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Poverty and Preference for Improved Solid Waste Management Attributes in Delta-State, Nigeria

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Abstract

The paper assessed household's preference for improved solid waste management in Asaba, Delta-State. Data were collected from a random sample of 115 households and the state waste management board through the use of a well- structured questionnaire. The data were analyzed using descriptive statistics, the Alkire and Foster multidimensional poverty methodology, the choice experiment and the conditional logistic regression model. The mean age of the household heads was 39 years with only 33.91 percent headed by females. The household heads are largely literate with an average of 14 years spent in school. The poverty status at dimensional cut-off of k=4, revealed that 25.2 percent of the households were identified as poor. The likelihood of households choosing an improved waste management option was influenced positively by the educational status of the household head, the number of working household members and negatively by the household's poverty status. The mean willingness to pay estimate is ₦1546.32 per month but reduced to ₦619.80, with consideration given to their socio-economic characteristics. In order of importance of attributes to household's willingness to pay; separation of waste ranks first, followed by provision of waste container, disposal method, service provider and collection frequency. It is recommended that the improved solid waste management (SWM) option to be proposed to households must include separation of waste and provision of waste containers. Also, the proposed fee for SWM should not be uniform for all categories of households. Due regard should be given to the poverty status of households in the different communities in the state.

Keywords: *Poverty, Solid waste management, Attributes Choice experiment*

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Introduction

Population growth and rapid urbanization have led to a massive rise in the amount of municipal solid waste that is generated around the world. In urban and rural communities alike, changing lifestyles and consumption patterns, including the increased use of goods made from non-biodegradable materials, have added to the

problem (IUCN 2004). Like many other environmental problems, it is the poor who suffer the most as a result of improper solid waste disposal. Municipal waste collection services are rarely if ever available in shanty towns and slums, putting the residents of such neighborhoods' at far greater risk of the health hazards associated with improper solid waste management. Repeated bouts of disease and chronic poor health, which affect productivity, potential rob workers of income and keep children out of school (CREATE 2010).

In Nigeria, the problem of solid waste management (SWM) has been a concern which has existed for long in Lagos metropolis and in other big Nigerian cities (Ayotomuno and Gobo, 2004);Ojeshina and Longe, 1996). This can be attributed in part to the poverty status of the dwellers in the environment. According to Abbas *et.al.* (2005), the poor reside in rural areas and urban slums; and these areas are characterized by the absence of social and economic infrastructure like portable water, waste management access, electricity, healthcare, good nutrition, education and other indices of well-being. Attempts to improve solid waste management in cities have paid more attention to enhancing institutional arrangements for solid waste service delivery, with special emphasis on the privatization of the waste management sector (Sansa and Kaseke, 2004). According to Longe *et al.,* (2009) and Parfitt *et al.,* (1994), the average income of the household is a variable that could influence their perception and attitudes on solid waste management system.

Delta-state was established in 1991 and the State's waste management board started its waste management activities in 2004. The Board, since inception, has been managing waste in 16 of the 23 towns in the state. Currently, the Board operates one temporary dumpsite each in these towns except in one where it operates two. These temporary dumpsites are the closest things to landfills that are in existence. Most of them are reclaimable burrow pits where the refuse is regularly pushed by bulldozers to fill the pits and burnt in the open (DSWMB Report 2012). The existing solid waste management system in Delta State is quite rudimentary, inefficient and unsustainable. The challenges encountered by the board include poor state of equipment and trucks in the face of an increasing demand for waste management services across the state.

Currently in Asaba, most wastes are disposed into poorly managed open dump landfills with little or no pollution protection measures by the public collectors. The disposal sites are also not too far from residential areas (DSWMB, 2012). This traditional disposal method creates visual dis-amenities making these dwelling places inappropriate. Currently, the price charged per household/month varies from N400 to N2500 for residential areas which are not consistent and are paid by only a few and also N20,000 and above for non-residential areas. In addition, consumers' attitude to waste management policies and public enlightenment is poor.

