

# HOUSEHOLD DEMAND FOR IMPROVED SOLID WASTE MANAGEMENT SERVICE IN ETHIOPIA: The Case of Bahir Dar City

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## Acronyms

SWM - solid waste management

CVM - contingent valuation methods

WTP - willing (ness) to pay

WMS - Waste Management Series

RUT - Random utility theory

MWTP - maximum willingness to pay

BDDLPC - Bahir Dar Dream Light Private limited Company

BDCM - Bahir Dar City Municipality

ANRFEDB - Amhara National Region Finance and Economic Development Bureau

## Abstract

*Mishandling solid waste management causes harmful environmental, health and economic effects and thus it calls for the use of efficient and adequate Solid Waste Management System. Therefore, this study aims at addressing the problem that the people of Bahir Dar face as a result of improper handling of solid waste and forwarding possible solutions. A CVM was applied using bidding game elicitation format with a single bound dichotomous choice question followed by open ended follow up question and face-to-face interviews were undertaken on a sample of 200 households. Descriptive analysis of the survey data reveal that the majority (60.5%) of the respondents were dissatisfied with the collection and disposal system of current private waste collector services. Of the 29.5% respondents that were satisfied with the existing service 65.5% need the proposed improved SWM service. This shows that even those households who seem satisfied need the improved service owing to the attributes that are included in the improved proposed SWM service. The result showed that 82% of the sampled households were WTP a positive amount for the improved SWM service with a mean MWTP amount of birr 14.5 per month. The econometric models results reveal that households WTP and the magnitude are affected by level of*

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*education, family size, number of children, length of time/years of stay, income and household work. Except for family size all other variables have a positive effect on WTP amount. The findings suggest that households are WTP for improved SWM. Thus, if the improved SWM service is provided in the city the environment will not be polluted and at the same time the demand for improved environmental quality of the household will be satisfied.*

## **1. Introduction**

Waste is an unavoidable by-product of human activities; households generate waste either directly or indirectly through their production or consumption (Tewodros, 2006). Economic development, urbanization and improving living standards in cities have led to an increase in the quantity and complexity of waste generated. Moreover, rapid growth of population and industrialization degrades the urban area and places serious stress on natural resources, which undermines equitable and sustainable development (Alberto et al, 2008).

In most cities of developing countries, SWM appears to be a serious environmental problem in and around people's home (Pearce and Turner, 1994). Waste materials that are generated from residential households are mostly organic. However, if it is not controlled and just dumped anywhere, it may harm people and constitute a major environmental and health hazard. In addition it will provide fly breeding spot pollute the ground and surface water through their lea hates, black roads, cause flood disaster when dumped into rivers and attract animals which may cause zoonotic infections (WMS, 1994).

According to Cointreau (1982) 30 to 50% of the solid wastes generated are often uncollected in cities of developing countries. Nowadays, solid waste has become an important issue in Bahir Dar city. Piles of wastes are often found almost everywhere in the cities such as on roads, river and other open spaces. Moreover, not only are there kebeles and neighborhoods in which wastes are not collected and unsanitary conditions arose even at the final disposal sites, but also the wastes are simply dumped and not buried in a sanitary manner, causing problems with bad smells and natural combustion to occur. In general, it has health and environmental problems.

The collection, transportation and disposal of municipal solid waste are all important aspects of waste management for public health, aesthetic and environmental reasons.

Bahir Dar solid waste infrastructure is struggling to cope with increasing levels of waste generation. Currently a single contractor (private limited company) operates in the city. In the entire city door-to-door collection service is practiced. This type of waste disposal system does not conform with the desire of waste generator even if it may be convenient for high-income areas. Under this new service the private company is authorized to collect SWM fees for its service. And the fee is determined by bargaining with the household.

Attempts to improve SWM in developing countries' cities have focused on the technical aspects of different means of collection and disposal; much less effort has been directed to investigating the demand side aspects related to SWM (Pearce and Turner, 1994).

Any planning for the provision of improved municipal SWM services in most cities are affected by two strongly held often untested beliefs about consumer demand. These are: one, that households consider solid waste services less important than other services; and, two, that households consider the provision of such services to be the obligation of the government (Altaf and Deshazo, 1996). The same is expected to hold in the case of Bahir Dar city.

Due to the magnitude of the problem SWM in Bahir Dar needs improvement. The improvement of SWM includes waste storage and separation at the source, collection and transport, resource recovery and recycling waste treatment and disposal. However, all these activities require high capital outlay. So the service beneficiary needs to pay for the improved SWM service. Thus, demand side information on whether or not and the extent to which the resident on WTP is necessary for the decision and designing of improved services.

More issues pertaining to people's attitudes and behaviours are vital in the strife for good waste management (Tewodros, 2006; P.2). This demand side information is used for policy makers to design appropriate tariff rate that is consistent with government policy. Thus, it has a paramount importance to study the determinants of households' WTP and estimate the magnitude that on average households are willing to pay so as to offer inputs for policy makers. Therefore, the main objective of this research is to conduct an economic study on the household demand for improved SWM service in Bahir Dar city.

## 2. Methodological Framework

### 2.1 Data Source and Collection and Sampling Design

Both primary and secondary data were used as the source of data for the analysis. Data collection method was undertaken by employing structured questionnaire, which was designed by the author and administered by enumerators to collect the data.

A hypothetical market scenario was designed as one of the most basic components of the survey questionnaire based on the improvement of existing SWM situation. To elicit households' WTP, a single bound dichotomous choice question was posed and substantiates the position of households with reasons; an open-ended question was followed.

The sample size was determined by a statistical technique as suggested by Cochran (1977) as cited in Lemma (2007). Accordingly, the sample household units (n) are given by:

$$n = \frac{NZ^2PQ}{d^2(N-1) + Z^2PQ}$$

Where; N-The total number of housing unit

Z denotes standardized normal variable with value equals 1.96 which corresponds to 95 percent confidence interval

P-Housing unit variable (residential houses in terms of percentage)

Q-Non residential houses (offices, schools, churches, etc in terms of percentage)

d- Allowable error (0.05)

There are about 30,987 housing units (N): out of these about 90 % are residential (P) and the remaining 10 % are for commercial activities and offices (Q). BDCM, 2009b in Bahir Dar Municipality,

$$\text{Hence } n = \frac{NZ^2PQ}{d^2(N-1) + Z^2PQ} = \frac{30,987(1.96)^2 \times (0.9)(0.1)}{(0.05)^2(30,986) + (1.96)^2(0.9)(0.1)} \approx 137.7$$

Therefore, n=137.7 is the minimum sample size of housing units for reliable results. To be safe in cases of non-cooperativeness of households, unobservable problems during collection the sample size was increased to 200 households. Therefore, results of 200

households' solid wastes information were analyzed; which is sufficiently enough according to the sample size calculated above.

A two-stage sampling technique was used to select sample households. In the first stage, three Kebele administrations (Belayzeleke Kebele, Shumabo Kebele and Shinbit Kebele) were randomly selected out of the 9 Kebele administrations found in Bahir Dar city. In the second stage, simple random sampling based on probability proportional to sample size of each Kebele sampling technique was used to select respondents from each Kebele category. The numbers of households drawn from each Kebele were determined by its own respective size.

