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Determinants of Willingness to Pay for Improved Household Solid Waste Management in Oyo State, Nigeria

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Abstract: This study examines the economic value of improved household solid waste management in Ibadan North Local Government, Oyo state. A dichotomous choice contingent valuation technique was used to elicit households' willingness to pay for an improvement in management of their solid waste. The data were analyzed using logit regression technique. The results show that the mean willingness to pay of households for improved solid waste management is .1, 240.92. The results further reveal that the significant factors determining households' willingness to pay for improved solid waste management (collection and disposal) are the posted price of the service, age, educational level, household size and household's monthly expenditure. The willingness to pay elasticity coefficients are generally inelastic and low. Households should demand for improved and efficient management of their refuse and pay for such service because of tremendous benefits that accrue to them from it, adopt an acceptable family planning programme to control their population as well as mobilize their family labour by establishing non-capital intensive small scale businesses in order to improve their income and hence their purchasing power and that they sort their solid waste for recyclable items which could be sold to make some income.

Key words: Soild waste, willingess, elasticity coefficients, households, recgclable items

INTRODUCTION

Management of municipal solid waste resulting from rapid urbanization has become a concern for government in most cities in developing countries. Urbanization brings about concentration of population that generates waste. Several studies have revealed that an average solid waste generation rate is 0.5 kg per person per day (Okpala, 1984). Haskoning and Konsadem Associates (1994) estimated an average per capita solid waste generation rate of 0.6kg per day, with a density of 300 kg m^{-3} for Ibadan city. Achankeng (2003) revealed that per capita solid waste generation rate of Ibadan city has increased to 1.1 kg with only 40% of the total population enjoying garbage collection. Due to population explosion the city is being characterized by heaps of undisposed refuse or open dumps on streets, highways, in both private and public places. The problems are likely to become even more pronounced as the level and pace of urbanization continues to grow rapidly and the changing economic trends continue.

The Ibadan city councils cannot single-handedly and satisfactorily collect and dispose them. Consequently, the government has allowed private collection and disposal of solid wastes. Despite this arrangement, the problem of inefficient solid wastes management in the city is yet to be tackled though the combined effort of the government and waste contractors seem to make some impacts. However such impacts have not been well noticed as the current privatisation arrangement only allows for collection of refuse from households twice in a month. This leaves refuse containers filled to the brim and spill over and more importantly allowing the refuse enough time to decompose and thereby constituting health risk to the households before being collected. In addition, under the present privatization arrangement, households have not been given the chance to choose service provider of their own or be involved in the effective management of solid wastes by stating their willingness to pay.

In Ibadan and indeed many cities in Nigeria, the role and performance of solid waste service providers such as local authorities and waste contractors have always been used as yard stick for measuring and assessing the standard of solid waste management. According to Sansa and Kaseke (2004), most legal policies and framework governing solid waste management have been directed at these providers thus completely ignoring the demand side to the problem. This leaves solid waste service providers not fully appreciated by households and other service receivers. As a result, the various players have directed

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less effort at investigating the demand side to solid waste management. This has however, inhibited the proper improvement of solid waste collection and disposal service in the past.

Linkages exist between poor solid waste management and health status of the households. Improper collection and disposal of solid wastes leads to spread of communicable diseases, causes obnoxious conditions and spoils biosphere as a whole. On the other hand proper solid waste management brings about better environmental which in turn leads to reduced illness and improve households savings as result of reduced treatment cost.

According to Sansa and Kaseke (2004), the involvement of the service receivers especially households who are the primary producers and generators of significant proportion of solid waste, may not only allow them (households) determine their providers via some arrangements and participate in making of sound policy decisions including designing of effective joint solutions to SWM but also help the providers to understand households' willingness to participate, pay and neighbourhood characteristics.

This study therefore examines the willingness to pay of households for improved solid waste management in Ibadan North Local Government Area.

Theoretical framework: Sansa and Kaseke (2004) stated that benefits from Solid Waste Management (SWM) include reduced contact of the vulnerable populations with garbage in streets, reckless dumping and improved management of designated dumpsites. In addition, reduced treatment for illness such as diarrhoea and cholera avert health costs and enhance productivity of the population.

