%	No	%	No	%	No	%
$0 < WTp < 8$)	125	41.4	26	40	47	38.5	52	45.2
$8 \leq WTp < 13$	112	37.1	26	40	48	39.3	38	33.1
$WTP \geq 13$	65	21.5	13	20	27	22.2	25	21.7
Total	302	100	65	100	122	100	115	100

Source: Own survey, (2017).

different income groups. As the table below indicated, the numbers of respondents decrease if the bid gets higher and higher (Table 2).

4. Discussions

4.1. Estimation of total willingness to pay

The total willingness to pay of households for improved solid waste management service was estimated based on the proportion (willing vs not willing households) of the survey result. As the result indicated, nearly 86.3% of sample respondents were willing to pay for improved solid waste management services. Based on this, 56,690 out of 65,690 households were willing to pay for solid waste management service. The total number of households in each class limit was obtained by multiplying the ratio of sample households in each class limit by the total number of households of Bahir Dar city (column V). Similarly, the willingness to pay of the total households was also calculated by multiplying the total households by the associated class mark of WTP (column VI). The total willingness to pay was obtained by adding the willingness to pay of the total households in each class limit. Finally, the result indicated that the total willingness to pay is 573,004.02 ETB/ month (Table 3). The result of this study is much higher than the amount of money collected by Bahir Dar city municipality (335,000 ETB).

4.2. Factors affecting households' willingness to pay

Thirteen explanatory variables were included into the ordered probit model to predict factors affecting farm households' willingness to pay for improved solid waste management services. Table 4 shows the sign, magnitude, statistical tests, marginal effects and significance level of each explanatory variable. Out of the 13 variables hypothesized to influence households' willingness to pay, four variables were found to be statistically significant at less than 1% significant level. These variables are sex of the household head, educational level, monthly aggregate income and disease outbreak. Whereas, number of children and quantity of waste generated were significant at less than 5% significant level.

Even though sex of the respondents was hypothesized negatively, the result of the model indicated that the variable had statistically significant negative effect on willingness to pay at less than 1% significant level. This implies that female respondents are more willing to pay for improved solid waste management than male headed households. In our country context, females are responsible for cleaning the house, waste collection and disposal. This creates awareness for females about the effect of improper disposal of solid waste on the environment and human health. The marginal effect result of the model indicated that male headed households are 42.1% less likely to pay high amount for improved solid waste management service; whereas, he/she is more willing to pay low and medium amount (Table 4).

Educational level of the respondents was positively hypothesized with households' willingness to pay for improved solid waste management service. As expected, the variable was found to have statistically significant positive effect on households' willingness to pay. This implies that increase in the respondent's level of education increases their knowledge about the short term and long term

Table 3. Estimated total willingness to pay for improved solid waste management service

WTP (class limit)	Class mark of WTP	Sample distribution		Total No households	Total WTP
		No	%		
1–6	3.5	125	41.4	27,189	95,161.82
7–12	9.5	112	37.1	24,378	231,586.81
13–18	15.5	37	12.3	8,047	124,728.89
≥19	20	28	9.3	6,076	121,526.50
Total		302	100	65,690	573,004.02

Source: Own computation.

Table 4. Factors affecting households' willingness to pay for improved solid waste management service

Variables	Coefficient	*T*-value	Marginal effects		
			Low	Medium	High
SEXOFHH	−1.217**	−5.17	0.363	0.056	−0.421
AGEOFHH	−0.003	−0.43	0.001	0.001	−0.002
MARITSTATUS	−0.247	1.44	−0.084	−0.042	0.127
EDUCLEVEL	0.262**	2.56	0.072	0.036	−0.108
MONAGGRINC	0.005**	4.07	−0.0002	0.0001	0.0002
NUMCHILD	0.513*	2.40	0.133	0.066	−0.199
DURRESIDENCE	0.012	1.37	−0.003	−0.001	0.004
ACCESSWAMGTS	0.607**	3.07	−0.203	−0.070	0.274
QUANWGEN	1.623*	2.54	−0.400	−0.200	0.601
JOBOFRES	0.517	2.22	−0.153	−0.043	0.196
RESPWMGT	0.078	−0.36	−0.032	−0.015	0.048
HEADST	0.078	0.39	0.041	0.023	−0.065
DISEOB	1.247**	4.46	0.409	0.031	−0.443
/cut1	0.824	Log likelihood			−143.21
/cut2	0.881	LR $\chi^2(13)$			246.36**
Number of obs.	302	Pseudo R^2			0.580

Source: Own survey (2017).

