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HOUSEHOLDS' PREFERENCES AND WILLINGNESS TO PAY FOR SOLID WASTE COLLECTION SERVICES IMPROVEMENT IN KANO METROPOLIS, NORTH-WESTERN, NIGERIA

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Abstract: *This study employed a choice experiment (CE) technique to estimate the households' willingness to pay (WTP) for improved solid waste collection services (SWC) in Kano metropolis, Nigeria. A multinomial logit (MNL) model was developed for deriving the households' preferences of SWC service attributes and their marginal value on the non-market values among households. The trade-off between five different SWC service attributes revealed that improvement in waste collection frequency (CF) is the most preferred service attribute. The total value for SWC services is estimated at ₦3341 76935.44 ($1696329.6215). This indicates households are willing to pay for improved SWC services to ensure environmental sustainability. Our results reported here have imperative policy implications for effective SWC services in minimising environmental degradation via pollution and to safeguards public health against filthy environmentally related public health threats.*

Keywords: *Choice Experiment, Households' Preferences, Multinomial Logit Model, Marginal Value, Service Attributes, Solid Waste Collection, Willingness to Pay.*

Introduction

Solid waste management (SWM) issue is perceived as one of most serious environmental worries particularly in most of the Nigerian major cities and urban centers. It has been observed that there was a remarkable increase in daily solid waste generation in Nigeria (Nabegu, 2010; Olanrewaju & Ilemobade, 2009). Following Ogwueleka (2009), In Nigeria there about 25 million metric tonnes of annual solid waste were generated. The consequence of waste mismanagement could be devastating when a country is having population growth, whereby waste generated cannot be effectively and adequately handled (Aliu et al., 2014). Thus, most streets in Nigerian major cities experience the persistent presence of indiscriminate dumps of wastes from the households or commercial activities (Babayemi & Dauda, 2009).

As reported by Hoornweg and Bhada-Tata (2012) that the global annual was collection of solid wastes is about 1.3 billion tonnes, contributing to about 5% emission of greenhouse gases (GHGs) of the organic component decayed. By 2025, waste generation is anticipated to increase considerably to about 2.2 billion tonnes. Futile waste management, which consists of a poor collection system and inefficient disposal method, may result in enviromental pollutions, and therefore contribute to the contamination of drinking water sources, and pose serious threats to public health. Nabegu (2008) opined that, the per capita generation of waste ranges from 0.75 kg/day in the suburban areas, with 1.2 to 1.7kg/day in the city and government reserved areas (GRA) in the Kano metropolis respectively, perhaps due to variations in the socio-economic status of the residential zones.

In the recent past, solid waste collection (SWC) services used to be the sole responsibility of municipal authorities (Yusuf et al., 2007). This obligation is not mutually exclusive because none of the local governments in the Nigeria meets the expense of the enormous financial, technical, administrative and human resource requirements to effectively carry out this specific constitutional obligation (Alabi, 2004). An account of the inability of the government at both local and state levels to manage SWC efficiently arose conceivably from the misconception of this task as a public good.

The capability to address the problems of waste collection denigrates with time due to the increase in capital for plant, equipment, operation and maintenance costs, combined with the rapid population and spatial growth, as well as the increase in waste generation and decrease in collection levels, confronted by the growing public demand for improved SWC services (Sule, 1979; Solomon, 2009; Oyeniyi, 2011). So, there is a need for the involvement of private service providers in the provision of SWC services in Kano metropolis. In relation to this, it is deemed feasible to estimate households' WTP for improved SWC services in the metropolis.

Literature review

Economic valuation is an important part of environmental economics as an area of study, focused on assigning values quantitatively on non-market environmental goods and services in absence of actual market prices. The ordinary market placement, economic valuation method is developed from economic theory to assign or allocate values for those environmental goods and services associated with pragmatic approaches empirically developed by economists (Bockstael, and McConnell, 1993). For example, such environmental goods (like watersheds, wetland, and forest reserves) and environmental services such as (pollution and flood control system, climate

regulation system, and water supply) are common examples of both environmental goods and services. However, non- traded elements of these environmental goods and services greatly involve indirect systems for non-market valuation technique that handle these environmental goods and services as quality features of privately consumed environmental goods and services. Thus, price allocation for these environmental goods and services utilize empirical methods as a way of economic valuation (Haab, and McConnell, 2002).

The economic value of non-market environmental goods and services are measured in terms of "willingness to pay" (WTP), though, non-market environmental goods and services are virtually not traded in a real market, indeed, WTP is often been used by environmental economists to describe the value of environmental goods and services, when they actually make any payment or not (Barbier, et al., 1997).

