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Determinants of Willingness to Pay for Improved Solid Waste Management in Dunkwa-on-Offin, Ghana

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Abstract

This study sought to examine willingness to pay for improved solid waste management in Dunkwa-on-Offin. A double-bound choice contingent valuation was used to elicit households' willingness to pay (WTP) for improved solid waste management. The data were subjected to logit regression technique analysis. The study also examined the existing solid waste collection systems in operation and household's level of satisfaction with them. The results showed that households perceived the current solid waste collection services to have some level of inconsistencies. The majority (94%) of the respondents were satisfied with the current solid waste collection services. The results of the study also revealed that willingness to pay for improved solid waste management is significantly related to level of education, gender, household size and age of the household head. It is recommended that the current collection operators should maintain service charges with the WTP levels while striving to improve services to maintain and attract new clients.

Keywords: Solid waste, Willingness to pay, Household, Dunkwa-on-Offin, Contingent evaluation

1.0 Introduction

Management of solid waste resulting from rapid urbanization has generated a lot of concern in most developing countries.

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Especially during the last decade the volume and complexity of solid waste generated particularly in large cities, have been increasing at an unprecedented rate. This increase has been attributed to two main drivers: intensification of urbanization and rising living standards (Rathi, 2007). The solid waste management (SWM) system comprises four activities: waste generation, collection, transportation and disposal (Sharholy, Ahmad, Mahmood & Trevedi, 2007). SWM therefore requires adequate infrastructure provision and maintenance for all four activities. When not managed adequately, solid waste generates several public health and environmental hazards. The increasing volume and complexity of solid waste pose the greatest challenges to large cities in developing countries, where organization and planning of solid waste collection and disposal services tend to be rudimentary. Due to budget and infrastructure constraints, public authorities in these cities are often unable to manage large amounts of solid waste generated. This fact is reflected in the unknown volume and types of solid wastes collected; amount recovered and recycled; the inadequacy of disposal sites, as well as efficient reutilization and recycling programmes (Buenrostro & Bocco, 2003).

Most municipalities in developing countries spend a large proportion of their budgets on the collection, transport, and disposal of solid wastes. According to Cointreau (1984), in most cities in developing countries, municipal SWM costs consume 20-50% of municipal revenues yet collection service levels remain low with only 50-70% of residents receiving service and most disposals being unsafe. This deplorable situation is not different in the urban areas of Ghana such as Accra, Tema, Cape Coast, Kumasi, Tamale and Sekondi-Takoradi. Based on an estimated population of 24 million and an average daily waste generation per capita of 0.45kg, Ghana generates annually about 3.0 million tonnes of solid waste. Accra, the capital, and Kumasi, the second largest city combined, with a population of about 4 million and a floating population of about 2.5 million generates over 3,000 tonnes of solid waste daily. It is however, estimated that throughout the country only about 10 percent of solid wastes generated is properly disposed off (Mensah & Larbi, 2005). In Accra, for example, only 11 percent of the 1.4 million residents benefits from home collection (Songsore, 1992), while the remaining 89 percent dispose of their waste at community dumps, in open spaces, in water bodies, and in storm draining channels (Asomani-Bonteng & Haight, 2004).

This situation is quite different in small town such as Dunkwa-on Offin which don't generate large quantities as that of the big cities.

Even though the government has privatized SWC, the public sector still collects half of the waste in cities. SWC systems differ depending on the income status of households. Low-income groups cannot afford to pay for proper waste disposal and they tend to dump domestic waste near their houses, in rivers, into sewages, drains and at other illegal sites. Furthermore, there are many problems associated with SWC. These include lack of financial support, lack of service consistency (especially the CCC for low-income areas), inadequate service facilities and the difference of collection services between high-income and low-income areas.

Most attempts to improve solid waste management in cities in developing countries have focused on the technical aspects of different means of collection and disposal (Flintoff, 1984). More attention has been paid to improving institutional arrangement for service delivery (Bartone, Liete, Triche & Schertentlieb 1991) with special emphasis on privatization options (Cointreau, 1994). By comparison, much less effort has been directed at investigating the demand-side aspects related to solid waste management. . Ghanaians pay a fee for the collection and disposal services but the exact value is unknown to the households.