Due to the overwhelming volumes of solid waste generated, the Asaba district of Delta State Waste Management Board cannot satisfactorily collect and dispose the large quantity of waste generated and as a result, there has been a gradual degeneration in the management of household waste in residential areas (DSWMB report, 2012). This paper therefore attempts to examine household perception of solid waste management by poverty status, determine their preference for improved solid waste management, estimate the willingness of households to pay for improved solid waste management and isolate factors influencing household willingness to

pay (WTP) for improved solid waste management

2. Literature review

There are various methods employed in literature to estimate household preference for solid waste management. These include contingency valuation, choice experiment, hedonic pricing and benefit-cost ratio. Various studies reviewed used the contingency valuation method including (Richard *et al., (*2012), Wang *et al.,* (2011), Niringiye and Douglason (2010), (Yusuf *et al.,* (2007), Mohammad *et al.,* (2007), Chowdhury (2007) and Jamal (2002). However, few studies employed the choice experiment and these include Pek *et al.,* (2008), Siriwardena and Gunaratne, (2007) and Jamal (2002). Pek *et al.,* (2008) used the choice experiment and the multinomial logit regression to investigate solid waste management in Malaysia. Their findings were that increasing generation of solid waste requires better quality disposal options in Malaysia. They concluded that sanitary landfill is more preferred in solid waste disposal by the residents. Similarly Siriwardena and Gunaratne, (2007) using the choice experiment model (CM) analyzed the trade-offs among various dengue management strategies as perceived by the public in the Kandy municipality. They derived estimates of compensating and equivalent surplus. This allows for different changes in the environmental quality as well as differences in socio economic characteristics when transferring benefit estimates (Morrison et al., 2002). Their results showed that, the willingness to pay by the respondents was negative and the respondents believe that the government should take care of the environmental issues. The implicit price obtained revealed that the households were not interested in environment improvement attributes. Jamal (2002) investigated household preferences for solid waste management in Malaysia and the utility derived from improved solid waste management. The CM only showed that households derive positive utility from the provisions of recycling facilities and compulsory kerbside recycling.

Birol *et al.,* (2009) estimated the value of improved wastewater treatment, a case study of river Ganga, in India. They used the conditional logistic model and discovered that all the coefficients were statistically significant and intuitively correct. Treated wastewater quantity and quality were significant factors in the choice of a wastewater treatment programme. These two attributes increase the probability that a wastewater treatment programme is selected. In other words, households value those wastewater treatment programmes that result in higher quality and quantity of wastewater treated. Sukanya *et al.,* (2008) used the conditional logistic model and the random parameter model to estimate preferences made by the respondents to improvement in solid waste management. They considered the following attributes; frequency of vat collection, covered vats, covered collection trucks and monthly increase in tax. Their findings were that the poor and the rich exhibit significantly different WTP values for each attribute. Whereas richer households were willing to pay more for higher wastewater treated to a quality, poorer households were rather wiling to pay more for higher quantity of wastewater treated.

These studies reveal that preferences differ among households. The socioeconomic characteristics particularly poverty status affect their choice. It is observed that the rich exhibit differences to the poor in their chosen attributes. Also, options that allow for recycling yield positive utility. The

application of this methodology to addressing solid waste management challenges is rare in our local context. The present study will consider these factors and methodology; and apply it to the case of Delta State.

3 Methodology

3.1 *Study area*

This study was conducted in Asaba province, located in South-East of Delta-State. The province is surrounded by water and characterized by urban and slum areas. It is divided into the eastern and western zones. Its population grew tremendously from 2,590,491 in 1991 to an estimate of 3,629,103 in 2003 and 4, 098,391 by 2006.

3.2 *Data collection*

The study obtained secondary information through interviews from various waste management boards. Personal interviews/ group discussions were conducted with some households in various areas on challenges faced and necessary attributes desired for waste management. Primary data were collected from the households through means of choice experiment. Data were collected on socio-economic and demographic charac-teristics, methods of waste storage, methods of waste disposal, perception of the environment and their choice among the various alternatives presented for waste management. Sampled households were identified through a two-stage sampling procedure. The first stage was the stratification of Asaba into the two existing zones namely, east and west zone. Secondly a random selection of 120 households was made from the two zones but only 115 households were willing to respond. This comprised of 45 respondents from the east zone and 70 from the west zone. The respondents were presented with a 9 choice sets of three alternatives, totaling 27 individual profiles and were asked to choose hypothetically an option of either alternative 1 and 2 or alternative three which was the status quo alternative. The 115 respondents gave a total of 3105 choice observations; made up of 115 by 27 observations. The choice observations were only valid for the choice modeling and estimation.

