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Households' Willingness to Pay for Improved Solid Waste Management in the Case of Bahir Dar City

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Abstract

Cities in developing countries experiencing rapid urbanization and population growth too often lack the financial resources and institutional capacity to provide the needed municipal infrastructure for adequate solid waste management. The continuous accumulation of solid waste has been one of the major causes of environmental problems in Bahir Dar cities. The main objective of this study is to identify factors affecting willingness to pay decisions and to estimate their willingness. The study used primary data collected from 342 sample households. The sample households were selected randomly, and a multistage random sampling technique was employed to select the sample households. The study shows that 47.37 percent of the sampled households were willing to pay for improved solid waste management, while 52.63 percent of the respondents were not willing to pay. The study designed the probit and Tobit models to identify the determinants of improved solid waste management decisions and amounts at the household level, respectively. Accordingly, the regression result reveals that income, family size, time spent in the area, frequency of solid waste collection, and education showed positive significant factors that determine households' willingness to pay an amount and their decision. Policy interventions aimed at enhancing households' willingness to pay and increasing household understanding of the benefits of improved solid waste management.

Keywords: Willingness to pay, solid waste, tobit model, and management

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Introduction

Solid waste generation is an increasing global environmental and public health problem (UNEP, 2004). Currently, world cities generate about 1.3 billion tons of solid waste per year, and this volume is expected to increase to 2.2 billion tons by 2025, when the generation rates will more than double over the next twenty years in lower-income countries. In addition to this, solid waste management costs will increase from today's annual $205.4 billion to about $375.5 billion in 2025, which will be the most severe problem with more than five-fold and four-fold increases in low-income countries, respectively (Kaza et al., 2018). A lack of appropriate planning, inadequate governance, resource constraints, and ineffective management of solid waste, especially insufficient collection and improper disposal, are major concerns for many rapidly growing cities in developing countries.

Continuing population growth and urbanization in developing countries are making the provision of urban environmental services very difficult. The most difficult challenge many cities in the developing world are facing today in relation to environmental health services is the proper management of solid waste (Aklilu, 2002). In developed countries, waste management has become a large problem, with landfills growing to enormous sizes and recycling rates remaining minimal or even unknown. This, in turn, creates foul smells and favorable habitats for mosquitoes and other vectors that could spread a large number of diseases such as encephalitis, dengue fever, and malaria.

Waste management issues are coming to the forefront of the global environmental agenda with increasing frequency as population and consumption growth result in increasing quantities of waste. While cities are generating an ever-increasing volume of waste, the effectiveness of their solid waste collection and disposal systems is declining. For instance, in urban centers throughout African regions, less than half of the solid waste produced is collected, and 95 percent of that amount is either indiscriminately thrown away at various dumping sites on the periphery of urban centers or at a number of so-called temporary sites, typically empty lots scattered throughout the city.

The composition of different wastes has varied over time and location. Industrial development and innovation are directly linked to waste materials. To meet the needs of a rapidly growing

population, it is obvious that production has to be increased by at least the population growth rate, which leads to waste production that is beyond the absorptive capacity of the environment due to the hygienic problems it generates as a result of the negative externalities it generates. Wastes that are not well managed can affect the environment in terms of the contamination of the atmosphere, soil, and water. This can cause severe problems for human and animal populations. It can also affect human health, in particular, by causing convulsions, dermatitis, irritation of the nose and throat, anemia, skin burns, chest pains, blood disorders, stomach aches, vomiting diarrhea, and lung cancer, which may lead to death.

In Ethiopia, the per capita amount of waste generated ranges from 0.28 to 0.83 kg/person/day (Act, Clean Air; Act, Recovery; and Act, Recovery, 2006), and the country lacks the financial resources and institutional capacity to provide the needed municipal infrastructure for adequate solid waste management. In Ethiopia, the government realized that it was impossible to address the problem of the environment, particularly SWM, without the involvement of local communities (Cheever, 2011). As a result, SWM is becoming a major public health and environmental concern in urban areas of Ethiopia, though only 65% of the population has access to solid waste collection services. An inefficient municipal SWM system may create serious negative environmental impacts like infectious diseases, land and water pollution, obstruction of drains, and loss of biodiversity (Khajuria et al., 2010).

Bahir Dar city is one of the most rapidly expanding and growing cities in Ethiopia. According to UNEP (2010), one of the challenges that Ethiopian cities such as Bahir Dar face is the problem of sanitation in general and SWM in particular. A total of 98.8 tons per day of solid waste is generated from Bahir Dar city. But the city municipality collects and disposes of only 58% of the total solid waste disposed to the environment. This implies that small proportions of urban dwellers are served and a large quantity of solid waste is left uncollected.