Budget constraints have made Metropolitan, Municipal and District Assemblies (MMDA's) unable to meet the cost in managing the ever increasing volumes of waste. Improvement in solid waste management is required; however, to obtain such improvements, a higher payment is also anticipated. In line with this, it is very important to explore the possibility of cost sharing by households and for this we need to explore the demand of these households for SWM services.

Numerous studies have documented issues on solid waste management systems. Consequently, this study would contribute to literature on the household perceptions as well as their level of satisfaction on the current solid waste management systems in the study area. The study would also contribute to the body of literature on household willingness to pay for solid waste management systems in developing countries.

Therefore, the objectives of this paper are: (1) to analyze the household level of satisfaction with the current solid waste management systems, (2) to examine household perception towards the current solid waste management system and (3) to examine factors that influence household willingness to pay for solid waste management systems.

The rest of the paper is divided into the following sections: section two provides the literature review. Section three describes the methodology that includes a description of the study area, sampling technique and data collection as well as analytical procedures. The empirical results are presented in section four and finally, section five provides conclusions and recommendations of the study.

2.0 Literature Review

Global concern over environmental impacts knows no boundaries. Jamaludin (2001) argues that complications of waste management covers not only effects of the management approach itself, but also the mechanism within the system, such as those effects derived from transportation activities to final disposal sites from households or transfer stations. Moreover, Clark (1994), Davio (2001), Park (1998) and Chertoff & Buxbaum (1986) consider public behaviour, consumer perceptions as well as perceptions of government officials as other components of the system.

There is definitely a need for an improved planning and management approach particularly among developing nations. Latest trends in an attempt to emphasize the environment have been shown by the development of standards at the international level such as the International Standards, ISO 14000, the Irish Standards, ISO 310, and the Canadian Standards Association Standard CSA Z750. It is one of the aims of the standardization of products and services to meet customer satisfaction. Thus, it requires some sort of consumer-based information in the management system. Therefore, it is clear that supporters of Life Cycle Analysis (LCA), a part of the 21 environmental management systems (EMS), view the importance of the understanding of consumer behaviours in the design of plans for future improvements. Thus, the level of understanding of the public concerning their rights to form a complaint of such acts should be studied in order to make the monitoring of industrial activities more effective.

The concept of waste is often that of an otherwise "useless or discarded material". However, the idea of what constitute a waste is often notional rather than a concrete term because waste is more easily recognized than defined. The concept of solid waste according to Furedy & Lardinios (2000) is therefore very tricky to define. In that light, it becomes clear perception of what contributes a waste are likely to differ widely and that the divide between a waste and resource may be indistinguishable (Collin, 1995). A waste is therefore what the person responsible for discarding the material regards as a waste. Generally, materials discarded for disposal are deemed to be wastes (Furedy & Lardinios, 2000). Based on this controversy, a material is only defined as waste if it is useless; as soon as it is usable it becomes a resource (Fobil, Armah, Hoyark & Carboo, 2007).

However, different authors have defined waste differently. Solid waste can be defined as any substance or article which requires to be disposed off as broken, worn out, contaminating or otherwise spoiling. Again it can also be defined as any material which constitutes a scrap material or other unwanted surplus substances arising from the application of any process. Solid waste is differentiated by their origin, physical form, detailed composition and risk potential. The quantity and the composition of some types of solid wastes, such as municipal waste, vary from day to day, season to season and from locality to locality.