## 2.2 Model Specification

### Theoretical Framework

From past studies, WTP of individuals is related to socio-economic and demographic factors of the household. Tewodros (2006), Aklilu (2002), Rahji and Oloruntoba (2008), Altaf and Deshazo (1996) and Jamal (2002) single out such factors as the cost of obtaining the environmental good or service (WTP for improved SWM service) the level of education, sex, age of the respondent, income and family size to explain the variations in respondents' WTP for environmental goods/services.

Contingent valuation method (CVM) has its theoretical basis on **random utility theory** (RUT). The basic idea underlying this theory is that from the investigator's point of view there are random elements of the utility function that are not observable. Suppose that the  $j^{\text{th}}$  respondent is confronted with a CVM scenario in which a discrete change in an environmental good from  $q_0$  to  $q_1$  is proposed and having an income  $Y_j$ . The indirect utility function can be specified as follows:

$$V_{ij} = V_i(q_i, Y_j, X_j, \varepsilon_{ij}) \text{-----} (1)$$

Where;  $X_j$  = vector of socio-economic and/or demographic factors

$i=1$  denotes the improved state and  $i=0$  the status quo (or the existing state)

$\varepsilon_{ij}$  = random component of the given indirect utility

If a payment (which is also called the initial bid,  $t_k$ ) is introduced due to changes in measurable attributes like quality or quantity of environmental goods, the consumer accepts the proposed bid if and only if

$$V_{1j}(Y_j - t_k, X_j, \varepsilon_{1j}) \succ V_{0j}(Y_j, X_j, \varepsilon_{0j}) \text{-----} (2)$$

In the CV scenario due to the random components of preferences a certain bid or cost is proposed even the researcher cannot be known currently and s/he can only make probability statement of 'yes' or 'no' responses. Thus, the probability that the respondent would respond with a Yes given the bid  $t_k$  can then be expressed as

$$\Pr o[Yes] = \Pr o[V_{1j}(Y_j - t_k, X_j, \varepsilon_{1j}) \succ V_{0j}(Y_j, X_j, \varepsilon_{0j})] \text{-----} (3)$$

We assume that the individual understands the proposed change in the environmental good and she/he is capable of evaluating the effect of this change on his or her utility and considers the proposed bid level.

This probability statement provides an intuitive basis to analyze binary responses. Assuming the utility function is additively separable in deterministic and stochastic preferences:

$$V_i(Y_j, X_j) + \varepsilon_i \text{-----} (4)$$

Given the additive specification of the utility function the probability statement for respondent j becomes:

$$\Pr o[Yes] = \Pr o[V_{1j}(Y_j - t_k, X_j) + \varepsilon_{1j} \succ V_{0j}(Y_j, X_j) + \varepsilon_{0j}] \text{-----} (5)$$

**Econometric Model**

Two econometric models estimation techniques are used, one of which was a Probit model to identify which factors are responsible for being willing or unwilling to pay for the improved services and Tobit model is used to identify factors determining the amount a household was WTP for the improved SWM. In this study, the respondents were asked at first whether he/she is interested in the proposed improvement or not and willing to pay the initial price. This is going to be analyzed with binomial probit model. Even if there is a possibility to use logit model for this function, the researcher

randomly chose probit model without any priority. The next question is for the person who is interested in the improvement, and then what is the maximum amount that he/she would be WTP which was useful for the Tobit analysis.

### The Probit Model

Probit model is used to identify factors that influence a household's WTP decision. The Probit model can be defined as:

$$I_j^* = \beta' X_j + \varepsilon_j \text{-----}(6)$$

Where;  $\beta'$  is vector of parameters of the model to be estimated,  $X_j$  is vector of explanatory variables and  $\varepsilon_j$  (the error term) and is assumed to have random normal distribution with mean zero and common variance  $\sigma^2$  (Greene, 1993).  $I_j$ =unobservable households' actual WTP for the improved SWM service. This is also known as a latent variable. We only observe a dummy variable.

What we observe is a dummy variable  $WTP_j$ , which is defined as:

$$WTP_j = 1 \text{ if } I_j^* > 0$$

$$WTP_j = 0, \text{ otherwise}$$

In this case the respondents are asked whether they accept the starting point price and WTP to get the improved service or not. The probability of a yes response or no response can be cast interms of random utility maximization chosen by the respondent. From the point of view of the researcher, on the possible values of the random utility functions depending on the responses of sample households, we have,

$$pro(WTP_j = 1) = \Phi(\beta' X_j) \text{-----}(7)$$

$$pro(WTP_j = 0) = 1 - \Phi(\beta' X_j) \text{-----}(8)$$

Therefore the expanded form of the above equation of the probit model is:

$$\text{Pr}(WTP_j = 1) = \beta_0 + \beta_1 AGE_j + \beta_2 SEX_j + \beta_3 EDUCA_j + \beta_4 INCOME_j + \beta_5 HHSIZE_j + \beta_6 HHWORK_j + \beta_7 TIME_j + \beta_8 CHILD_j + \beta_9 QUANTITY_j + \beta_{10} DISEASE_j + \beta_{11} SATSFA_j + \beta_{12} MEANAGE_j + \beta_{13} PAY_j + \beta_{14} HOUSE_j + \varepsilon_j \text{-----} (9)$$

**The Tobit Model**

As indicated above Probit model was used to estimate the probability of WTP for the improved SWM service as a function of some socio-economic variables. Using Tobit model the amount of money a person or family spends on SWM service in relation to socio-economic variables are estimated.

Since the data for SWM expenditure is available only for those household who are WTP, those values of  $WTP \leq 0$  should be censored.

Let  $MWTP$  be a latent variable which is not observed when it is less than or equal to zero but is observed if it is greater than zero. Following Maddala (1983), the Tobit model for observed  $MWTP$  is given by:

$$MWTP_j = \alpha + \beta \cdot X_j + \varepsilon_j \text{ if } WTP > 0, \\ = 0, \text{ otherwise} \text{-----} 10$$

Where  $MWTP$  is the maximum amount that a household  $j$  is willing to pay for individual  $j$  is censored,  $\alpha$  is the intercept term,  $\beta$  vector of coefficients,  $X_j$  vector of independent variables and  $\varepsilon_j$  is the disturbance term which is independently and normally distributed with mean zero and common variance  $\delta^2$  with  $\varepsilon_j \sim N(0, \delta^2)$ .

Expanded in terms of the variables:

$$MWTP_j = \beta_0 + \beta_1 AGE_j + \beta_2 SEX_j + \beta_3 EDUCA_j + \beta_4 INCOME_j + \beta_5 HHSIZE_j + \beta_6 HHWORK_j + \beta_7 TIME_j + \beta_8 CHILD_j + \beta_9 QUANTITY_j + \beta_{10} DISEASE_j + \beta_{11} SATSFA_j + \beta_{12} MEANAGE_j + \beta_{13} PAY_j + \beta_{14} HOUSE_j + \varepsilon_j \text{-----} (11)$$

With,  $\varepsilon_j \sim N(0, \delta^2)$

Where; all the variables are as defined above



The total aggregate WTP estimates depend on both the benefits per person or household and the number of beneficiaries. Those who accrue benefits from the improved services are the residents of Bahir Dar.

$$\text{Total Revenue} = R \times M$$

Where;  $R$  is the mean/median amount of WTP and  $M$  is the total number of residential or housing units.