Statement of the Problem and Objective

Waste is an unavoidable consequence of the consumption and production activities of a society. Proper waste management is becoming a serious problem in cities all over the world, especially in developing countries where financial and technical constraints are crucial. According to the United Nations Environment Program (2013), the risks associated with inadequate solid waste

management are human health, environmental, and aesthetic risks. Human health risks involve diseases caused by pathogenic organisms such as insects, rodent vectors, and water and air pollution-related diseases. People's primary defense against disease is environmental health, i.e., proper management of solid waste, the provision of safe water, and proper disposal of human excreta. All these things will block disease-causing organisms from entering the human body. But many preventable diseases are occurring in the developing world because of a lack of good solid waste management systems. Poor management of solid waste can lead to diseases that kill people or make them less productive at work. This lowers their income and makes it more likely that they will lose their jobs.

Government and citizens shall have the duty to protect the environment" (Cheever, 2011). But these interventions that aim to improve the coverage and quality of SWM services are not demand-oriented. Accordingly, the contribution of urban dwellers to SWM service plays a great role in the improvement of SWM in the community (Ezeah et al., 2013). At present, the Bahir Dar city municipality is allowing jobless youths to participate in waste management via door-to-door collection using a pushcart and donkey or horse cart. To get the service, households are expected to store the solid waste they generate in plastic bags or other temporary storage inside their home and hand it over to these private solid waste collectors. Due to the insufficiency of service coverage, what is observed is different; that is, there are wastes that are dumped on the street, in the drainage system, and in the forest. In addition, burning in the village is a common practice. The collected waste is also disposed of improperly at an uncontrolled disposal site near agricultural and residential areas. Due to this, different types of waste debris have been carried away by the wind from the disposal sites, which trashes surrounding farms and homesteads.

Many studies have been conducted on the willingness of households to pay for improved SWM in Ethiopia and the rest of the world. These studies identified the factors that affect households' willingness to pay for SWM service. For instance, factors that significantly affect households' willingness to pay are level of income, level of education, age, awareness of environmental quality, sex, amount of solid waste generated, number of children, and access to SWM. In addition, occupation type, level of satisfaction, and education attainment and households' awareness about the impacts of poorly managed solid waste, plans to live permanently in the area, and duration of residence in the area also significantly affect households' willingness to pay. However, to the best

of my knowledge, there has been no study conducted in the study area on improved solid waste management. As a result, the purpose of this study was to assess household willingness to pay for improved solid waste management (SWM), as well as the associated demographic and socioeconomic factors that influence household willingness to pay for improved solid waste management service in Bahir Dar. The general objective of this study is to determine household willingness to pay for improved solid waste management in Bahir Dar with the following research questions: What is the status of the existing solid waste collection, transportation, and disposal practices in Bahir Dar city? And what are the determinants of willingness to pay for improved solid waste management?

Related Literature Review

Solid waste management is defined as the collection, transportation, storage, recycling, or disposal of solid waste, or the subsequent use of a disposal site that is no longer operational. It is also defined as the collection, transfer, treatment, recycling, resource recovery, and disposal of solid waste in urban areas. The goals of municipal solid waste management are to promote the quality of the urban environment, generate employment and income, protect environmental health, and support the efficiency and productivity of the economy. Some environmental goods and services in the past have been assigned zero or low values due to the difficulties involved in assigning economic values to such commodities or the assumption that they are free goods. Thus, it is important to integrate environmental values into economic decision-making processes because failure to do so can have adverse implications for not only current generations but also future generations.

A large body of environmental economics literature has grown since the late 1960s, encompassing a range of monetary valuation methods and techniques designed to 'price' the spectrum of environmental goods and services provided by the biosphere. Because many environmental goods and services are non-marketed commodities, the valuation methods utilized involve market-adjusted, surrogate, and simulated market approaches. The basic strategy for environmental valuation is the 'commodification' of the services that the natural environment provides. The services are used by households and firms and are treated as arguments in utility and production functions, respectively.

The assignment of monetary values to non-marketed goods and services is referred to as valuation. A good or service has economic value if it has a positive contribution to human wellbeing. Yet, the positive contribution of a non-marketed good or service to an individual's wellbeing is determined by whether or not it satisfies his or her preferences. In the absence of markets or market prices, other ways of obtaining estimates of the values of such resources are required. In response to this, economists have devised a variety of empirical tools for estimating the monetary values of environmental goods and services whose markets are not easily observed. Hence, to measure the value people attach to goods, which do not have a perfect market or any market at all, we need to understand the concept of value.

The economic theory of value is based on the ability of things to satisfy human needs and wants or to increase the wellbeing or utility of individuals. Under this view of welfare, the economic value of something is a measure of its contribution to human wellbeing. The economic value of resource-environmental systems, then, resides in the contributions that the variety of ecosystem functions and services make to human wellbeing. … The theory also assumes that people know their preferences and that these preferences have the property of substitutability among the market and non-market goods making up the bundles. Value measures based on substitutability can be expressed in terms of either willingness to pay (WTP) or willingness to accept compensation (WTA).

