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An Econometric Model of Factors Influencing Households' Willingness to Pay for Improved Solid Waste Management Service within the Sekondi – Takoradi Metropolis in the Western Region of Ghana

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Abstract
Solid waste disposal, in particular, has become a daunting task for the municipal authorities. This paper presents an assessment of household's willingness to pay for improved solid waste management service. The paper engaged household's that demand the services of Solid Waste Management (SWM) within Sekondi -Takoradi Metropolis. Data for the study were collected through survey of households living at the Effiakuma estates. Three hundred questionnaires were administered to respondents to gather information on their willingness to pay and the amount they were willing to pay for an improved service. In this study, contingent valuation method (CVM) was used as a method of valuation. Probit and Tobit models were used in the empirical analysis to determine the factors that influence WTP and MWTP of households for improved SWM respectively. The outcome of the study shows that, environmental awareness, occupation, income, perception and house ownership significantly determined households willingness to pay for an improved SWM service. The paper recommends that government should create more employment opportunities so that people can earn regular income. In addition government and various stake holders should make efforts towards improving residents' income as willingness to pay relates positively to income. More so, educational programs about the dangers of waste in our communities should be organized by various organizations in a quest to increase environmental awareness so as to increase the WTP for improved environmental quality in general and improved solid waste management in particular. Last but not least, the policy frameworks which have been set aside by government for service providers or companies must be given a strict enforcement.
Keywords: Solid Waste Management, Willingness to pay, Contingent valuation method, Probit and Tobit model, Marginal effect, Sekondi – Takoradi and Effiakuma Estate.

1. Introduction

Modernization is a multifarious trend that provides opportunities and benefits for economies but it is also coupled with social, economic and environmental harms. One major environmental difficulty that confronts many economies is the proper disposal of solid waste. The concern is serious, particularly in the capital cities, which are often gateways to the countries for foreign diplomats, businessmen, and tourists.

Solid waste, according to Miller (1996), is any useless, unwanted or discarded material that is not liquid or gas. According to the United Nation Environmental Programme (UNEP) (2004), solid waste generation has become an increasing environmental and public health problem everywhere in the world, particularly in developing countries. The fast expansion of industrial activities stimulated by rapid population growth has produced vast amounts of solid and liquid wastes that pollute the environment and destroy resources.

Rapid, uncontrolled urbanization in Ghana has saddled the country's cities with problems of physical, socio-economic and environmental nature. Besides the physical problems of poor infrastructure, inadequate housing, congestion and poor accessibility, major cities in the country are confronted by socio-economic challenges including increasing levels of unemployment and poverty, social exclusion and rising crime and violence (Songsore, 2003). Furthermore, environmental conditions in the cities are appalling due to inadequate provision for services such as sanitation and waste disposal. These problems, and many others, constitute obstacles to the socio-economic development of the country and, therefore, hinder improvements in the lives of the population.

Devas and Korboe (2000) estimated that throughout the country only about 10 percent of solid wastes generated are properly disposed of. Ghana generates annually about 3.0 million tons of solid waste. They showed that most areas of the city had inadequate waste collection services in addition to other environmental problems. In smaller towns and rural areas the issue of solid waste disposal has never really been a priority issue. Few districts are known to invest in the development of solid waste disposal sites.

Considering the fact that urbanization rate in Ghana is increasing, waste management is of great concern to both government and households. Due to the inadequate budgetary allocation by government for the management of solid waste, it has become eminent to ask three questions. These include: Who pays? Will the private sector take up bills for the improvement in service and what is the willingness to pay by households?

The general objective of the study was to determine through contingent valuation, households' willingness to pay for improved solid waste management services. In other to achieve this objective, the study aims to identify salient factors that influence households' willingness to pay for improved solid waste management services and detect the factors that determine the amount households are willing to pay for improved solid waste management service.

These objectives cannot be achieved without testing the following hypotheses:

- There is no significant relationship between income and households willingness to pay for an improved solid waste management service.
- There is no significant relationship between one's environmental awareness and households' willingness to pay for improved solid waste management service.
- Current perception on solid waste has no significant relationship with households' willingness to pay for an improved solid waste management service.
- There is no significant relationship between house ownership and households' willingness to pay for improved solid waste management service.
- There is no significant relationship between income and the amount households are willing to pay for an improved solid waste management service.
- There is no significant relationship between environmental awareness and the amount households are willing to pay for an improved solid waste management service.
- There is no significant relationship between house ownership and the amount households are willing to pay for an improved solid waste management service.

The outcome of the study will provide information on people's perception about financing the waste they generate. This can give useful guidelines to funding agencies who will act to improve the provision of such services. The study will also contribute to knowledge in the sense that the final outcome will bring out new ideas, recommendations, solutions which can be used to solve identifiable problems by MMDAs' waste management departments. It will be useful for policy makers at all levels both in the public and in private sectors in the area of waste management.

2. MATERIALS AND METHODS

This section presents a discussion of the relevant materials and techniques applied during the data collection stage. It also describes explicitly, the model and various variables to be used in the work. Topics to be discussed include data collection and design, theoretical framework, model specification and variables to be estimated.

2.1 Data Collection and Design

In relation with the topic, the questionnaire was designed by using the contingency valuation method (CVM). The survey instrument was designed and structured based on the recommendations of Carson (2000) that a CVM survey questionnaire should include an introductory section which helps set the general context for the decision to be made, a detailed description of the good to be offered to the respondents, the institutional setting in which the good will be provided, the manner in which the good will be paid for, a method by which the survey elicits the respondent's preferences with respect to the good, debriefing questions about why respondents answered certain questions the way that they did and the collection of a set of respondent characteristics including attitudes, debriefing questions, and demographic information. The target population for the study comprised residents staying in Sekondi – Takoradi metropolis in the Western Region of Ghana who were within the selected strata. The study considered all households within the selected area. The population was made up of heterogeneous groups of households. The sample for the study was drawn using multistage-sampling technique. The selected area called Effiakuma Estate is divided into compounds; that is the old and new compounds. In each compound we have blocks with numbers. Households were randomly selected from both compounds and from each block. In all, 300 households were selected to form the sample for the study. A number of factors were taken into consideration in the selection of the sample. These were cost, time and resource availability.