However, the elicitation of WTP is further sub-divided into two categories of empirical methods as revealed preference (RP) and stated preference (SP) methods. The dissimilarities between these empirical methods are the dependence of the former methods on the prices of other goods, whereas, the other is exclusively dependable on WTP elicitation. The categories of economic valuation methods for non-market environmental goods and services is depicted in figure 1 below;

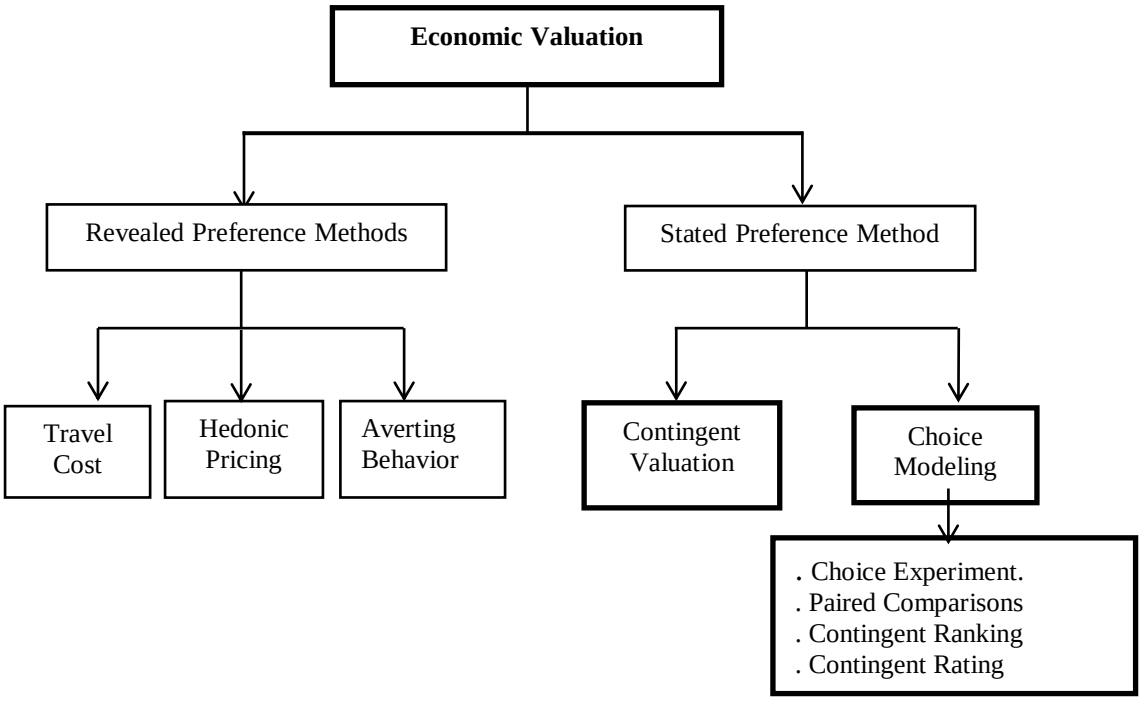

Figure 1*:* Economic Valuation Technique Model

Source: Bateman et al., (2002)

The applicability of choice modelling (CM) approach has widely been employed in estimating improvement value of the environmental quality, also in valuing environmental natural resources. Adamowicz, et al., (1998) urged that the CM technique originated from conjoining analysis, which was primarily established in the transport and marketing studies by Louviere & Hensher, (1982). Ryan, & Hughes, (1997) bewailed that over the years the CM has been used in many disciplines.

Then, of recent CM procedure has been used in the non-market valuation of environmental goods and services (Bennett, & Blamey 2001; Blamey et al., 2000; Hanley et al., 1998; Adamowicz, et al., 1994). The CM technique has been widely used in several types of research of non-market valuations areas. For instance, such studies among others includes; landscape management (de Ayala, et al., 2015), solid waste management (Das et al., 2010), wetland conservation (Kaffashi, et al., 2013); water quality improvement (Barton, & Bergland, 2010), preferences on wetland attributes (Birol, et al., 2006), valuing cultural sites (Navrud, & Ready, 2002), forest conservation (Rolfe, Bennett, & Louviere, 2002). Hence, Adamowicz, et al., (1998) opined that CM technique could be used to measure both used and non-use environmental values. Additionally, this procedure has been gaining more ground due to its accessibility to the provision of additional information, as well as its capability in generating attributes value for resources as opposed to CVM (Bennett, & Blamey, 2001).