Given their existing preferences or tastes, individuals will possess a number of held values that, in turn, result in objects being given various assigned values. In order, in principle, to arrive at an aggregate measure of value (total economic value), economists begin by distinguishing use values from non-use values. Use values are values that individuals attach to the use of a resource or an environmental attribute by an individual. It can be categorized into direct, indirect, and option use values. Direct use values refer to both consumptive and non-consumptive uses that involve some observable interaction between human beings and the environment. Consumptive uses involve extracting a component of the ecosystem for an anthropocentric (consumption) purpose, whereas non-consumptive uses involve the direct use of services provided directly by the ecosystems without extraction, such as the provision of recreational opportunities and scenic vistas. Indirect use values are values that are derived indirectly from ecological functions such as flood control, groundwater recharge, and water filtration. Option value is the value gained from keeping the

option to use the good or service at some point in the future; sometimes it is treated as a special case of use value. Non-use values refer to all values people hold that are not associated with the use of an ecosystem good or service; rather, people may benefit from the knowledge that an ecosystem simply exists unfettered by human activity. Nonuse values are all remaining values aside from use values, including bequest and existent values.

Generally, valuation methods could be broadly classified into revealed preference and stated preference methods. Revealed preference techniques are based on the observation of individual choices in existing markets that are related to the environmental amenities that are the subject of valuation. In this case, it is said that economic agents 'reveal' their preferences through their choices. The two main methods in this approach are the travel cost method and the hedonic pricing method.

The travel cost method (TC) is mostly relevant for determining recreational values. It assumes the cost that the individual incurs in visiting a recreational site, which can be used to estimate his or her valuation of that site. The approach involves asking questions about where the individuals are from and the costs they incurred. As a result, the data gathered is related to the number of visits in order to generate a demand curve for the recreational site in question. The information collected in a travel cost survey includes travel costs (petrol, food, and other travel-related expenses), income, an alternative site, and personal motivations. The demand curve is then constructed using several assumptions, including that people will respond to the cost of travel in the same way that they would respond to a site entry fee and that the marginal (highest-cost) visitor derives no benefit from visiting in excess of the cost they incur. The demand curve is used to estimate the amount of consumer surplus associated with visiting the site or to examine how visit rates and consumer surplus might change if entry fees were increased.

The hedonic pricing method is used to estimate the value of environmental amenities that affect the prices of marketed goods. This method is based on the characteristic theory of value developed. The method identifies environmental service flows as elements of a vector of characteristics describing a marketed good, typically housing. In this method, consumers consider the level of environmental quality (such as air quality) in addition to other characteristics of a house when

deciding about their location for living, and house prices are expected to differ depending on the environmental quality.

The stated preference path uses people's responses to questions regarding their willingness to pay for hypothetical situations. Interest in stated preference methods has been kindled by their capacity to yield estimates of the full array of use and non-use environmental benefits and costs. The basic idea behind any stated preference technique for estimating non-marketed environmental values is to quantify a person's willingness to bear a financial impost in order to achieve some potential (non-financial) environmental improvement or avoid some potential environmental harm. The most commonly applied methods are the contingent valuation method (CVM), choice modeling/choice experiment (CM), and conjoint analysis. Both revealed and stated preference methods have their own advantages and disadvantages. Both methods can measure usage values. Unlike revealed preference methods, stated preference methods such as contingent valuation and choice modeling are the most widely used methods and have been used to measure use and non-use values. Stated preference is the only option when there is no proxy market to value non-marketed goods and services.

The contingent valuation method is a non-market valuation method commonly used to find the economic value of environmental commodities. The valuation is termed contingent because the information sought from the survey respondents is conditional on some particular hypothetical market context. This method involves delivering questions to a randomly selected sample of the population to determine whether they are willing to pay or accept a clearly defined change in the provision of a good or service, or to prevent the change. In the case of solid waste services, the goal of the economic analysis is to identify whether the households served would collectively be willing to pay enough of their money to finance the costs of the service.

There are four most widely used value elicitation formats in CVM: open-ended, bidding game, payment card, and single-bounded or double-bounded dichotomous choice. The open-ended method is the first and earliest method used in which respondents are asked to state their maximum WTP for the good or service that is being valued. In the case of the payment card, respondents are asked to choose the stated WTP amount that is presented on the card with a visual aid. Hence, respondents put a tick next to the monetary value that they are willing to pay and a cross next to

the amounts that they are not willing to pay. The "bidding game is another value elicitation format in which respondents are asked iteratively to state their WTP until a yes answer changes into a no or a no answer changes into a yes answer. In the case of a dichotomous or discrete choice format, randomly assigned prices are distributed to each respondent for the non-marketed good or service in question. Then each respondent gives a yes or no answer for the stated WTP amount in the case of a single bound, and the respondent is asked for higher or lower bids if he or she says yes or no, respectively, in the case of a double bound.