Data for the study were collected after a pre-test. Three hundred (300) questionnaires were administered.

2.2 Analytical Framework

Much of the concern of empirical environmental economics has been with the economic benefit of changes in the level of environmental quality. That is, environmental and resources economists have been preoccupied with how changes in the provision of environmental public goods impacts upon individual's utility or welfare and estimating it in monetary terms. In this regard, two most common approaches that have been used constitute Marshallian consumer surplus and Hicksian compensated demand (Carson 2002).

The Marshallian demand approach tracks the 'full price effect' and has been typically used to show

how much the quantity consumed of a normal good increase when its price falls. In the case of environmental public goods, however, the individual is usually faced with a quantity rather than a price constraint with the good in question often being un-priced. Furthermore, these goods often have much higher income elasticities than those associated with many ordinary market goods (Bateman, et al., 1992), which may undermine the consumer surplus approach of measuring welfare change. Therefore, the Hicksian compensated demand approach is preferred and theoretically more accurate approach of measuring welfare change in this context.

The Hicksian approach evaluates welfare change as the money income adjustment necessary to maintain a constant level of utility before and after the change of provision of the environmental public good. Two such welfare change measures are feasible for such an approach, 'Compensating Variation' (CV) and 'Equivalent Variation' (EV). The CV is the money income adjustment (welfare change) necessary to keep an individual at his initial level of utility (U_0) throughout the change of provision, while the EV is the money income adjustment (welfare change) necessary to maintain an individual at his final level of utility (U_1) throughout the provision change (Bateman & Turner, 2000). Similarly the derivatives of these welfare measures are the corresponding demand functions.

Depending on the property right assigned, the preferred Hicksian welfare measure can also be expressed in terms of either willingness to pay or willingness to accept compensation (Carson, 2002). For a proposed change in provision of the environmental public good which increases utility, the CV measure tells us how much money income the individual should be willing to give up (WTP) to ensure that the change occurs which is appropriate for the issue at hand.

Suppose now an organization is considering an improvement in environmental quality and desires a measure of WTP, that is, Hicksian compensated surplus where a participant is asked to respond by giving the difference of two expenditure functions:

$$e(p, q_0, U_0, Q, T) - e(p, q_i, U_0 Q, T) \qquad (1)$$

Where p is a vector of prices for the marketed goods, q_i is the environmental quality being changed, U_0 is the initial or status quo levels of utility to which the respondent is assumed to be entitled, Q is a vector of other public goods that are assumed not to change, and T is a vector of participant's taste parameters.

Suppose that Y_0 is the value of the first expenditure function, that is, the participant's current income and Y_1 is the level of income that solves for U_0 given $p, q_1\, Q$ and T the value of the second expenditure function. Then, we can now define WTP as the difference between Y_0 and Y_1. Willig (1976) condition states that (1) can equivalently be expressed in an income compensation function form. If WTP is the desired benefit measure, then WTP function is given by:

$$WTP(q_1) = f\,(p, q_0, Q_0, T) \qquad (2)$$

Now q_0 is the base line level of the public good of interest. This equation forms the basis for estimating a valuation function that depicts the monetary value of a change in economic welfare that occurs for any change in q_1 (Carson, 2002).

In this study, contingent valuation method (CVM) was used to estimate the benefits from improved solid waste management service. Compared with other valuation techniques, it is considered very flexible and adaptable to some valuation tasks that alternative valuation techniques cannot handle. It is one of the most widely used and generally acceptable techniques for estimating the total economic value of many classes of public goods and services that other economic techniques cannot accommodate. In addition, its results are also relatively easy to understand, interpret, and to use for policy purposes. Despite its advantages and wide range of applicability and value including the non – used values, CVM have been criticized for many biases comprising strategic bias, design bias, hypothetical bias, and operational bias (Pearce & Turner, 1990). However, it has to be noted that the limitations are inherent to any valuation method of damages from deprivation of passive-use and not special to the CVM (Arrow, et al., 1993).

2.3 Model Specification

The main objectives in WTP survey are to calculate mean WTP and estimating parametric model to allow inclusion of respondents' socio-economic factors in to WTP function. Incorporation of individuals' socio-economic variables into the CVM helps the researchers to gain information on validity and reliability of the CVM results and increase confidence in practical application of results obtained from the CVM empirical analysis (Haab & McConnell, 2002). The issue at hand involves ‘’yes’’ or ‘’no’’ response, on one hand, and elicitation of specific monetary value for the yes responses, on the other hand. Therefore, two models that is

Probit and Tobit were used to analyze the WTP of household. Firstly, since we do not know the random part of preferences and can only make probability statements about "yes" or "no", we use the probit model to estimate the probability of WTP. Secondly, since the dependent variable (WTP) is not fully observed, that is censored at zero, we used Tobit model.

2.4 Estimation Procedure of the Probit Model

The building block for this model starts with the specification of an indirect utility function for each CVM respondent (Haab & McConnell, 2002). Assume that the representative household gain utility from the improvement in SWM and the two possible levels of environmental quality involved are: the status quo represented by q and a specific level of improvement represented by q^1. Hence, her/ his utility function at status quo (no improvement) will be:

$$U_0 = U(y_1, z_1, q^0, \varepsilon_0) \quad (3)$$

Whilst her/his utility function with improvement will be:

$$U_1 = U(y_1, z_1, q^1, \varepsilon_1) \quad (4)$$

We can rewrite equations (3) and (4) into one equation as:

$$U_{ji} = U(y_1, z_1, q_1, \varepsilon_1) \quad (5)$$

Where $j = 0,1$ refers to the two different states of the environment and $i = 1, 2, \ldots, n$ refers to individual i and U_{0i} and U_{1i} represent, respectively, indirect utilities at the status quo and the hypothetical improved scenario, y_i is the i^{th} utility maximizer's (individual consumer$i$) discretionary income, z_i represents a vector of household socio-economic, demographic, environmental and design variables, q_i refers to the quality of the good being valued (environmental improvement), ε_j represents other variables known to the utility maximizer but not observed by the researcher or commonly the error term.