### **Definition of Variables and Expected Sign**

Like any other environmental and public goods, demand for improved SWM is expected to be affected by different factors. Some of these with their expected signs are defined as follows:

**AGE (Age of Respondents):** This is a continuous variable with a negative expected sign. This is due to a simple reason that the old people/respondents tend to go for the lower cost and may consider solid waste collection as government's responsibility and could be less WTP for it while the younger generation might be more familiar with cost sharing like for education, health, etc, and could be more WTP.

**SEX (Sex of Respondents):** Sex is a dummy variable taking 1 if the respondent is male; 0 otherwise with a negative expected sign. Female respondents might prefer the improved service and be more WTP than their men counterparts. This could be the case since traditionally it is the role of women to clean the house, dispose the waste and face a higher burden of cleaning the environment caused by poor SWM facilities.

**EDUCA (Education of Respondent):** This variable is considered to capture the level of understanding of the respondent about the desirability of proper management of solid waste. The study expects education positively determines the WTP. This is because it is expected that the better educated the respondent the better can be understand and be aware of the health and environmental benefits that could be gained from improved solid waste service and of the consequence of mishandling of SWM.

**INCOME (Household Gross Monthly Income):** This variable refers to the monthly money income of the household in terms of Birr. It includes the income of the head and all other members of the household from all sources. It is expected that as the higher

household/family gross income the more the household would be WTP for the proposed service. It is also expected that solid waste service is a normal economic good, the demand for which increases with affluence.

**HHSIZE (Number of Household Members living together):** There are two different arguments concerning the impact of family size on WTP. On one side when family size increases the wastes that are generated in the household would also increase and could crave for a better service by giving high WTP for the improved service. On the other side, as family size increases the household job distribution is low, so they can manage it by themselves. Thus a negative sign is expected in the second case.

**HHWORK (Number of household Members who have a job):** This is continues variable. This is expected to influence WTP positively. As the number of members of household working increases income of the household would be higher and support the improved service.

**TIME (Time Spent in the Area):** This refers to the number of years the household has been living there. It is expected to be positively related. The longer the years the household has been there, they would understand the problem of SWM of that area and, hence, are expected to be more WTP.

**CHILD (Number of Children Below 15 Years of Age in the Household):** This is also a continues variable, This is because when the number of children below 15 years of age are more, households would be more willing to keep the environment clean and healthy, hence it is positive relationship with WTP.

**QUANTITY (the Maximum Quantity of Waste Generated per week):** For this the unit of measurement used is a shopping plastic bag that is 'Kurtu', which was commonly known almost to all respondents during the survey. The study hypothesizes that the more the household would be WTP the more would be the quantity of waste generated by the household.

**DISEASE (Case of Diseases in the Household):** This is a dummy taking 1 if any member of the household was attacked by any one of waste related diseases such as typhoid, dysentery, influenza, trachoma, etc 0 otherwise. It is hypothesized that households who are affected by any kind of solid waste related disease would be the supporter of the improvement of SWM.

**SATSFA (Satisfaction with the Current SWM Service):** This is a dummy variable 1 is specified for households satisfied with current sanitation system and zero otherwise. Those individuals who are satisfied with the existing SWM service are expected not to favor the improved plan. Thus, it is expected to have a negative sign.

**MEANAGE (the average age of household members):** This is a continuous variable that takes the average age of household members. The presence of large mean age in the household means the household members are labor force that are capable of handling the waste. It is expected that mean age and WTP are negatively related.

**PAY (the Existing Payment for SWM Service):** Respondents current solid waste expenditure, households with high expenditure on the current SWM would be WTP a higher amount for the improved service.

**HOUSE (Housing Arrangement/ownership):** This is a dummy variable taking 1 if the household owns its house; 0 otherwise (if the household is renting the house from Kebele, public agency or individuals). It is expected to have a positive sign. Households who live in their own house would be more WTP for the improved SWM services than those who are paying rent. This could be credited to the fact that private ownership creates the incentive to make the environmental clean. Besides, for rent paying households, since a huge part of their income goes to house rent they would be more averse to extra costs emanating from improved SWM services.

### **3. Empirical Findings**

#### **3.1 Descriptive Analysis**

##### ***Household Socio-economic Characteristics***

Out of the 200 respondents 62.5% were male and the rest 37.5% were female. The data on age shows a wide range of responses where the average is found to be 41 years of age, the minimum age was 20 years while 86 years was the highest age. The average number of household members who lived in the same house was around 4.4 with a minimum of 1 household member and a maximum of 11 household members. About 43.5% of the respondents had 1 working member in the household while 42% and 7% reported 2 and 3 respectively. The remaining 7.5% include households with no working members and have more than three members who have a job. The mean number of working household members was 1.6. The mean number of years that respondent

households have lived in the area is estimated to be around 9.5 years whereas the minimum and maximum lengths of stay are three months and 45 years respectively. The survey result shows 59.5% of the interviewed households are living in their own houses while 40.50 % live in houses rented from kebeles, government agencies or individuals.

About 86.42% of the respondents are found to live in rented houses from individual owners. The average monthly income of the respondent households was 2210.315. As data shows 34.5% of the respondents' income is less than or equal to 1500. 48.5% of the interviewed households' income falls within the range 1501 to 3000. Households with their incomes exceeding 3001 were only 17%. This shows that the sample incorporates different income groups.

**Table 1: Socio-economic and Demographic Characteristics of Sample Respondents**

Variables	Observation	Mean	Std. Dev	Min	Max
AGE	200	41.225	13.20478	20	86
HHSIZE	200	4.435	1.871708	1	11
CHILD	200	1.155	1.080189	0	5
TIME	200	9.4545	10.31661	.25	45
INCOME	200	2210.315	1370.949	350	11000
HHWORK	200	1.545	.7752289	0	4
MEAN_AGE	200	26.74778	9.010293	13.5	70

Source: Own survey result, 2010

As regards to the educational level of the respondents, 11% of them have no exposure to formal education while 37% have attended primary education, which includes those that can read and write up to those who attended sixth grade. The remaining 35.5% have attended secondary level and 16.5% have attended higher education.

Concerning the occupation of the respondents 15.5% of them run their own private business, 47.5% were government employees', and 7.5% and 5.5% were employed in private companies and NGOs respectively, while the rest 24% were jobless when the study was conducted. This was due to their being housewives (domestic service), students, and pensioners are too old to work.

To crosscheck the income figure respondents were also asked to state their average monthly expenditures. The data show that, the total monthly expenditure on average was 1673.6, as compared to the average gross income (2210.3 birr/month) with major

expenditure that a household spends; it is found that they are close showing that households have revealed a fair estimate of their income.

### ***Rank for Various Social Services***

To investigate households' preferences for social services in terms of priority, they were asked to rank the importance of the various socio-economic sectors for government budgetary allocation. Seven different social services were listed; education, crime prevention, poverty reduction, defense, environmental protection, housing and public Health. It is interesting to note that environmental sector was one of the least important areas. From the mean rank at aggregate level environmental protection ranked 5<sup>th</sup> out of 7. Overall result of the study clearly shows that, residents of Bahir Dar have consistently ranked environmental protection as one of their least priority services.

### ***The Existing Situation of SWM***

This section is dealing mainly with the existing situation and practices of SWM in Bahir Dar city. Of the total 200 respondents (96%) use temporary storage material and 82.8% use *Madaberia* while the remaining households store their wastes in different materials like barrel, basket, container, *jerikan*, plastic bag and tanker which are made of stone and cement temporarily till it is disposed of.