Solid Waste is classified based on their origin, treatability and risk potential. Based on the origin, solid waste can be sub-classified into food waste, rubbish, ashes and residues, demolition and construction waste, municipal waste, industrial process waste and agricultural waste. Food wastes are the animal, fruit and vegetable residues resulting from the handling, preparation and eating of foods. They are putrescible and decompose rapidly causing malodour. The rubbish waste comprises combustible and non-combustible solid wastes of households, institutions of commercial activities etc excluding putrescible materials. The combustible rubbish consists of materials such as paper, cardboard, furniture parts, textiles, and rubber, leather, wood and garden trimmings. Non-combustible rubbish consists of items such as glass, broken crockery, plastic, discarded tins, aluminium cans and materials made of ferrous and non-ferrous metals. Ashes and residues are materials remaining from the burning of wood, coal, coke and other combustible wastes in homes, stores, institutions, industrial and municipal facilities for the purpose of heating and cooking and above all the remains of combustible wastes are categorised as ashes and residues.

Ashes and residues are normally composed of fine powdery materials, cinders, clinkers and small amounts of burned and partially burned materials.

Waste from demolished buildings and other structures are classified as demolition wastes. Wastes from the construction, remodelling and repairing of individual residences, housing complexes, multi-storied flats, commercial buildings etc are classified as construction wastes. The constituents of this waste are stones, concrete, bricks, plaster and plumbing. Wastes such as street sweepings, roadside litter, and litter from municipal dustbins, dead animals and abandoned vehicles are referred to as municipal wastes. Industrial process waste includes the solid and semi-solid wastes from industrial plants. The specific characteristics of these materials vary depending on the nature of the manufacturing process. Agricultural wastes are residues resulting from cultivation of plants and raising of livestock such as crop residues from fields and waste from feedlots.

Based on characteristics, solid wastes can be classified as biodegradable and non-biodegradable. This classification is based on the quality of solid waste generated from different sources. The biodegradable waste consists of all carbonaceous wastes that can be biodegraded into useful or less polluting products by the action of microorganisms and such animals like Annelids and Insects. Non-bio degradable wastes include inorganic wastes, and non-degradable polymeric organics like certain type of plastics.

Wastes that pose a substantial danger immediately or over a period of time to human, plant or animal life are classified as hazardous wastes. A hazardous waste exhibits the characteristics like ignitibility, corrosivity, reactivity or toxicity. They are classified into following categories as radioactive substances, chemicals, and biological wastes containing radioactive materials, flammable wastes and explosives. The chemical category includes wastes that are corrosive, reactive or tonic. The biological waste category is represented by dangerous wastes emanating from hospitals and biological research facilities.

Many authors have analyzed the effects of socioeconomic and cognitive variables on household's willingness to pay for a service. Afroz, Hanki & Hasegawa-Kurisu (2009) in their analysis on the household's willingness to pay for improved solid waste management in Daka city, Bangladesh maintained that age, household size and income maintain an increasing function with consumers' willingness to pay for improve solid waste management system. However, they found female to have positive influence on consumers WTP and males to have negative influence on consumers WTP. Aggrey & Douglason (2010) confirmed the findings of Afroz *et al* (2009) by stating that these variables and other variables like household expenditure, quantity of waste generated and consumer's level of education also pose a significant influence on consumers WTP.

Aggrey and Douglason (2010) hypothesized that the higher the level of education the more people would appreciate the consequences of mishandling of solid waste and the more value the individual would give in order to avoid the risk of being a victim of unclean environment. Afroz *et al* (2009) also reiterated the fact that education relates to a better understanding of the problem of solid waste and hence WTP for waste management.

Empirical results on age on WTP are mixed. Afroz *et al* (2009) pointed out that holding all other factors constant, older people are willing to pay more than younger people. This suggest that older citizens make more mature decisions related to evaluating health and environmental issues, possibly due to their age , leading them to express a high WTP value. However, according to Aggrey & Douglason (2010), age affects WTP waste management negatively. Old people may consider waste collection as government's responsibility and could be less willing to pay for it. Whiles the younger generation might be more familiar with cost sharing and could be willing to pay.

Household size is another factor that influences WTP for waste management. Chuen-Khee & Othman (2002) pointed out that the more the number of people in the household, the more willing the household will appreciate a clean environment. Tamura (2005) in analysing the individual attributes of the demand for solid waste collection in Accra, Ghana found that the more income people have, the more willing they are to pay for solid waste collection.