Choice modeling has both strengths and weaknesses relative to the other stated preference techniques, notably the CVM. Among the strengths, the most significant is the techniques' ability to produce a rich database on people's preferences to generate a statistically robust model of choice. Thus, policymakers are able to make decisions about both the provision and management of natural resources that are far better informed and hence more likely to generate net benefits for the community at large. CM faces some specific problems. The first is its ability to yield a rich data set by enabling a more complex questioning process that places greater strain on the respondent's cognitive capacity. The other one is that if CM respondents make choices that are conditional on their expectations regarding the choices of other respondents, they may choose from those options they think have a reasonable chance of 'winning' even when this excludes their most preferred option.

The choice between contingent valuation (CV) and choice modeling (CM) techniques, such as choice experiments (CEs), is complex, and should be based on respondent perceptions of the change being valued, the decision objective being taken into consideration, and the type of information required, according to Johnston et al. (2017). Three main factors are advised when choosing between CVs and CEs: First, will the item's specific attributes or its overall value be impacted by the value change, and what information do decision-makers need? The second question is whether respondents see (and value) the change in terms of unique qualities or as a whole. Third, how does the respondents' comprehension of the object to be valued differ depending on how the information is presented?

Methods of the Study

The data for the study were generated from both primary and secondary sources. Primary data were collected using a structured questionnaire that included both closed and open-ended questions and was distributed to household heads in Bahir Dar cities. Moreover, secondary data were gathered from different sources, including published and unpublished materials from the administrative office. The questionnaire for the household survey was designed in three parts. A pretest with open-ended questions provides some information on the bounds of respondents' WTP. As a result, 10 households were randomly selected for a pretest before the actual survey. Before pre-testing the questionnaire, three enumerators received two days of training to help them understand each question and how they should approach and interview respondents to obtain valid information.

Depending on the result of the preliminary survey, initial bids (20, 30 and 50 ETB/month) were determined using a closed-ended contingent valuation format. As a result, 20, 30, and 50 ETB per month followed by closed-ended questions were randomly assigned to 188 sample households in the final survey. Questionnaires were designed to get the most precise data on households' WTP, assessing the existing situation of solid waste management, determining factors of WTP, and determining the maximum amount of WTP. The survey was conducted by translating the questionnaire into the local language, "Amharic, for better understanding by both the respondents and enumerators. Finally, the cross-sectional data were collected using a carefully designed CV survey questionnaire.

The design of the CV questionnaire used to elicit WTP from respondents was done. which suggested a CVM survey questionnaire should include: (1) an introductory section that helps set the general context for the decision to be made; (2) a detailed description of the good to be offered to the respondent; (3) the institutional setting in which the good will be provided; (4) the manner in which the good will be paid for; (5) a method by which the survey elicits the respondent's preferences with respect to the good; (6) debriefing questions about why respondents answered certain questions the way that they did; and (7) the collection of a set of respondent characteristics including attitudes and demographic information. Accordingly, a multi-stage random sampling

technique was employed to address the objective of this study, and the total sample size taken was 350. Both descriptive and the econometric method are applied.

Table 1

Summary of Explanatory Variables and Hypotheses

Variables	Specification	Category of variables	Expected effect of the variables
Age	Year	Continuous	-
Sex	1 if household head sex is female 0 if household sex is male	Categorical	-
Income	Household monthly income	Continuous	+
Family size	Number of people living together	Continuous	+
Education	The number of years staying in the class	Categorical	+
MRS	1 if married 0 if otherwise	Categorical	+
Time Spent in the Area	Number of years staying in the citify	Categorical	+
Quantity of Waste Generated	2 if enough access 1 if not enough access 0 if none at all	Continuous	+
House Ownership	1 if owner house and 0 otherwise	Categorical	+
Willingness to pay	1 if they are willing to pay 0 if not	Categorical	+
Number of collections	2 if enough access 1 if not enough access 0 if none at all	Continuous	+

Results and Discussion

A total of 350 questionnaires were prepared and distributed to the inhabitants of the cities. As shown in the table below, 341 of the 342 questionnaires were returned completely filled out, representing a 97.71 percent response rate.

Table 2

Demographic and Socio-Economic and Institutional Characteristics of The Respondents

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Age	342	34.49	10.29	23	65
Family size	342	3.21	1.37	1	7
Time	342	5.75	4.47	1	30
Quantity of waste	342	1.57	0.51	1	3
No of collection	342	1.29	0.45	1	2
Amount	342	121.54	176.1844	0	1000
Income	342	11688.79	9451.84	1600	48310