Respondents were also asked to estimate maximum amount of wastes they generated in a week in terms of plastic bag, which is "*Kurtu*", for all types of solid waste. On average the amount of waste generated per household was 2.5 *Kurtu* per week or 10 *Kurtu* per month. The maximum number of wastes generated per week per household was 10 *Kurtu* and the minimum was 0.25.

With regard to the ways households dispose their solid waste before August 2009 all the respondents used '*Genda*' as a way of disposing solid waste. Very recently, the majority of the households get the service of solid waste collection and disposal from the private formal waste collector. This private waste collector company signs a 10 year contract with the city municipality to collect and dispose wastes in a door-to-door basis for all residential and some non-residential areas of the city. In this system all the residents are expected to be the beneficiary and have to pay for the service. But from the 200 interviewed households only 74% of the respondents were legally registered to get the service, the rest 26% are either digging a hole around the house and hide it out or throw their waste to the nearby river and open space. Moreover, some respondents use informal

waste collectors who take the waste on daily payment. The average monthly payment for the formal private service collector was 8.4225 birr for the sampled respondents for the door to door service. The maximum payment was birr 16 per month.

**Table 2: Waste Generation Vs Existing Payment**

<i>Variable</i>	<i>Observation</i>	<i>Mean</i>	<i>Std. Dev</i>	<i>Min</i>	<i>Max</i>
Quantity	200	2.50575	1.667892	.25	10
Payment	200	8.4225	3.846651	0	16

Source: Own survey result, 2010

The above table shows that on average a household that generates 10.023 (2.50575\*4) Kurtu of solid waste per month pays birr 8.42. Therefore the household that generates one Kurtu of solid waste per month is expected to pay 0.84 birr or 84 cents per month. Despite the good intention of the master plan there is no sanitary landfill in Bahir Dar city for waste disposal. Solid wastes that are collected from the formal and informal collection system in the various districts of the city are transported to a single dumpsite (landfill). As a result, problems associated with odor and air pollution from burning waste at the sites have been significantly increased.

The types of solid wastes the households recovered were old clothes and glasses that were either sold or given away to formal/ informal door-to-door collectors. Plastic wastes which have a high potential for recycling, had the highest re-use value for households for burning. Some portions of the food wastes in Bahir Dar were recycled for composting. Household composting was normally undertaken to enhance garden soil. They also use yard wastes for burning purpose. Regarding awareness about recycling, about 29% of the respondents never heard about it.

Regarding sorting out of waste at household level 61.5% never practiced waste sorting. Only 38.5% households practiced waste sorting. Papers, glasses, bottles, clothes and tins were the types of wastes that the households sorted out.

#### ***Household Attitude and Perception about SWM***

To assess attitude and perception of the respondents on SWM, respondents were asked how SWM was an issue worth discussion in Bahir Dar. Accordingly, 24.5% of them were conscious and responded that they are very serious, whereas 37% of the respondents claim that it was not worth discussing about at all. The rest 38.5% said it was not an issue critically; it became an issue only when the private company started to collect the

waste. Almost all (99.5%) of the respondents agree on the importance of proper SWM. In addition, the majority (92%) of the sampled households perceive that waste recycling is important whereas 3.5% and 4.5% of the respondents either know nothing about recycling or perceive recycling as not important respectively. About 68.5% of the respondents were conscious and aware about the importance of waste minimization even if most of them did not take any action to reduce the waste.

Concerning the issue of waste generation pattern in relation to household consumption 83.5% of the respondents know that solid waste generation is affected by their own consumption pattern. About 38% of the respondents consider those people who handle wastes as dirty, poor and inferior, and 53% of the sampled households were appreciating the commitment of those individuals who are courageously working and dealing with SWM. Moreover, the respondents worry about the workers life, since they do have life insurance and proper safety cloth. The rest 9% felt nothing about the workers.

Regarding attitude of respondents on the responsibility of handling SWM service for the households, 60.5% of the respondents think that it is the responsibility of the society to handle SWM of which 84.3% of the respondents were WTP for the improved SWM service and on average they were WTP 15.8 birr per month. However, about 38% percent said that both the society and the government should be responsible, that is, the households are responsible only to store wastes somewhere at the site determined by the municipality, after that the transportation and disposal of waste including the cost should be covered and handled by the government. But 78.9% of them accept the improvement and are WTP 13 birr per month on average. The rest (1.5%) said it should be handled by the local government and reject the payment for the improved service. Similar result is obtained for the responsibility of environmental quality. This might suggests that WTP for SWM service is inversely related with the behavior of the respondents in terms of expecting the government to provide free SWM service as expected a priori (Table 3).

**Table 3: WTP vs. Responsibility**

	<i>Household only</i>	<i>Local government</i>	<i>Both</i>
Frequency	121	3	76
Percentage	60.5	1.5	38
% of WTP	84.3	0	78.9
Mean maximum WTP	15.8	0	13

Source: Own survey, 2010

About 95.5% of respondents of this survey choose the current private service provider as compared to the previous service. This is due to different reasons of these private collectors provide door-to-door collection service and focus on the issue of SWM. Moreover the current system reduces job burden of the municipality and creates a good job opportunity for the society as well. The respondents also recommended that the government should out source SWM to the private company and control it.

With regard to the level of effort made so far by the municipality of the city for the previous service, 77% of respondents said it was poor, 15% and 8% said it was good and fair respectively. From among the respondents who receive SWM service from the current private company 58.5% said that the current service system is better than the previous one but there are still so many problems. The problems are not only lack of awareness creation and training on how to handle solid waste but also on timely collection. Households also face shortage of *Madaberia* (temporary storage) since mostly it is taken by the service provider. They also suggest the necessity of improvement on transportation system (open truck), alarming system (knocking at the door) and the collection frequency. Most respondents did not know the responsible body for collecting dead animals. Moreover, respondents suggest payment system should in line with the quantity of waste generated and they do not agree with the existing forceful payment. The result shows the necessity of demand side analysis before implementing the service.

Respondents were also asked whether or not they need an improvement for SWM service now and the result shows all sampled households preferred to get an improved service. With regard to cost/expense of the improvement if somebody undertakes the service for SWM, majority i.e. 66.5% of the respondents expressed that the society should cover the expense which is an interesting implication for the necessity of the improvement. About 17.77% said that all the government, private and NGO should coordinate and cover the expenses. And the rest 15.73% said that either the government or NGO should cover the cost and provide free improved SWM service to the citizens. On the other side, 39.50% of the respondents reported that they have encountered disease of family members in relation to mishandling of SWM before.

With regard to the problem that the households face as a result of mishandling of solid waste, only few respondents can remember the problems that the households face. These are health problem, environmental pollution, economic problem, aesthetic problem, loss of



beauty, sanitations fill with solid wastes. Moreover it is also observed that more than half percent of the respondents cannot remember on the time of the interview.

The respondents were also asked whether there is any action, rule or regulation that the municipality of the city has taken on persons who improperly dispose their waste. However, 82% responded that there is no action/punishment at all and they also believe that the administrative body doesn't give enough attention to the problems related to the provision of improved SWM and all have said that they are in dire need for a better administrative responsibility as it relates to waste. 16.5% of the respondents knew nothing about it, 1.5% said there was a punishment for those individuals who improperly dispose these wastes.