However, random utility theory (RUT), is the fundamental basis of the choice modelling technique, primarily centred on Lancaster's characteristics theory of value, in which environmental goods and/or services could be valuated based on their specific attributes and their levels (de Ayala, et al.,2015; Mogas, Riera, & Bennett, 2006; Hanley, et al., 2001; Ruto, & Garrod, 2009). Accordingly, Hanley, et al., (2001) opined that consumers' utility for good can be disintegrated into utility for composting characteristics. Thus, Bateman, et al., (2002), argued that good(s) can be described based on the attributes and their corresponding levels. For example, the automobile could just be simply described based on its mechanisms such as capacity, speed, gear-type, and colour. However, in the case of estimating solid waste management economic value, attributes could aesthetic, public health and environmental quality. Thus, in the CM studies, respondents are asked to choose their highest preferred option, out of the sequence of alternative resource use choices prompted to them. Such that a choice set containing a set of multiple options with associated alternative and each alternative having attributes and their levels. An important variable that could be involved as an attribute is the monetary value or price. A baseline alternative usually termed as status–quo designates the current situation is equally an essential part of the choice set. Set of attributes and their levels usually assigned to attributes are described as options from which potential respondents are asked to a choice between the "status- quo" which is a constant situation and multiple "proposed" situation, usually, minimum of three and maximum six of choice sets are incorporated in the questionnaire. The trade-off of respondents depends on the multiple proposed alternative options and the status-quo situation. The advanced statistical technique would then be employed to quantify the value of selected options or alternatives. The results of trade-offs can then be utilized for the estimation of value to each of the environmental attributes, while one of the attributes is the monetary value (Bateman, et al., 2002; Rolfe, et al.,2002; Hanley, et al., 2001).

Also, choice modelling uses a questionnaire for data collection. The configuration of the questionnaire in CM is like that of CVM questionnaire, that is, it consists of the socio-economic level of the respondents, background information on the non-market good, attitude and elicitation questions(Alvarez-Farizo, et al., 2007; Mazzanti, 2003). Invariably, the major differences between choice modelling and CVM techniques are with regard to the elicitation questions. In the present method, in the CM questionnaire, respondents are prompts with a series of multiple choice sets and each set consists of about three or more choices describing environmental good or services together with the monetary value attribute, respondents are asked to make the best option among others. The options in the choice sets are distinct centred on the characteristics of the good or services for valuation with a set of varying levels of each of the distinctive attribute to distinguish

one alternative from another (de Bekker-Grob, et al., 2012; Huhtala, 2000; Fowkes, & Wardman, 1988).

Materials and Methods

Generating Attributes for the Choice Experiments

It involves some steps; the first stage entails choosing attributes and their corresponding levels for improvement of the problem for an adequate understanding of the researcher's point of the current condition in choice experiment (CE) study. The second stage is to define possible alternatives based on Hensher et al. (2005). The selected choices in this work are labesled as Collection Frequency, Storage Facilities, Disposal Method, Pre-collection Services, and Monthly Charges, whereas these alternatives are dubbed as Management option 1, Management option 2, and Status quo. The decision for choosing the labelled alternatives is an basic part of the CE design for its impact on the number of parameters to be estimated (Rose & Bliemer, 2009). Thus, the attributes and their levels must be determined right after identifying the number of alternatives to be included in the survey (Hensher et al., 2005; Rose & Bliemer, 2009).

Selection of the Attributes and their Levels

Defining the attributes of SWM may be valuable at the initial step of identifying the most relevant attributes of non-market goods undervaluation in the development of a CE study. In this step, the relevant attributes and their levels in the choice decisions were identified through an intensive literature review of economic evaluation studies on SWM. Focus group discussions (FGD) was done with stakeholders including public officials, experts or professionals, private service providers in waste management and households' heads in order to determine the number of attributes and their levels, and the values given to the attributes. The task of FGD is to offer information on reliable minimum and maximum attribute levels. Identifying any possible interactions between the defined attributes is also essential. According to Bateman et al., (2002); Hanley & Barbier, (2009), If the researcher's aim is to estimate welfare measures, then the cost attribute must be included too. This study involves of five main survey attributes specified in each choice alternative, as indicated in Table 1 below.

Table 1: Service attributes and their levels used in the survey

Attribute	Definitions	Attribute levels
Collection Frequency	The rate at which waste is been collected at periodic intervals.	**Irregular***
		Regular 3x a week
		Regular 4x a week
Storage Facilities	This service attribute refers to the type of the container for which waste is collected in it.	**Any Container***
		Nylon Bags
		Wheel Waste Bins
Disposal Method	This service attribute refers to the technique that is used to dispose of waste.	**Open Dumps***
		Control Landfills
		Incinerator
Pre-Collection Service	This attribute refers to pre-collection service provision that entails waste collection from tenements either by using carts or light-weight trucks for final transportation.	**Cart Pre-collection***
		Motorized Pre-collection
		Cart and Motorized Pre-collection
Monthly Charge	This service attribute refers to the fees payable for improvement in solid waste management services.	**N 0000***
		N 1000
		N 1500
		N 2000
		N 2500

***** Status quo (current condition) of SWC in Kano Metropolis.

The Experimental Design

One common problem with CE approach is the complication regarding the number of choice sets and attributes. Thus, each choice set may affect the quality of response in a survey. There is a trade-off between the complexity in CE survey and the quality of responses (List et al., 2006; Alpizar et al., 2003). The orthogonal design was obtained using SPSS software based on the attributes and levels selected for the experiment design approach in this survey.

