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Evaluation of Factors Determining the Household's Willingness to Pay for Improved Solid Waste Management Services: The Case of Logia Town.

Seid Ahmed [1*]
1*. Samara University College of business and Economics, Department of economics,

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ABSTRACT*: This paper evaluated the factors determining the households WTP for improved solid waste management services in Logia town. In this study 201 respondents are included to analyses the household's willingness to pay for improved solid waste management services in the logia town using the Contingent Valuation Method (CVM) techniques. The Sampling technique respondents were selected by lottery method (simple random methods) because of the population homogeneity. Both primary and secondary sources of information were collected and the study was applied a binary logit model. Out of 201 respondents, about 65.17% are willing to pay for improved SWM services with an average maximum willingness to pay is 13 Birr per month this shows households have an interest to contribute to environmental protection. The result shows that respondents age, distance between resident area and waste disposal facility, unpaid options (all with negative), sanitary supervisor visit, dwelling type and attitude (awareness) (all with positive) have significant effects on the willingness to pay for improved solid waste management services. In conclusion, the majority of the households are willing to pay for improved solid waste management services, which implies that any policy effective for improved solid waste management services in the study area is needed.*

KEY WORDS: contingent valuation method, solid waste, willingness to pay, binary logit model, afar region

INTRODUCTION

Nowadays, the world's environment getting polluted and its comforting ability for life becomes decline. The most dynamic engines for environmental pollution are rapid urbanization, fast expansion of urban, agricultural and industrial activities, which motivated by population growth. Economic growth in less developed countries has led to the huge movements of people from less urban areas to urban areas for searching better life. Because of this, the numbers of persons, additional to the urban population in undeveloped countries create challenges to governments, urban planners, urban administrations and some others. Due to this, urbanization and high rate of population growth are especially accountable for high aggregate rate of solid waste management (SWM) service supply. Even though advanced countries generate greater quantities of solid waste than developing countries (Solomon C, 2011).

Effective solid waste collection and disposal is a vital component of public services provisions and should take priority particularly in emerging cities. Because falling to have such services can result in many unfavorable outcomes in the long run; this may have serious adverse effects on public health and the environment. But the expansion of such services provisions is often a challenging task for governments of developing nations due to heavily burdened, and stretched financial and economic resources that lead to relatively high opportunity cost of funds (Murad et al, 2007). Solid waste management is one of the developmental challenges facing city authorities worldwide, especially in most developing countries (UNEP, 2013). Poor solid waste management, coupled with inadequate financial resources, has led to indiscriminate dumping of solid waste into open spaces and drainages, blocking pipes and causing flooding, environment pollution and public health issues (UNEP, 2013).

Rapid urbanization has made solid waste management a serious problem in poor and less industrialized countries. Waste management is becoming a very serious problem in Ethiopia also. For this, we must evaluate the factors determining the households' willingness to pay for this service. The information can be used to raise people's welfare by introducing cost recovery by assigning into households' willingness to pay.

The problem in less industrialized countries is further difficult because of increasing greatly the size and arrangement of waste being generated and the demand for waste recovery service in municipal areas by rapid growth in population and urbanization. This implies that the problem of SWM in the unindustrialized world is more important than developed countries, because as long as humans have been living in settled communities, waste generation has been a clear and serious issue in all nations (Zerbock, 2003).

According to Schubeler, Wehrle, and Christen (1996) municipalities in developing countries spend a large proportion of their budgets on the management of solid waste materials. This problem is growing due to inappropriate planning by waste management authorities, inadequate governance, lack of resource availability and unsuccessful management in fast growing cities of the developing countries.There are a number of problems associated with the inappropriate waste management mechanism in the densely populated areas. The open waste amounts create health problems and leachate pollutes the underground water, ultimately causing waterborne diseases. This study seeks to evaluate factors that determine households WTP for improved solid waste management services in Logia town Afar Region.

METHODOLOGY

Description of the study area

Afar is located in eastern part of Ethiopia. The region has common boundaries with the state of Eritrea in the north-east, with Tigray in the north-west, with Amhara in the south-west, with Oromia in the south, with the state of Somalia in the south-east and with the republic of Djibouti in the east. According to Ethiopian statistical authority (CSA) has estimated the July 2008 E.C populations of the afar administrative region at 1449,000 of which 137,000 are urban residents.