When the quality of good q (environmental quality) changes from q^0 to q^1 (as a result of an improvement), the individual's utility also changes from $u(y_i, z_i, q^0, \varepsilon_{0i})$ to $u(y_i, z_i, q^1, \varepsilon_{1i})$ Therefore, the condition that utility maximizer i answers yes to the yes/no CVM question at offered price (bid) bi is given by:

$$U_1(y_1, z_1, q^1, \varepsilon_{1i}) > U_0(y_1, z_1, q^0, \varepsilon_{01}) \quad (6)$$

(6) states that household i will answer yes to the yes/no CVM question at offered price (bid) b_i if his/her utility at the improved level, net of the required payment, exceeds his/her utility at the status quo. However, because one typically do not know the random part of preferences and can only make probability statements about "yes" or "no", the probability of a utility maximizer answering yes to the valuation question is consequent upon $U_1 > U_0$(that is., the utility maximiser is better at q^1 even with the required payment b_i). Hence, the probability of yes for utility maximizer i is given by:

$$Pr(yes) = pr[u_1(y_1 - b_1, z_1, q^1, \varepsilon_{1i}) > U_0(y_1, z_1, q^0, \varepsilon_{01})] \quad (7)$$

According to Haab and McConnell, (2002), two things turn out important for parametric estimation of the above model. First, one need to choose a functional form for $U(y_1, z_1, q^1, \varepsilon_{1i})$and secondly, one must also specify the distribution of the error termε_{ji}. Generally, most applied empirical research work be it those employing the Random Willingness to Pay Model (Cameron & James, 1987) or the Utility Differential Model (Hanemann, 1984), begin their specification by assuming a utility function that is additively separable in systematic and stochastic components of preferences as

$$u_j(y_1, z_1, \varepsilon_{ji}) = v_1(y_1) + \varepsilon_{ji} \quad (8)$$

Now, given the specification in(8), the probability of utility maximizer i giving a positive response to the valuation question become:

$$\left.\begin{aligned} Pr(yes) &= pr[v_1(y_1 - b_1, z_1, q^1) + \varepsilon_{1i} > v_0(y_1, z_1, q^0) + \varepsilon_{0i}] \\ &= pr[v_1(y_1 - b_1, z_1, q^1) - v_0(y_1, z_1, q^0) > \varepsilon_{0i} - \varepsilon_{1i}] \end{aligned}\right\} \quad (9)$$

The probability of utility maximizer giving a negative response or rejects the improvement, is

$$pr(no) = 1 - pr(yes) \quad (10)$$

This equation is still too general for parametric estimation. However, when the systematic part of the preference function is assumed linear in income and other covariates, the model can be simplified as:

$$v_{1j}(y_1) = \alpha z_1 + \beta(y_1) \quad (11)$$

Where y_i represents the individual consumer's income, z_i represents an *n* vector of household socio-economic, demographic, and environmental variables and α is an n dimensional vector of parameters. For the new SWM/CVM scenario, in which the DC question will require a 'yes' or a 'no' response at some offered price b_i, the probability respondent i answering yes to the valuation question is given by:

$$pr(yes) = pr(\alpha z_1 + \beta b_1 + \varepsilon_1 > 0) \quad (12)$$

To estimate equation (12), we assume that the error term is normally, independently and identically distributed with mean zero and variance 1, the result is a probit model.

Let us assume that $\eta = \varepsilon_1 - \varepsilon_{1i}$ and let $F_\eta(\Delta v)$ be the cumulative distribution function of η then the probability that the individual is willing to pay for the improvement is:

$$\left.\begin{aligned} Pr(yes) &= F_\eta(\Delta v) \\ \Pr(no) &= 1 - F_\eta(\Delta v) \\ \Delta v &= V_1(y_1 - b_1, z_1, q^1) - V_0(y_1, z_1, q^0) \end{aligned}\right\} \quad (13)$$

The main purpose of the analysis is to estimate WTP so that from the assumed utility function we can derive a WTP function. Assume that P_i is unobservable individual household's actual WTP for improved SWM service, then:

$$\left.\begin{aligned} P_i\ \alpha z_1 + \beta(y_1) &= \alpha_0 z_1 + \beta y_1 + \varepsilon_1 \\ &= \alpha_1 z_1 + \beta(y_1 - b_1) + \varepsilon_{1i} \\ &= \alpha_1 z_1 + \beta(y_1 - WTP_1)\,\eta_1 \quad (14) \end{aligned}\right\} \quad (14)$$

P_1 is unobservable individual household's actual WTP for improved SWM service. By solving this individual $i's$ WTP can be given by

$$WTP_1 = \frac{\alpha z + \eta_1}{\beta} \quad (15)$$

In the probit model $F_\eta(\ldots)$ is the normal cumulative distribution function. As it have been defined above, the unobservable individual household's actual WTP for improved SWM service is P_i in linear relation with the initial bid, b_i and the covariates, then the actual WTP for an individual can be presented as follows:

$$\left.\begin{aligned} WTP_1 &= 1\ if P_1 \geq b_1 \\ WTP_1 &= 0\ if P_1 < b_1 \end{aligned}\right\} \quad (16)$$

This gives as shown below:

$$\left.\begin{aligned} WTP = \alpha + \beta_1\, inc + \beta_2\, occ + \beta_3 sex + \beta_4\, age + \beta_5 edl \beta_6\, awr + \\ \beta_7 famsz + \beta_8 mar + \beta_9\, per + \beta_{10} hon + \varepsilon \end{aligned}\right\} \quad (17)$$

Where inc represents monthly income of the head of the household, occ represent Employment, sex represents gender of respondent, age represents age of respondent, edl represents educationalleve1 of respondents, awr represents environmental awareness of the respondent, $famsz$ represents number of members of the household, mar represents marital status of the respondent, per represents perception of the

respondent on the current solid waste management and hon represents house ownership of the respondent.