The final design in the CE part contains 12 options in 6 choice sets, each choice set haves two purposed options and a status quo. Three distinct options were presented, distinguished by their attributes and related cost. Option 1 and option 2 comprise various combinations of SWC services and monthly cost, whereas option 3 is the baseline with no cost. The choice of options 1, 2, or 3 to each question yields information as to the rank of each scenario for a respondent. Analysis of some of the responses, although sets of options change between questions, permits statistical calculation of the value for each attribute level. All the responses from a respondent are presumed to be independent, hence the sample size for regression in the model will simply reflect not the number of persons sampled, rather the total number of valid choice question responses of the respondents. Table 2 is an example of a choice card used in the survey.

"*Suppose service option 1 and option 2 are service options for SWC as below, which option do you prefer*?"

Table 2: Example of the Choice Card

Attributes	**Option 1**	**Option 2**
Collection frequency	Regular 3x a week	Regular 3x a week
Storage facilities	Nylon Bags	Wheel waste bin
Disposal Method	Sanitary landfills	Open Dump
Pre-collection services	Motorised pre-collection	Cart pre-collection
Monthly charge	N1000	N2500
Options	**X**	

OR would you prefer NO CHANGES with the CURRENT SERVICE in the solid waste collection with IRREGULAR waste collection frequency, ANY CONTAINER for waste storage and OPEN DUMP waste disposal method, CART Pre-collection and with NO additional cost to improve SWM?	

Analytical Framework

Utility function is the basis of random utility theory which is not directly observable, but categorised into deterministic and random components. Which is established on the hypothesis that the individual choices depend on the characteristics of goods together with some degree of randomness. Though individuals know their utility function, due to unmeasured attributes of the goods undervaluation, the random component can be endorsed to the element of randomness in their preferences. However, the individual utility function (for individual i), where the respondent is fronting a set of K choices (j =1… K), can be expressed as:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \qquad [1]$$

Where U_{ij} is the utility individual i obtain from alternative set j, V_{ij} is a not stochastic utility function, and ε_{ij} is a random component.

This function can also be expressed in another way by decomposing the indirect utility function for each respondent i (U) into two: deterministic and stochastic elements, thus, a deterministic element (V), which would typically be specified as a linear index of the attributes (X) of the jth alternative in the choice set, and a stochastic element (e) which represents the error term; viz:

$$Ui\,j = Vij(Xij) + \varepsilon ij = bXij + \varepsilon ij \qquad [2]$$

The purpose of equation (2) is to show the socio-economic variables. It can be incorporated alongside with the choice set attributes (the X term). As the socio-economic variables are constant for the choice sets for individuals and as long as individuals' income does not change from the first to the other choices, these variables can simply be entered as interaction terms by main attributes or splitting the data set (Hanley et al., 2001).

At this instant, suppose an individual is being asked to choose among two alternative goods, which are presumed to be distinguished by their attributes and levels. For instance, for the case of this study, this two could be the two alternatives of waste collection services, with different attributes

such as collection frequency, storage facilities, disposal method, etc. These alternatives were termed, j and k. To choose between them, a respondent was assumed to compare the utility he/she could get with either choice, for selecting the alternative with the highest utility. The respondents were asked to make a choice from them and assumed that they were the only available choices. The list of all available options was termed as choice set.

Though an error component is used in the utility function, estimates cannot be made with certainty. Thus, the analysis becomes a probabilistic choice. The probability of a respondent (individual i) prefers option j in the choice set to any other alternative, if Uij > Uik, (this utility is known only to the individual). This means that the utility correlated with option j exceeds that associated with all other options:

$$P_{ij} = (V_{ij}+\varepsilon_{ij}) > (V_{ik}+\varepsilon_{ik})$$

$$= P\,[(V_{ij}-V_{ik}) > (\varepsilon_{ij}-\varepsilon_{ik})] \qquad [3]$$

Therefore, it can be expressed that the probability of choosing alternative j over k is simply that the differences between deterministic parts of their utility beat the differences in error parts. If the error terms are assumed to be independently and identically distributed (IID), and if this distribution can be assumed to be Gumbel, the above can be expressed in terms of the logistic distribution (McFadden, 1973). Then, the probability of choosing option j by respondent i is:

$$P_{ij} = \frac{\exp(\mu V_{ij})}{\sum_j^i \exp(\mu Vik)} \qquad [4]$$

The assumption of (IID) error terms implies to the independence of irrelevant attributes (IIA). This means that the ratio of choice probabilities for any two alternatives is unaffected by adding or removing other unchosen alternatives (Bennett & Blamey, 2001). While "μ" is a scale parameter, an appropriate value for which may be chosen without upsetting evaluation results, if the marginal utility of income is presumed to be linear. Following Yacob et al. (2009), if it is assumed that the vector V_{ij} is linear, the utility function of the respondents' components can therefore be:

$$Vij = \beta 1Xij + \beta 2X2in\ j+\ldots+ \beta nXnij \qquad [5]$$

Where, Xs variables in the utility function, βs coefficient to the estimates. If a single vector of coefficient βs applies to the whole, and the associated utility functions and scale parameter μ are assumed to be equal to 1, equation 5 can then be rewritten as:

$$Pij = \frac{exp(\beta Vji)}{\sum_j^i exp(\beta\beta Vik)} \qquad [6]$$

Where P_{ij} = probability of respondent i choices alternative j

X_{ij} and X_{ik} = vectors of attributes i and j, while,

B = vector of coefficient

The LIMDEP, Nlogit 4.0 econometrics software was applied to estimate the multinomial logit model (MNL) by conventional maximum likelihood procedure:

$$\log L = \sum_{i=1}^{N} \sum_{j=1}^{J} Yij \; log \left[\frac{exp(Vij)}{\sum_{j=1}^{J} exp(Vij)} \right] \qquad [7]$$

Where:

Y_{ij} is an indicator variable that takes the value of one if the respondent i chooses option j and zero otherwise, and N is the number of samples.

The last step of CE technique was to compute WTP estimate, based on β values. Refer to Equation (5) to clarify the meaning of β values; it can be seen that the model estimates the value β, which indicates the effect on the utility of a change in the level of each attribute. For instance, β_1 shows the effect on the utility of change in attribute X_1 (Hanley et al., 2009).

The price or cost attribute must be included for WTP estimation. WTP value is typically derived by dividing the β value of each non-monetary attribute by β value of the price attribute, for marginal change in an attribute. Thus:

$$MWTP = \beta_{X1}/\beta_C \qquad [8]$$

The implicit price or marginal rate of substitution (MRS) is the value for any attributes other than price (Hanley et al., 2009).

Results and Discussion

Respondents' Socioeconomic Profiles

Table 3 presented a summary of the households' socioeconomic profiles. The respondents' disproportion across gender indicated that the males (n=234) represented 59.8 percent, while females (n=157) accounted for a relatively smaller size of 40.2 percent. The average age of the respondents was 36 years. This Showed that majority of the respondents were within their active or productive age. Among these age cohorts, 9.7 percent disclosed to have attended informal educational system, while 90.3 percent of the samples have formal education. The average household size was 6 members per household. The mean households' income was approximately

₦38,000, in which 46.8 percent of the surveyed respondents earned a monthly income of ₦40, 000 and below ($203 and below).

Table 3: Respondents' Socioeconomic Profiles

Variable(s)	Freq.	%	Mean±SD	Min.	Max.
Gender					
Male	234	59.8			
Female	157	40.2			
Age/Age Group			**36.14±11.95**	**18**	**68**
Below 30	146	37.3			
31-40	114	29.2			
41-50	76	19.4			
51 and Above	55	14.1			
Educational Level					
Informal	38	9.7			
Primary	25	6.4			
Secondary	110	28.1			
Tertiary	218	55.8			
Household Size			**6.13±2.30**	**2**	**13**
2-3 Persons	40	10.2			
4-6 Persons	200	51.2			
7-9 Persons	117	29.9			
10 and Above	34	8.7			
Household Monthly Income			**37692.33±11834.00**	**₦18000**	**₦85000**
₦40000 and Below	183	46.8			
₦41000-60000	131	33.5			
₦61000-80000	52	13.3			
₦81000 and Above	25	6.4			

Note: *1 USD = ₦197*

The Basic Multinomial Logit (MNL) Model

The estimated Multinomial Logit Model (MNL) for waste collection services is presented in Table 4 shows. Three models were estimated, thus, the basic model and the interactive model, as well as the marginality model using maximum likelihood procedure. However, the difference between the basic and the interactive MNL models lies in the coefficients.