#### ***Household WTP for the Improved SWM Service***

Out of the total 200 surveyed households, 164 (82%) households responded positively to the CVM questions while 36 respondents were not WTP for the improved SWM plan. The mean WTP was found to be 14.5 birr per month, with a MWTP of birr 50 per month. Moreover, it is interesting to observe that the majority (60.5%) of the respondents were dissatisfied with the collection and disposal system of current private waste collector services. This implies that there is a desire for improvement of SWM services in Bahir Dar. About 10% of the respondents did not know or were undecided as to whether or not they were satisfied with the service, but 12 % of them were WTP. The cross tabulating result confirmed that those who have dissatisfaction are seeking the improved services and are more WTP for such service. Of the total unsatisfied respondents 85.9% need and WTP 16 birr per month (on average). Of the 59 respondents that were satisfied with the existing service 65.5% need the proposed improved SWM service and on average the mean MWTP amount is 12 which were less than those of unsatisfied.

**Table 4: Comparison of WTP for Satisfied and Unsatisfied Respondents**

	<i>Satisfied</i>	<i>Dissatisfied</i>	<i>Undecided</i>	<i>Total</i>
Frequency	59	121	20	200
Percentage	29.50	60.50	10	100
% WTP from each group	65.5%	85.9%	60%	
Mean MWTP	12	16	13.2	

Source: Own survey, 2010

**Zero Willingness to Pay Responses**

In this study 36 respondents did not accept the improved SWM services and revealed zero WTP. To identify whether these responses are protest zero responses, a follow-up question was raised to the respondents. 24 of the respondent revealed that they do not have enough income to pay for the improvement; some respondents (13.89%) seem to be comfortable with the existing services and are not WTP; and others (19.44%) rejected the suggested improvement, and they said that the government should pay. Thus none of these were considered as protest answers.

**Table 5: Distribution of Protest Zeros**

Reasons for not willing to pay	Frequency	Percentage	Cumulative
I can't afford	24	66.67	66.67
The existing system is adequate	5	13.89	80.56
The government must pay	7	19.44	100.00
Total	36	100	

Source: Own survey, 2010

The comparison of socio-economic and demographic character of those respondents who were willing to a positive amount and those who were reject the improved service are summarized in the following table,

**Table 6: Comparison of Socio-Economic Variables of the Respondents**

Variable	Unwilling to pay			Willing to pay		
	Mean	Std. Dev.	CV (%)	Mean	Std. dev	CV (%)
AGE	49.56	14.87	30	39.39	12.11	30.74
EDUCA	2.89	3.44	118.9	8.02	3.52	43.93
HHSIZE	6.28	1.47	23.35	4.03	1.70	42.25
CHILD	0.89	1.24	139.16	1.21	1.04	85.52
TIME	14.3	13.26	92.7	8.39	9.27	110.44
INCOME	1128.86	864.25	76.56	2447.71	1397.64	57.1
QUANTITY	2.39	1.63	68.4	2.53	1.68	66.32

Source: Own survey, 2010

The above table shows the comparison of some socio-economic variables between those respondents who were willing and unwilling to pay for the proposed improved SWM services. With regard to age those who were WTP were relatively younger than those who oppose the service. Those respondents, who were WTP, on average, had

higher educational attainment, monthly gross income and more number of children aged below 15. Relatively less for number of years they stayed in the area. Those sampled households who were not WTP had lower value for those variables but had a higher household size and the number of years they stay in the area than those who were WTP. Interm of the quantity of waste that the household generate relatively significant difference is not observed.

With regard to the coefficient of variation (CV), those who were not WTP on average had greater disparity in the distribution of their monthly income, educational attainment and the number of children who were aged below 15. These variables show low variability for WTP respondents. But for those respondents who were WTP greater variability were in their family size and the number of year they stay in the area. Other variables (age and the quantity of waste that the household generate) had not shown greater difference among willingness and unwilling to pay respondents. The disparity on the above variable could explain for their willing or unwilling to pay for the respondents.

Concerning the payment vehicle, of the total WTP majority respondents i.e. 49.39% of them support the existing payment system i.e. on its own. On the other hand 43.29% of them are found to support the payments of solid waste service with water. This is to save time and transportation cost of the payment collector. They also fear that absence of money during money collection and they also said that waste is part of hygiene and sanitation so it must be collected with water. 4.88% of the respondents agree with electric bill and the remaining 1.83% does not care about the form of payment rather the amount they are WTP.

### **3.2 Econometric Model Result and Discussion**

As described in the methodology part, to examine factors affecting WTP multivariate econometric analysis was used. Since Multivariate analyses provide better information and clear focus on the factors that affect the WTP responses that gives policy implication/recommendation. In the econometric analysis different socioeconomic, demographic variables and attitudinal variables that are expected to explain the dependent variable are included.

## Determinants of Household's Willingness to Pay Responses

### The Probit Model

In the methodology part it was indicated that probit model is employed to analyze factors that determine whether or not households' WTP for the improved SWM services. Before running the econometric model estimation, data exploration for the pervasiveness of multicollinearity was tested since this problem reduces the accuracy of estimating the coefficient of variables having this problem it is difficult to sort out the effects of each explanatory variable on the dependent variables. Multicollinearity is a serious problem if the correlation matrix is in excess of 0.8 (Gujirati, 1988, p.359). Thus the result indicates multicollinearity problem is not a serious problem in the data.

The maximum likelihood estimates for a household to be willing or not is corrected for potential heteroscedasticity problem. As shown in Table 7 the Wald chi square which are 76.41 shows the overall significance of the probit model at 1% level of significance. The pseudo R<sup>2</sup> is 62.91%, which implies that percentage of the variation in the probability of being WTP or not is explained by the variables included in the model.

**Table 7: Probit Estimation Results <sup>a</sup>**

<i>Explanatory Variables</i>	<i>Coeff.</i>	<i>Rob. Stan. Errs</i>	<i>P&gt;/z/</i>	<i>Mar. (dF/dx )</i>
AGE	.027624	.0228455	0.227	.0018066
EDUCA	.1559996 ***	.0488346	0.001	.0102024
HHSIZE	-.8924425 ***	.22769	0.000	-.0583659
CHILD	.7125418 ***	.2449989	0.004	.0466003
TIME	.0548455 **	.0232125	0.018	.0035869
INCOME	.0005022 **	.0002546	0.048	.0000328
HHWORKE	.5533233 ***	.2174405	0.011	.0361874
QUANTITY	.0941772	.0964093	0.329	.0061592
PAYMENT	.0109191	.0376738	0.772	.0007141
MEAN-AGE	-.0531143 *	.0302225	0.079	-.0034737
SATSFA	.2509701	.3262719	0.442	.0157169
DISEASE	.5550186 *	.3104888	0.074	.0336098
HOUSE	.3463461	.3962902	0.382	.0243999
SEX	-.5598867	.3680854	0.128	-.0331726
_cons	1.225827	.8794758	0.163	
Pseudo R2	0.6291			
Wald chi2	76.41		0.000	
Log likelihood	34.971712			

<sup>a</sup>\*\*\* Significant at 1%, \*\* Significant at 5%, \* Significant at 10%

Education level of the respondent is statistically significant at 1% level of significance with positive sign. This implied that the more educated person is more aware and easily understands the health and environmental impact and consequence of poor handling of SWM. Thus, a household head that who is educated is more WTP than a household with little or no educational background. When the education level of household head increases by one year the probability of WTP for the improved service would be increase by 1.02 percentages keeping other things constant. Hence education is one factor that determines households' WTP for the improved SWM services in Bahir Dar city.