In a dichotomous choice CVM elicitation format, the i^{th} respondent (utility maximizer) is asked if he/she would be willing to pay the initial bid (b_i) to get a given improvement in environmental quality or both quality and quantity in solid waste management improvement.

The probability of yes or no response can be presented as:

$$\left.\begin{aligned} Pr(yes\ to\ b_1) &= \Pr(P_1 \geq b_1) \\ Pr(no\ to\ b_1]) &= \Pr(P_1 < b_1) \end{aligned}\right\} \qquad (18)$$

2.5 Estimation Procedure of the Tobit Model

In certain application when the dependent variable is zero for a substantial part of the population, the dependent variable in this case of the WTP is not fully observed. The alternative to OLS when dependent variable response is zero for a significant fraction of the observation is the Tobit model (Verbeek, 2000).

Generally, the standard Tobit model can be summarized as follows (Greene, 2003):

$$\left.\begin{aligned} y_1^* &= \beta x_i + \varepsilon_1, i - 1, 2, \ldots . n \\ Py_1 &= y_1^* (if\ y_1^* > 0) \\ &= 0\ (if y_1^* \leq 0) \end{aligned}\right\} \qquad (19)$$

Where ε_i is assumed to be NID (0, σ^2) and independent of $\mathbf{x}_i$.

Let MWTP be 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 Verbeek (2000), the Tobit model for the observed maximum willingness to pay (MWTP) for this particular study is given by:

$$\left.\begin{aligned} MWTP_1^* &= \alpha + \beta x_i + + \varepsilon_1 \\ MWTP_i &= MWTP_1^*\ (if MWTP_1^* > 0) \\ &= 0\ (if MWTP_1^* \leq 0) \end{aligned}\right\} \qquad (20)$$

Where $MWTP_i$ is the unobserved maximum willingness to pay of an individual for improved solid waste management, $MWTP_1^*$ is the actual maximum willingness to pay of an individual for improved solid waste management, $\mathbf{x}_i$ is vector of independent variables, β is a vector of coefficients, α is the intercept and ε_i is disturbance term, which is assumed to be NID$(0, \sigma^2)$and independent of $\mathbf{x}_i$.

Assume that Censoring point is zero

$$\left.\begin{aligned} WTP &= \alpha + \beta_1\, inc + \beta_2\, occ + \beta_3 sex + \beta_4\, age + \beta_5 edl + \\ &\beta_6\, awr + \beta_7 famsz + \beta_8 mar + \beta_9\, per + \beta_{10} hon + \varepsilon \\ &if MWTP_1^* > 0 \end{aligned}\right\} \qquad (21)$$

Where the variables are the same as explained in (17) above.

2.6 Marginal Effects

The marginal effects of the explanatory variables on the dependent variable were determined after estimation of the parameters. These effects would actually enable us to identify the variables that have the greatest influence on the willingness to pay. Marginal effects of the probit refer to the change in predicted probability associated with changes in the explanatory variables (Anderson & Newell, 2003; Greene, 2003). Following Greene (2003) the marginal effects for the probit model are given as

$$\frac{\partial E[\mathrm{y}|X]}{\partial X} = (\beta' x)[1 - \Lambda(\beta' x)]\,\beta \qquad (22)$$

Where y is the choice variable; x is a vector of explanatory variables; β is a vector of parameter estimates and Λ is the logistic distribution function. The procedure for finding the marginal effects of the independent variables is given by(22).

3. RESULTS AND DISCUSSIONS

Table 1 presents the summary statistics of some of the variables that were used. The minimum age of the

respondents was 16 years and the maximum age was 84 years. In addition the largest number of people in one household that was interviewed was 18 with the minimum to be one. It gave a mean value of approximately 5.0 and standard deviation of 2.7. Considering the level of income, we recorded the maximum and minimum values to be 900 and 10 Ghana cedis respectively. On the average the mean income was 261.1 with standard deviation to be 217.9.

After subjecting the data to statistical analysis, a significant number of the respondents (255) representing about 85% agreed that there was a problem with the collecting of solid waste in the area. The problem of littering in the area was also not left out as it had as much as 245 representing about 81.7% of respondents responding yes (see Tables 2).

Though STMA waste management department is in charge of solid waste management in the metropolis. Most of its functions have been contracted to private companies, which reiterate Gourley (1992) assertion that in larger cities, collection and disposal of solid waste is a municipal responsibility but the actual business of disposal is often contracted to private firms. Therefore, to know the level of satisfaction, there was the need to examine how the respondents perceive the activities of such service providers. All the households that were interviewed noted that they received a collection service. It is worth mentioning that about 53.0% stated emphatically that they were not satisfied at all with the service they received. About 111 (37.5%) of the respondents that were interviewed also answered that they were reasonably satisfied with what was being offered to them as can be inferred from Table 2. As a result of the responses that were given it was then necessary to find out why a greater number of the respondents were not very satisfied with the service. Here again, about 57.9 complained about the frequency of the service. That is the interval between the collection periods was just too long to the extent that sacks and containers full of rubbish are left in front of their apartment for days unattended to. A sizable number of about 94 respondents representing approximately 32.9% stated that the service was not reliable. The workers were also not left out. They received their fair share of the complaints. Approximately 9.1% of the respondents made it known that the collection workers were rude and impolite (infer from Table 2).