The quantity of waste generated by a household also influences WTP for waste management. Aggrey & Douglason (2010) pointed out that, the higher the generation of waste, the more the household faces the challenges of waste disposal and the greater the willingness to pay.

Satisfaction on waste collection services also influences WTP for improved waste management. People who are more satisfied with waste collection services are willing to pay more than dis-satisfied people (Afroz *et al*, 2009 and Kassim & Ali, 2006).

3.0 Methodology

3.1 The Study Area

Dunkwa-on-Offin is a rapidly growing town, the municipal capital of Upper Denkyira East which is one of the thirteen Administrative Districts of the Central Region of Ghana. The population of Dunkwa-on-Offin increased from 15,437 in 1970 to 16,905 in 1984 and to 26,215 in 2000. The main economic activities within the town are agriculture, trading, small scale mining and artisans. Two main types of waste collection services are provided in the Municipality; the communal and house-to-house collection methods. The solid waste collection is a public-private managed system. It is the Municipal assembly which contracts the private company for solid waste collection. The only private waste collection company in the Municipality is Zoomlion Ghana limited.

3.2 Sampling Techniques and Data Collection

Multi-stage sampling procedures were used in selecting the respondents. The first stage involved a stratification of households into three socio-economic strata: High, Middle and Low-income groups based on the Municipality's socio-economic status index. The advantage of employing the stratified sampling is to ensure that all income groups of the target population are represented in the sample. At the second stage, households receiving the central communal container (CCC) and house to house collection (HHC) method of solid waste collection services were targeted. These two groups were targeted because they constitute the most organized form of solid waste collection in Dunkwa-on-Offin.

Finally, a simple random sampling was used to select the required sample size from each stratum based on the development plan percentages for each income group. In all a total of 100 respondents were selected for the study.

3.3 Theoretical Framework

Despite a variety of validity and measurement issues (Carson & Haneman, 2006) application of contingent valuation (CV) surveys are argued to be a viable method of collecting information on preferences for providing public goods and services in developing countries (Washington, 1998). For instance Aggrey & Douglason (2010) in Kampala, Chuen-Khee & Othman (2002) in Malaysia and Afroz et al., (2009) in Dhaka provide examples of recent CV studies in developing country contexts. Many of these studies provide evidence that households are willing to pay a significant amount for the provision of improved waste management. Eliciting a respondent's preferences through the CV method requires careful survey design, choice of survey mode, and selection of random sample (Whittington, 2002). Hence, the study adapts a double bound contingent valuation method.

Following the work of Kimenju & De Groote (2008), the WTP of a group of consumers for a particular product at a price (or bid) B can be assumed to have a certain probability distribution function. This distribution function can be seen as a function of price, with a higher price having lesser probability of being accepted. In applied research, the logistic distribution is commonly used, and the effect of price is entered indirectly in an argument called the index function, denoted as v. The most common index function is linear in the price or bid B:

$$v = \alpha - \rho B, \quad (1)$$

and the probability distribution of the WTP is then presented by

$$P(WTP = B) = \exp(v)/(1+\exp(v))^2. \quad (2)$$

The logistic function has the advantage of a closed-form cumulative distribution function $G(.)$, which then represents the proportion of the population whose WTP lies below a certain value B:

$$G(B) = P(WTP < B) = \exp(v)/(1+\exp(v)). \quad (3)$$

People who will accept an offer of value B are those whose WTP is equal to, or higher than B, (Haneman & Kanninen, 1998; Haneman, Loomis & Kanninen, 1991).