3.3 *Analytical procedure*

The methods of analysis employed include descriptive statistics, Alkire and Foster methodology for poverty estimation, the choice experiment and a conditional logistic regression to estimate factors that influenced the households' decision.

3.3.1 *Estimating the poverty status of households*

The level of household poverty was estimated using the Alkire and Foster methodology[1]. In this study, six dimensions were considered to account for poverty. They are education and knowledge, standard of living, asset possession, psychological condition of household head, social interaction level of the household head, and the household income. The first cutoff is a threshold point explaining the criteria for individual or household to be declared as deprived or non-deprived within each dimension and denoted by "z". The first cutoff for the various indicators of all the dimensions is in Annex 1. The second cutoff, k, is the number of dimensions in which a household is deprived by which they are considered to be poor. Following Alkire and Foster, a cutoff of 4 was chosen which shows

[1] For detailed exposition on the methodology, see Alkire and Foster(2007), Adeoti and Popoola(2012)

household's deprivation in at least four dimensions.

3.3.2 ***Estimating perception***

In estimating household's perception, the likert scale was used from which the severity index was generated. Modifying the expression by Majid & McCaffer (1997) and Longe *et al.,* (2009), for a three scale response rating, the severity index is expressed as;

Severity index (SI):

$$SI = \left(\frac{\sum_{i=1}^{3} a_i x_i}{3\sum_{i=1}^{3} x_i} \right) 100 \quad \ldots\ldots\ldots\ldots (1)$$

Where:
SI = Severity index
a_i = Weight given to each response i
The responses i are rated as Disagree = 1, No knowledge = 2, Agree = 3.
X_i = Frequency of response

The severity indexes were classified as shown below following Majid & McCaffer (1997) and Longe et al (2009):
Disagree $0.00 \leq SI < 37.5$
Neutral $37.5 \leq SI < 62.5$
Agree $62.5 \leq SI < 100$

3.3.3***Choice experiment (Modeling) Method (CE/CM)***

Choice experiment, an economic and environmental valuation technique which uses a surrogate market by directly eliciting consumers' preferences and willingness to pay for some proposed market conditions which offer potential improvements or avoid potential damages, was employed to elicit and estimate environmental values. It estimates environmental goods or services in monetary or market values. It is based on Lancaster's proposition that consumers derive satisfaction not from goods themselves but from the attributes they provide (Lancaster, 1966). A common feature of this type of approach is the requirement that survey respondents consider alternatives, which are described in terms of their component attributes, or alternatives. These alternatives are constructed by combining attributes at different 'levels'.

Choice Model (CM) has its theoretical basis in random utility theory (RUT) (Luce 1959; McFadden 1974). According to RUT, the i^{th} respondent is assumed to obtain utility U_{ij} from the j^{th} alternative in choice set C. U_{ij} is held to be a function of both the attribute k^{th} of the j^{th} alternative and the characteristics of the individual, *Si. Uij* is assumed to comprise a deterministic or systematic component *V*ij and a random component e_{ij}. Whilst V_{ij} relates to the measurable component of utility, e_{ij} captures the effect of omitted or unobserved variables. Assuming that an individual's preference can be represented as a function, each choice (alternative) is represented with an indirect utility function. The utility function consists of an observable deterministic or systematic part (V) and an unobservable stochastic or random element (ε). The attributes contained in the choice experiment are shown in the Annex II. Respondents were then requested to choose an alternative that reflects their preference; of which alternative 3 was constant for all the choice sets. The attributes were varied at different levels for the three alternatives using an orthogonal design by the use of SPSS statistical software. In all, 27 designs were generated and put into 9 choice sets.