With all these worries and complaints by the people it was therefore not surprising that a greater percentage of the respondents that were interviewed were very happy when they got to know about the proposed improved service. Table 2 shows that about 236(78.7%) of the respondents were willing to pay for an improved service.

It is believed that people's socio-economic status determines their willingness to contribute to environmental improvement. Out of the total number of 236 respondents who were willing to pay for an improvement in the solid waste management, a greater proportion of female respondents, approximately 69.9% had positive WTP for improved SWM as compared to male respondents who were willing to pay constituting about 30.1 %. The simple reason might be that traditionally females are more responsible for solid waste management as can be observed in Table 3.

It is logical that as respondent's educational level increases, their income increases and this leads to increase environmental demand. From Table 3, respondents with no schooling who were willing to pay constituted just about 10.2%. The percentage of those who were willing to pay kept on increasing from about 29.2% to 29.7% then to 30.9% as the educational level also increased from primary to secondary then to tertiary level respectively. From this one can comfortably agree with Damodaran (2003) who argued that reducing quantities of waste generated is considered an educational and awareness task, which has to be promoted in all societies.

It appears married households are more responsible and have higher WTP than the unmarried ones. A greater percentage of about 55.9% of those who were married were willing to pay as compared to those who have separated attracting just about 2.9%.

It can also be seen from Table 13 that about 69 (29.2%) respondents who were never married had a positive willingness to pay whiles only about 16 (6.8%) respondents who have been married before but are divorced were willing to pay. A total number of about 12 (5.0%) of those who were widowed also contributed to the number of respondents willing to pay for an improvement in the waste management (see Table 3).

Occupation defines the sector in which an individual is engaged as far as employment is concerned. In this research occupation type was classified into three: civil/public sector, self-employed and unemployed. Majority of individuals who were willing to pay for an improvement fell into the civil/public sector category representing about 122 (51.7%). It will be logical to say that respondents who did not earn any regular income had the smallest number of people willing to pay; that is about 49 (20.8%). Approximately 65 (27.5%) of respondents who were into their own private business were willing to pay for an improvement (make reference to Table 3).

A higher-income consumer apparently has a greater demand for the waste management amenity and is, therefore, more willing to pay for it. Respondents who earned more income were more willing to pay. Only about 31(38.8%) of those whose income were less than 100 Ghana cedis were willing to pay as compared to about 59 (98.3%) and 34 (91.7%) of those within the range of 301-500 and above 500 Ghana cedis respectively.

Table 15 supports Jha and Majumda (1999). They argued that greater income signified greater affordability and so lead to increased demand for an environmental service (perceive from Table 3).

Upon the responses that were given by the respondents, it came out clearly that most of them were willing to pay for an improved service. Now the question was to find out the additional amount that they were willing to pay. According to Whitehead (2000), a closed ended question is normally applied when an enquiry is made about the amount to be paid by people. By so doing it reduces the disparity in values given. Whitehead noted that the additional amount offered to be paid by respondents must normally not exceed half or the mean of what was originally being paid. In this regard, it was revealed after conducting the pre-test that households who were receiving a service paid a maximum of 10 Ghana Cedis. Going by the argument made by Whitehead (2000), the maximum additional amount that should be set for households to pay was 5 Ghana Cedis. Approximately 81 (34.3%) respondents were willing to pay additional amount of 2 Ghana cedis whiles only about 28 (11.9%) respondents were willing to pay an additional amount of 5 Ghana cedis. The various statistics are displayed in Table 4. Approximately 72 respondents representing 30.5 percent were willing to pay an additional amount of 3 Ghana Cedis. Those who were willing to pay 4 Ghana Cedis as additional amount constituted about 55 representing about 23.3 percent.

Knowing that respondents will be willing to pay different amounts, it became necessary to find out the reasons. 19 (8.1%) respondents were of the view that it will save cost. Their justification was that anytime their waste is left unattended to, a person must pay an amount of 20 pesewas each time you dump your refuse at the public dumping area. Approximately 6.8 percent who were particular about their health also believed that paying the additional amount will prevent diseases. According to them, common outbreak of diseases like typhoid, cholera and malaria were all as a result of the improper disposal of waste. Moreover a large number of respondents were of the view that it will keep the city clean. This testifies that most people are very much worried about the sanitation problem in the city and are willing to help. Respondents who believed that the company will be more reliable constituted about 24.2 percent. This is supported by the observation made by Rushbrook (1988) that waste management is not only a technical problem, but is also strongly influenced by cultural, social and economic circumstances. It should be recognized that ultimately only the people of a nation can solve waste management problems in their country.

A number of economic and socio-demographic variables were identified and used to determine the willingness to pay for an improved solid waste management service. The variables were income, education, family size, sex, among others. The coefficients of the variables were estimated using Stata (version 11). The results of estimation are presented in Table 5. The variables that are significantly related to providing positive WTP values are household income, level of environmental awareness, perception about the current situation, house ownership and occupation. All of the signs of these five variable coefficients make intuitive sense. A higher-income consumer apparently has a greater demand for the waste-management amenity and is, therefore, more willing to pay for it. Households with higher awareness of environmental in relation to the problems that solid waste can cause, also tend to provide positive WTP values.

Based on literature, a positive relationship between perception and WTP can be expected. This is supported by the observation of Gibson (1969). He is of the view that perception guides our behaviour because what we perceive determines what we do next. Thus the way individuals or communities perceive waste influences the way they would treat the waste.

People who lived in their own house will naturally be more concerned about their surroundings hence they will have a greater demand for an improvement in the services they receive in terms of solid waste. The type of occupation is related to level of income, which determines ability to pay for waste management services. This means that people who are employed have a positive WTP.