In the models the coefficients of the attributes in the survey for CF2, CF3, SF2, SF3, DM2, DM3, as well as, the PCS2 and PCS3 at all levels were all positive and statistically significant at 1%. Except for PRICE which has a negative sign, but, also statistically significant at 1% confidence level. All the variables have the correct expected sign. This means that as waste collection price increases, respondents are less likely to pay because of a decrease in the utility level.

Table 0: Basic Multinomial Logit (MNL) Model

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
CF2	2.86261178	.19502696	14.678	.0000
CF3	7.33167968	.44634290	16.426	.0000
SF2	.95543966	.14971649	6.382	.0000
SF3	4.82814929	.25482233	18.947	.0000
DM2	2.19546065	.12164976	18.047	.0000
DM3	5.81229719	.32986728	17.620	.0000
PCS2	.60021625	.10437612	5.751	.0000
PCS3	4.60954038	.28573130	16.132	.0000
PRICE	-.00301247	.00013679	-22.022	.0000

Number of observations 2346

Log likelihood function -1493.917

R-sqrd 0.26568

All parameters significant at 1% level

Multinomial Logit Model with Interaction

According Rolfe, et al., (2000) and McConnell, & Tseng, (2000), the inclusion of socio-economic attributes is an important step for estimating more accurate models of choice. As socio-demographic variables are the same for a given respondent, apart from selecting options 1, 2, or 3, for each choice question, so these variables are entered into the model with the interaction of the attributes variables. Subsequently, the socio-demographic characteristics of respondents enter the model as intercept shifters. Status quo was selected as a base level in the model. The interaction models is presented in Table 5 below.

Table 5: Multinomial Logit Model with Interactions

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
CF2	3.31053381	.25002737	13.241	.0000***
CF3	8.03945719	.51890811	15.493	.0000***
SF2	.95480305	.14944054	6.389	.0000***
SF3	4.89468341	.25619908	19.105	.0000***
DM2	2.40777985	.16260192	14.808	.0000***
DM3	5.85285749	.32825083	17.830	.0000***
PCS2	.81138295	.13102950	6.192	.0000***
PCS3	4.04182676	.40234594	10.046	.0000***
PRICE	-.00304306	.00013740	-22.147	.0000***
PCS3_AGE	.01732559	.00811284	2.136	.0327*
PCS2_EDU	-.37873129	.14210732	-2.665	.0077**
CF2_GEN	-.63515130	.21283274	-2.984	.0028**
CF3_GEN	-.99639877	.36024804	-2.766	.0057**
DM2_GEN|	-.31888000	.16257366	-1.961	.0498*

Number of observations 2346

Log likelihood function -1481.735

R-sqrd 0.27167

Note: *Variables significant at 1% level is indicated by '***', at 5% by '**' and at 10% by '*'.*

The socio-economic variables included in the model such as age, gender, income and education as interactive attributes in the model has a positive effect on the model fit. There are means to improve the model fitness, and to observe where the sources of inaccuracy in the choice model might be occurring; this will of course assists in rich data sets generation. Thus, one of such possibilities is by incorporating the socio-demographic variables of the respondents, since heterogeneity of preferences may be accounted (Radam, et al., 2008). Hence, in this study information on respondents' socio-demographic characteristics were employed to interact with the main survey attributes to determine the effects of these variables on the choice behaviour of the survey respondents, hence, the interactive model shows that age, gender, and education have a significant influence on choice in this survey.

The inclusion of the socio-economic parameters from the log likelihood ratio of the model with the interaction has improved relatively compared to the basic model, Table 5 where the Pseudo R^2 was also improved from 0.26568 in the basic model compared to 0.27167 in the interactive model

Table 5 and the log likelihood from -1493.917 to -1481.735. This shows that the statistics indicators, log likelihood ratio and the Pseudo R^2 improved in the MNL interactive model and therefore, indicates a more accurate model specification is achieved.

However, households prefer those solid waste collection services, which do not have proposed additional cost to them. Thus, the sign of the payment coefficient that indicates the effect on the utility of choosing a choice set with a high payment level is negative, as expected. The economic function of the model is provided as below:

Consequently, the economic function of the model is provided as follows:

$$U = \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 9X1Y1 + \beta 10X2Y2 + \beta 11X3Y3 + \beta 12X4Y4 + \beta 13X5Y5 \ldots + \varepsilon$$

Where X1 is CF2, X2 is CF3, X3 is SF2, X4 is SF3, X5 is DM2, X6 is DM3, X7 is PCS2, and X8 is PCS3.

While, Y1 is Age, Y2 is Edu, and Y3 is Gen, as the parameters interacting with main attributes.