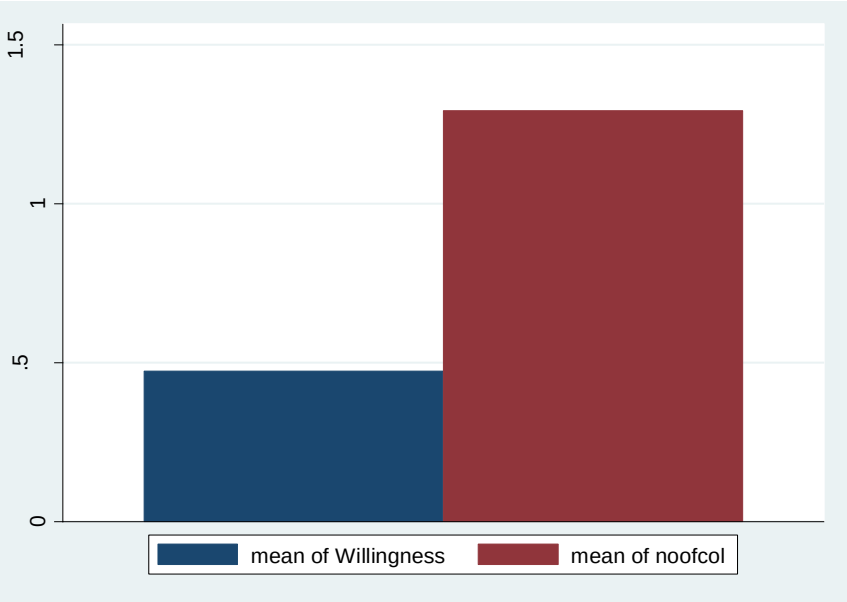
Source; Own survey, 2022

The above table shows the demographic and socio-economic characteristics of the respondents; the result reveals that of the total, 50.29% were male and 49.71% were female. With regard to the marital status of the respondents, 63.74% of them were married, while 36.26% of them were otherwise. The results also show that 40.64% of those polled had a bachelor's degree or higher, with 28.07% having a high school diploma. The majority of respondents (42.40%), followed by 39.40% who own their own home, and the remaining 18.13% who live in kebele houses. With regard to the willingness to pay decision, 52.63% of the respondents are not willing, while 47.37% of the respondents are willing to pay for Bahir Dar solid waste management.

One of the objectives of this study was to establish the status of existing solid waste collection, transportation, and disposal practices in Bahir Dar city. This section therefore starts with solid waste collection as presented herewith. The information presented herein is shown in figure 1. It shows that 70 percent of the respondents responded that solid waste is collected with a frequency of once a month, and 30 percent of the respondents responded that solid waste is collected twice a month.

Figure 1

Frequency of Collection of Solid Waste

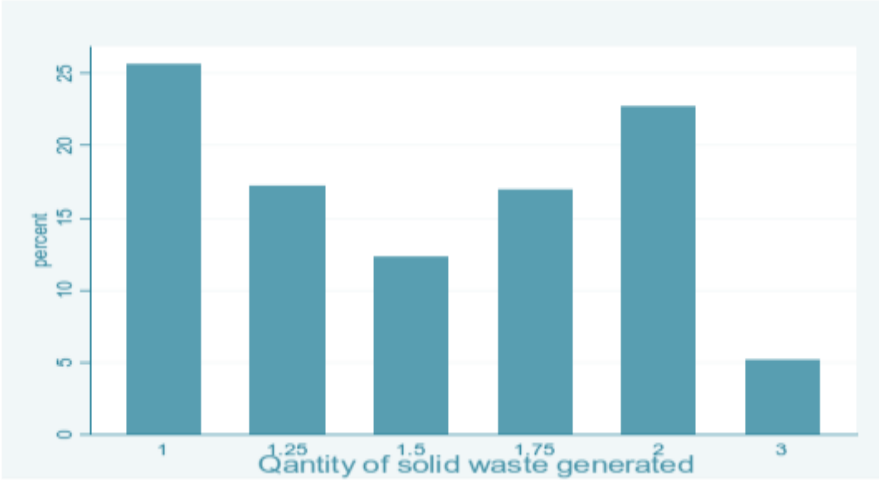


Source: - Stata Output

As presented in the bar chart below, about 5 percent of the respondents generate 3 or more sacks of waste on a monthly basis, around 26 percent generate 1 sack, 23 percent generate 2 sacks, and the rest, 46 percent, generate between 1.25 and 1.75 sacks in a month.

Figure 2

Quantity of Waste Generated



Source: - Stata Output

Respondents were asked whether they have solid waste storage facilities in their compound or not. In line with this, 93.15 percent of the respondents have no storage receptacle for storing solid waste, and only 6.85 percent of the respondents have storage receptacles. Even for those who have storage containers, they are usually inadequate and inappropriate. Due to this, more of the solid waste generated by town households is thrown on an open space, on the street, or in the nearest river, resulting in environmental and health problems.

Table 3

Reponses Of Household on Solid Waste Storage Receptacles

Response	Frequency	Percentage
Yes	23	6.85
No	313	93.15
Total	342	100.00

Source: Own survey

The survey result shows that the majority of the respondents got solid waste collection service from the privately organized collectors, accounting for 49.12 percent; 21.64 percent of the respondents dug a hole in the compound or village and burned it; 15.50 percent of the respondents threw it on an open space or river; 7.60 percent of the respondents took it to the nearby secondary storage receptacle (genda); and 6.14 percent of others responded differently.

