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Household Willingness to pay for improved solid Waste management: The case of Werabe town, Siltie zone, Ethiopia

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Abstract: Cities in developing countries experiencing rapid urbanization and population growth too often lack the financial resources and institutional capacity to provide needed municipal infrastructure for adequate solid waste management, despite citizens' demand for it. This paper uses a cross-sectional survey of 384 randomly selected households in Werabe town, Ethiopia, to assess the existing situation of solid wastes in the town and the willingness to pay (WTP) of residents for improved urban waste management, and suggest mechanisms for cost recovery. We used Logit and Tobit models in the empirical analysis to determine the factors that influence households' WTP for improved solid waste management.Resultsrevealed thatresidents'WTPforimprovedsolid waste management is significantly relatedtoAge,wealthstatusandawarenessofenvironmentalquality,amongotherfactors.The resultssuggest that the current city fee for sanitation is far below the WTP of the residents. Themeanmaximum WTP we found which is 34.10 birr can be a guide for municipal officials in setting a more appropriate fee that can finance improvements in city solid waste management, where all households receive collection services, waste is disposed of properly, and recycling features areadded.

Keywords: 1. Ethiopia 2. Solid waste management 3. Tobit Model 4. Willingness to Pay

Introduction

Continuing population growth and urbanization in developing countries is making the provision of urban environmental services very difficult. The most difficult challenge many cities in the developing world are facing today in relation with environmental health service is the proper management of solid waste (Amiga, 2002). In our rapidly urbanizing global society solid waste management will be a key challenge facing cities in the entire world (Medina, 2010, WB, 2013).

Solid wastes by definition include refuses from households, non-hazardous solid waste from industrial and commercial establishments. Waste management is the precise name for the collection, transportation, disposal or recycling and monitoring waste (Modak p. (2010).

The higher rate of population growth, the increasing economic activities, and the living standardsof the community have caused the increase in products demand, which forced the industries to manufacture more products to meet these needs. Fulfillment of these needs apparently has caused the increase in residual materials that translates into the increase amount of waste produced by them (GAIA report, 2003).

According to a survey by the UNDP, of 151 mayors of cities around the world, the second most serious problem (after unemployment) faced by city dwellers is insufficient (unsatisfactory) solid waste disposal. (UNDP, 1997) as cited in (Sandec, 2008).This is because the uncollected waste in developing countries become a source of public health problems (UNEP, 2004; Sebastian, k.V. 2010). Ten years ago, there were 2.9 billion urban residents who generated about 0.64 kg of MSW per person per day (0.68 billion tones per year)Hoornweg and Bhada-Tata (2012).

Thus, sound solid waste management system necessitates clear delineation of jurisdiction and responsibility, with all stakeholders (such as the households, private enterprises as well as the government) participating in system design, and with those affected, at every level, aware of the lines of accountability(UNEP, 2005).

Statement of the problem

Ethiopia in general and Werabe city in particular have made several attempts to alleviate the waste menaces. Even though there is an improvement in solid waste management year from year still there is a problem and also it is unsatisfactory. To improve this pressing problem, the government and other stakeholders have to put maximum effort. Therefore, this study is designed to generate demand side information, which is vital to improve the solid waste management in the area.The study is on the assumption that environmental

service strategy, which solely depends on government funding, is not sustainable and therefore household's contribution in funding waste collection activity is crucial.

Some previousstudies have been conducted on identifying SWM constraints and most of them reached different conclusions for the same research ideas (Tadesse, 2006; Dagnew et al., 2012; Amiga, 2002, Ayenew et al, 2019), that required further study. To this effect, it is impossible and does not guarantee to deal with the wide world urban areas by only taking the studies conducted in a certain specific area.

Factors affecting people's willingness to pay differs from place to place. In addition, there is dearth of sufficient evidence about the subject in the study area. Thus, it has become highly important to assess household's willingness to pay for improved solid waste management in this area.Hence, this study is timely to examine the demand side picture of solid waste management and to find the real factors affecting households" willingness to pay for improved SWM practice of the town The study uses both Logit and Tobit model to attain this objective.

Methodology

Research design

Both qualitative and quantitative methods of data analysis were considered. Qualitative data played supplementary role and content analysis of the ideas, opinion, and concepts of data was considered. Nonetheless,for quantitative analysis of the data, Epi Data(v4.6.0.2)softwareandSTATA16were employed. Data was analyzed by various descriptive statistics. Contingent valuation method was employed to elicit household's willingness to pay for the proposed improvement in solid waste management service. The data from CVM survey was analyzed by using econometric models of Logistic regression and TobitModel

Result and Discussion

Descriptive Statistics of The Sample Households

The most important socio-economic characteristics discussed in this section include, sex, marital status, education level, household size and age, employment status, income and quantity of solid waste.