The breakdowns by gender 803,000 are males and 646,000 are females. The study was conducted in Dubti Woreda at one city administrations (Samara-logia). Logia is one of the rapidly growing towns in the Afar Region, Ethiopia, some 241 mi (or 388 km) North-East of Addis Ababa, at Latitude: 11°47'55.44" Longitude: 41°0'43.49" and the total population of logia town in 2007 was 14038. Out of the population, 7,411 are males and 6,627 are females. The average number of households in logia town is 3.1. (CSA, 2 007).

Sample size and Sampling technique

This study was used two-stage sampling techniques. In the first stage, from 34 woredas, one woreda (Dubti) and one city administrations (Samara-logia) were selected purposively. In the second stage households were selected randomly from each kebeles from logia town. I used simple random sampling to select the sample of the study with the help of Cochran sample size determination techniques.Cochran formula allows you to calculate an ideal sample size given a desired level of precision, desired confidence level, and the estimated proportion of the attribute present in the population. Cochran's formula is considered especially appropriate in situations with large and unknown populations. A sample of any given size provides more information about a smaller population than a larger one, so there's a 'correction' through which the number given by Cochran's formula can be reduced if the whole population is relatively small.

The Cochran formula is: $n_0 = \frac{Z^2 pq}{e^2}$

$$n_0 = \frac{(1.418)^2(0.5)(0.5)}{0.05^2} = 201.072 \approx 201$$

Where

n_0	The sample size
Z^2	The normal curve that cuts off an area α at the tails (1 –α equals the desired confidence level).
p	The (estimated) proportion of the population which has the attribute in question.
q	1 – p.
e^2	The desired level of precision (i.e. the margin of error).

Research Design and Methods

In this study both qualitative and quantitative approaches were used. This study employed cross sectional study design because the data collection was limited to a single time period for each household head.

Data type and collection

In this study both primary and secondary sources of data were used. Both quantitative and qualitative were collected for the evaluation of factors determining the household's willingness to pay for improved solid waste management services.

Method of Data Analysis

Both descriptive and inferential statistics was used. In addition to this binary logistic regression was used. The logistic regression model is used to describe data and to explain the relationship between one dependent binary variable and one or more nominal, ordinal, interval independent variables. The willingness to pay question was the dichotomous choice format, the Binary logit model was better for analysis in this study.

Table1. Definition, descriptive statistics and expected sign of variables

Variable	Definition	Measurement	Expected sign
PSWM	Price of SWM	In Birr/ETB	-
IncomHh	Income of households	In Birr/ETB	+
EdunHh	Educational level	In year	+
Famsize	House hold size	Number	-
SanitAdvis	Sanitary supervisor advise	Number	+
DwelType	Dwelling type	1 for Own house,0 otherwise	+
HouseOwner	House ownership	1 for Yes, 0 Otherwise	+
AttSWM	Attitude about SWM	1 for positive,0 otherwise	+
Age	Age household head	In Year	-
Gender	Sex of household head	1 for female, 0 otherwise	-/+
UnpaidSWM	Unpaid Options to SWM	1 for yes, 0 otherwise	-
DistancSWM	Distance from disposal services	In kilo meter	-

Model specification

The binary logit model

Willingness to pay question was a dichotomous choice, i.e. ‘yes’/‘no’ thus a binary logit model (Greene 2003) can be applied in the analysis of factors associated with respondent’s willingness to pay for improved solid waste management services.

The probability **P** that the respondent will give a ‘yes’ response, i.e. willing to pay is given as follows:

$$\mathbf{P[yes]} = \frac{1}{1+\exp(-bx)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

Where ß is a vector of parameters to be estimated and X is a vector of the respondent characteristics.