Table 4

The Usual Way of Disposing Solid Waste By Households

Disposal methods	Frequency	Percentage
Take it to nearby secondary storage receptacle (Genda)	26	7.60
Digging a hole in the compound or in the village and burn it	74	21.64
Throw it on an open space or river	53	15.50
Privately organized collectors take it	168	49.12
Other	21	6.14
Total	342	100.00

Source: Own survey

In accordance with the data in Table 5, it has been found that 35.38 percent of the respondents responded that they strongly disagree with the service provided for solid waste collection and disposal, 42.69 percent responded that they disagree with the services, 6.14 percent agreed with the services, and 1.46 percent of the respondents were neutral and strongly agreed with the service provided, respectively.

Table 5

The Satisfaction Level the Existing Waste Collection and Disposal Services

Degree of satisfaction	Frequency	Percentage
Strongly agree	5	1.46
Agree	21	6.14
Neutral	49	14.33
Disagree	146	42.69
Strongly disagree	121	35.38
Total	342	100.00

Source: Own survey

In this case, which is about 78.07%, the current service is far below the required level, and something has to be done soon. Only 7.6 percent of the respondents said they are satisfied with what the city's administration is doing in the area, while 14.33 percent of them are neutral. As presented in Table 6, below, respondents were asked which organ (between households and the city administration) was responsible for properly managing and financing solid waste management. 52.92 percent of the respondents said the city administration, 20.47 percent said the households, and 26.61 percent said both the city administration and the households together.

Table 6

Responsible Bodies for Managing and Financing of Solid Waste in the Town

Responsible body	Frequency	Percentage
cities administration	181	52.92
Households	70	20.47
Both cities administration and households	91	26.61
Total	342	100.00

Source: Own survey

To assess the status of households' willingness to pay for solid waste management in Bahir Dar cities, household respondents were asked whether they are willing to pay or not in the form of a yes-or 'no' response question. Similar studies used such an objective response and a direct measure of a binary dependent variable to determine willingness to pay. As a result, for the purpose of investigating common explanatory variables affecting households' willingness to pay decisions, both willing and unwilling households were included in the analysis.

Table 7

Status of Household's Willingness to Pay

Respondents' willingness to pay decision	Frequency	Percent	Cumulative
Willing	162	47.37	47.37
Not willing	180	52.63	100
Total	342	100	

Source: Own survey

According to Table4.8, out of a total of 342, 162 respondents (47.37%) were willing to pay for Bahir Dar city solid waste management, while 180 (52.63%) were not. This implies that more than half of the respondents are not willing to pay. The reason why they are unwilling is because of a lack of money and the wrong belief that construction of improved solid waste management is the responsibility of the government.

Econometric Results

In this section, the econometric method of data analysis is used to estimate the coefficients of the socio-economic variables that affect households' willingness to pay for solid waste management. In order to estimate the coefficients for the socio-economic variables, two econometric models (the Probit and Tobit models) with the maximum likelihood estimation method are employed. Before estimating the effect of the explanatory variables on households' WTP decisions for solid waste management, tests were made for better estimation of the coefficients of the variables. Diagnostic tests of multi-co linearity, heteroskedasticity, and normality were checked before estimating the regression model to estimate the potential effect of each explanatory variable on the dependent variable of willingness to pay and amount. The results of these tests show no problems with severe multi-co linearity, model specification bias, or goodness of fit testing.

The probit model was used to analyze the explanatory factors that affect households' WTP decisions for solid waste management. The regression result shows and the regression estimation result indicate that there are factors that have explanatory power to determine households' willingness to pay decisions in the study area at the 1 and 5 percent level of significance. The probit model was estimated using STATA software application version 14. From the probit regression result depicted in the table below, we can observe that the explanatory variables identified in the model sufficiently explain variation in the dependent variable, which was shown by the probability of chi-square 0.000 being statistically significant at the 1 percent significance level, which indicates that all explanatory variables taken together are significant in explaining the model. A number of studies have shown that several socio-economic factors, such as household income, education, family size, age of the household, future time spent in the town, house ownership, quantity of waste generated, and number of solid waste collections per month, influence a household's willingness to pay. These variables are time, family size and number of collections, education, and income of the household. Furthermore, the variables came up with the expected sign.

Table 8

Maximum Likelihood Estimates of the Probit Model

Variables	Coefficient	Std Error	Z	p- value
Age	-0.0147481	0.0146061	-1.01	0.313
Time	0.1399344	0.0449785	3.11	0.002***
Family size	.3050432	0.1131898	2.69	0.007***
Quantity of waste	.2613479	0.2880801	0.91	0.3464
No of collection	0.6909893	0.3351985	2.06	0.039**
Sex	-0.4691767	0.2977324	-1.58	0.115
Education	0.8272	0.1101543	7.51	0.000***
Marital status	.271	0.1708	1.59	0.113
Income	0. 000075	0.0000107	6.99	0.000***
House ownership	0.1025	0.1107	0.09	0.926
Constant	-4.208	0.699	-6.02	0.000***

Source: Estimation Result

Based on the sign and level of significance of those coefficients, it is simple and possible to interpret the coefficients of the independent variables. The Probit model's results, however, do not reveal the size of the explanatory variables' effects on the likelihood of respondents' willingness to pay. The Probit model coefficients are frequently explained in terms of marginal effects in the statistics literature.