β = the coefficient

ε = the error term, thus:

$$U = \beta_1 CF2 + \beta_2 CF3 + \beta_3 SF2 + \beta_4 SF3 + \beta_5 DM2 + \beta_6 DM3 + \beta_7 PCS2 + \beta_8 PCS3 + \beta_9$$

$$PCS3\_AGE + \beta_{10}\, PCS2\_EDU + \beta_{11}\, CF2\_GEN + \beta_{12}\, CF3\_GEN + \beta_{13}\, DM2\_GEN + \varepsilon$$

The positive function of all the attributes in both levels 2 and 3 means that higher improvement of solid waste collection services is preferred more than the baseline or status quo. However, the increase in Pseudo R^2 implies that in the expanded model, the proportion of choice has increased compared to that of the basic model. All the attributes are statistically significant at 1% confidence level.

All the coefficients of the non-monetary parameters in the extended model were expected to positively correlate with utility. The Wald test indicates that all the coefficients are significant at 1% confidence level. This implies that improvements in all the non-monetary parameters can lead to positive utility among the respondents. The coefficient of the parameters of CF2, CF3, SF2, SF3, DM2, DM3, as well as PCS2 and PCS3, are positive with a prior positive sign expectations to the parameters, and similar to that of the simple or basic model, with both levels 2 and 3 in the models are significant at 1% confidence level. In fact, the positive signs, as a theoretical expectation in all the models, imply that increasing improvement of solid waste collection brings more utility to the respondents. Hanley et al. (2002) observed that the respondents prefer moving away from status quo situation and this rationally contributes in a high level of environmental improvement even if they would have to pay for it.

The variable CF (Waste Collection Frequency) was significant at 1% for both level 2 and 3. Both of these levels had correct positive signs. The finding showed that the coefficient for CF was positive, and it seemed that waste collection frequency was much more familiar than other attributes, and people were more concerned about it. Positive sign means that improvement in waste collection frequency results in higher level of utility for individuals. Thus, the positive sign of the variable coefficient for waste collection frequency denotes that households derive positive utility by the improvement of waste collection frequency and may be deduced as the net increase in utility (benefits) accrued to the households towards a sustainable SWM. In a nutshell, the coefficient for waste collection frequency is very high compared to other attributes in magnitude. The result can be described in the fact that, even though the residents generally recognise the need to improve on environmental quality, however, because the waste collection frequency is more noticeable, the households are especially concerned about waste collection frequency improvement to a higher level as much as possible. The results revealed that the households acknowledge that environmental quality also depends on the improvement in the cleanness via effective and efficient waste collection frequency, the high improvement of waste collections may therefore have implications on the public health and environmental risks. Previous studies have found that respondents pay (or WTP) for improving waste collection frequency increases from their income (Othman, 2007; Othman, 2002; Das et al., 2010).

In both the basic and the extended MNL models, the PRICE (i.e., monthly charges, or MC) was found to be significant at 1%. The research finding shows that the coefficient for PRICE, which is the monetary attribute, was a negative sign, and it indicates that the respondents prefer improvement in solid waste collection services that are less costly for them. In all the samples, the monetary attribute had a negative sign and was significant at the 1% level. This entails that the higher the cost (PRICE) associated with an alternative (option), the lower the probability that alternative (option) was chosen, given the fact that all other attributes are equal. Comparing the results obtained (especially in term of attribute signs) with those of the previous studies showed that our results are consistent with some past studies (Othman, 2007; Othman, 2002; Das et al., 2010).

The significant positive sign on the age variable in interaction with pre-collection service level 3 in PCS3_AGE variable implies that the older household heads have more interests than young age to improve solid waste collection services to a higher level than the status quo. Education variable was significant at the 1% level, and negative sign, in interaction with level 2 in PCS2_EDU. It indicated that the respondents with low educational level prefer pre-collection service at the second level of improvement via motorised pre-collection service that entails waste collection using either push-carts or light-weight trucks for final transportation. In Kano, this is done by using motorised tricycle trucks which can access roads in urban poor settlements, or urban slum areas in which roads are often narrow and with no asphalt (untarred roads). This makes urban slums inaccessible to heavy compactor trucks. However, most respondents with low education levels reside in such urban slums (i.e. regarded as urban poor settlements) characterised by high population density, and mostly dominated by the low-income earners.

In the final model, the significant negative sign on the gender variable at 1% in interaction with waste collection frequency levels 2 and 3 in CF2_GEN and CF3_GEN variables implies that women have more interests than men to improve waste collection services to a higher level than the status quo. This is perhaps, women at the domestic level are the ones managing solid wastes. Likewise, there was significant negative sign on the gender variable at 1% in interaction with waste

disposal method level 2 in DM2_GEN variable. However, the negative sign might suggest that the female respondents also had the tendency to go for the higher improvement options in SWM than the baseline. These findings are also in conformity with the similar results obtained in Malaysia by Othman (2002; 2007) who stated that women were generally more willing to opt for SWM improvement compared to men.