The probability that the respondent will give a ‘no’ response, i.e. not willing to pay is given as follows:

$$\mathbf{P\ (no) = 1\text{-}P\ (yes)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(2)}$$

$$\mathbf{P[no]} = \frac{1}{1+\exp(bx)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3)}$$

Handling of (2) and (3), gives

$$\textbf{1-P (yes)} = \frac{1}{1+\exp(bx)}$$

$$\frac{p(yes)}{1-p(yes)} = \exp(bx)$$

Where, exp (bx) is the ratio of the probability of a 'yes' to the probability of a 'no' response. The logarithm of the odds ratio is given as follows:

$$\ln\left[\frac{p(yes)}{1-p(yes)}\right] = bx$$

$$WTPwm = B0 + B1X1 + B3X3 \ldots\ldots Bnxn + \varepsilon$$

Where B_0 is the intercept, B_1 is the coefficient associated with the price **X1**, and **Bn** a vector of regression coefficients associated with other characteristic of the respondent **Xn** and **Ɛ** is the error term which is logistically distributed.

RESULTS AND DISCUSSION OF FINDINGS

Descriptive analysis of the survey data

This study found that Out of the total 201 respondents, about 61.19% were male. Around 47.76% of the respondents are house owner and the remaining 52.24% are not house owner. The higher number of the house owners in the study are pay for environmental quality improvement. The respondents overall attitude of the quality of their environment and SWM, almost are positives.
The existence of unpaid waste disposal option in their area about 66.17% of them has the opportunity to unpaid options, this indicate almost of solid waste is uncollected (i.e. waste may be dumped in river, bury, burning and removed in other forms). And the remaining respondents have no unpaid options, this indicates that there is a willingness for the improved of SWM options in logia town.

Sex of households head	**frequency**	**percent**
Female	78	38.81%
Male	123	61.19%
House ownership	**frequency**	**percent**
Yes	96	47.76%
No	105	52.24%
Environmental attitude	**frequency**	**percent**
Positive	121	60.20%
Negative	80	39.80%
Unpaid waste disposal options	**frequency**	**percent**
Yes	133	66.17%
No	68	33.83%

Table1. Summary of categorical variable

The mean age of respondents for sample was around 46 years with a minimum 29 of and a maximum 0f 68 years, this therefore, shows that respondents are at the critical age to know the advantage of environmental quality and hence make smart decisions about solid waste management. The average years of schooling were 7 years and about 6.97% of the respondents did not attend any formal education, about 65.69% at primary level, 19.01% at secondary level and 7.47% at university/college level respondents are attended in formal education. The average monthly total household income for the sample was birr 2552.1 with minimum of birr 500 and maximum of birr 6450.The average family size of the survey households was 3 which is similar to the National census result of 3.1 for logia town in 2007, with minimum of 1 and maximum 5.The respondents dwelling type, around 53.23% of respondents are living in their own occupied, 40.3% of them rented from private and 6.47% are live in the relative house without payments. The Average household solid waste produced per month was about 1.4 sacks with minimum 0.50 of maximum of 2 sacks it is too small compared to Yonas B. (2010); Muhdin H. (2016) and others studies, because respondents were not estimate perfectly how much they produce solid wastes per month. The Sanitary supervisor visit received per month, about 36.32% answered no supervisor visit per month, 46.27% once per month, 9.45% twice per months and 7.96% three times per month. The Distance between Households resident area and Municipal waste Disposal Facility, the average was 2.2 km with a minimum 1km and a maximum 4km. Almost 50.75% of respondents are currently payer for SWM and when respondents are asked about current price for SWM the average was 18.3 birr with a minimum 0 birr and a maximum 50 birr. Respondents suggested that there is unfair payment system for SWM even if they are pay without any services per months.

Variable	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
Age	201	45.85075	9.582672	29	68
Education	201	7.079602	3.548751	0	17
Household size	201	2.696517	1.054722	1	5
Income	201	2552.075	1428.542	500	6450
Amount pay	201	18.30846	7.373898	0	50
Distance from waste municipal disposal facility	201	2.223881	.8857917	1	4
Sanitary supervisor visit	201	.8905473	.8763334	0	3
Dwelling type of respondents	201	2.064677	1.233206	1	5

Table 2. Summary of continuous variable

The willingness to pay question

The willingness to pay question was the dichotomous choice format. The respondents were asked whether they would have WTP for improved solid waste management or not. The respondents who was say 'yes' would ask how much ETH birr they pay in each month. The respondents who would not have WTP for improved solid waste management services were asked to give the reason(s). The respondents were asked a series of socioeconomic questions (education, gender, income and household size, asset ownership, age and marital status). They would asked about their apartment and the travel time from their residence to the nearest waste collection point. The respondents were asked whether the activities of sanitary supervisors were strongly handled in their areas and whether they are happy with private sector participation in household waste management.