Table 9

Marginal Effects after Probit Regression

Variables	dy/dx	Std Error	Z	p- value
Age	-0.0036798	0.00364	-1.10	0.313
Time	0.0349148	0.01125	3.10	0.002***
Family size	.0761109	0.02825	2.69	0.007***
Quantity of waste	.0652086	0.07188	0.91	0.364
No of collection	0.1724078	0.08366	2.06	0.039**
Sex	-0.0781	0.06385	-1.22	0.221
Education	0.2063962	0.02733	7.55	0.000***
Marital status	.1235868	0.07601	1.63	0.104
Income	0. 0000357	0.0001	6.43	0.000***
House ownership	0.00357	0.04405	0.09	0.926

Source: Estimation Result

Time spent: Duration of residence in the area has a direct relationship and significant effect on willingness to pay for improved SWM service at the one percent level of significance. Keeping other variables constant, households that lived in the area for a short period are more willing to pay and have about a 3.5% higher probability of WTP for the improved SWM service compared to those that stayed for a longer period in the area. This result is consistent with the expected sign and consistent with findings from other studies in the literature. The previous studies found similar results with regard to the correlation between time spent and willingness to pay. Other studies found that household time spent in the area was indicated to be a significant positive factor that affected households' willingness to pay.

Family size: As expected, family size was found to be a positive significant factor that affects households' willingness to pay for improved solid waste management at the 1% significance level.

This is because households with a larger family size generate more solid waste as compared to households with a smaller family size. This makes households demand improved solid waste management. The marginal effect for family size (0.0767) indicates that the probability of willingness to pay increases on average by 7.67 percent relative to each one-person increment in the household family size. This study came up with similar findings to those of Hina (2007) and Medina (2000), which found family size as one determinant factor that affects improved solid waste management decisions.

Number of collections: The frequency of solid waste management was found to be a significant positive factor that affected households' willingness to pay at the 5% significance level, as expected. If collectors come on time to collect households that generate more waste, those households are willing to pay more. Therefore, the frequency of solid waste should be promoted and encouraged so as to increase the respondent's willingness to pay. The marginal of this variable, 0.172, indicates that when the frequency of solid waste collection increases by one, the probability of being willing to pay for improved solid waste management increases by 17.20.

Educational status: As expected, educational status was found to be a positive significant factor that affects households' willingness to pay at the 1% significance level. The result of the study shows that the probability that the household is willing to pay will increase as the respondent's educational status increases. From table 13, we can clearly see illiterate households are less likely to be willing to pay, but as their educational level increases, their willingness to pay increases. The marginal effect of educational status (0.2064) indicates that the probability of a household's willingness to pay decision on average increases by 20.64 percent relatively as one stage increment of the respondent's educational status. The finding of the study was consistent with most of the previous studies conducted on households' willingness to pay for improved solid waste management. Alemu, 2000, found that education is a positive and significant factor that affects households' willingness to pay.

Income: The results of the model show that household income affects households' willingness to pay for improved solid waste services positively and significantly at the 1% level of significance. This relationship is consistent with the expected sign and the results of other findings mentioned in the literature. Households' with more income are more willing to pay for the improvement and

have a higher probability of accepting the improvement in SWM. Keeping other variables constant, a one percent increase or decrease in a household's total monthly income leads to about 0.00035% increases or decreases in the probability of accepting the improvement. This finding is consistent with most of the previous research findings.

The Tobit model was used to analyze the explanatory variables that affect households WTP for Bahir Dar's solid waste management. Thus, the explanatory variables that affected WTP were discussed as follows:

Table 10

Maximum Likelihood Estimates of The Tobit Model

Variables	Coefficient	Std Error	Z	p- value
Age	-2.328278	1.628653	-1.43	0.154
Time	7.715	3.511353	2.20	0.029***
Family size	22.51416	12.25727	1.84	0.067*
Quantity of waste	54.70791	32.38093	1.69	0.092*
No of collection	66.43612	35.64026	1.86	0.063**
Sex	-50.0789	32.55743	-1.54	0.125
Education	92.39022	11.83407	7.81	0.000***
Marital status	60.63714	35.17149	1.72	0.086*
Income	0.0122186	0.00118099	6.75	0.000***
House ownership	10.00	21.4039	0.47	0.572
Constant	-704.7749	123.3714	-5.71	0.000***

Source: Estimation Result

Time spent in the area: Time spent in the area is a positive significant factor that affects households' willingness to pay an amount at the 1% significance level. The reason behind this is that, when respondents spend more time in the area, they can understand the problems related to solid waste management and develop a sense of ownership in the town's sanitation and related projects. The coefficient of time spent in the area (7.71) indicates that when a household's time spent in the area increases by one year, the amount of birr the household could pay for improved solid waste management increases by 7.71 birr.