The goodness of fit measure, including the accuracy with which the model approximates the observed data was also tested. Some of the measures of goodness of fit are PseudoR^2 and McFadden. The result of test for goodness of fit is: PseudoR^2 = 0.4404. As the value of the calculated result closes to one (1), the explanatory power of the model will increase. The variables that are significantly related to WTP values are monthly income, level of environmental (awareness) quality, household ownership, perception of the problem with solid waste collection and disposal, occupation (employment). The positive signs of the coefficients of these variables conform to expectation and make intuitive sense (refer to Table 5).

The results indicate that income variable has the predicted sign and significant. This shows that households with more income, comparatively, have a greater demand for waste management amenity and are more willing to pay for improved service in solid waste disposal than poorer households. A household with a one (1) percent higher monthly income increases the likelihood of willingness by such a household to pay for improved waste collection and disposal. A look at the results in Table 5 reveals that the variable relating to environmental awareness is significant at one percent level and has the expected sign. The positive sign of education variable indicates that more awareness about the environment means respondents know the benefit of the environment and it is likely to have more environmental demand. The estimated coefficient of the

environmental variable indicates that being aware and conscious of one's environment increases the likelihood of willingness to pay improved SWM.

Perception of respondents for the current solid waste management was found to have a positive impact on willingness to pay for improved solid waste management and significant at ten (10) percent. The positive relationship indicates that households who perceive the current SWM system as problematic will be more willing to pay than households who perceive the current solid waste management system as not problematic. The estimated coefficient of the perception variable indicates that perception of the system of disposal as problematic increases the likelihood of willingness to pay for an improved solid waste management service.

The self – employed and those employed in the civil/public sector compared to those unemployed as a base category employment dummies were significant. The dummies for civil/public sector and self - employed were positive and significant at 5 percent. The coefficient of civil/public sector worker dummy shows that being employed in the civil/public sector increases the likelihood for willingness to pay. Likewise, the estimated coefficient shows that being a private sector worker or being self – employed increases the likelihood for willingness to pay for an improved SWM. It is apparent from the results that employment has significant and positive impact on WTP of individuals.

At 10 percent level of significance House ownership has significant impact and positive relation with willingness to pay. This means that households who live in their own house are more willing to pay for improved SWM system than those living in rented houses. This may be because of those people living in a rented house considers their residential area as temporary or may be related to increases in income from rent. The estimated coefficient indicates that being a house owner or living in one's own home increases the likelihood for willingness to pay for an improved solid waste management service.

As seen in Table 6 the marginal effects of monthly income, level of awareness of environmental quality, household ownership and current perception on the solid waste are significant. The marginal effect of 0.077431 indicates that a respondent who stays in his/her own house or owns a house has 0.077431 higher chance of being willing to pay for improved solid waste disposal than a respondent who stays in a rented house.

The marginal effect of 0.2567421 indicates that a respondent who is aware of his/her environment has 0.2567421 higher chance of being willing to pay for improved solid waste disposal than a respondent who is not aware of his/her environment. The marginal effect of 0.1529163 indicates that a one percent increase in the monthly income of individuals increases the probability of the individual's willingness to pay by about 0.15. With respect to public sector dummy, a respondent employed in this sector has 0.1310274 higher chance of being willing to pay for improved solid waste disposal. Likewise, the marginal effect for self-employed dummy of 0.0955247 indicates that the probability of willingness to pay for individuals who are self-employed is 0.0955247 greater than those unemployed (see Table 6).

Given that the dependent variable is zero for a part of the population, according to Verbeek (2000) an alternative to OLS is the Tobit model. Based on the empirical and theoretical literature on willingness to pay, the same variables as were used in the probit formulation were used in the Tobit regression model. These variables included: income, household ownership, level of education, family size, environmental awareness, and perception of the solid waste disposal problem, sex, age and employment. The study estimated and presented both the coefficients of the variables and the marginal effects of the estimated variables. The estimated coefficients of the variables are displayed in Table 7. The variables including age, house ownership, income, perception and environmental awareness were significant and had predicted signs. It can be observed that a one percent increase in age of the respondents has a negative significant effect on the maximum amount of willingness to pay. This implies that the younger one is, the higher the amount the person will be willing to pay. This is because old people may consider waste collection, as government's responsibility and could be less willing to pay for it. While the younger generation might be more familiar with cost sharing and could be more willing to pay.

The environmental awareness variable has a positive relationship with the maximum amount of willingness to pay and is statistically significant at one percent. This means that a one percent increase in the environmental awareness of an individual will increase the maximum amount one is willing to pay for an improved solid waste management service. This was expected because more awareness about the environment means people know the benefit of the environment and they are likely to have more environmental demand which will translate into a higher amount paid for improved solid waste disposal and collection.

Observe further that monthly income of respondents exhibits a positive connection with the amount of WTP. It is significant at one percent level. A one percent increase in income will increase the maximum amount an individual will pay for an improvement in the solid waste management service. This is consistent with economic theory that establishes that income is positively related with demand in general and environmental demand in this respect. This also indicates that environmental good is a normal good since its demand increases with income.

Perception of respondents for the current solid waste management was found to have a positive effect

on the amount of WTP for improved solid waste management and statistically significant at 5 percent. The positive relationship indicates that households who perceive the current SWM system as problematic will be more willing to pay than households who perceive the current solid waste management system as not problematic.

House ownership has significant impact at one percent and positively related to the amount of WTP. This means households who live in their own house will be willing to pay higher amount for improved SWM system than those living in rented houses. This could be explained from the fact that people living in a rented house considers their residential area as temporary or may be due to the current condition in the city that only house owners pay for sanitation.