The majority ofthe respondents (267 or 69.53%) are male while the remaining respondents (117 or 30.47%) are females. Regarding the gender of participants, 58% and 42% participants are male and female respectively.The mean age of male respondents is 32 years old whereas that of female is 29. And the average age of the total respondents is

30.70years old whereas the minimum and the maximum age is 18 and 63 respectively.Concerning the educational status of the respondents, the majority of the heads of households (27.34%) had attained elementary education, followed by 26.04% and 25.26% of the heads of households who had attained degree and high school education respectively. And 2.86% 14.84%, and 3.65% of the heads of households were illiterates, college graduates and post graduates. Respectively. As for the family size of the respondents, the majority of the household heads had the household size of '2' (17.45%) followed by '4' (15.63%%), '5' (13.54%) and '3' (13.02%). The minimum size of the household is '1' whereas the maximum size is 14. The average household size of the respondents is 4.3. It can be understood from the descriptive statistics that the majority of the households (51.82%) own the houses they live in and 45.31% of the households rent the houses they live in.regarding the marital status, majority of the heads of households (78.13%) were married, 19.01% of the heads of households were single, and 2.86% of the heads of households were in other categories such as widows or widowers.

Household Willingness to Pay

The Willingness to pay was estimated using EpiData V4 and Stata 16software to determine the relationship between WTP, dependent variable, and each of the independent variables.

Distribution of Protest Zeros

Reasons for not willing to pay	Kebele of therespondent **kebele 01kebele 02**		Total
I can't afford to pay	1	0	1
The service doesn't need improvement	1	0	1
responsibility of government	2	4	6
Other	1	1	2
Total	5	5	10

Source: Own survey, 2013 E.C (2021 G.C).

From the above table 2. it can be understood that 6 (60%) of the total 10 (100%) protesters are not willing to pay because they do believe that solid waste management is the responsibility of the governemnt and hence, financing it has nothing to do with households. The remaining protesters provide their reasons behind their lack of willingness. For instance, some of them are not willing to pay because of their inability to pay. Some others are happy with the status quo. Yet the others are not willing since they do

not have any trust with the governemnt. However, the total number of protests amounts to be 2.60% of the total sample respondents. The remaining 97.40% of respondents have positive willingness to pay (see the appendices).

Distribution of WTP for initial bid fees

Willingness to pay per month	Freq.	Percent	Cum.
0	10	0	0
10 birr	50	13.37	13.37
15 birr	68	18.18	31.55
20 birr	139	37.17	68.72
25 birr	42	11.23	79.95
30 birr	75	20.05	100.00
Total	384	100.00	

Source: Own survey, 2013 E.C (2021 G.C.).

Table 3.above shows that the respondents are provided with bid choice to know the amount of their willingness to pay. Out of these choices, 37.17% of the total respondents are willing to pay 20 birr. Whereas, 20.05% of the respondents are willing to pay 30 birr. The minimum and the maximum willingness to pay is 0 and 200 birr, respectively. The average maximum willingness to pay of the sample respondents is 34.10 birr which is higher by almost 20 birr thanthe current fee. The total WTP of 374 sample respondents was estimated to be **12,753** birr per month (or **153, 041** birr per year). (see the appendices for more).

Average and aggregate willingness to pay of households for SWM

Total household (Y)	**Projected households with "no" responses**	**Projected households with "yes" responses**	**Mean WTP**	**Mean WTP per year**	**Aggregate benefit per year**
17835	463.71	17371.29	34.10	409.2	7,108,331.868

Source: Own calculation, 2013 E.C (2021 G.C)

1.(A) 10(2.60 %) of our 384 sampled households were protest zeros. So, A is the expected number of households which are expected to protest for the proposed project. It

iscalculated by multiplying the percentage of sampled protest zeros (2.60 %) with the total population 17835.
2.(B) Is Y-A which is the total households in the study area which are expected to have a valid response
3.The mean WTP calculated from the maximum amount of Birr that a household could pay for SWM.
Is mean multiplied by the number of total households which are expected to have valid response (B*Mean WTP)

As it is indicated in Table 4 above, the aggregate WTP was calculated by multiplying the mean WTP by the total number of households who were expected to have a valid response in the study area. Following this, in this study the aggregate WTP per month for improvement of SWM practices was computed at 592,360.989 birr. Whereas the aggregate annual benefit is 7,108,331.868 birr.