As the survey shows that out of 201 respondents, about 65.17% are willing to pay for improved SWM services (table 3); this is more than the current solid waste management disposal status for respondents. And the remaining are said 'no' willingness to pay for solid waste management services.

Table3. Households' willingness to pay for improved solid waste management services.

Willingness to pay	Frequency	Percent
Yes	131	65.17%
No	70	34.83%
Total	**201**	**100%**

Although the respondents were free to give reasons for their willingness or unwillingness to pay for the improved solid waste management options, most of the respondents gave similar reasons. Those respondents who have WTP for SWM are for the sake of keeping their environment clean and healthier. And about 34.83% of respondents who were not have WTP for SWM options reason out that not satisfied with the current SWM services, lack of information on SWM services, they believe that general taxes should cover the cost of services and they can't have enough money to pay for the full cost.

Table 4, Monthly maximum willingness to pay

	Mean	Std. Dev.	Min	Max
Maximum willingness to pay	12.71	12.35	0	60

The average maximum willingness to pay is 13 birr with a minimum 0 birr and a maximum 60 birr WTP for improved solid waste management options, this shows households have an interest to contribute for environmental protection. The respondents said that this is our desires to pay for the services option with pleasure rather than the current services. (Table, 4).

Table 5. The logistic regression results.

Variable	Coefficient	Standard error	Significant
Age	-.0482701	.0198709	0.015*
Gender	.1003459	.3936558	0.799
Education	.1228228	.0694446	0.077*
Famsz	-.3034194	.1790778	0.090*
Income	.0000246	.0001669	0.883
Amountpay	.0294013	.0250539	0.241
Kmfar	-.6040216	.207324	0.004*
Ownership	.061723	.4625283	0.894
Unpaid	-.8821662	.388459	0.023*
Supervisit	.454222	.225685	0.044*
Dwelling	.4127323	.1958351	0.035*
Attitude	1.569827	.4116413	0.000*
Cons	2.0482	1.34057	
Statistic Summary ***No. of Obs. 201*** ***Log likelihood = -101.24547 Pseudo R2 = 0.2207*** ***LR chi2(12) =57.35 Prob > chi2 =0.0000***			Significance Level ***** Significance at 10%

Logistic regression analysis

The logistic regression results are presented in table 5. I found that multicollinearity is not a serious problem in my data set because all independent variables have less than 10 and greater than 1 VIF value. Testing heteroskedasticity shows no problem because the probability value of chi-square is statistically insignificant it is 0.061, greater than 0.05. And there is no omitted variable. In order to test for the goodness of fit, the pseudo R2 was used. The pseudo R2 is 0.22 which implies that 22% of the variation in the probability of WTP or not is explained by the variables included in the model.

The estimated result showed that respondents age, distance between resident area and waste disposal facility, unpaid options and family size (all with negative signs), sanitary supervisor visit, dwelling type, attitude and education (all with positive signs) have significant effects on the willingness to pay for improved solid waste management services. This result is similar with earlier findings (Tolina, 2006; Aklilu, 2002; Hagos, 2003 Yohanes, 2010). And respondents level of education, household size, income size, This result in similar with earlier findings (Yohanes Berihun,2010); amount to pay (price), house ownership, gender similar with earlier findings(Hagos ,2003) are do not significantly influence willingness to pay for improved solid waste management option.

However, age of respondents as estimated has a negative and significant effect on WTP. This shows that as peoples grow older their WTP for waste management options become diminish. This possibly can be the result of older respondents adapted to free government services in the past government. But, the younger peoples are to be expected to be more familiar to cost sharing like for education and health care services etc. The distance between resident area and waste disposal facility as estimated has a negative and significant effect on WTP. This shows that as peoples are far away from any services their Willingness to consume become low, then as the distance between respondents area of resident and municipal waste disposal facility become far-off the WTP for this solid waste management services become low.

