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WILLINGNESS TO PAY FOR IMPROVED SOLID WASTE DISPOSAL IN TEMA METROPOLIS

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Abstract
The main objective of this study was to find out the willingness to pay for improved solid waste disposal in the Tema Metropolis using the Contingent Valuation Method (CVM). A cross-sectional survey design was used to carry out the study. A survey questionnaire was administered to respondents to draw a sample of 156 for the study. The Tobit regression was used to estimate the determinants of willingness to pay for improved solid waste disposal. The Tobit result revealed that age, educational level, number of dependants, income, size of household and distance to the refuse dump were important in explaining the willingness to pay for solid waste disposal. It is concluded that income, education level, number of dependants, household size influence the willingness to pay for sanitation improvement. We recommend that government in collaboration with waste collecting agencies should invest more resources into the provision of recycling plants that will help in dealing more efficiently and effectively with the waste disposal problem. Furthermore, the educational campaigns of the various metropolitan, municipal and district assemblies on good sanitation practices should be intensified to increase the awareness of households. The various environmental units of the district assemblies should also be well resourced to effectively enforce sanitary laws.

Keywords: Willingness to pay, Improved solid waste disposal, Tema Metropolis, Contingent valuation method

Introduction

According to Tsiboe and Marbell (2004), events of the 20th century and early into the 21st century indicate that waste, in whatever form or classification (solid, liquid, or toxic) has become a major consequence of modernization and economic development. In our quest for 'Western-styled' development, humanity did not budget for the associated problems related to the management of waste. Municipal solid waste management is a serious concern, and collection, transportation and disposing of municipal solid waste presents formidable challenges to many developing countries. Although it consumes a larger portion of municipal budgets, the problem is

growing due to inappropriate planning by waste management authorities, inadequate governance, lack of resource availability and ineffective management in rapidly growing cities of the developing countries. These challenges have resulted in health related problems, loss of properties as a result of choked gutters, indiscriminate waste disposal and uncollected refuse in communal waste containers. These wastes find themselves in water bodies destroying the ecosystem (Puopiel, 2010).

The Tema Municipality is a city with increasing urbanization and economic activities which are accompanied by increasing waste generation. Most of the waste generated from the residents in Accra and Tema is not effectively collected. In light of the indiscriminate disposal of waste in Tema, many residents have expressed grave concern about the need for the Metropolitan authorities to act urgently to save Tema from major health hazards. Refuse is found littered on streets, lorry parks and other open spaces in the community with the resultant stench and flies nuisance. Residents do not take the pains to dump refuse into containers strategically placed at vantage points by the Metropolitan Assembly. Some of those who take refuse to these containers simply dump the refuse on the ground rather than into the container. The uncollected waste emits foul smell into the atmosphere particularly in low income areas where the solid waste is often mixed with human waste due to inadequate sanitation facilities (Boadi and Kuitunen, 2003).

Anomanyo (2004), found that improper solid waste management leads to substantial negative environmental impacts (for example, pollution of air, soil and water, and generation of greenhouse gases from landfills) and health and safety problems (such as diseases spread by insects, viruses and rodents attracted by garbage heaps, and diseases associated with different forms of pollution).

The major problem that gives the authorities in the Metropolis cause to worry is the slow pace at which the private sector is developing – after over 10 years of private sector participation in waste management. The private sector has not expanded their operations to other sectors such as recycling, composting but have restricted their operations to just waste collection. Specifically, this study seeks to determine the relationship between the socioeconomic characteristics of residents and their willingness to pay for improved solid waste disposal. It is also to find out the relationship between the distances to the public dump and the willingness to pay for improved solid waste disposal.

There has been extensive literature on the willingness to pay for solid waste management by other researchers. Studies such as the one by Alta and Dehazo (1996) showed that the willingness to pay for solid waste management is associated with income, education, quantity of waste generated, household size and age. Previous studies done by Cairncross (1990) and the World Bank (1995) also showed that low-income consumers are willing to pay for services they want. Another study carried out by Awunyo-Vitor, Ishak and Jasaw (2013) in the Kumasi Metropolis of Ghana revealed that income, age, number of children, quantity of waste generated and education have significant effects on the willingness to pay, while the amount of money the households are willing to pay was influenced by their income, quantity of waste generated, education, house ownership, and number of children. A study by Niringiye & Omortor (2010) with a sample of 182 respondents in Uganda, Kampala City revealed that respondents' level of education, marital status, quantity of waste generated, household size and household expenditure do not significantly influence willingness to pay for improved waste management.