In the double-bounded dichotomous choice model, the consumer is presented with two consecutive bids, and the second bid depends on the response to the first. If the consumer answers "yes" to the first bid (B_i), the second bid (B_i^u) is set higher, but if the individual responds "no" to the first bid, the second bid (B_i^d) is set lower. There are four possible outcomes: "yes" to the first bid followed by a "yes" to the second bid (with probability denoted by π^{yy}); "yes" followed by "no" (π^{yn}); "no" followed by "yes" (π^{ny}); and two consecutive "no" answers (π^{nn}). To receive information on a wider range of values, different amounts for the bids are assigned randomly between respondents i. The probability of receiving a "yes" answer to both questions equals to the probability that the respondent's WTP is higher than the highest bid offered:

$$\pi^{yy}(B_i, B_i^u) = \Pr(B_i^u < WTP_i) = 1 - G(B_i^u). \quad (4)$$

Similarly, the probability of receiving a "yes" followed by a "no" equals the probability that the WTP of respondent i lies between the initial bid and the second, higher bid offered:

$$\begin{aligned} \pi^{yn}(B_i, B_i^u) &= \Pr(B_i^u < WTP_i < B_i^u) \\ &= G(B_i^u) - G(B_i). \end{aligned} \quad (5)$$

The probability of receiving a "no" followed by a "yes" is again the probability that WTP_i lies between the initial and second bid, now lower, bid offered:

$$\begin{aligned} \pi^{ny}(B_i, B_i^d) &= \Pr(B_i^d < WTP_i < B_i) \\ &= G(B_i) - G(B_i^d). \end{aligned} \quad (6)$$

Finally, the probability of receiving two "no" answers are equal to the probability that WTP_i lies below the second, lowest bid offered:

$$\pi^{nn}(B_i, B_i^d) = \Pr(B_i^d < WTP)_i = G(B_i^d). \quad (7)$$

Combining the probabilities of four outcomes, the log-likelihood function for a sample of N consumers takes the form

$$\ln L^D(\theta) = \sum_{i=1}^{N} \left\{ d_i^{yy} \ln \pi^{yy}(B_i, B_i^u) + d_i^{nn} \ln \pi^{nn}(B_i, B_i^d) + d_i^{yn} \ln \pi^{yn}(B_i, B_i^u) + d_i^{ny} \ln \pi^{ny}(B_i, B_i^d) \right\}, \quad (8)$$

Where $d_i^{yy}, d_i^{nn}, d_i^{yn}$, and d_i^{ny} are binary variables with 1 denoting the occurrence of that particular outcome, and 0 otherwise.

3.4 Empirical Specification

Household willingness to pay for improved solid waste management can be specified as:

$$WTP = \alpha + \rho b + \beta z + \varepsilon \quad (9)$$

Where b represents the last bid level which the respondent was offered, z is socio economic factors and ε is the random variable accounting for unobserved factors, α, ρ and β are parameters to be estimated.

The empirical formulation of equation (9) is finally formulated as:

$$WTP = \alpha + \rho b + \beta_1 AGE + \beta_2 GEND + \beta_3 EDU + \beta_4 INC + \beta_5 MSTA + \beta_6 COSAT + \beta_7 HHS + \varepsilon \quad (10)$$

Where AGE is the age of the respondent, $GEND$ is the gender of the respondent, EDU is the number of years of schooling of the respondent, INC is the average monthly income of the respondent, $MSTA$ is the marital status of the respondent, $COSAT$ is satisfaction with already existing waste collection service and HHS is the household size of the respondent.

The descriptions, measurements and *a proiri* expectations used in the Logit model are presented in table 1 below.

Table 1: Description, measurement and a priori expectation of the variable used in the Logit model

Variable	Description	Measurement	a priori expectation
AGE	Age of respondents	Years	
GEND	Gender of respondents	dummy: 1 if male; 0 if otherwise	+
EDUC	Number of years of formal education	Years	+
INC	Average monthly income of respondent	Ghana cedis	+
MISTA	Marital status	dummy: 1 if married; 0 if otherwise	+
COSAT	Satisfied with current SWM system	dummy: 1 if yes; 0 if no	+
HHH	Household size of the respondent	Number	+

4.0 Empirical Results

4.1 Demographic Characteristics of Respondents

From the descriptive statistics in Table 2 , majority (66%) were between 25-45 years with a mean age of 41 years. This is an indication that most of the respondents are in their active years. Probably due to their ages, they will make more mature decisions related to evaluating health and environmental issues leading them to express a higher WTP value. Moreover, 10% of the respondents are male headed household and 90% of households are female headed.