3.3.4 ***The econometric model***

Conditional logit is appropriate for models in which a choice among alternatives

is treated as a function of the characteristics of the alternatives, rather than (or in addition to) the characteristics of the individual making the choice; (Hoffman S and Duncan G, 1988). The conditional logit is preferred to the multinomial logit because the multinomial focuses on the individuals as unit of analysis and uses the individual characteristics as explanatory variables while the conditional logit focuses on the set of alternatives for each individual and the explanatory variables include the characteristics of those alternatives. Generally, it can be written as:

$U_{ij} = V_{ij} + \varepsilon_{ij}$ …… (2)

Utility derived by individual i; from alternative j depend on environmental attributes (Z) and socioeconomic characteristics (S) expressed as:

$U_{ij} = V(Z_{ij}, Si) + \varepsilon(Z_{ij}, Si)$ …… (3)

The individual would choose the alternative j in the choice set to any alternative m, if $U_{ij} > U_{im}$. Since the utilities include a random element, predictions cannot be made with certainty. Thus, analysis becomes one of the probabilistic choices (Bateman *et al*., 2002).The probability of choosing the alternative j over m can be expressed as:

$Prob\ (i/C) = Prob\ \{V_{ij} + \varepsilon_{ij} > V_{im} + \varepsilon_{im}\ ;\ j \in C\}$ (4)

Where C is the complete choice set. It is assumed that the error terms of the utility function are independently and identically distributed (IID). A consequence of this assumption is the property of independence of irrelevant alternatives (IIA). The IIA states that the probability of choosing one alternative over the other is entirely dependent on the utility of the respective alternatives. This property may be violated by the presence of close substitutes in the choice sets. McFadden (1974) showed that if error term in the equation (2) is independently and identically distributed (IID) with a type one extreme value (Gumble distribution) the probability of any alternative j being chosen as the most preferred can be expressed in terms of the logistic distribution. An example is the Conditional logit model (Bateman *et al*., 2002).

Equations 2 to 4 specify that u_{i1} and u_{i2} is independent across period and have logistic marginal distribution functions. Equation 4 can be estimated following the form:

$$p_{ij} = \frac{\exp(Z_{ij}\alpha)}{\sum_{k=1}^{j}\exp(Z_{ik}\alpha)} \quad \text{…… (5)}$$

Where the conditional indirect utility function is estimated as

$V_{ij} = \alpha + \beta_1 Z_1 + \beta_2 Z_2 + \ldots\ldots + \beta_k Z_k + \varepsilon_{ij}$ ….(6)

The α is the Alternative Specific Constant (ASC) was introduced to take up any variation in choices that cannot be explained by the attributes. k is the number of attributes and β is the estimated coefficient of the vector of attributes. Equation 6 was estimated and also an extension of the model to include the socio-economic variable following equation 3.

The Basic Empirical Model

$V_{ij} = ASC + \beta_1 Collection_j + \beta_2 Separation_j + \beta_3 Disposal_j + \beta_4 Provider_j + \beta_5 Container_j + \beta_6 Price_j$…… (7)

The extended model is given by:

$V_{ij} = ASC + \beta_1 Collection_j + \beta_2 Separation_j + \beta_3 Disposal_j + \beta_4 Provider_j + \beta_5 Container_j \alpha_1 ASC*Educ_j + \alpha_2 ASC*Age_j + \alpha_3 ASC*Occupation_j + \alpha_4 ASC*Gender_j + \alpha_5 ASC*Perception_j + \alpha_6 ASC*Poverty_j + \alpha_7 ASC*Working\ members_j$ …….. (8)

where
V_{ij} = Utility of household i from the jth alternative (1 = choice option, 0 = non choice)
ASC = Alternative Specific Constant
Perception =Total number of response counts.
Poverty status of household=1=poor, 0=otherwise
Number of working members=Working household members.