The main purpose of this study is to address the pertinent question that comes to mind: what are the factors that influence the amount households are willing to pay for solid waste disposal. However, many researchers have conducted research in this area but what this paper seeks to contribute to literature is the location with reference to Tema. In order to address this pertinent question, the dichotomous choice Contingent Valuation Method (CVM) was used to determine the factors that influence an individual's willingness to pay for improved solid waste. The CVM technique is superior to other valuation methods because it is able to capture use and non-use values. Other valuation methods like Hedonic Pricing and Travel Cost method tend to underestimate satisfaction derived from services rendered since they measure use values only. As Freeman (1993) noted, non-use values could be larger in some cases and as such, the use of measurement techniques that capture only use values underestimates the total derived values. The CVM technique however suffers from one major drawback despite its ability to measure total economic values. The hypothetical nature of the questions used in CVM surveys may pose problems since respondents may have little incentive to provide information on their true willingness to pay. Despite this limitation which is well acknowledged in this paper, CVM was used because of its ease of data collection and requirement compared to other valuation methods.

Contextual issues

Tema is a coastal city, situated about 25km east of Accra. It shares boundaries on the Northeast with the Dangme West District, Southwest by Ledzekuku Krowor Municipality, Northwest by Adenta Municipality and Ga East Municipality and the South by the Gulf of Guinea. The Metropolis covers an area of 396km and lies within the coastal savannah zone. From the 1960s through 1980s, Tema has been transformed rapidly from a small fishing village into an industrial nerve center of Ghana's economy. With a deep seaport, Tema handles about 70% of all shipments to Ghana and some land locked countries in the West African Sub-Region. The total population of Tema as at 26th September, 2010 was approximately 402,637 (GSS, 2010).The Tema municipality is a city with increasing urbanization and economic activities which are accompanied by increasing waste generation in these areas. This feature of the area motivated its choice for the current study.

Methodology and Data

Data Collection and Sampling technique

The basic research design used in this study was cross-sectional survey where data collection occurred at a point in time for each household head. The data were collected with the use of structured questionnaires and an in-depth interview. To obtain a good representation for the study and to ensure a valid generalization, random sampling technique was adopted. This method was chosen because the research work was basically concerned with households' willingness to pay for solid waste disposal. In all, a total of 156 households were sampled from four areas; Tema Manhean, Tema communities four, five and seven. These areas were chosen because they are found to be places where refuse is generated on a larger scale and also where one could observe

very heavy heaps of refuse. The study would have benefited from higher sample size but due to inadequate funding as well as time constraint the sample size could not be increased

The Tobit Model

The Tobit model was developed by Tobin in 1958 and has been used in estimating the willingness to pay for improved waste management as well as waste disposal (Pindyck and Rubinfeld, 1981). However, the logit model provides information only with respect to the household heads' decision to pay for improved waste management services or not to pay, but not on the amount of money they are willing to pay. To estimate the determinants that captures both the willingness and unwillingness to pay for an improved solid waste, the Tobit model is employed. Hagos, Mekonnen & Gebreegziabher (2012) suggested that if the dependent variable, or the WTP, is not fully observed and the dependent variable assumes zero values for a substantial part of the sample, then Tobit model is employed to estimate that. Because an OLS (ordinary least squares) estimator cannot be applied, we use a Tobit model for the observed maximum willingness to pay (MWTP) as well.

Justification for the use of Tobit regression model

One significance of the Tobit model is that it allows one to identify the factors that determine how much the respondents are willing to pay for improved waste management services. One weakness of the Tobit model as identified by Maddala (1999) and Sigelman and Zeng (1999) is that if the zeroes in the data are the result of non-observability (strictly a nonnegative distribution) rather than true censoring at zero (some of the zeros representing negative values), then the mechanical application of the Tobit estimator is not fully appropriate. The Tobit model was used for the study because the nature of the decision problem for determining the WTP is unknown.

The Tobit regression model specified below was used to obtain the willingness to pay of the households for improved waste disposal. Pindyck and Rubinfeld (1981) expressed the general formulation of the Tobit model in terms of an index function. The Tobit regression model specified in equation (1) was used to obtain the willingness to pay by the households for an improved waste disposal.

$$Y_i = \mathrm{X}'\beta + \varepsilon_i \text{.....(1)}$$

where Y_i is the dependent variable. In this case, it captures the respondents that are willing as well as those who are not willing to pay. X' is a set of explanatory variables, and ε_i is assumed to be an independently and normally distributed stochastic term with zero mean, (μ), and constant variance, (σ^2). Assume that there is a perceived utility (y) for paying for improved waste management services, and, a utility (0) for not paying for improved waste management services.