*Significance at 5%.

**Significance at 1%.

impact of accumulated solid waste on human health and esthetic value of the environment which increases the probability of household's willingness to pay for solid waste management service. This is because educated respondents clearly understand all the threats, diseases and damages caused by improper solid waste management. The marginal effect result of the model indicated that the probability of households' willingness to pay of low and medium amount would be increased by 7.2 and 3.6% if educational level of households increased by one year (Table 4).

As expected, monthly aggregate income of the household was found to have statistically significant positive effect on households' willingness to pay. This implies that the higher the income of the respondents, the maximum amount they are willing to pay for improved solid waste management services. This also proves that the amount high income respondents are willing to pay is expected to be more in comparison to lower income respondents. This is because having more income increases

the purchasing power of respondents. As the model result indicated, increase in income of the households positively influence households' willingness to pay for medium and high amount.

The number of children in the household was negatively hypothesized with households' willingness to pay for improved solid waste management service. But, the variable had statistically significant positive relationship with households' willingness to pay. This indicates that increase in the number of children in the household leads to increase in households' willingness to pay. This is due to the fact that households who have large family size generate more waste as compared to households having small family size.

As expected, access to solid waste management service had positive effect on households' willingness to pay for improved solid waste management. This indicates that access to municipal waste management service create awareness for the respondents about the environmental and health effect of solid waste management. So, this service triggers the households' willingness to pay for better solid waste management service. The result of the model indicated that municipal solid waste management service users are 27% more likely to pay high amount for improved solid waste management service.

Quantity of waste generated per week by shopping plastic bag was positively hypothesized with households' willingness to pay. The result of the model indicated that the variable was found to have positive and statistically significant effect at less than 5% significant level. This reveals that the higher the quantity of waste generated, the higher the amount the households' willingness to pay for improved solid waste management services. The probability of households' willingness to pay for high amount will be increased by 60.1% if the quantity of waste increases by one kurtu.

The occurrence of diseases in the household has statistically significant positive effect on households' willingness to pay. This implies that the incidence of diseases in the household because of improper solid waste disposal increases his/her responsiveness about the value of solid waste management services. So, the better and more rewarding services of solid waste management increases households willingness to pay for improved solid waste management to save them from improper solid waste disposal-induced diseases.

5. Conclusion

The daily waste generation amount (144.6 tons per day) in Bahir Dar city is increasing from time to time. To alleviate this problem, Bahir Dar city municipality collects a monthly flat fee of 8ETB per month from households. But the revenue collected from households is not sufficient to cover all the costs of solid waste management services (392,500 ETB) because the payment rate is reported as being low (only 50% of the households pay the collection fee). Therefore, this study aimed to assess solid waste management system of Bahir Dar city, to elicit urban households' willingness to pay for improved solid waste management service and to analyze factors affecting households' willingness to pay. The result indicated that only 22% of the respondents were satisfied with the existing solid waste management service. Although the municipality planed to provide solid waste management services for residents once per week, only 29% of the sample households received solid waste management services weekly. Contrary to this, 25% of sample households never received solid waste management services. This indicates there is a gap in monitoring and evaluation of waste management service provision and implementation of the plan. The contingent valuation survey result revealed that 86.3% of sample respondents were willing to pay for improved solid waste management services with the mean WTP of 13ETB. This implies that the respondents' average willingness to pay is much higher than the current solid waste management service charge. As a result, it is better to design and implement demand oriented improved solid waste management service to collect more funds and deliver better service for Bahir Dar city dwellers.

The study also attempts to discover significant explanatory variables that are assumed to influence households' willingness to pay using ordered probit model. The result demonstrated that education level of household head, monthly aggregate income, access to solid waste management service, disease outbreak, number of children and quantity of waste generated per week had statistically significant positive effect on households' willingness to pay. This implies that the above variables increase the probability of households' willingness to pay for improved solid waste management services unlike negatively related variables (sex of household head). The implications of the findings are that the municipality of Bahir Dar city should consider these significant variables to design and implement improved solid waste management services. In addition to this, urban households, micro and small enterprises, governmental and non-governmental organizations should work together to upgrade the existing low status of solid waste management service.