Part-worth value or Implicit Prices of attributes

It reflects the relative importance respondents put on attributes or the tradeoffs they are willing to make among them. If cost is included in the model, it is possible to estimate the willingness to pay for all attributes (Roessler Regina *et al.,* 2008). The WTP are estimates of the price (implicit prices) that respondents will pay for a unit increase in the attribute of concern. It is also known as the mean willingness to pay and is given by:

$$Part\text{-}worth\ (implicit\ price) = \frac{-\beta\ Nonmonetary\ attribute}{\beta\ Monetary\ attribute} \quad (9)$$

The equilibrium value of non monetary attributes can be estimated using equation 10.

$+ \beta_6 Price_j$

The waste collection variables are as defined in Annex II. Other variables are as defined as follows: Education of household head = Number of years spent in school
Age =Age of respondent in years
Occupation of the household head =1if employed in the formal sector; 0 otherwise.
Gender of household head =1 if female, 0 otherwise

$$Equilibrium\ value/Marginal\ rate\ of\ substitution = \frac{\beta\ Refrence\ attribute}{\beta\ Other\ attribute} \quad \ldots(10)$$

These attributes can also be ranked using the estimated equilibrium values (EqV) or their respective implicit prices.

4 Results

4.1 *Household characteristics and poverty Status*

The percentage of men and women were about 66.1% and 33.9% respectively as shown in the Table 1. This agrees with the pattern of family heads in developing countries where most family heads are male. About 75.7% of them were married with about 89.5% employed in the formal sector. About 95.7% have spent at least nine years in school, indicating a high literacy level in the area. The mean age of head of households was 39.3 years old and is classified as being economically active (UNDP, 2006). The mean household size was 4 showing moderate sizes.

Table 1: Socio-economic and demographic characteristics of household heads

Characteristics	Frequency	Percent
Gender		
Females	39	33.91
Males	76	66.09
Marital status		
Single	23	20.00
Married	87	75.70
Widowed	5	4.30
Household size		
1 – 2	24	20.90
3 – 4	30	26.10
5 – 6	54	46.90
7 – 8	6	5.20
9 – 10	1	0.90
Mean household size		4.29
Primary occupation		
Farming	1	0.9
Civil servant	91	79.1
Public servant	12	10.4
Self-employed	9	7.8
Unemployed	2	1.7
Years spent in school		
No formal education	2	1.72
Adult literacy training	2	1.72
1 – 5 years	1	0.87
9 – 12 years	13	11.35
13 - ≥ 16 years	97	84.34
Age in years		
< 30 yrs	12	10.4
30-39 yrs	53	46.1
40 - 49 yrs	34	29.6
50 - 59 yrs	14	12.2
60-70 yrs	2	1.72
Mean household head age		39.28

Table 2 presents the result of the estimated household poverty index. Following Alkire and Foster (2008), a poverty cut-off of k=4 was chosen, which shows household's deprivation in at least four dimensions. At k = 4, the headcount ratio is 0.252, which shows that 25.2% of the households are poor representing 29 households while others are non-poor. As k increases the number of poor households' decreases, although the intensity of poverty among the poor increases. Using the average number of deprivations in dimension among households with at least four deprivations, the headcount is adjusted to give an MPI of 0.183, which shows that only 18.3 were poor after adjusting for this dimension effect.

Table 2: Poverty status of households

Cutoff *k*	Number of Households	Headcount ratio *H*	Intensity of poverty (A)	Multidimensional Poverty Index (MPI)
1	104	0.904	0.425	0.386
2	83	0.722	0.490	0.355
3	50	0.443	0.593	0.262
4	29	0.252	0.726	0.183
5	7	0.061	0.836	0.051

4.2 *Household waste disposal methods and perception to solid waste management*

Table 3 shows the different disposal methods used for different types of waste. These include garbage truck, burning, burying, and roadside dumping. However, the most commonly reported disposal method by all poor and non-poor with regards to all waste types except plastics and paper waste was the use of garbage trucks at specific dumpsites and burning. Burning was also common because it had no direct cost implication though it is environmentally unfriendly. This finding also shows that there is no proper practice of waste separation as most households' muddle up their waste.

Household perception to solid waste management as measured by the severity index is contained in Table 4. In general, the severity index was high ranging from about 72.5% to 97.4%. Households' agreed that litter leads to unattractive environment (97.4%) and that the government was not doing enough to manage solid waste (96.5%). Also they agreed to the negative health consequences of poor solid waste management. The implication of this can be severe. The index for illegal dumping was the lowest, which showed that although it occurs, it is the least of the problems of solid waste management.