The existence of unpaid waste disposal opportunity in a given area negatively affects their WTP for improved solid waste management services. As the estimated result show that the WTP for improved solid waste management services and the existence of unpaid waste disposal opportunity in a respondent area negatively related. The 66.17% of respondents has unpaid options (dumping in river, bury and burning) to avoid their waste. This indicates respondents may have low WTP for other solid waste management options.

The attitude(awareness) of respondents which show that individuals who are aware and has positive attitude with environmental protection have a greater position towards the WTP for improved solid waste management than those who are not aware. This shows that the environmental protection awareness in study area is positive factor for WTP for solid waste management services. The existence of sanitary supervisor visit in the society increases the awareness and the importance of environmental care for the weal fare improvement. Then, as the estimated result show the role of sanitary supervisor visit positively affects the WTP for improved solid waste management services. Finally, as the estimated result shows the dwelling type of respondents positively significant for the WTP for improved solid waste management services in the study area. This suggested that peoples who live in their own house have more WTP for improved solid waste management services than who live rented from private/ live in relative hose without payment.

Table 6. The logistic regression for categorical variables to report odds ratio

Logistic Regression **No of obs = 201**
LR chi2(5) = 28.19
Prob > chi2 = 0.0000
Pseudo R2 = 0.1085
Log likelihood = -115.82596

WTP	Odds ratio	std.err.	z	p>|z|	[93% conf.	Interval]
Gender	1.399453	.5108727	0.92	0.357	.7222675	2.711555
Ownership	.8777328	.3622638	-0.32	0.752	.4155147	1.854122
Unpaid	.4366683	.1549335	-2.34	0.020	.2295895	.8305224
Dwelling	1.377036	.2401194	1.83	0.067	1.003991	1.88869
Attitude	3.131768	1.145549	3.12	0.002	1.614186	6.076109
-cons	.8067211	.480167	-0.36	0.718	.27438	2.371889

Interpretation

An examination of the odds ratio coefficient for unpaid showed that peoples those have unpaid options for solid waste disposal were less likely **[Exp (β) = 0.43]** willing to pay for improved solid waste management services in the logia town than those have not an unpaid options for solid waste disposal. And the examination of respondent's attitude those have a positive attitude for solid waste management were three times more likely **[Exp (β) = 3.13]** willing to pay for improved solid waste management services in the logia town than those have a negative attitude for solid waste management services.

CONCLUSION

The survey result shows that the majority, which 60% of total respondents states that they have positive concerns for environmental protection and well-being. About 40% of respondents are not satisfied with the current SWM services and they are not worried about environmental protection. During the survey the respondents were also asked about the performance of a sanitary supervisor visit to their area, 36% of respondents answered there is no any sanitary supervisor conduct about SWM.

The study concludes that it is an essential to prepare a new solid waste management of the society in the study area. Based on this around 65.2% of the respondents are willing to pay for improved solid waste management option like a door-to-door waste collection. The average willingness to pay is ETB 13 Birr. This shows households have an interest to contribute of environmental service, even more than the existing fee.

Binary logistic regression was employed to identify factors affecting households WTP for improved solid waste management system. The outcome shows that eight variables are found to be statistically significant. These are age, distance between respondent resident and waste disposal

facility, existence of unpaid options, sanitary supervisor visit, respondents dwelling type and household's attitude about solid waste management ,family size and education.

Recommendation

Based on the findings the following recommendations were made to improve SWM in Logia town.

- Awareness creation and training should be given to the community about the importance of solid waste disposal through the community service.
- Increasing the community participation in local solid waste management decision making activities is better.
- Entrepreneurs and innovators should be encouraged to develop improved methods for waste collection and management.
- Policy makers should consider important variables like age, distance between respondent resident and waste disposal facility, existence unpaid option, sanitary supervisor visit, respondents dwelling type and households attitude.
- The municipal authority should control those individuals who collect unwilling payment without service from the households.
- The municipal authority should prepare the opportunity to households would receive planned and properly scheduled waste management services.
- Regular support and monitoring should be given to the business enterprise households engaged in solid waste management system.

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