According to Bernstein (2004), as a direct impact, improvement in solid waste conditions can lead to better health which in turn can help to improve productivity and increase incomes. An indirect impact of improved solid waste conditions can lead to decrease in health problems and hence, savings from spending on health. The savings and better living environment per se would provide the poor with resources, time and most importantly a 'better quality of life' to enrich their skills (and thereby increase their capabilities) to earn higher income and fight poverty. Furthermore, an increase in incomes would also enable the poor to pay for the basic environmental services they need.

The most widely used approach to eliciting information about the respondent's WTP is the so-called dichotomous-choice format. A dichotomous choice payment question asks the respondent if he would pay .X to obtain the good. A frequently used wording of the payment question is whether the respondent would vote in favour of the proposed plan or policy if approval of the plan would cost his household .X (in the form of extra taxes, higher prices of products, etc.). There are only two possible responses to a dichotomous choice payment question: yes and no (or vote for and vote against). The naira amount .X is varied across respondents and is usually termed the bid value.

This method has the chief advantage in that it considerably reduces strategic bias (Arrow . .., 1993). Strategic bias arises when respondent attempts to influence the results of a WTP survey by answering in such a way as to serve his own interest rather than reveal his true valuation of the good or service. For instance, the respondent might give very low amount of WTP if he felt that the answer would influence the lowering of the amount he would be charged for the improved SWM (Sansa and Kaseke, 2004). There exists two basic parametric approaches for estimating willingness to pay for public goods from contingent valuation referendum data. One approach develops from utility-maximizing choice model and views referendum data as binary choice data (Hanemann, 1984), while the other approach is based upon the premise that if we could measure valuation exactly, we would use it explicitly in a regression-type model (Cameron, 1988). According to Branka and Kelly (2001), using either yields similar willingness to pay estimates.

Binary choice model: Suppose an individual n is faced with a choice between two alternatives from a choice set Cn = (i,j), where alternative i represents choosing to vote "yes" for tax payment of $A for public good G and alternative j represents choosing to vote "no" for tax payment of $A for public good G. An individual n derives utility U_{in} by choosing alternative i and U_{ij} by choosing alternative j. Following Hanemann (1984), if we define G = 1 if i and G = 0 if j and using the condition that in consumer equilibrium entire income is spent on goods and/or services, meaning that utility of all other goods can be represented by income I_n, utilities U_{in} and U_{ij} can be formulated as follows:

$$U_{in} = V_{in} + e_{in} = v(1, I_n - A_n, S_n) + e_{in} \quad (1)$$

$$U_{jn} = V_{jn} + e_{jn} = v(0, I_n, S_n) + e_{jn} \quad (2)$$

Where V_{in} and V_{jn} are assumed nonrandom, systematic components of the U_{in} and U_{jn}, respectively, while e_{in} and e_{jn} are assumed random components of the U_{in} and U_{jn} respectively. S_n represents vector of observable attributes of an individual n that might affect his/her preferences and A_n represents tax payment of $A that respondent n can pay for the public good G.

Probability of an individual n choosing alternative i is then defined as:

$$\begin{aligned} P_n(i) &= Pr(U_{in} = U_{jn}) \\ &= Pr(V_{in} + e_{in} \cdot V_{jn} + e_{jn}) \\ &= Pr\{v(1, I_n - A_n, S_n) + e_{in} \cdot v(0, I_n, S_n) + e_{jn}\} \\ &= Pr\{e_{jn} - e_{in} = v(1, I_n - A_n, S_n) - v(0, I_n, S_n)\} \end{aligned} \quad (3)$$

while probability of an individual n choosing alternative j is defined as

$$P_n(j) = 1 - P_n(i) \quad (4)$$

Under the assumption that $e_n = e_{jn} - e_{in}$ is logistically distributed, probability that an individual n will choose alternative i can be written as

$$Pn(i) = \frac{\exp\mu vin}{\exp^{\mu vin} + \exp^{\mu vjn}} = \frac{1}{1 + \exp^{-\mu(vin-vjn)}} \quad (5)$$

Which is a binary logit model.

Willingness to pay: If probability of an individual n choosing an alternative i is given with

$$Pn(i) = 1/1 + \exp^{-(\beta_1 + \beta_2 A_n)} \quad (6)$$

we can, based on the maximum likelihood estimates obtained by solving (11), estimate mean willingness to pay (WTP) using the following formula (Hanemann, 1989):

$$\text{Unrestricted mean WTP} = \frac{\beta_1}{|\beta_2|} \quad (7)$$

This model implies that mean WTP can? assume both positive as well as negative values.