Household size was significant variable at 1% level of significance. It has inverse relationship with WTP for improved SWM service. The result showed that other thing remaining constant if the number of family size increases says by 1 person, the probability of households' WTP for the improved SWM service is reduced by 5.83 percentages. Which means having more household members may mean low job distribution among the family members and/or on the other side increase in the family size would increase the burden of providing food and other necessities by the family, thus the household would be unable to pay for such kind of service. Thus family size is one of the determinants of households' WTP for the improved SWM services in the Bahir Dar city.

The other determinant variable that was found in this survey is number of children below 15 years of age in the household; it has a positive impact on the WTP decision and it was significant at 1%. This was in line with our expectation and the result indicates that a unit additional child in the household would increase the probability of being WTP by 4.66%, keeping all other factors constant. A household having more children needs to keep clean environment not to be affected by improper handling of SWM, hence the household would support the improved service. On the other side this positive relationship may also arise as a result of bequest value. The one with more children needs to keep the city for the future generation to be clean and would be WTP more.

Length of time/year of stay in the area was significant at 5%. It has also positive sign. This could be because of longer stay in the area would help to understand the problem of poor handling of solid waste and would be more keen to pay for an improved SWM service. Thus, the time spent in the area is one of the major determinants of WTP for the improved SWM service in Bahir Dar. The marginal effect reveals that a one additional

year of stay in the area would increase the probability of accepting the improved service by 0.35% while the other factors are held constant.

Household income was found to be one of the determining factors for WTP for improved SWM service. It had a positive sign and was significant (at 5% level of significance). The significance and positive sign of the variable income was consistent with economic theory. The result showed as household income increases WTP for improved SWM service also increases which is generally to be expected. This shows that SWM is a normal economic good whose demand changes in the direction of income change. Keeping all other factors constant a unit increase in the income of the household increases the probability the household's WTP for the improved service by 0.0032%.

As expected more family member having a job increase the probability the household would be WTP for the improved services and was significant at 5% level. The marginal effect shows that one additional member of the household getting a job increases the probability of being WTP by 3.61%, other things held constant. Since the time spent in the home is reduced they may not have time to properly dispose the waste so they would favor the service.

The variable mean age of the household members was significant at 10% and negatively related with household demand for improved SWM service. The result shows that other things remaining constant if mean age of member of the household increases say by 1 year the probability of households' WTP for the improved SWM services decreases by 0.34 percentages. Since high mean age may mean many members of the household are likely to be of the age capable of disposing the waste by themselves. Hence, mean age of the household member is one of the determinants of WTP for improved SWM in Bahir Dar city.

The variable solid waste related diseases has the expected sign and was significant at 10% level of significance indicating that those households members who are affected by disease are more willing to participate in the improved SWM service than those who were not affected. The result reveals that being affected by waste related disease would increase the probability of saying yes for the improved SWM service by 3.36% while the other factors are held constant.

Age and sex of respondent, quantity of solid waste generated, payment, satisfaction, housing arrangement were not significant variable that determines WTP decision in the study area for this specific study.

### Results of Tobit

As indicated in the methodology section Tobit model is used to estimate the amount of money a person or family spends on SWM service or mean MWTP in relation to socio-economic variables. The overall model goodness of fit is represented by pseudo  $R^2$  in the model (pseudo  $R^2 = 0.0929$ ), which indicates that the fitted model has the power to explain the dependent variable.

**Table 9: Tobit Model Estimation Results <sup>a</sup>**

Explanatory variables	Coef.	Std. Err.	P> t	Marg. Effect(dF/dx)
AGE	.0280791	.1181575	0.812	.0004689
EDUCA	.4744972*	.2512905	0.061	.0079245
HHSIZE	-3.407329***	.657054	0.000	-.0569054
CHILD	3.675702***	1.040227	0.001	.0613875
TIME	.1389228	.108933	0.204	.0023201
INCOME	.0033388***	.0006148	0.000	.0000558
HHWORKE	2.303086**	1.107002	0.039	.0384636
QUANTITY	-.116245	.5041116	0.818	.0019414
PAYMENT	.7352731***	.2158924	0.001	.0122797
MEAN-AGE	-.0982751	.1628645	0.547	-.0016413
SATSFA	-1.725267	1.545758	0.266	-.0295721
DISEAS	.5683988	1.566402	0.717	.0094153
HOUSE	2.952282*	1.779665	0.099	.051387
SEX	-2.560101	1.706021	0.135	-.0409811
_cons	4.127273	4.697921	0.381	
Pseudo R2	0.0929			
LR chi2(14)	129.01		0.000	

<sup>a</sup>\*\*\* Significant at 1%, \*\* Significant at 5%, \* Significant at 10%

Level of education was significant at 10% level of significance. The education level of the respondent was not only significantly affect whether or not the household was WTP as mentioned in the probit model but also affect the amount that the household was WTP. This indicates that as people get more educated their awareness for the environment

and health impacts of improved SWM service would also increase. As education level of the respondent increases by one year the WTP amount increases by 0.08 cents per month, keeping all other variables held constant.

The variable household/family size was found highly significant (1%) and has a negative sign. As the rationale was given in the probit part, family size significantly affects both the household's willingness to participate and the amount that they were WTP. The marginal effect shows that, keeping other things constant, an increase in family size by one more member would reduce the amount the household was WTP by 0.57 birr.

The other variable, which was highly significant at 1% level of significance, was children. It was positively related to the amount the household would be WTP, which implies that the households that had more children had more concerns with health and well being of the child and hence pay more. The same result was also found for participation in decision for the proposed improved service in the probit estimation. The marginal effects of the Tobit model indicate that an increase in the number of children of the household by one unit would increase the WTP amount by 0.61 birr per month, other things held constant.

The household gross income variable had a positive sign and it was significant at 1%. The finding of the Tobit model showed that a one birr increase in family income raises the WTP amount by  $5.6 \times 10^5$  birr per month keeping other things held constant. The positive sign indicates that the household whose family incomes are high would be WTP more for the improved service.

The other variable which was found to be significant (5%) in the Tobit model was household work. It has a positive relationship with the actual amount that a household would be WTP. This implies that the more the number of income earners in the household the more they would be WTP. The marginal effect showed that other things being held constant when one household member gets employed the household WTP amount rises by .0384636 birr per month.

Contrary to the probit result which was insignificant the variable existing payment for waste collection service has a positive and significant (at 1% level of significance) impact with the amount that the household would be WTP. Its positive sign indicates that households who currently pay more would be WTP more for the improved service.



The variable housing arrangement had positive sign as expected with a 10% level of significance. The positive sign indicates living in the rented house may not care about the surrounding environment and would be WTP less for the improved service than those who live in their own house. This idea was similar with what we observe for householders who pay rent for the house they live feel that solid waste disposal charges should be paid by the owner of the house. Thus housing arrangement is one of the determinant factors in deciding the amount that the household would be WTP. The marginal effect showed that being living in their own house increases the amount that the household would be WTP by 0.51 birr per month.