Table 3: Households type of waste and most common disposal method

Type of waste	Disposal method			
	Non-poor		Poor	
	Most common disposal method	Percent	Most common disposal method	Percent
Electronic waste	Garbage truck	52.33	Garbage truck	41.38
Food waste	Garbage truck	51.15	Garbage truck	48.28
Glass wares	Garbage truck	46.51	Garbage truck	44.81
Metals	Garbage truck	47.67	Garbage truck	41.38
Papers	Burning	48.83	Burning	58.62
Plastic	Garbage truck	37.21	Garbage truck/burn	37.95
Hedges and trees	Garbage truck	34.89	Burning	41.38
No in population	*89*	*74.78*	*29*	*25.22*

Note: The options are not mutually exclusive

Table 4: Household perception towards current solid waste management

	Perception								
	Poor				Non poor			Total	
Response	R	N	D	A	N	D	A	N	D
Litter leads to an unattractive environment	Freqn.	2	0	27	3	2	81	5	2
	%	6.90	0.00	93.10	3.48	2.32	94.19	4.35	1.74
Improper storage and disposal of waste causes diseases such as malaria.	Freqn.	5	1	23	8	5	73	13	6
	%	17.24	3.45	79.31	9.30	5.82	84.88	11.30	5.22
Prevalence of Illegal dumping in area of study.	Freqn.	9	10	10	6	30	50	15	40
	%	31.03	34.48	34.48	6.98	34.88	58.14	13.04	34.79
Garbage generation and disposal in Asaba the state capital is generally poor.	Freqn.	5	9	15	6	16	64	11	25
	%	17.24	31.03	51.73	6.98	18.60	74.42	9.56	21.74
The government of the day is not doing enough to fix the garbage problems encountered.	Freqn.	3	1	25	1	3	82	4	4
	%	10.34	3.45	86.21	1.16	3.48	95.36	3.48	3.48
Mean									

Note: D=disagree, N=Neutral, A=Agree. R= Response, SI= Severity Index

4.3 *Households willingness to pay improved solid waste management (SWM)*

The household's willingness to pay (WTP) was estimated following equations 9 and 10 and the results of the basic and extended models are presented in Table 5. The Chi-square statistic showed that the equations were significant at 1%t and therefore the null hypothesis that the attributes were not significant determinants of willingness to pay is rejected. The log likelihood is 1819.74 and 954.01 for the basic and extended model respectively, indicating that both models have good fit for the data.

All attributes in the basic model were significant and agree with apriori signs, while five of the attributes and all but one of the socioeconomic variables were significant at not less than ten percent in the extended model. In both models, separating waste at source, the price, availability of container for disposal, type of service provider and the collection frequency had positive and significant influence on the probability of choosing an improved SWM plan. The collection frequency was significant, implying the more frequent the services was provided, the more the households will be willing to choose an improved plan. The coefficient for separation was positive and significant implying that the households prefer to have their waste separated. The waste container used for disposal was significant which means that households were willing to pay in other to make use of an improved waste storage bins. Service provider was positive and significant implying their preference for private collector as against the public collectors, while the method of disposal significant in the basic model was not in the extended model. This shows that different users differ on the method of waste disposal and it does not affect their choice uniformly. The price at which the improved services will be rendered was negative implies that higher levies decrease the probability of choosing an improved option and thereby lowers the utility derived by the households. However, it should be noted that the size of the estimated coefficients was small and the least of all in both models; therefore the influence was small.

The coefficients of education, number of working household members, employment in formal sector, having a female as household head, perception of households towards the current solid waste management and age were positive and significant implying that they had positive impact on preference for improved SWM. The age coefficient was positive contrary to the findings of Yusuf *et al.*, 2007. This indicates that the probability of a household adopting an improved method increases as the age increases. As respondents advance in age, they tend to be more conscious of their health and are really concerned about managing their waste. They prefer improved options of waste management. The poverty status was negative and significant at 1%. This implies that poorer households are less willing to adopt an improved method of SWM compared with non-poor households. This also implies that the poor were of the opinion that government should take care of environmental issues. This is similar to the finding of Sukanya *et al.*, (2008).