Again, 88% of the respondents are married while only 12% are single. A high percentage of married recorded in all the residential areas will influence their family size and hence their waste generation levels. This is due to the fact that married people are likely to be more responsible to keep the environment clean than the

unmarried ones. The mean household members are seven per household. Majority of the respondents had at least 10 years of formal education.

Moreover, Table 3 reveals that 5 percent of respondents have income below GH¢50, 46 percent between GH¢51 to GH¢150, 38 percent between GH¢151 to GH¢300 and 11 percent between GH¢301 to GH¢600. The low income level of respondents is considered a very important variable that could influence negatively people's WTP for improvement in solid waste management. The low income levels can be attributed to the higher percentage of female respondents. Most females, until recently were housewives and not into major or full time employment.

Table 2: Socio-economic Characteristics of the Respondents

Variables	Type of Residential Areas							
	High Income		Middle Income		Low Income		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
a) Gender								
Male	2	13.3	6	17.1	2	4	10	10
Female	13	86.7	29	82.9	48	96	90	90
Total	15	100	35	100	50	100	100	100
b) Age								
25-35	5	33.3	11	31.4	17	34	33	33
36-45	5	33.3	12	34.3	16	32	33	33
46-55	2	13.3	5	14.3	12	24	19	19
56-65	3	20	6	17.1	4	8	13	13
66-75	0	0	1	2.9	1	2	2	2
Total	15	100	35	100	50	100	100	100
c) Marital status								
Married	12	80	32	91.4	44	88	88	88
Single	3	20	3	8.6	6	12	12	12
Total	15	100	35	100	50	100	100	100
d) Educational level								
None	0	0	0	0	4	8	4	4
JHS/Middle	2	13.3	7	20	13	26	22	22
SHS/Tech	8	53.3	20	57.1	20	40	48	48
Tertiary	5	33.3	8	22.9	13	26	26	26
Total	15	100	35	100	50	100	100	100
e) Household size								
1-4	7	46.67	7	20	15	30	29	29
5-9	8	53.3	27	77.14	32	64	67	67
10-15	0	0	1	2.86	3	6	4	4

Source: Field Survey, 2011

Table 3 Distribution of Respondents by income level

Income	Type of Residential Areas							
	High Income		Middle Income		Low Income		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
< GH¢50	0	0	2	5.7	3	3	5	5
GH¢51-150	4	26.7	16	45.7	26	52	46	46
GH¢151-300	9	60	12	34.3	17	34	38	38
GH¢301-600	2	13.3	5	14.3	4	8	11	11
Total	15	100	35	100	50	100	100	100

Source: Field survey, 2011

4.2 Frequency of Collection

With respect to the collection frequency of the existing solid waste collection system as indicated in Table 4, 70 percent of the respondents indicated inconsistency in the collection, 4 percent once a week, 2 percent twice a week and 24 percent three times a week. The higher percentage of collection frequency being inconsistent in the low income residential areas may be attributed to the low priority given to people in low income areas when it comes to issues that concern their welfare. The high and regular collection frequency in the high income residential areas may be due to the high premium paid by households relative to the other residential areas.

Table 4: Frequency of Collection

Responses	Type of Residential Areas							
	High Income		Middle Income		Low Income		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Inconsistent	1	6.7	22	62.9	38	76	61	61
Once a week	1	6.7	3	8.6	1	2	5	5
Twice a week	8	53.3	2	5.7	0	0	10	10
Three times a week	5	33.3	8	22.9	11	22	24	24
Total	15	100	35	100	50	100	100	100

Source: Field survey, 2011

4.3 Level of Satisfaction with the Current Solid Waste Collection Services

As indicated in Table 5, the majority of the respondents (94%) were satisfied with the solid waste collection services in Dunkwa-on-offin. The higher percentage of respondents recorded as satisfied could be mostly those receiving the CCC system of

solid waste collection. This is the case as people who do not pay anything for a service being rendered naturally do not complain much. A hundred percent satisfaction recorded in the high income residential areas may be due to the high rates they pay, hence they are normally provided with quality services.

