

## HOUSEHOLDS' WILLINGNESS TO PAY FOR SOLID WASTE MANAGEMENT SERVICES IN TARKWA AREA COUNCIL, GHANA

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(Received On: 07-03-15; Revised & Accepted On: 31-08-15)

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### ABSTRACT

*The willingness to pay for solid waste management services was assessed in Tarkwa Area Council, Ghana, to determine the factors influencing it. Five (5) suburbs, namely Cyanide, Government Hill, Kamponasi, Market Circle and Tamso were purposively selected and two hundred and sixty-five (265) household heads were interviewed from randomly selected houses using a questionnaire. The data were analyzed using descriptive statistics and logistic regression model. By employing the logistic regression model, it was found that respondents' sex, educational level, mode of collection and monthly willingness to pay potential among other variables were statistically insignificant. However, parameters like age, satisfaction, desire for better solid waste management services and whether respondents pay for the current solid waste management services had significant effect on willingness to pay. Based on this, it is recommended that programmes that will enable potential investors in solid waste collection, management and appropriate disposal be introduced whilst payment for this service should be made affordable to encourage households that are willing to pay.*

**Keywords:** Tarkwa Area Council, Waste Management, Waste, Logistic Regression, Descriptive Statistics and Willingness to Pay.

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### 1. INTRODUCTION

Ever since humans ceased from living nomadic life, solid waste management has been a pressing issue with the main focus on eradicating waste and all its sequels from immediate human environment. In today's world, despite the glowing trend of technology and the modernized ways of doing things around the global world, most Cities, Districts and Municipalities in Africa and Ghana in particular are bereft of a sustainable human environment. In the phase of mounting heaps of refuse on major roadsides and highways, the public's confidence in the ability, credibility and capability of the Local Government Authority (LGA) to eradicate the problem of waste collection, management and appropriate disposal have gone down.

According to Anarfi, (undated) the far-reaching World Bank report on the state of Municipal Solid Waste (MSW) around the world estimated that the amount of MSW will rise from the current 1.3 billion tons per year to 2.2 billion tons per year by 2025. The situation is not different in Tarkwa and, for that matter, Ghana at large. Ghana produces about 13000 tons of waste daily (Anarfi, undated), but has one of the poorest waste management systems across the globe. Technological facilities such as engineering land fill sites and waste recycle plants are far-fetched across the country. It is estimated that the total municipal solid waste generated in the country increased from about 2,200,000 metric tons in 1984 to about 3,730,000 metric tons in the year 2000; the volume of solid waste produced in Ghana has also increased with population growth over the years. While the total population of Ghana increased by about 54% between 1984 and 2000, the total solid waste generated grew 69.5% within the same period (Ampofo, 2011). Surprisingly, the average waste generated in Tarkwa Area Council (TAC) between 2006 and 2011 is estimated to be 85612.8 tones which constitute 2.29% of the total waste generated in Ghana as at 2000 and the graph of the projected waste using Time Series shows that the trend will be increasing (Ademola *et al.*, 2012). Nevertheless, environmental quality value can be estimated from what people are willing to pay to improve or restore their environment, using evaluation techniques which measure peoples' choices. Unfortunately, much of studies in recent times have focus on most urban centers, cities and semi-rural urban communities with little known about the factors that influence households' willingness to pay for solid waste management services in TAC. Therefore, this paper attempts to address this urgent need by assessing the variables that influence households' willingness to pay for the management of the waste generated in TAC.

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It is obvious that the growth rate of environmental issues in Africa and beyond is on the ascendancy. In spite of this, most people believe that environmental quality value can be estimated from what people are willing to pay (WTP) to improve or restore their environment, using valuation techniques which measure peoples' choices. This is evident from what Anarfi (undated) said in his paper solid waste management in Ghana: "The Environmental Health and Safety Unit believes that the Ghana-Polluter-Pay Principle (PPP) is the answer to waste generation and management: The PPP is a civil and social act that would enable economic agents as well as individuals to pay for waste they produce daily." Willingness to pay (WTP) is simply defined as the maximum amount that a household is willing to pay voluntarily for the management of solid waste the household generates.