Family size: Family sizes are also a positive significant factor that affects households' willingness to pay an amount at the 10% significance level. This is because households with a larger family size generate more solid waste as compared to households with a smaller family size. This makes households demand improved solid waste management. The coefficient of family size (22.51) indicates that when a household's family size increases by one person, the amount of birr the household could pay for improved solid waste management increases by 22.51 birr.

Number of collections: The frequency of solid waste management by the concerned body is also a positive significant factor that affects households' willingness to pay an amount at the 10% significance level. When solid waste collectors come on time to collect, households that generate more waste are willing to pay more. The coefficient of the number of collections per month (66.43) indicates that when the frequency of solid waste collection by the concerned body increases by one time, the amount of birr the household could pay for improved solid waste management increases by 66.43 birr.

Education: The educational status of the respondents was a positive significant factor that affects households' willingness to pay an amount at the 1% significance level. The result indicates that willingness to pay for improved solid waste management requires better knowledge and understanding. The coefficient of education (92.39) indicates that when the educational status of the respondents increases by one stage, the amount of birr households could pay for solid waste management increases by 92.39 birr.

Income: At the 1% significance level, respondents' monthly income is a positive significant factor influencing their willingness to pay amount. This result is also in line with the basic economic theory, which states that an individual's demand for most commodities or services is positively related to their income level. The coefficient of income (0.0122) indicates that when the income of the farmer increases by one hundred Birr, the amount of Birr households could pay for solid waste management increases by 1.22 Birr.

The amount of aggregate willingness to pay for the use of improved solid waste management can be estimated by taking the total numbers of actual and potential beneficiaries in the study area. The amount of aggregate willingness to pay can be estimated using the amount of mean willingness to

pay of households for the use of a solid waste management project. The total amount of willingness to pay is 121.54*2800 = 340,312. birr per year, and the average willingness to pay is 28,359.33 per month. That means the total amount of payment indicates that at the end of the year, a huge amount of money can be collected. As a result, the collected money is helpful to construct improved solid waste management in Bahir Dar cities.

Conclusion and Recommendations

This study was conducted with the objectives of estimating the mean price per unit of solid waste management per year and identifying determinants of households WTP for improved solid waste management. The result shows that 47.37 percent of households were willing to pay for improved solid waste management, with an average annual WTP amount of 121.54 birr per household, and the total estimated amount of willingness to pay for Bahir Dar's improved solid waste management if it is collected from 2800 households is 340,312 birr per year. This indicates that the mean amount of payment and the positive response of households are indicators of the importance of solid waste management pricing to create a clean, suitable living town and, in the long run, to improve households' livelihoods and the significance of improved solid waste management in the study area.

The probit model shows that household income, time spent in the area, educational level, family size, and frequency of solid waste collection are factors that positively affect a household's willingness to pay for improved solid waste management. The result of the Tobit model indicated that time spent, family size, number of solid waste collections, education, and income were all found to be positively and significantly related to the amount of willingness to pay for improved solid waste management.

Based on the findings from the study, it can be concluded that city households are willing to pay for solid waste management. Thus, the participation of the community should be ensured in every decision-making process and the formulation of policies and strategies related to improved solid waste management. This promotes the commitment of the community to the conservation programs and helps them to develop a sense of ownership, which has its own contribution to the sustainability and effectiveness of solid waste management.

For the realization of the potential health, environmental, and livelihood improvement benefits for households, understanding factors that determine households' willingness to pay and amount for improved solid waste management offers various possible insights and policy implications. So that, based on the findings of this study, the possible recommendations are as follows: The result shows that the frequency of solid waste collection positively affects both households' willingness to pay and the amount of solid waste management. Hence, the concerned body should set up an appropriate solid waste collection program with serious follow-up to build a sense of ownership and make them aware they should be willing to pay for improved solid waste management.

Household income determines their willingness to pay decisions and amounts positively. Payments for solid waste management should be based on willingness and ability to pay rather than making them flat and mandatory across all income groups. Therefore, this study recommends that the town's solid waste sanitation fees need to be revised based on the respondents' income levels. A household's willingness to pay and amount is positively related to its educational status. Therefore, increasing understanding of the benefits of solid waste management should be strengthened.

The result shows that there is no more primary storage receptacle in the study area due to the high amount of solid waste generated by town households being thrown on an open space, on the street, or into the nearest river, which will result in environmental and health problems. Therefore, both the town municipality and households must do a lot in this area. Finally, environmental policies and laws have helped a lot to achieve the desired result in many parts of the world. Bahir Dar cites some environmental laws that prohibit activities that harm the environment. For instance, there is a law against deforestation; likewise, there must be a clear and fast law against illegal dumping of solid waste on an open space, street, or river to make Bahir Dar a clean and attractive city.

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