$y_i = 1$ if $y_i^* > 0$ for paying for an improved solid waste

$y_i = 0$ if $y_i^* \leq 0$ for not paying for an improved solid waste

Here, y_i^* is the unobserved latent variable or the threshold which is observed only when y_i or the amount of money households are willing to pay is positive. The expected value E_y of the amount of money households will be willing to pay for improved waste disposal is depicted by equation (2).

$$E_y = X_i \beta F(z) + \sigma f(z) \text{.....(2)}$$

X= is the vector of explanatory variables;

(z)= the cumulative normal distribution of z;

(z)= the value of the derivative of the normal curve at a given point. That is the unit normal distribution)

z is given as $X\beta/\sigma$;

β= a vector of Tobit maximum likelihood estimates;

σ= is the standard error of the model.

The relationship between the expected value of all observations, E_y, and the expected conditional value above the limit E_y^* is given by equation (3)

$$E_y = F(z)E_y^* \text{.....(3)}$$

The marginal effect is used to obtain the observed variable of interest in this paper. Pindyck and Rubinfeld (1981) expressed it in the form:

$$\frac{\delta E(y/X_i)}{\delta X_i} = \beta^* \Pr ob(0 \angle y^* \angle 1) \text{.....(4)}$$

The log likelihood of the Tobit model is specified as

$$\ln L = \sum_{y_i>0} -\frac{1}{2}\left[\log(2\pi) + \ln\sigma^2 + \frac{(y_i - X_i'\beta)^2}{\sigma^2}\right] + \sum_{y_i=0} ln\left[\frac{1-\phi(X_i'\beta)}{\sigma}\right] \text{.....(5)}$$

The maximum likelihood estimates of the parameters are obtained by maximizing the likelihood function with respect to β and σ.

To identify the factors influencing willingness to pay for improved solid waste disposal by households, the household response to the WTP question was regressed against the households WTP potential and other socioeconomic characteristics of the household. The Tobit regression model is specified as:

$$Y_i = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7) \text{.....(6)}$$

Mathematically, $Y_i = MWTP^* \; if \; MWTP^* > 0, \; = 0 \; if \; MWTP_i^* \leq 0$.....(7)

Where MWTP = responses of the household WTP which is either 1 for those willing to pay for improved solid waste disposal or 0 for those unwilling to pay for improved solid waste disposal.

Thus the empirical model to be estimated is as indicated in equation (8).

$$Y_i = \beta_0 + \beta X_1 + \beta X_2 + \beta X_3 + \beta X_4 + \beta X_5 + \beta X_6 + \beta X_7 + \varepsilon_i \text{ ..... (8)}$$

X_1= Age of Respondent (years)

X_2= Educational level of Respondent (Number of years spent in the school)

X_3= Number of dependants in the household (number of individuals that depends on the household head)

X_4 = Household size (number of individuals in the house)

X_5 = How often income is earned by respondents (weekly, monthly, bi-weekly, half year)

X_6 = Level of income (in Ghana Cedis, GHS)

X_7 = Distance from house to the dump site (in meters)

Definition of Variables

Like any other environmental and public good, whether households are willing to pay or not for an improved solid waste disposal, they are expected to be affected by various factors. Some of these factors with their *apriori* expectations are defined as follows.

X_1: how old the respondents are. This is expected to affect willingness to pay for solid waste disposal. The age of household head is measured in years. The effect of age on the willingness to pay is indeterminate since it can be positive or negative.

X_2: The education level of the household head is taken to capture the level of understanding of the respondent about the desirability of proper management of solid waste and the willingness to pay for its improved disposal. It is hypothesized that the higher the level of education the more the household would appreciate the consequence of mishandling solid waste and the more value the individual would will be willing to offer to avoid the risk of being a victim of unclean environment. Education is expected to have a positive and significant effect on willingness to pay.

X_3: this refers to the number of children and other people that depend on the respondent. This variable is expected to have either a positive or negative effect on willingness to pay. On one hand, this could be due to the fact that the more children in the household, the more willingness to maintain a clean environment in the future in which children will grow with lesser risk due to cleaner environment. On the other hand, increasing number of dependants may raise household expenditure burden and therefore could reduce the willingness to incur any additional expenditure.

X_4: This variable refers to the number of members in the household. As the number of members increases in a given household, the household will be more aware of the risk involved with insanitary situation and thus crave for a better service by being more willing to pay for improved service.