If we wish to rule out negative values of mean WTP, we can truncate the estimate of the expected WTP at zero. Given model (12) mean WTP can then be calculated as follows (Hanemann, 1989):

$$\text{Restricted mean WTP} = \frac{1}{|\beta_2|} * \ln(1 + e^{\beta_1}) \quad (8)$$

The disadvantage of doing this is that we may overestimate true WTP (Hanemann, 1989). It can also be theoretically inconsistent because during the stage of estimating parameters it is assumed that WTP can undertake both positive and negative values. In the stage of calculating mean WTP it is assumed that WTP can undertake only positive values. Nevertheless, this approach (that is restricted mean WTP) is often used in practice as a means to resolve the problem of negative WTP (Branka and Kelly, 2001).

MATERIALS AND MATHODS

Data collection and sampling technique: The study area was Ibadan North local government area. The area was selected as it is the most populated among the 11 LGA in Ibadan city. The primary data used in the study were collected from selected households through a well-structured questionnaire. A systematic random sampling technique was used to select household sample used for the study. This was done by dividing the entire study area into new and old areas. The study covers five locations in each of the two areas. The locations covered in the new area include Agbowo, Bodija, Ashi-Basorun, Sango and Mokola while those covered in the old area were Oje, Igosun/Alawada area,Yemetu, Adeoyo-odoye and Igbo-agala area. In each of the two areas, a household was selected from every 15th house until 70 households were obtained. A total number of 140 households were sampled in all for the study.

The information obtained includes socioeconomic characteristics and willingness to pay of the respondents. The Questionnaires administration to households follows OECD (1995) and Bernstein (2004) as used by Zaim (1999) in a willingness to pay study in Istanbul and Sansa and Kaseke (2004) in a willingness to pay study in Kampala.This study used four price levels and a total number of 35 respondents for each price level. This gives a total number of 140 household respondents. The four price levels used for the study were N1000, N1250, N1350 and N1500. Given the fact that the existing refuse management service (collection of refuse two times in a month) in the area costs between N500 and N1000 and that an improvement in the service (increment in frequency of refuse collection to four times in a month that is weekly) will necessarily require an additional charge, the four prices levels were then chosen from the adjustment of the price levels of the existing service (which are .500, .600, .700, .800 and .1000 at various locations in the area) to reflect the proposed improvement with a pretest. This was done by using the method by Loomis .. (1994) and OECD (1995) as used by Zaim (1999) in willingness to pay study in Istanbul and Branka and Kelly (2001) in a willingness to pay study in the USA. The price range was such that, at the low end, anyone who valued improved refuse management service would very likely pay at least N1000 whereas almost no one was expected to pay more than N1500 per month for the service.

The willingness to pay question is presented as this: Suppose there is a project to improve domestic solid waste collection and disposal in Ibadan North Local Government Area; this proposed improvement will include

increasing the number of times that refuse is collected from household (from two times to four times in a month) and ensuring regular and adequate care and maintenance of refuse collection container in individual house. These will reduce the length of time that refuse stay for within the household and consequently prevent outbreak of disease due to decomposing garbage. If this new improvement in solid waste collection will cost your household . …… per month, will you pay for the improved service?

a. Yes ( ) b. No ( )

Logit model: Logit model was used to determine the mean willingness to pay of households for an improved refuse management service and the factors influencing their willingness to pay. The logit model was adopted since the Ordinary Least Square (OLS) procedure was not appropriate particularly when the dependent variable is dichotomous. The problem with the OLS estimate however is the non-fulfilment of $0 = E(Y_i/X) =$ since $E(Y_i/X)$ in the linear probability model measures the conditional probability of the event Y occurring given X, and must necessarily lie between 0 and 1 (Gujarati, 1988). The logit model is based on the cumulative logistic probability function. Roopa (2000) stated that logistic regression analysis is a uni/multivariate technique which allows for estimating the probability that an event will occur or not, by predicting a binary dependent outcome from a set of independent variables. The approach in this study follows the model by Hanemann (1989) as used by Loomis .. (1994) in a study on willingness to pay for improved environmental mannagement in Oregon, USA, Zaim (1999) in a study on willingness to pay for improved garbage collection in Istanbul (Branka and Kelly, 2001) in a study on willingness to pay for improved conservation of environmental species in the USA.