Aside the estimation of the coefficients of the Tobit model, the study also conducted the marginal effects. The results of the marginal effects are presented in Table 8. The marginal effects indicate the predictive power of the independent variables. It can be perceived that age, house ownership, income, perception and environmental awareness were significant and had predicted signs. The negative estimated magnitude of -0.02061 of the age variable implies that an increase in the age of individuals by one year decreases the probability of willingness to pay a higher amount for improved waste management by 0.02061. This is because old people may consider waste collection, as government's responsibility and could be less willing to pay for it. While the younger generation might be more familiar with cost sharing and could be more willing to pay.

With respect to the monthly income variable, the magnitude 0.8602914 implies that a one percent increase in the monthly income of individuals increases the probability of willingness to pay a higher amount for improved waste management by about 0.86.

Environmental awareness of respondents was also significant at I% and had a positive relationship with the maximum amount of WTP whiles perception and house ownership had a positive relationship and were significant at 5%.

The other variables such as sex of respondents, family size of the household and marital status of respondent have no significant impact on the amount of WTP for improved solid waste management.

Based on the results gathered, about 236 (78.7%) of the respondents were willing to pay for an improved solid waste management service. In accordance with the objective to identify the factors that may affect households' willingness to pay for an improved solid waste management service, it came out that environmental awareness has a significant relationship with households' willingness to pay for improved SWM. This was significant at one percent. In addition, the null hypothesis that income has no significant relationship is rejected. Income was significant at one percent. We reject the null hypothesis that there is no significant relationship between current perception and households' willingness to pay for improved solid waste management. This was because current perception was significant at 10 percent level. House ownership contributed to factors that determined household's willingness to pay for improved SWM at 10 percent significance level. This implies that we reject the null hypothesis that there is no significant relationship between house ownership and improved SWM.

The second objective was to identify the factors that determined the maximum amount households were willing to pay for an improved solid waste management service. The Tobit model was used to determine these factors and the null hypothesis that there is no significant relationship between income and the amount households are willing to pay for an improved SWM is rejected. This is because income was significant at one percent level. It was also observed that at one percent level of significance, environmental awareness was one of the factors that determined households' willingness to pay for improved SWM. Therefore, the null hypothesis that there is no relationship between environmental awareness and the amount households are willing to pay is rejected. We reject the null hypothesis that there is no significant relationship between house ownership and the amount households are willing to pay for improved solid waste management. House ownership was significant at *5* percent level.

Accordingly, it has been established that income, environmental awareness, occupation (employment), perception and house ownership significantly influence household's willingness to pay for an improved solid waste management service.

4. CONCLUSION

Measuring WTP for environmental goods and services is of considerable importance because funding agencies and policy makers can use this information for improving the provision of such services. This study was an example of such an attempt to elicit household's willingness to pay for an improved solid waste management service in the Sekondi-Takoradi metropolis. The extent of the problem related to waste as evident from the recent outbreak of cholera in the country and specifically in the region.

We have been able to investigate into the determinants of household's willingness to pay for an improved solid waste management service in the Sekondi-Takoradi metropolis. The results evince that a greater number of people are willing to pay for an improved solid waste management service.

The willingness to pay for an improved solid waste management service by households is explained by socio-economic and demographic characteristics. We have established that households WTP for an improved SWM service in Sekondi – Takoradi is dependent on income, employment, perception, marital status, age, environmental awareness, house ownership, sex and household size as has been the case in most cities in Sub – Sahara African countries. Though all the variables exhibit the expected signs and made intuitive sense, income, environmental awareness, current perception of the solid waste situation, house ownership and occupation were the variables which had significant relationship with willingness to pay for an improved service.

In line with related literature, the same variables were used in determining the maximum amount households were willing to pay. Among the variables that were significantly related to the maximum amount that households were willing to pay were age, income, environmental awareness, perception and house ownership. By making reference to the average additional amount that respondents were willing to pay, we arrived at 2.5 Ghana cedis. This implies that people were not willing to pay so much for a reason among others as believing that general taxes can be used to cover part of the cost.

We recommend that government should create more employment opportunities so that people can earn regular income. In addition government and various stake holders should make efforts towards improving residents' income as willingness to pay relates positively to income.

Secondly, more educational programs about the dangers of waste in our communities should be organized by various organizations in a quest to increase environmental awareness and hence increase the WTP for improved environmental quality in general and improved solid waste management in particular.

Lastly, the policy frameworks which have been set aside by government for service providers or companies must be given a strict enforcement. It is our candid suggestion that households should be encouraged to accept an additional amount charged to them as this probably will propel high degree of efficiency and reliability in service delivery.

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Table 1: Summary Statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
WTP	300			0	1
Sex	300			0	1
Occupation	300			1	3
Education	300			0	3

Table 1 cont'd

Variable	Observation	Mean	Std. Dev.	Min	Max
Marital Status	300			1	5
Awareness	300			0	1
Own house	300			0	1
Perception	300			0	1
Income	300	261.1033	217.9058	10	900
Family size	300	4.97	2.661964	1	18
Age	300	39.38667	15.28756	16	84
MWTP	300	2.5	1.873062	0	5

Source: Results from analysis of data, June, 2015.

Table 2: Responses, opinions and reasons giving by respondents on certain issues relating to SWM.

	Frequency	Percentage
Response to Problems with Solid Waste Collection		
No	45	15.0
Yes	225	85.0
N	300	100
Response to Problems with Littering		
No	55	18.33
Yes	245	81.67
N	300	100
Opinion of Current Service been Received		
Not serious	28	9.46
Somehow serious	111	37.5
Very serious	157	53.04
N	300	100
Reasons for Dissatisfaction with Service		
Service not reliable	94	32.98
Interval too long	165	57.89
Workers are rude	26	9.12
N	300	100
Households WTP for Improved Service		
No	64	21.33
Yes	236	78.67
N	300	100

Source: Results from analysis of data, June, 2015.