Econometric Results

Determinants of Household Willingness to Pay

LogisticregressionmodelandTobitmodel to identify the factors influencing WTP for improvedSWM services, the household responses to the WTP question was regressed against socioeconomic characteristics of the households and the results reported in the tablesbelow.

Logistic regression result

wtp(Independent Variable)	Coef.	Std. Err.	Z	P>z
Wealth Status	-1.019173	.5637561	-1.81	0.071*
Age	.1745936	.0906613	1.93	0.054**
Marital_stataus	.5799995	.6969715	0.83	0.405
ASWG	.3839484	.6604652	0.58	0.561
Gender	-.332874	.8521528	-0.39	0.696
Mode_SWD	.9567625	.3541875	2.70	0.007***
Quality_service	-1.001756	.6762928	-1.48	0.139
Educ_level	.7083241	.4252194	1.67	0.096*
Monthly_Inc	-.0455327	.5553078	-0.08	0.935
Fam_size	-.0772058	.2076905	-0.37	0.710
Awareness	.0337046	.0182878	1.84	0.066*
Coll_freq	.0344595	.4436724	0.08	0.938
Cases_disease	-.5821106	.7574408	-0.77	0.442
Empl_status	-.1499758	.4042275	-0.37	0.711

_cons	-1.391354	4.15021	-0.34	0.737

Note: ***, ** and * significant at 1, 5 and 10% probability levels, respectively

Table 5 above, presents the logit analysis of the factors that influences the willingness to pay for improvedwastedisposalservices.Theresultsoflogitregressionanalysisshowedthatrespondents' marital status, gender, monthly income, amount of waste solid generated (ASWG), kinds of solid waste, family size, cases of diseases as well as employment status do not significantly influence the willingness to pay for improved solid waste disposal. However, wealth status, age, mode of solid waste disposal, education level and awareness are statisticallysignificant.

Pseudo R2 value is about 0.4763, which means that about 47 percent of the variables in WTP are explainedbytheincludedindependentvariablesandtheremaining53percentisunexplained.The value of R^2 for our logistic regression model is 0.4763, this is quite acceptable, because that regressions on CVM data usually yield R2 values between 10% and40%.

Age of household head

As it is expected the age variable had a positive sign and was significant implying that theprobabilityofwillingnesstopayforimprovedSWMbyolderpeoplewashigherthantheyoungerpeople.Thisismightbebecauseofolderpeoplemakewiserdecisionsonhealthandenvironmental issues like SWM, probably due to their age. Theresultisinlinewiththe previous studies (Mussa, 2015;Bhatarai,2015).

Wealth Status of household head

This variable has a negative sign as expected with a 10% level of significance. This is to some extent may be explained by the income effect of house ownership in the city as some of them get extra income by renting rooms in their house or extra houses in their compound. Specially if the owners have no financial obligation to meet because of the house, this will help to reduce the financial obligation to the household. As observed in this study those who pay rent for the house they live feel that solid waste disposal charges should be paid by the owner of the house. Similar result is confirmed by Amiga (2002).

Mode of SWM

This variable has a positive sign and significant, which shows that there is the probability of willingness to pay for improved SWM by the respondents according to the attributes presented, becauseupgradingthisattributeraisestheirutility.Improvingthewaysofsolidwastedispos alwill increase household's willingness to pay for solid waste management. For instance, Mussa (2015) has got similarresult.

Education level

This variable shows positive and significant effect at 10% level of significance. This resultshows there is a positive impact of education on willingness to pay amount. This result suggests that investing in education of people both formally and informally might help to maintain clean environment. The result is also confirmed by previous studies (Amiga, 2002; Ayenew et.al, 2019).

Awareness

Environmental awareness of respondents is positively associated with the amount of WTP and is significant at 10 percent. Households who have good awareness about the severity of poor solid waste management found to be more willing to pay.

The logistic regression result shows that the amount of solid waste generated (ASWG) is statisticallyinsignificanttoinfluencehousehold'sWTP.The result is somehow contrary to the previous findings (Mussa, 2015; Amiga, 2002; Dagnew, 2013) who got positive and significantresult.

The coefficient of marital status is positive but insignificant. Although it is unexpected result, the insignificant relationship between marital status and WTP was also found by (Omortor et al, 2010; Bhatarai, 2015).