Table 5: Satisfaction with Current Collection Services

Responses	Type of Residential Areas							
	High Income		Middle Income		Low Income		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Yes	15	100	30	85.7	49	98	94	94
No	0	0	5	14.3	1	2	6	6
Total	15	100	35	100	50	100	100	100

Source: Field survey, 2011

4.4 Respondents Perception on the Current Solid Waste Problem

Respondents were asked to rate their perception on the current waste problem in the study area. This is presented in table 6. Two percent of the respondents perceived the current waste problem as very serious, 10 percent rated it as serious and 88 percent considered it not serious. The percentage of residents in the middle and low income residential areas' rating the waste problem to be serious may be due to the low priority given to them in terms of waste management. Generally the high percentage of respondents seeing the current solid waste problem as not serious is not surprising as Dunkwa-on-Offin is a developing town and is yet to experience fully this negative aspect of development.

Table 6: Respondents' Perception on the Current Solid Waste Problem

Responses	Type of Residential Areas							
	High Income		Middle Income		Low Income		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Very serious	0	0	0	0	2	4	2	2
Serious	0	0	4	11.4	6	12	10	10
Not serious	15	100	31	88.6	42	84	88	88
Total	15	100	35	100	50	100	100	100

Source: Field survey, 2011

4.5 Determinants of WTP for Improved Solid Waste Management

For the double dichotomous choice question, double bounded logit analysis model was used in this study. The independent variables used in the double bounded logit analysis and their basic statistics are given in Table 7. To analyze the influence of different factors on households' WTP for improved solid waste management, the parameters of the model were estimated and the marginal effects also calculated in Table 8

Table 7: Descriptive statistics of the variables used in the Logistic regression

Variables		Type of Residential Areas					
		High Income		Middle Income		Low Income	
		Mean	S.D	Mean	S.D	Mean	S.D
Dependent							
Willingness to pay	1 if willing to pay; 0 otherwise	0.27	0.46	0.23	0.43	0.08	0.27
Independent							
Bid	Gh¢ /month	11.17	3.99	7.71	5.5	4.55	4.48
Gender	1 if male; 0 if female	0.13	0.35	0.17	0.38	0.04	0.2
Age	Years	40.13	11.05	41.66	11.55	41.38	10.6
Education	Years of schooling	12.93	2.46	12.31	2.35	11.3	4.23
marital status	1 if married; 0 otherwise	0.8	0.41	0.9	0.28	0.88	0.32
Household size	Number	5.07	1.71	5.66	1.66	5.56	1.88
Income	Gh¢ /month	222.03	108.26	190.24	124.05	167.7	104.7
Collection services	1 if satisfied with current collection; 0 if otherwise	1	0	0.86	0.36	0.98	0.14

Source: Field survey, 2011

The probability of a households' WTP was modelled as a function of socio-economic and cognitive factors. The pseudo R-squared explains the proportion of variation in the observed values of the response variable explained by the regression.

It summarizes the proportion of variance in the dependent variable associated with the independent variables, with larger pseudo R-squared values indicating that more of the variation is explained by the model. A pseudo R-squared of 0.5014 was

obtained suggesting that the degree of correlation between the dependent variable and the independent variable is 50.14%. The log-likelihood ratio statistics also computes the difference between the log-likelihood function of the full model and restricted model. The value of the log-likelihood function is -59.817 for the WTP of households.

Gender had a negative coefficient and is significant (ρ <0.10) on willingness to pay. This indicates that female respondents are more willing to pay for improved solid waste management than males, since traditionally it is the role of women to clean the house and dispose of the waste. This result leads credence to findings of Afroz *et al* (2009) and Aggrey & Douglason (2010).