Table 3: Households WTP by sex, level of education, marital status, employment type and income levels of respondents

	Yes	Percent	No	Percent
Households WTP by Sex of Respondents				
Male	165	69.92	17	26.56
Female	71	30.08	47	73.44
N	236	100.00	64	100.00
Households WTP by Level of Education				
No schooling	24	10.17	12	18.75
Primary	69	29.24	20	31.25
Secondary	70	29.66	15	23.44
Tertiary	73	30.99	17	26.56
N	236	100.00	64	100.00
Households WTP by Marital Status				
Never married	69	29.24	21	32.81
Married	132	55.93	34	55.93
Divorced	16	6.78	3	4.69
Separated	7	2.97	1	1.56
Widowed	12	5.08	5	7.81
N	236	100.00	64	100.00
Households WTP by Employment Type				
Unemployed	49	20.76	5	12.81
Civil/public servant	122	51.69	21	37.50
Self employed	65	27.54	19	29.69
N	236	100.00	64	100.00
Households WTP by Level of Income				
< GH¢ 100	31	38.75	49	61.25
GH¢100-300	112	90.32	12	9.68
GH¢301-500	59	98.33	1	1.67
>GH¢500	34	91.67	2	8.33
N	88	100.0	212	100.0

Source: Results from analysis of data, June, 2015.

Table 4: Maximum amount from bid

	Bids			
	2.0	**3.0**	**4.0**	**5.0**
Willingness to Pay	81	72	55	28
Percentage	34.4	30.5	23.3	11.9

Source: Results from analysis of data, June, 2015.

Table 5: Probit results of WTP

Variable	Coefficient	Std. Err.	Z	P>z
Sex	0.11343	0.26733	0.42	0.671
Age	-0.01254	0.009735	-1.29	0.198
Primary	0.045074	0.388528	0.12	0.908
Secondary	0.220015	0.42306	0.52	0.603
Tertiary	0.168327	0.434966	0.39	0.699
Size of HH	-0.00451	0.042873	-0.11	0.916
Married	0.123945	0.317234	0.39	0.696
Divorced	0.219497	0.556217	0.39	0.693
Separated	0.468599	0.901417	0.52	0.603
Widowed	0.004745	0.583431	0.01	0.994
Own the house	0.466473*	0.243694	1.91	0.056
Perception	0.439012*	0.246169	1.78	0.075
Income	0.916139***	0.146593	6.25	0.000
$Env.$ Awareness	1.169597***	0.231206	5.06	0.000
Public servant	0.781275**	0.304704	2.56	0.01
Self Employed	0.734745**	0.324585	2.26	0.024
Constant	-4.9766***	0.988787	-5.03	0.000
LR chi2 (16)	136.97			
$Prob$> chi2	= 0.0000			
Pseudo R2	= 0.4404			
Number of obs.	= 300			

Source: Results from analysis of data, June, 2015.
Note: ***,**and * denote significant at 1%, 5% and 10% levels respectively.

Table 6: Marginal effects for WTP

Variable	dy/dx	Std. Err.	Z	P>z
Own the house †	.077431 *	0.04108	1.88	0.059
Cur. Perception †	.0864227*	0.05541	1.56	0.069
Income	.1529163***	0.02671	5.73	0.000
$Env.$ awareness †	.2567421 ***	0.0615	4.17	0.000
Public service †	.1310274**	0.05023	2.61	0.009
Self $Empt$ †	.0955247**	0.03436	2.78	0.005
Y = Pr(WTP)(Predict)	= .0906600			

Source: Results from analysis of data, June, 2015.

Note: (†)dy/dx is for discrete change of dummy variable from 0 to 1 *** and ** indicate statistical significance at 1% and 5% levels respectively.

Table 7: Tobit results for maximum WTP (MWTP)

Variable	Coefficient	Std. Err.	Z	P>z
Sex	-0.06454	0.289482	-0.22	0.824
Age	-0.02061 *	0.011374	-1.81	0.071
Primary	0.350036	0.464062	0.75	0.451
Secondary	0.645029	0.479336	1.35	0.179
Tertiary	0.719495	0.497209	1.45	0.149
Size of HH	-0.03457	0.047772	-0.72	0.470
Married	-0.06882	0.346586	-0.2	0.843
Divorced	-0.009	0.633286	-0.01	0.989
Separated	0.388245	0.826945	0.47	0.639
Widowed	-0.22858	0.719138	-0.32	0.751
Own the house	0.547367**	0.259483	2.11	0.036
Perception	0.746511 **	0.320383	2.33	0.021

Table 7 cont'd

Variable	Coefficient	Std. Err.	Z	P>z
Income	0.860291 ***	0.148882	5.78	0.000
Env. Awareness	1.579074***	0.294201	5.37	0.000
Public servant	-0.14097	0.318178	-0.44	0.658
Self Employed	-0.09397	0.37378	-0.25	0.802
Constant	-3.63493***	1.071084	-3.39	0.001
Sigma	2.022776	0.103563	1.818927	2.226624
Number of *obs*	= 300			
LR chi2 (16)	= 118.81	*Prob*>chi2	= 0.0000	
Log likelihood	= -531.25863	Pseudo R2	= 0.1006	

Source: Results from analysis of data, June, 2015.
Note: *** and ** indicate statistical significance at 1% and 5% levels respectively.

Table 8: Marginal effects for MWTP

Variable	dy/dx	Std. Err.	Z	P>z
Age	-.02061 *	0.01137	-1.81	0.070
Own the house†	.5473667**	0.25948	2.11	0.035
Current Perception†	.7465111 **	0.32038	2.33	0.020
Income	.8602914***	0.14888	5.78	0.000
Env. Awareness†	1.579074***	0.2942	5.37	0.000
Y = Linear Prediction (predict)		= 2.1014175		

Source: Results from analysis of data, June, 2015.
Note: (†) dy/dx is for discrete change of dummy variable from 0 to 1
***, ** and * indicate statistical significance at 1%, 5% and 10% levels respectively.

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