Mean willingness to pay of the households: To obtain the mean willingness to pay of the households for an improvement in their solid waste management, the responses of the households to the willingness to pay question were regressed on the prices they were asked to pay for the improved service. The coefficient estimates obtained were then used to calculate the mean willingness to pay of the households. The logit regression model is specified as

$$Y = \frac{1}{1 + \exp^{-(\beta_0 + \beta_1 X)}} \qquad (9)$$

Where

Y = Response of household to the willingness to pay question which is either 1 if yes or 0 if no.

$_{0}$ = Constant

$_{1}$ = Coefficient of the price that the household was asked to pay

X = The price that the household was asked to pay for the improved service (.)

The mean willingness to pay of the households for improved solid waste service was then calculated using the formula derived by Hanemann (1989). The formula is given as

$$\text{Mean WTP} = \frac{1}{|\beta_1|} * \ln(1 + \exp \beta_0) \qquad (10)$$

Where $_{1}$ and $_{0}$ are coefficient estimates obtained from the logistic regression and mean WTP is the mean willingness to pay of households for improved refuse management.

Factors influencing willingness to pay of households: To identify the factors influencing the willingness to pay of households for improved solid waste management, the household's responses to the willingness to pay question were regressed on the prices they were asked to pay and on other socio-economic characteristics of the households. The logit regression model is specified as

$$Y = = \frac{1}{1 + \exp^{-z}} \qquad (11)$$

Where Y = Response of the household to the willingness to pay question which is either 1 if Yes or 0 if No

$$Z = _{0} + _{1}X_1 + _{2}X_2 + \ldots\ldots\ldots + _{6}X_6 \qquad (12)$$

$_{0}$ = Constant

$_{1} \ldots . _{6}$ = Coefficients of the explanatory variable $X_1 \ldots . X_6$

X_1 = The price that household is asked to pay monthly for the improved service (.)

X_2 = age (yrs)

X_3 = Marital status; dummny variable (married =1, single = 0)

X_4 = Educational level (no of years spent in school)

X_5 = Household size (no of people in the household)

X_6 = Monthly expenditures (.)

The apriori expectations of the households' willingness to pay would be:

$_{1}<0$, $_{2}<0$, $_{3}>0$, $_{4}>0$, $_{5}<0$ and $_{6}>0$; Loomis .. (1994), Marchand (1998), Sansa and Kaseke (2004).

Monthly expenditure was used because it is a proxy to income as people can only spend what they have and more so people do not normally disclose their true income.

The chi-squared (that is the log likelihood ratio statistic) and McFadden pseudo R squared were used to measure the goodness of fit of the model. Also the significance level of the Chi-squared (that is the log likelihood ratio statistic) was used to evaluate the significance of the model.

RESULTS AND DISCUSSION

Mean willingness to pay: The mean willingness to pay of the household for improved solid waste management was estimated to know the economic value of the proposed improvement. A logit regression was used to obtain the parameter estimates that are used to calculate the household mean willingness to pay. The result of the logit regression is shown in Table 1.

Following Hanemann (1989), the calculated mean willingness to pay is .1240.92. The result shows that the mean willingness to pay is positive. This implies that households demand solid waste management in which improvement in the solid waste management will directly improve their welfare also.

The positive and considerably high mean willingness to pay estimate obtained can be attributed to the fact that the majority of the heads of the households interviewed were earning salaries (either from government or private) that have regular and guaranteed monthly income and thus would be able to afford monthly payment for the improved environmental service. In addition most households interviewed were living in rented houses where in most cases they use the same refuse container with co-tenants and jointly pay for the management of their solid wastes like other public goods such as electricity. This makes contribution from individual household in rented houses for the payment of the service fee relatively low and affordable.

Factors affecting households' willingness to pay: Multivariate logit regression was used to determine the factors that influence the probability of households' willingness to pay for improvement in their solid waste management. The result is shown in Table 2.

The chi-squared (which is the same as the LR statistic) shows that the overall goodness-of-fit of the model was statistically significant at 1% level. The McFadden pseudo R squared indicates that 41.65% of the variance was explained by the independent variables.

Table 2 shows that holding everything else constant, coefficients indicate the following.