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The authors declare no competing interest

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References

Aklilu, A. (2002). *Households' willingness to pay for improved solid waste management: The case of Addis Ababa*. Addis Ababa: Addis Ababa University.
Alam, P., & Ahmade, K. (2013). Impact of solid waste on health and the environment. *International Journal of Sustainable Development and Green Economics (IJSDGE), 2*(1), 165–168.
Ali, T. M. (2015). *Assessment of solid waste management system in Khartoum locality*. Khartoum: UOFK.
Amfo-Otu, R., Debrah, W., Adjei, K., & Akpah-Yeboah, S. (2012). Willingness to pay for solid waste collection in semi-rural Ghana: A logit estimation. *International Journal of Multidisciplinary Research, 2*(7), 40–49.
Ayenew, B., & Meride, Y. (2015). Labor as a payment vehicle for valuing soil and water conservation practice: An application of contingent valuation method in Abaro-Toga Watershed, Southern Ethiopia. *Journal of Economics and Sustainable Development, 6*, 17–26.
Bartone, C. (2000). *Strategies for improving municipal solid waste management*. Workshop on planning for sustainable and integrated solid waste management, Manila.
Belhaj, M. (2003). Estimating the benefits of clean air contingent valuation and hedonic price methods. *International Journal of Global Environmental Issues, 3*(1), 30–46. https://doi.org/10.1504/IJGENVI.2003.002410
Bewketu, E. (2013). *Assessment of the sustainability of solid waste collection and transport service delivery by MSEs: The case of Bahir Dar city, Ethiopia*. Rotterdam: International Institute of Urban Management.
Birke, Y. (1999). *Solid waste management in Ethiopia*. Integrated Development for Water Supply and Sanitation, 25th WEDC conference, Addis Abeba.
Chinasho, A. (2015). Review on community based municipal solid waste management and its implication for climate change mitigation. *American Journal of Scientific and Industrial Research, 6*(3), 41–46.
CSA. (2007). *Population and housing census report*. Addis Ababa: Central Statistical Agency.
Damtew, Y. T., & Desta, B. N. (2015). Micro and small enterprises in solid waste management: Experience of selected cities and towns in Ethiopia: A review. *Pollution, 1*(4), 461–427.
Ejaz, N., Akhtar, N., Nisar, H., & Naeem, U. A. (2010). Environmental impacts of improper solid waste management in developing countries: A case study of Rawalpindi city. *The sustainable world, 142*, 379–387. https://doi.org/10.2495/SW10
Fenta, B. A. (2017). Waste management in the case of Bahir Dar city near Lake Tana shore in Northwestern Ethiopia: A review. *African Journal of Environmental Science and Technology, 11*(8), 393–412.
Fentahun, W. (2014). *Households'demand for improved water supply service in rural areas of Ankasha Woreda, Amhara regional state in Ethiopia*. Addis Ababa: Addis Ababa University.
Fikreyesus, D. (2011). Ethiopia solid waste & landfill. Country profile and action plan: Community development research. *Global Methane Initiative*. Retrieved from https://www.globalmethane.org/documents/landfills_cap_ethiopia.pdf
Gebremariam, G. G. (2012). *Households'willingness to pay for soil conservation practices in Adwa Woreda, Ethiopia: A contingent valuation study*. Zomba: University of Malawi.
Gossaye, F. (2007). *Households'willingness to pay for improved water services in Debre-Zeit Town, Ethiopia*. Addis Ababa: Addis Ababa University.
Hagos, D., Mekonnen, A., & Gebreegziabher, Z. (2012). *Households' willingness to pay for improved urban waste management in Mekelle city, Ethiopia*.
Hagos, D., Mekonnen, A., & Gebreegziabher, Z. (2013). Households willingness to pay for improved urban solid waste management: The case of Mekelle city, Ethiopia. *Ethiopian Journal of Economics, 22*(1), 107–138.
Henry, R. K., Yongsheng, Z., & Jun, D. (2006). Municipal solid waste management challenges in developing countries–Kenyan case study. *Waste Management, 26*(1), 92–100. https://doi.org/10.1016/j.wasman.2005.03.007
Hoyos, D., & Mariel, P. (2010). Contingent valuation: Past, present and future. *Prague Economic Papers, 19*(4), 329–343. https://doi.org/10.18267/j.pep.380
Kasaye, B. (2015). *Farmers willingness to pay for improved soil conservation practices on communal lands in Ethiopia*. Addis Ababa: Addis Ababa University.
Kassa, Z. (2010). *The challenges of solid waste management in urban areas, the case of Debremarkos town*. Addis Ababa: Addis Ababa University.
Kassie, K. E. (2016). The problem of solid waste management and people awareness on appropriate solid waste

disposal in Bahir Dar city: Amhara region, Ethiopia. *ISABB Journal of Health and Environmental Sciences, 3*(1), 1–8.