The positive coefficient for age (ρ <0.10) indicates that holding all other variables constant, older people are willing to pay more than younger people. This suggests that older citizens make more mature decisions related to evaluating health and environmental issues, possibly due to their age. This result is consistent with findings of Afroz *et al* (2009) but contradicts the findings of Aggrey & Douglason (2010). They are of the view that old people may consider waste collection, as government responsibility and could be less willing to pay for it.

Education had positive significant effect on willingness to pay at 1% level of significance. Holding all other variables constant, educated people are willing to pay for improved waste solid management than less educated people. This result seems straightforward and reasonable since level of education could be related to a better understanding of the problem of solid waste. This result is consistent with the findings of Afroz *et al* (2009) and Chuen-Khee & Othman (2002) who conducted similar studies in Bangladesh and Malaysia respectively.

The negative coefficient for household size (ρ <0.10) indicates that holding all other variables constant, the number of persons in the household even though significant did not have the expected sign on WTP. This result is consistent to the findings of Afroz *et al* (2009) and Aggrey & Douglason (2010) but contrast the work of Altaf & Deshazo (1996)

Table 8: Estimates of Household WTP with Respondents Characteristics

Variables	Coefficient	Standard Error	Z-value	Marginal Effect
Constant	-1.035	2.347	-0.44	
Bid	-0.247	0.310	-0.80	-0.0600
Gender	-0.882*	0.544	-1.89	-0.2162
Age	0.045*	0.025	1.82	0.0110
Education	0.211***	0.081	2.61	0.0511
Marital status	0.379	0.485	0.78	0.0924
Household size	-0.313*	0.146	-2.15	-0.0758
Income	0.001	0.002	0.33	0.0002
Collection satisfaction	-0.102	0.485	-0.21	-0.0246
Log likelihood	-59.817			
Pseudo R^2	0.5014			
Observation	100			

Source: Field survey, 2011

****, ** and * indicates 1%, 5% and 10% level of significance*

Household size is expected to have a positive coefficient due to the fact that the more the number of people in the household, the more willing the household will appreciate a clean environment. The negative relationship between household size and WTP could be due to their income level, as low income household generate low volumes of waste. It is also due to more waste generated by larger households and the fact that they cannot pay for all the waste they generate. Large household sizes are also associated with low income households. The size of the effects can be gauged by analyzing the marginal effects, which are indicators of percentage change in people's willingness to pay, when all other factors are kept at their average value. An increase in the respondents collection satisfaction index of 1, for example decreases the respondents willingness to pay for the improved solid waste management by 2.5 percent.

5.0 Conclusions and Recommendations

Results from the descriptive statistics revealed that about 70% of the respondents think there are inconsistencies in the number of times waste collection is done per week. However, majority (94%) were satisfied with the current waste collection services.

Results from the Logit regression model revealed that gender, age, household and education significantly influence household willingness to pay for improved waste management systems.

The study provides the following recommendations: A key policy recommendation of this study is that policy makers can choose from a set of scenarios, which includes different levels of attributes and WTP estimates for each attribute, in designing an improved solid waste management project for Dunkwa-on-Offin. Households should be educated on effective solid waste disposal through regular sensitization programmes by a collaborative effort of key stakeholders in the solid waste management such as local government, the private sector, NGOs and residents as there was statistically significant effect of education on willingness to pay for solid waste collection. The ever increasing population growth means that the volume of waste generation is likely to increase. Hence strengthening or increasing the capacities of relevant stakeholders involved in the provision of solid waste collection services would provide satisfactory service delivery as households maximise their utility from improved services. The municipal assembly and the service operator should concentrate on awareness campaigns about the consequences of waste mishandling and benefits of payment for improved waste management.

The study also provides contributions to the existing literature by analysing the determinants of household willingness to pay for waste collection services. Hence, the results of this study would enrich our understanding of household willingness to pay for waste collection services in the developing countries and provide a guide to policy makers. This study was done in Dunkwa-on-Offin municipality and may not be a representative of the whole country. Therefore, extending the study to other parts of the country is highly recommended for future study.

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