Table 1: Results of logit regression

Variable	Coefficient	Standard error	Z-statistic
Constant	4.04037	1.32829	3.042****
Price	-0.00327	0.00103	-3.165****

****Statistically significant at 1%, Degree of freedom 1, Log likelihood -85.84377, Chi-squared (LR statistic) 10.81817, Restricted Log likelihood -91.25285, McFadden R-squared 0.05928, Significance level 0.00101

Table 2:multivariate logit regression

	Marginal effect on probability of willingness to pay		
Variable	Coefficients	Standard Error	Z-statistics
Constant	0.58985	0.76982	0.766
Price		-0.00082	0.00037
-2.191**			
Age	-0.04586	0.01125	-4.076****
Marital status	0.20407	0.15479	1.318
Educational level	0.06895	0.03723	1.852*
Household size	-0.14543	0.04374	-3.325****
Expenditure	0.00005	0.00001	5.000****

****Statistically significant at 1%, Chi-squared (LR statistic) 76.00604, ** Statistically significant at 5%, Degree of freedom 6, *Statistically significant at 10%, Significance level 0.00000, Log likelihood -53.24984, McFadden R-squared 0.41646, Restricted Log likelihood -91.25285

- As the price of the improved refuse collection and disposal increases the likelihood of households paying for the service decreases. The result shows that the marginal effect on probability of households paying for the service with respect to price is -0.00082. This implies that for every N1 increase in the price of the improved service, the probability of the households paying the price reduces by 0.00082.
- Likelihood of households paying a given price for improved refuse collection and disposal decreases as respondent's age increases. The result reveals that the marginal effect on probability of households paying for the service with respect to age is -0.04586. This means that as age of household head increases by one year, the likelihood of paying for improved refuse collection and disposal decreases by 0.04586.
- Likelihood of households paying a given price for improved refuse collection and disposal increases when the respondent interviewed is married. The result shows that the marginal effect on probability of households paying for the service with respect to marital status is 0.20407. This implies that when a respondent is married, the likelihood of paying the price increases by 0.20407.
- Likelihood of households paying a given price for improved refuse collection and disposal increases as respondent's educational level measured by the number of years spent in school increases. The result reveals that the marginal effect on probability of households paying for the service with respect to educational level is 0.06895. This means that as the number of years respondents spent in school increases by one year, the likelihood of paying for improved refuse collection and disposal increases by 0.06895.
- Likelihood of households paying a given price for improved refuse collection and disposal decreases as household size increases. The result shows that the marginal effect on probability of households paying for the service with respect to household size is-

0.14543. This implies that as household size increases by one, the likelihood of paying for improved refuse collection and disposal decreases by 0.14543.

- Likelihood of households paying a given price for improved refuse collection and disposal increases as household monthly expenditure increases. The result reveals that the marginal effect on probability of households paying for the service with respect to household monthly expenditure is 0.00005. This implies that for every .1 increase in household monthly expenditure, the likelihood of paying for improved refuse collection and disposal increases by 0.00005.

CONCLUSION

Improved solid wastes collection and disposal will result in increased welfare gains for the households and improve the environmental quality in general. In line with data analysed and interpreted, it can be reasonably concluded that the estimated mean willingness to pay for improved solid wastes management (which is positive and high) showed that households demand solid waste management in which the improvement in solid waste management will directly improve their welfare also.

Based on the findings of this study the following recommendations are made:

- Household size affects likelihood of households' willingness to pay for improved solid waste management. Majority of the households in the study were found to have a considerably large family size. More so most of the households had low income which indicates that majority of the members of the households in the study were dependants. Therefore households should adopt an acceptable family planning programme to control their population. Households should also find ways of mobilizing their family labour through establishment of less capital intensive small scale businesses in order to improve their income and hence their purchasing power.
- Households' monthly expenditure which is proxy to their income has a relationship with household likelihood to pay. Most households in the study were found to have low level of monthly expenditure. As a result, households should seek ways of improving their income level. One way of achieving this is for households to sort their solid wastes for recyclable items which can be sold to generate some income.
- Improved solid waste management leads to welfare gains. The study revealed that the calculated mean willingness to pay of households for improved refuse management is positive. This implies that benefits accrue to households from the improved service. Therefore households should demand and pay for improvement in the management of their solid waste as this will bring about tremendous benefits for them.

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