Table 5: Attribute estimates for households choice for solid waste management

Attributes	Basic model		Extended model	
	Coefficient	Standard error	Coefficient	Standard error
Collection frequency	0.1899***	0.0624	0.1858*	.1065
Separating waste at source	0.9242***	0.1466	1.2316***	.2215
Method of waste disposal	0.2835***	0.0785	0.1108	.1024
Service provider	0.2654**	0.1186	0.3389**	.1642
Container for disposal	0.2916**	0.1315	0.5266***	.1784
Price	-0.0013***	0.0002	-0.0039***	.0003
Educational status			0.6648***	.0675
Age			0.0348***	.0077
Occupation			0.3651*	.1869
Gender			0.2417**	.1197
Household Perception			0.0869**	.0416
Poverty status			-0.4080***	.1509
Working household members			0.3709***	.0954
Pseudo R^2	0.0661		0.4104	
LR chi2(6)	257.66		1989.12	
Probability chi^2	0.0000		0.0000	
Log likelihood	-1819.7398		-954.01238	
No of Observations/Responses	3105			

****significant at 1%; **significant at 5%; *significant at 10%*

Table 6: Estimates of mean willingness to pay of households

Attributes	Basic Model (₦)	Extended Model (₦)
ATTRIBUTES	WTP	WTP
Collection frequency	148.17	48.10
Separation of waste at source	721.28	318.90
Method of waste disposal	221.23	28.70
Service provider	207.09	87.75
Waste container for disposal	227.55	136.35
All attributes	***1546.32***	***619.80***

Note: ₦156.27 = 1USD

The mean willingness to pay of households with respect to each of the attributes and all the attributes under the basic model was ₦1546.32 (USD 9.90)/household/month) as shown on Table 6 and this was higher than that of the extended model ₦619.80 (USD 3.95/ household/month). This means that without regard for their socioeconomic characteristics, the mean willingness to pay is high. The socioeconomic characteristics were introduced to observe the true willingness to pay of the households due to heterogeneity in household's poverty status and the amount they are willing to pay reduced. The mean willingness to pay by households reveal that separation of waste at source has the highest contribution, followed by availability of waste container for disposal. A possible reason is due to the fact that some waste can be recycled and serve as source of income.

Table 7 shows the tradeoffs between the non-monetary attributes that will leave households on the same utility level and the ranking of the attributes. The result reveals that the households under both the basic and extended model rank the separation of waste as the most important attribute of concern and collection frequency and method of waste disposal as the least. The waste disposal attribute under the extended model was not significant and thus has the least importance. This implies that in order of importance of attributes, separation ranks first, followed by the waste container, disposal method, service provider and collection frequency.

Table 7: Equilibrium values for non-monetary attributes of solid waste management

Attributes	Basic model 1 (units)	Ranking	Extended model	Ranking
Collection	1	5	1	4
Separation	0.2054	1	0.151	1
Disposal	0.6698	3	1.676	5
Operator	0.7155	4	0.548	3
Container	0.6511	2	0.353	2

5. Conclusion

About two third of the household heads were men as typical in African settings and over 90% were literate. The mean age of head of households was 39.3 years old and classified as being economically active. A quarter of the households were poor. Irrespective of poverty status, the use of garbage trucks at specific dumpsites and burning were the common methods of waste disposal. Households agreed that the present solid waste management was poor with negative health consequences. All attributes which were the separation of waste at source, higher levies for collection, availability of container for disposal, private service provider and the increased collection frequency had positive and significant influence on the probability of choosing an improved SWM plan. However, when considered along with socioeconomic characteristics of household heads, method of disposal was not important. The factors that

had positive influence on preference for improved SWM were education, number of working household members, employment in formal sector, having a female as household head, perception of households towards the current solid waste management and age. The poverty status was negative which implies lower probability of poorer households to adopt an improved method of SWM.