X_5: This variable shows the number of times the household head receives income. If the income source is very reliable, then he or she might allocate some for waste collection. However, if his or her income does not come regularly, the willingness to pay for an improved solid waste might be low as compared to the one with regular income.

X_6: This variable refers to the monthly money income of the household measured in Ghana cedes. It includes the income of the head and all other members of the household from all sources. There

is a general agreement in environmental economics literature on the positive relationship between income and demand for improvement in environmental quality. Therefore, we expect income to affect willingness to pay positively.

$X_{7:}$ This variable is expected to influence willingness to pay for improved solid waste positively. As the distance to dumping site increases, the likelihood of the household willingness to pay for improved waste management also increases. The increase in distance increases the cost (finance and time) of waste disposal by the individuals. Hundred meters increase in distance to dumping site increases the households' willingness to pay for improved solid waste disposal.

Results and Discussion

Table 1 presents the socioeconomic characteristics of the respondents. These comprise the age, marital status, level of education, size of the household and monthly income. As revealed in Table 1, 35.9 percent of the respondents represent respondents within the 41 - 50 age brackets, 28.8 percent falls within 21 – 30 years while 20.5 percent of the respondents were between 31 – 40 years with 14.7 percent comprised those who are 51 years and more. The average age in the study area is 42 years. This implies that respondents are in their active age and therefore can work to earn more income. Concerning the marital status, 80.1 per cent of the sample were married, 7.7 per cent reported that they were single while 5.1 percent were divorced. In terms of educational level, only 8.3% of those involved claimed not to have had no formal education; the rest managed to complete primary, (7.7%), junior high school, (10.9%), senior high/ technical (26.9%) and tertiary (46.2%). Families with household size greater than nine members were (44.9%) with (9.6%) being the household with the least members (less than three members) whereas the rest; 6-9 members (27.6%), 3-5 members (17.9%). About 43 percent falls within the income bracket of GHS900 and above while 26.7 percent are those that received between GHS500 and GHS899. Nearly 16 percent claimed that they received less than GHS100 whereas 13.5 percent received between GHS100-499.

Table 1: Socioeconomic characteristics of the respondents

Item	Elements	Frequency	Percent
Age	21-30	45	28.9
	31-40	32	20.5
	41-50	56	35.9
	51 and above	23	14.7
Marital status	Married	125	80.1
	Single	12	7.7
	Separated	6	3.9
	Divorced	8	5.1
	Widowed	5	3.2
Education	No formal education	13	8.3
	Primary	12	7.7

	JHS	17	10.9
	SHS/Technical	42	26.9
	Tertiary	72	46.2
Size of Household	> 3	15	9.6
	3-5	28	17.9
	6-9	43	27.6
	<9	70	44.9
Monthly income	>GHS100	25	16.0
	GHS 100-499	21	13.5
	GHS 500-899	43	27.6
	GHS 900 and above	67	42.9

Source: Field survey, 2014

Willingness to pay responses

The respondents' willingness to pay for solid waste disposal is presented in table 2. From the table, 85.9 percent of the respondents responded Yes (affirmatively) and 14.1 percent responded No (negatively) when asked about their willingness to pay for improved solid waste disposal.

Table 2: Respondents willingness to Pay

Max. Willingness to Pay	Frequency	Percent
Yes	134	85.9
No	22	14.1
Total	156	100.0

Source: Field survey, 2014

The study revealed that a good proportion of 134 (85.9%) households were willing to pay for improved services while 22 (14.1%) were unwilling to pay for improved services. Those who were not willing to pay gave the following reasons that it is the responsibility of the Government to pay for them. Second, it is not necessary to pay for waste when there are other equally important things to invest in and finally, they prefer disposing their waste either by burning or burying them (secondary receptacle) of which they were not charged for to paying for their waste to be collected.

Tobit Regression Analysis

The Tobit regression results is presented in Table 3. In order to test for the goodness of fit, the Pseudo R^2 was used. The Tobit regression gave a Pseudo R^2 of 0.6664. As the value of the calculated R^2 result approaches 1, the explanatory power of the model increases by 0.67. The estimated R^2 is 66.6% suggesting that approximately 67% of the variation in WTP is explained by the explanatory variables.