Conclusively, from the results obtained in the models, it can therefore be deduced that households in Kano metropolis support improvement in SWM for solid waste collection services in terms of collection frequency, storage facilities, disposal method and pre-collection services.

Estimation of Households' Marginal Willingness to Pay

The marginal willingness to pay (MWTP) was computed by calculating the marginal rate of substitution between the attribute of interest and the cost factor, thus, by taking the total derivative of the utility index. The "value ratio" is identifiable between non-monetary elements of a utility called the implicit price (IP) (Hanley et al., 2009). For example, in this study, one of the attributes was collection frequency; dividing the β value of this attribute by the β value of price would show the respondents' average willingness to pay to improve collection frequency from the current level. For the dummy coded, the marginal value of solid waste collection attributes was estimated using the following formula:

$MV = -\beta attribute / \beta$ monetary variable

The results reported in Table 6 using Wald test procedure in Limdep 8, Nlogit 4, was employed to estimate the WTP values of the attributes, it showed that the mean values range from ₦950 ($4.8) for pre-collection services to ₦1530 ($7.7) for improvement in waste collection frequency. Thus, waste collection frequency (CF3) has the highest marginal value of ₦2433 ($12.4), followed by waste disposal method (DM3), waste collection frequency (CF2), pre-collection services (PCS3), waste storing facilities (SF3), waste disposal method (DM2), storing facilities (SF2), and finally the pre-collection service (PCS2) in the LCM model class2 respectively, while both improvement levels of options 2 and 3 have a positive sign which means increased utility.

Table 6: Marginal Values for Attributes

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
CF2	950.254807	68.3376799	13.905	.0000
CF3	2433.77880	80.9302678	30.073	.0000
SF2	317.161809	51.7132174	6.133	.0000
SF3	1602.72242	41.8391355	38.307	.0000
DM2	728.791468	41.7069274	17.474	.0000
DM3	1929.41404	65.7356516	29.351	.0000
PCS2	199.244053	35.1453191	5.669	.0000
PCS3	1530.15436	56.8686702	26.907	.0000

Number of observations 2346

Wald Statistics 6340.09752

Prob. from Chi-squared [8] .00000

Source: Author's Computation

The marginal value of CF3 (four times a week) of regular waste collection frequency was found to be higher than that of CF2 (three times a week) regular waste collection frequency. This means that CF3 is the most preferred choice attribute with the highest improvement level for waste collection frequency in this survey and it has a positive effect on the utility. For waste storage facilities, the statistic for the probability of SF2 and SF3 shows that the marginal value of SF3 (wheel waste bin) for waste storage facilities was higher than SF2 in the CLM Class2; thus, the survey respondents preferred choice attribute SF3 to SF2, since SF3 is also the highest improvement level here.

For the waste disposal method, however, the result revealed that the marginal value of DM3 is higher than that of DM2, this means that the survey respondents prefer DM3 over DM2 improvement level. Meanwhile, the marginal value for the pre-collection services of PCS2 and PCS3 showed that PCS3 is also higher than PCS2, which means PCS3 is preferred over the PCS2 level of improvement in all the models.

Aggregate annual SWC services benefit measured from the improvement in management options in the marginality model, where CF3 has the highest coefficient and indicates respondent choose improvement in the waste collection frequency as the most preferred waste management attribute followed by DM3 and SF3. The marginality accordingly are ₦950 ($4.8), ₦2433 ($12.3), ₦317 ($1.6), ₦1602 ($8.1), ₦728 ($3.7), ₦1929 ($9.8), ₦199 ($1.0) and ₦1530 ($7.8). By taking the average, it shows that the mean WTP for SWC services benefit is ₦1211.44 ($6.1). From the mean WTP obtained from the households ₦1211.44 ($6.1) the expected SWC service value can therefore be estimated base on the result from the logit model and the households population of Kano

Metropolis (275,851). Computing this figure with the mean WTP, the total SWC services value is estimate at ₦3341 76935.44 ($1696329.6215). This indicates households are willing to pay for waste collection services improvement to ensure sustainable waste management and improve on the enviromental quality.

Conclusions

A disaggregate relative importance for attribute levels' pair indicates that CF3, DM3, SF3, and PCS3 are the most preferred improvements of attributes combination levels, while CF2, DM2, SF2, and PCS2 are considered as least preferred by the households. This indicates the utility people acquire from improvement in waste collection services and the situational change from status quo, which is viable.

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