Finally the intercept term 4.127 showed the predicted MWTP amount when all the explanatory variables are zero. As compared to the average MWTP amount which was 14.5 it was very small. But as p-value shows it was found to be insignificant. Thus the constant term that measures the mean MWTP amount when all the predictor variables are zero is statically rejected at 10% level of significant.

The variable Age and sex of respondents, the length of time/years the respondent stayed in the area, quantity of waste that is generated, existing payment, mean age of the household, satisfaction and disease were not found significant in influencing the WTP amount for the proposed improved SWM service for this study.

### **Estimating Aggregate Willingness to Pay and Total Revenue**

In this section total WTP and the total revenue at various prices that households would be WTP is calculated. The demand curve for improved SWM is derived and finally the possible benefits or total revenue that could accrue, if improvements were underway is estimated.

According to the ANRFEDB (2009) the population of Bahir Dar town for the year 2002 was estimated to be 204,277 and the average family size 4.4 per household which was obtained in the survey. Dividing the population by average family size and after rounding a total of 46426.6 households is estimated to be found in the study area. To make aggregation over the whole household's class intervals for MWTP were used.

Thus, the aggregate revenue that is expected from the provision of improved services as shown in Table 9 is calculated by multiplying the mid points of the WTP interval which is

column (b) by total number of households' WTP for the improved services at least minimum amount which is column (g). The aggregate revenue expected from the provision of the improved SWM service given each household is willing to participate and pay for the improved service at least a minimum amount of column (g).

Taking the population of the sampled households, that falls within the class boundary. We estimate the total number of households which is column (d); and column (e) which is the total WTP is obtained by multiplying column (b) midpoint value of the class boundary by column (d) total number of household that fall within the boundary. By summing up the total WTP amount of each class boundary, the grand total WTP (aggregate benefit) for proposed improved SWM service is found to be 629196.497 birr per month.

**Table 9: Total WTP and Total Revenue from the Suggested SWM Services**

Class boun. for WTP amount (a)	Class mark for WTP amount (b)	Sample Distribution (c)		Total no hhs (d)	Total WTP (e)=b*d	Sam.hhs WTP at least that amount (cummm) (f)		Minimum amount Hhs are WTP (g)	Total revenue (h)
		No	%			No	%		
0-5	2.5	49	24.5	11374.52	28436.2925	200	100	46426.6	116066.5
6-10	8	40	20	9285.32	74282.56	151	75.5	35052.08	280416.7
11-15	13	35	17.5	8124.655	105620.515	111	55.5	25766.76	334967.9
16-20	18	40	20	9285.32	167135.76	76	38	17642.11	317557.9
21-25	23	13	6.5	3017.729	69407.767	36	18	8356.788	192206.1
26-30	28	13	6.5	3017.729	84496.412	23	11.5	5339.059	149493.7
31-35	33	0	0	0	0	10	5	2321.33	76603.89
36-40	38	4	2	928.532	35284.216	10	5	2321.33	88210.54
41-45	43	2	1	464.266	19963.438	6	3	1392.798	59890.31
46-50	48	4	2	928.532	44569.536	4	2	928.532	44569.54
<b>Total</b>		<b>200</b>	<b>100</b>	<b>46426.6</b>	<b>629196.497</b>				

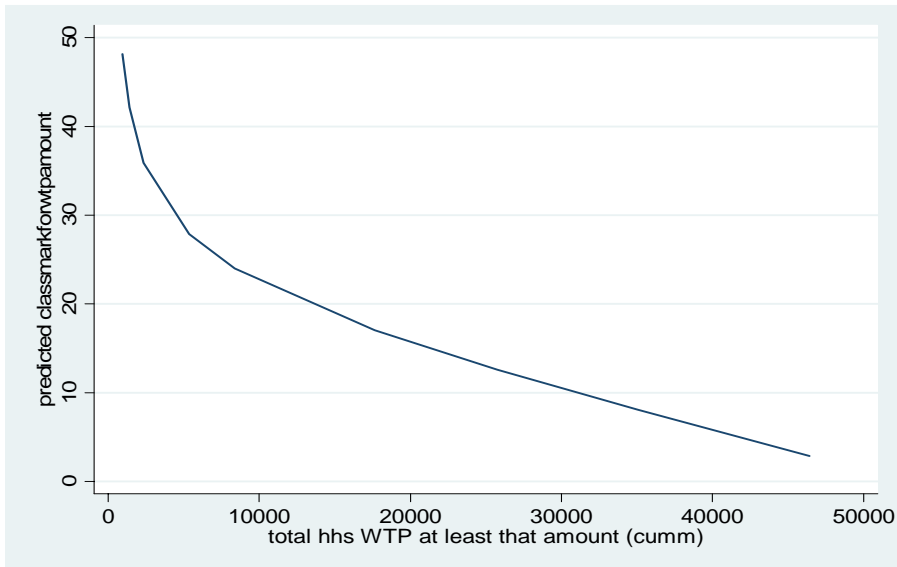
Source: Survey result, 2010

The figure (629196.497) is higher than the existing amount of money that is collected by the private service provider which is 105 thousand (birr) (BDDLPC, 2010). Currently 75% of the residents of Bahir Dar are the beneficiary of the existing service. If the whole society (100%) were the beneficiary of the existing door-to-door service, then the total

revenue obtained would have been Birr 104,000 with the existing charge. The potential revenue per month that could be generated if we apply the WTP principle becomes more than four times the actual pay. Nonetheless, it is less likely to use price discrimination policy and charge different prices based on WTP principle for the same purpose with the motive to generate Birr 629196. Thus, if the proposed improved SWM service is implemented the service provider as well as the society will be the beneficiary.

As shown in Table 9 the predicted total number of households that are WTP at least that amount for the suggested improved SWM service at low price such as birr 8 it is larger (35052.08 households) than at higher price say birr 28 which is only 5339.059 households. This is due to the expectation that at low price, such as 2.5, all households in Bahir Dar can afford and participate for the proposed improved SWM service. This implies that there is a negative relationship between price and the total number of households that demand the improved SWM service. So it is possible to derive the demand curve for the suggested improved SWM; where the vertical and horizontal axis represents the class mark for WTP amount and the total households that are WTP at least that amount respectively.

**Figure 1: The Estimated Household Demand curve for Improved SWM Service**

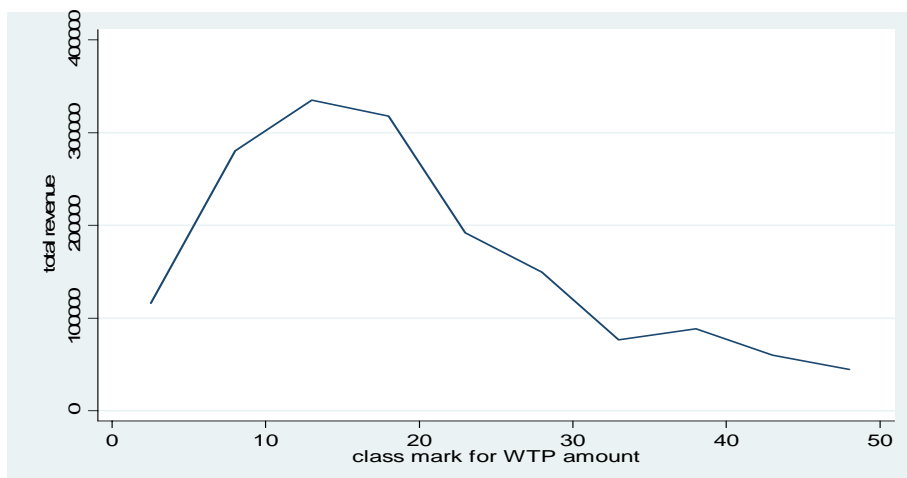


As the graph shows there is a discouragement effect of higher price on the demand for the proposed improvement, all other variables held constant. The result conforms to the general demand theory that price and quantity demanded have inverse relationship.