The mean willingness to pay of households with respect to all the attributes without regard for household socioeconomic status was ₦1546.32 (USD 9.90/household/month) and was higher than N619.80 (USD 3.95/ household/month) when socioeconomic status were considered. The separation of waste at source had the highest contribution to the mean willingness to pay by households, followed by availability of waste container for disposal and this may be due to the fact that some waste could be recycled and serve as source of income. In order of importance of attributes to household's willingness to pay, separation ranks was first, followed by the waste container, disposal method, service provider and collection frequency.

In conclusion the improved SWM option to be proposed to households should include separation of waste and provision of waste containers. Since the consideration of socioeconomic characteristics reduces the mean willingness to pay, the proposed fee for SWM should not be uniform for all categories of households. Due regard should be given to the poverty status of households in the different communities in the state.

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Annex 1: Household poverty dimensions, indicators and levels

Deprivation dimensions	Poverty indicator	First cut-off/source
Education and Knowledge	Books read in the last one year	At least 10 (Enrica Chiappero Martinetti, 2000)
	Schooling level achieved	Universal basic Education (9years)
	Newspaper reading frequency	Once a week (Enrica Chiappero Martinetti, 2000)
Standard of living		
	Regularity of water	Regular-Yes
	Toilet facilities	Access to constructed and flush toilets
	Waste management facilities	Have access-Yes
	Water source	Access to public and individual taps
	Household size to room ratio	Two persons per room(Enrica Chiappero Martinetti,2000)
Psychological Condition of Household head	Job desirability	If Yes=1
	Job satisfaction	If Yes=1
	Favourable working conditions	If Yes=1
Social interaction	Political interest	Have interest=1
	Community development participation	Participates=1
	Visit to friends	Visits=1
Asset possession	Possession of car	Household possess one-Yes
	Possession of motorbike	Household possess one-Yes
	Possession of phone	Household possess one-Yes
	Possession of radio	Household possess one-Yes
	Possession of television	Household possess one-Yes
	Electricity lightening	Household possess one-Yes
	Possession of electric fan	Household possess one-Yes
	Possession of pressing iron	Household possess one-Yes
	Possession of a set of chairs	Household possess one-Yes
	Possession of bicycle	Household possess one-Yes
Income	Above mean income of the sample	

Note: The source of the psychological conditions, social interaction, asset possession and income is Enrica Chiappero Martinetti,2000.

Annex II: Solid waste management attributes and attribute levels

Attributes	Definitions/source	Levels
Collection frequency (COLLECTION)	The frequency of waste collection by service operator. Currently, waste collection is irregular and the proposal is make it regular at two, four or six times per month. (Jamal, 2002)	Two times a month. Four times a month. Six times a month. which must be regular.
Separation of waste (SEPARATION)	This concerns separation of waste by the households into component parts in separate disposable nylons. Currently wastes are lumped up and the separation of waste would lead to effective recycling and wealth generation. (Richard *et al.*, 2012)	Waste are separated Yes. No
Waste container (CONTAINER)	This is the type of container used in the storage of the waste type and they include Thick sack (rice bags), disposable Nylon, or closed containers. The current level of storage is the use of open waste bins by the households (Gage, 1998; Post, 2003).	- Thick sack , - Disposable Nylon, - Closed containers,
Waste disposal method (DISPOSAL)	The methods of waste disposal to be introduced are that which encourages waste to be treated to a minimal level that reduces pollution of the environment and encourages environment sustainability. The current level is the open dumping and burning of garbage by the waste collectors (DSWMB, 2012, Jamal, 2002).	-Sanitary land filling, -Incineration, -Recycling.
Service provider or operator (OPERATOR)	Besides provision of services by public service collectors of the DSWMB, improved service provision by private collectors (Contractors) is to be introduced which would encourage effective waste management. The current practice is the use of public service provider and self disposal into various sites. (DSWMB, 2012).	Private operator Public operator.
Cost of disposal/ Price of delivery. (COST)	The payment service by households identified by survey of existing prices by the state waste management board, waste management boards of two other states (Lagos and Ibadan), and interview of the households in the study area.	Three levels N1000.00 N1200.00 N1500.00