The gender variable is negative but insignificant which may enable us to conclude that gender is not important variable in explaining willingness to pay for solid waste management. The casesofdiseaseand employment status variablesareinsignificant.

The family size and monthly income variable have negative sign but statistically insignificant. Thus, the logit result indicates that family size and monthly income are not an important variable to influence household's willingness to pay.

Tobit regression results

MWTP	. Coef.	Std. Err	T	. P>t
Gender	1.698751	2.377441	0.71	0.475
Age	.0129805	.1283724	0.10	0.920
Educ_level	.599658	.9552809	0.63	0.531
Empl_Status	-.0035294	1.129092	-0.00	0.998
Marital_Status	3.13708	2.413841	1.30	0.195
Fam_size	-1.303697	.5805602	-2.25	0.025**
Monthly_Inc	4.35863	1.385964	3.14	0.002***
Wealth_Status	-2.064039	1.361108	-1.52	0.130
Awareness	-.2601975	2.681298	-0.10	0.923
ASWG	3.358461	1.674767	2.01	0.046**
Quality_service	-2.184754	1.684505	-1.30	0.195
Mode_SWD	1.373724	.7949301	1.73	0.085*
Coll_freq	.0854985	1.560914	0.05	0.956
Cases_Disease	2.738059	2.161265	1.27	0.206
_cons	26.4884	12.3336	2.15	0.032
var(e.MWTP)	417.825	30.3101		

Note: ***, ** and * significant at 1, 5 and 10% probability levels, respectively

Thetobitresultshowsthat4outof14variablesarestatisticallysignificant.Therefore,familys ize, monthly income, amount of solid wastes generated (ASWG), as well as mode of solid waste disposal are found to be significant. The rest of variables are found to beinsignificant.

Family size

This variable has negative sign and significant in the case of Tobit model. This might be due to the fact that households with large family size may not afford to pay more money for improved solid waste management due to the economic pressure they are facing. Similar result is obtained by (Ayenew et. al, 2019)

Monthly income

This variable has found to be positive and significant (at 1%) in our tobit regression result. This shows that solid waste management is a normal economic good whose

demand changes in the directionofincomechange.

ASWG

OurtobitregressionresultshowsthatASWGhaspositivesignandsignificant.Thus,wefindthathouseholdsthatgeneratedmoresolidwasteshaveahigherdemandforimprovedSWM.Thisresult is supported by previous studies such as (Amiga,2002).

Mode of SW

HereourtobitresultshowsthatthisvariablehasapositivesignandissignificantConsistentwith the logit model, tobit result tells us that with the improvement of mode of SWM, household's willingness to pay tends toincrease.

Conclusion

Inadequate supply of solid waste management has always been a main environmental problem in the city. The major cause of this problem is inadequate finance for this service. Hence the main objective of this study is to see the possibility of cost recovery by looking at the demand side of solidwastemanagementinWerabe town; throughservicecharges.This study tries to fill this gap. For this the Contingent Valuation Method (CVM) is used to estimate the value households in Werabe town give for an attempt to improve solid waste management. The study randomly selected 384 households were interviewed from the two kebeles.

The descriptive analysis indicates about 69.53% of the respondents are male headed whereas 30.47% of the total respondents are female headed. The average age of the total respondents is30.70 year. The average household size of the respondents is 4.3. whereas 40.89% of the total respondents are working in informal business (for instance, carpenters, brokers, and street vendors). The majority of the household heads (46.88%) generated the amount of solid waste in between 0.5-1.5 sack per week. 58.7% of the total respondents are affected by diseases which are caused by improper solid waste management.

The data further show that 64.58% of total respondents generated food related wastes, followed by paper and plastic wastes (33.33%).Moreover, 51.6% of the total respondents are using the waste vendors as a way of disposing their solid wastes. mode of SWM and large amount of SW generation induce the households to be more willing to pay for the improved SWM services.

Policy recommendation

This study recommends the revision of sanitation fees in Werabe town. This is because the average willingness to pay of the residents is much greater than that of the current

sanitation fee.The city municipal has to improve mode of SW disposal. This is because, the residents are more willing to pay if there is an improvement in the current mode of solid waste disposal. There is also a need to increase awareness about these verity of poor solid waste management. Education and conducting trainings about the importance of environmental hygiene should also be encouraged. The government also has to cooperate with older people who make wiser decisions on health and environmental issues like SWM.

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