Column (h) of Table 9, i.e., the total revenue gained from the improved service is obtained simply by multiplying the total household's WTP at least that amount column (g) and class mark for WTP amount column (b). As we see from Table 9 when price 2.5 birr 46426.6 households would pay for the suggested improved service and the aggregate total revenue is expected to be 116066.5 birr per month. In general as price increases the total revenue generated increases, it reaches maximum and finally starts to decline. This arises due to the reduction in the number of households that are WTP as price increases. The price level that makes the total revenue to be maximum (334967.9) is 13 birr per month when the total number of households that are WTP at least at this price are 25766.76. Since birr 13, which is determined by the total revenue maximization criteria, is less than the mean MWTP amount (14.5) it is a better price for the society as well as profitable for the service provider for this improved service.

The information that is obtained in Table 9 about total revenue can also be represented graphically below.

**Figure 2: The Estimated Revenue Curve**



The overall result of the survey shows that households in Bahir Dar demand and are very much WTP for the suggested improvement. Thus the concerned body is better to much

the household demand and supply of SWM service for a better and healthy environment.

## **4. Conclusions and Recommendation**

### **4.1 Conclusions**

Economic development, urbanization and improving living standards in cities have led to an increase in the quantity and complexity of waste generated all of which hold true for Bahir Dar. If not followed by a concomitant improved and proper handling of waste (SWM), it can harm residents and constitute a major environmental and health hazard. However, improved SWM requires high capital outlay. Therefore, the service beneficiary needs to pay for the improved SWM service. Yet, to improve the service, demand side information including whether or not WTP and the amount of WTP is necessary. Hence, the main objective of the study was to analyze whether or not households demand an improved SWM service to solve the problem that they face and to identify factors that determine their WTP decision and WTP amount for the suggested improved SWM service. This demand side information could be used for policy makers to design appropriate tariff rate that is consistent with government policy.

In this study both primary and secondary data were used. For the primary data CVM were employed on 200 randomly selected households. The questionnaire was administered through face-to-face personal interview using bidding game elicitation format with an open-ended follow up question in determining the MWTP. For data analysis both descriptive and econometric techniques were used. Two econometric models were estimated. Probit to estimating the probability of WTP for the improved SWM service as a function of some independent variables and Tobit model identify factors that affect the amount of money a person or family spends on SWM service WTP and to estimate mean MWTP.

As expected households consider SWM, as a whole environmental sector as one of the least important areas. About 96% of the respondents use temporary storage material, the majority of them (82.8%) use; Madaberia, the remaining households store their wastes in different materials like barrel, basket, container, plastic bag and tanker made of stone and cement temporarily till it is dispose of. On average the amount of waste generated per household was found to be 2.5 Kurtu per week. As regards to waste disposal 74% of the respondents were the beneficiary of formal private collector who

takes the waste through door-to-door collection basis but due to time regularity problem and or any reason if the service provider does not take it the households throw waste in any open spaces outside their home. The remaining 26 % throw their waste in to the nearby river and around their home (open space). Moreover, there are informal waste collectors who take the waste on daily payment. This is removed during street cleaning, which is undertaken by the municipality. The respondents also mention the problem that the current service imposes on them. They collect the waste they placed it in a temporary place, which is around the village and stays there from 3 to 5 days. In addition, the respondents are not comfortable with the current transportation system, which is an open truck that drops the waste everywhere during transportation. Respondents also worry about the concerned body for dead animals, they said both the private collector and street cleaner do not dispose it, so it creates environmental and health problem. All these things need major improvement.

Regarding the sorting out of waste at household level, the majority, i.e., 61.5% never practiced waste sorting. Concerning the attitude of the respondents on the responsibility of handling SWM service, 60.5% think that it is the society's task to handle the service while 38% percent said that both the community and the government should take the role of administering SWM service, and the rest (1.5%) said it should be handled by the local government. Similar result was obtained for the responsibility of environmental protection.

It is interesting to observe that the majority of the respondents (60.5 %) were dissatisfied with the collection and disposal system of current waste collection services. This implies that there is a desire for the improvement of SWM services in Bahir Dar city. As expected households WTP for SWM service is inversely related with the behavior of the respondent in terms of expecting the government to provide free SWM service.

The mean MWTP was found to be 14.5 birr per month with a maximum amount of 50 birr. The total WTP amount of each class boundary, the grand total WTP (aggregate benefit) of the proposed improved SWM service is found to be 629196.497 birr per month, which is four times higher than the existing monthly revenue. Thus, if the proposed improved SWM service is implemented the service provider as well as the society will be the beneficiary.

The probit estimates in this study identified eight variables to be significant ones in the decision on whether or not household is WTP for the proposed improvement. These include educational level, family size, and number of children, length of time/years of stay, income, household work, mean-age and disease. The other variables such as age, quantity, payment, satisfaction, housing and gender were found to be insignificant. The result of the Tobit model also reveals that educational attainment, family size, number of children, income, household work, payment, and housing are the significant determinants of the amount the households would be WTP whereas the other variables age, quantity, mean-age, satisfaction, disease, time and gender turned out to be not significant.

The overall result of the study shows that there is a room for improving SWM service system at household level in Bahir Dar city. An interesting implication is that if local government implements the service, there is tangible evidence that many people do need improved SWM service and above all they are WTP for such a service. In addition, since the existing system of SWM in Bahir Dar is poorly organized, we believe that in the future the local government pays attention to the actual needs of the people and the service must be designed to fit their socio-economic conditions.

## **4.2 Recommendations**

Having reviewed the major findings of the empirical studies, the following are the policy implications and recommendations:

Any policy to bring about efficient SWM service needs to include the demand side information to yield the needed environmental impacts since it is useful for policy makers to balance households' demand for and the supply of improved SWM services. As regards to service charges for SWM, it should be based on willingness than imposing them to accept the supplied service.

Education and awareness in the area of waste and SWM is important from a global perspective of resource management. Therefore, efforts should be made by the local government and the private sector in Bahir Dar to create awareness of SWM issues at the grass roots level, and televised discussion should be prepared on SWM.

The strong positive relationships between the income, family size, number of children, and household working members and their willingness to pay for the improved SWM services in both Probit and Tobit models show that policy makers should consider these variables in designing improved SWM service for Bahir Dar city.

The survey result shows that there is no punishment for illegal dumping of wastes, so enforcement of waste management legislation and a proper policy and planning framework for waste management especially against illegal dumping of solid waste is required to bring a good result.

The capacity of the private sector to provide reliable waste collection service, and of the public sector to supervise them, should be strengthened.

The survey results show that households are WTP for improved SWM. Thus, if the improved SWM service is provided in the city the environment will not be polluted and at the same time the demand for improved environmental quality of the household will be satisfied.



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