Table 3: Tobit regression results of factors influencing respondents' willingness to pay for improved waste disposal

Empirical Results

Number of observation = 156
F (7, 149) = 15.08
prob>F = 0.0000
Log pseudo likelihood = -27.584669 Pseudo R^2 = 0.6664

WTP	Coefficients	Robust Standard error	t	P>|t|	$\frac{dy}{dx}$
Age	0.15337	0.08033	1.91	0.058*	0.1534
Education	0.42917	0.08409	5.10	0.000***	0.4292
Dependants	-0.28557	0.10086	-2.83	0.005**	-0.2856
Size	0. 49805	0.09402	5.30	0.000***	0.4980
Often	0. 25781	0.18806	1.37	0.172	0.2578
Income	0. 23179	0.97593	2.38	0.019**	0.2318
Distance	0. 16466	0.08080	2.04	0.043**	0.1647
Constant	-1. 99137	0.42496	-4.69	0.000	2.2447

*** Statistically significant at 1%, ** statistically significant at 5%, *statistically significant at 1

Determinants of Households' Willingness to Pay for Improved Solid Waste Disposal

Age of respondents (X_1) is statistically significant at 10% and has a positive impact on willingness to pay. This conforms to a priori expectation which can be explained by the fact that as people get older; they tend to understand the need to keep a clean environment. In addition, they may also know that access to funds by waste management organization can improve their services. As age increases by one year, the willingness to pay increases by 15%. This contradicts the previous studies of Awunyo-Vitor, Ishak and Jasaw (2013) done in Kumasi Metropolis which states that

age has no significant effects on willingness to pay for solid waste. However, this result confirms the study by Niringiye & Omortor (2010).

Moreover, educational was found to be positively associated with the willingness to pay for improved waste disposal services at a significant level of 1%. This result supports the findings of Zerbock (2003). The higher the educational level attained, the higher the probability of the person's willingness to pay for improved waste disposal services. As individuals receive higher education, they tend to understand the need for waste management better. The marginal effect of respondents' educational level showed that an additional year of schooling would increase the likelihood of a person's willingness to pay for improved waste management services by about 43%.

Furthermore, the size of the household (X_4) is another determinant which has a significant impact on WTP. It is significant at 1% and has a positive relationship with willingness to pay for improved services. As the number of members in a given household increases, the household will try to keep the environment clean in order to avert any disease outbreak which may potentially harm the members of the household. This confirms the findings of Abdarbo (1996) on his study on sanitation provision. This study revealed that as the family size increases, willingness to pay for an improved service is likely to increase. The marginal effect of 50% in table 4 also indicates that households with greater size are more likely to pay for improved solid waste disposal than those with lower family size, all other things been equal.

Number of dependants (X_3) is statistically significant at 5% alpha level but negative when regress on WTP for an improved solid waste disposal. This variable was expected to have a positive effect on willingness to pay nevertheless it negative. The negative relationship can be attributed to a situation where the household may be large in number that an attempt by the household to pay for an improved solid waste will increase its spending. The household head might think for him or her to pay for the waste will worsen his expenditure more hence the desire to pay been negatively related to WTP. Therefore, an additional person introduced into a family will reduce the willingness to pay by 29%.

Monthly average income of respondents (X_6) is statistically significant at 5% and has a positive impact on willingness to pay. An additional unit increase in income will increase the willingness to pay by 23%. This is consistent with economic theory that indicates that income is positively related with demand in general and the same with environmental demand. This also indicates that environmental good is a normal good since its demand increases with income and this is in conformity with the work of Niringiye & Omortor (2010).

Distance to the dump site (X_7) is another determinant which has a significant impact on WTP. It is significant at 5% and has an anticipated positive relationship with willingness to pay for improved services. This means that respondents who walk longer distance to dispose-off refuse have a higher willingness to pay than respondents who walk shorter distances. The marginal effect shows an increase in WTP by 16%. This confirms the earlier findings of Alta and Dehazo (2000) and Cairncross, (2002). According to Awunyo-Vitor, Ishak and Jasaw (2013), distance to solid waste dumping sites significantly influences willingness to pay. This is because increase in distance complicates the problem of solid waste disposal as people would have to walk long distances to

dispose-off their waste. Thus they will be willing to pay to have their waste collected for them rather than having to cover those long distances.

Conclusion and Policy implications

The determinants of willingness to pay for improved waste management services were identified using Tobit regression model. Educational level, number of dependants, income, size of household and distance to solid waste dumping sites were noted to significantly influence the respondents' willingness to pay for improved waste disposal in Tema Metropolis. Since income, education level, household size affect the willingness to pay for sanitation improvement, we recommend that government in collaboration with waste collecting agencies should invest more resources into the provision of recycling plants that will help in dealing more efficiently and effectively with the waste disposal problem. Furthermore, the educational campaigns of the various metropolitan, municipal and district assemblies on good sanitation practices should be intensified to increase the awareness of households. The various environmental units of the district assemblies should also be well resourced to effectively enforce sanitary laws.

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