Lohri, C. R., Camenzind, E. J., & Zurbrügg, C. (2014). Financial sustainability in municipal solid waste management–Costs and revenues in Bahir Dar, Ethiopia. *Waste Management, 34*(2), 542–552. https://doi.org/10.1016/j.wasman.2013.10.014

Marta-Pedroso, C., Marques, G. M., & Domingos, T. (2012). *Willingness to pay and demand estimation for guaranteed sustainability labelled beef* (pp. 1–33). Retrieved from https://fenix.tecnico.ulisboa.pt/downloadFile/3779578408974/Marta-Pedroso%20et%20al.%20(2012)%20Willingness%20to%20pay.pdf

Mekete, D., Atikilt, A., & Hana, T. (2009). *Solid waste management in Bahir Dar city*. Bahir Dar: School of Civil and Water Resources Engineering, Bahir Dar University.

Memon, M. A. (2010). Integrated solid waste management based on the 3R approach. *Journal of Material Cycles and Waste Management, 12*(1), 30–40. https://doi.org/10.1007/s10163-009-0274-0

Monavari, S. M., Omrani, G. A., Karbassi, A., & Raof, F. F. (2012). The effects of socioeconomic parameters on household solid-waste generation and composition in developing countries (a case study: Ahvaz, Iran). *Environmental Monitoring and Assessment, 184*(4), 1841–1846. https://doi.org/10.1007/s10661-011-2082-y

Monyoncho, G. (2013). *Solid waste management in urban areas Kenya: A case study of Lamu town*. Nairobi: University of Nairobi.

Nkansah, E., Dafor, N., & Essel-Gaisey, F. (2015). Willingness to pay for improved solid waste disposal in Tema metropolis. *UDS International Journal of Development, 2*(1), 116–127.

Park, H. M. (2015). *Regression models for binary dependent variables using STATA, SAS, R, LIMDEP, AND SPSS* (Technical report). Retrieved from https://scholarworks.iu.edu/dspace/handle/2022/19740

Sankoh, F. P., Yan, X., & Tran, Q. (2013). Environmental and health impact of solid waste disposal in developing cities: A case study of granville brook dumpsite, Freetown, Sierra Leone. *Journal of Environmental Protection, 04*, 665–670. https://doi.org/10.4236/jep.2013.47076

Seadon, J. (2006). Integrated waste management–Looking beyond the solid waste horizon. *Waste Management, 26*(12), 1327–1336. https://doi.org/10.1016/j.wasman.2006.04.009

Solomon, C. (2011). *Assessment of municipal solid waste management service in Dessie town*. Addis Ababa: Addis Ababa University.

Thanh, N. P., Matsui, Y., & Fujiwara, T. (2011). Assessment of plastic waste generation and its potential recycling of household solid waste in Can Tho city, Vietnam. *Environmental Monitoring and Assessment, 175*(1–4), 23–35. https://doi.org/10.1007/s10661-010-1490-8

Thirumarpan, K., & Dilsath, M. (2016). Household willingness to pay for improved solid waste management in Batticaloa, Sri Lanka. *Tropical Agricultural Research and Extension, 18*(2), 76–86.

Tilahun, M., Mathijs, E., Muys, B., Vranken, L., Deckers, J., Gebregziabher, K., Bauer, H. (2011). *Contingent valuation analysis of rural households' willingness to pay for frankincense forest conservation*. Paper presented at the 2011 International Congress, Zurich: European Association of Agricultural Economists.

UNEP. (2010a, June). 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, ANRS Region Bureau of Environmental Protection, Land Administration and Use*.

UNEP. (2010b). Solid waste characterization and quantification of Bahir Dar city for the development of ISWM plan. *Forum for Environment, ANRS Region Bureau of Environmental Protection, Land Administration and Use*.

USAID. (2015). *Situational analysis of urban sanitation and waste management. Strengthening Ethiopia's Urban Health Program (SEUHP)*. Addis Ababa: John Snow Inc.

Wooldridge, J. R. M. (2002). *Econometric analysis of cross section and panel data*. Cambridge, MA: The MIT Press.

Zerbock, O. (2003). *Urban solid waste management: Waste reduction in developing nations. Written for the Requirements of CE, 5993*. Michigan: Michigan Technological University.