Among the many factors that are expected to influence a households' WTP for solid waste services are satisfaction with current level of waste management services, the perception of waste management as a problem, the maximum amount to be paid and socio-economic characteristics such as household size, assets owned, education and occupation of the household head. Moreover, aspects such as gender, age, current disposable income of household heads and marital status are also likely determinants of the level of willingness to pay.

A series of studies have identified various variables to be influential on one's WTP for waste management. For instance, Amfo-Otu *et al.* (2012) found in Akuapem North District, Ghana, that variables like mode of collection, occupation and age affected the WTP for waste management. In another study in Nigeria, Osun State, Adepoju and Salimonu, (undated) discovered that sex, education and household expenditure were the determinants of households' WTP for improved disposal services in the area. In a similar study in Ibadan, Nigeria, evidence from the logit model indicated that seven (7) variables which include income, assets owned, education, occupation and age among others had influence on the households' WTP for the said services (Rahji and Oloruntoba, 2009). However, income and assets owned were positive and significant at  $p < 0.01$ . Moreover, Amfo-Otu *et al.* (2012) found respondents' sex, level of education and income among other variables to be statistically insignificant which is quite contrary to the findings of Adepoju and Salimonu, (undated).

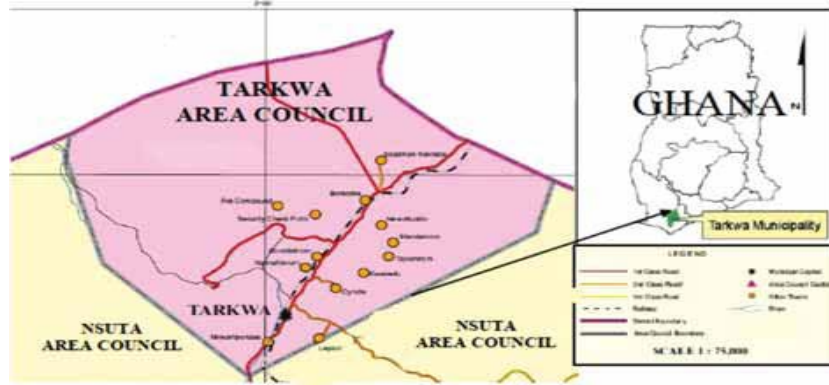
In another study, Yusuf *et al.* (2007) found in Oyo State, Nigeria that price of the service, age, educational level, household size and household monthly expenditure affected the WTP for waste management. In Dar es Salaam residential area, Massito (2009) identified income of the household, the bid value and the size of the household to be influential in WTP for garbage collection. In the Lake Victoria Crescent region of Uganda, Ekere *et al.* (2010) also found that income of household head, location of the household, gender of the household head, level of environmental concern, age of the household head and quantity of crop waste generated by the households were significant and explained the households WTP for waste management. Banga *et al.* (2011) found in Kampala, Uganda, that both the decision to pay for and the amount households were willing to pay for improved solid waste collection services were influenced by income, education, age and home ownership. It can therefore be noticed from the various authors that income status, age and educational level significantly affect the willingness of people to pay for solid waste management services.

## 2. STUDY AREA

Tarkwa-Nsuaem Municipality (TNM) of the Western Region of Ghana with Tarkwa as its administrative capital is surrounded by Wassa Amenfi East District, Ahanta West District, Nzema East Municipal and Mpohor Wassa East at the North, South, West and East respectively. The municipality is located between latitude 400'N and 500 40'N and longitudes 10 45'W and 20 10'W and has a total land area of 2354 km<sup>2</sup>. Tarkwa is about 100 km from Takoradi, the regional capital and 300 km west of the capital city, Accra (Elorm, 2013).

The Tarkwa Area Council (TAC) is one of the six councils under the administration of TNM. It is approximately 160 m above sea level and has a population of about 40397 as of 2005 (Elorm, 2013). As a result of the mining activities in the area, it has people from all over Ghana and beyond and the People of Wassa (the natives) spread over all the suburbs in the area. The Municipality lies within the South-Western Equatorial Zone and is noted for double maximum rainfall. The first asserted raining season ranges from late March to the end of July whilst the second season is from October to halfway November with annual rainfall of 1878.3 mm and a fairly uniform temperature stretching from 26 °C in August and 30 °C in March (Ademola 2012).

Air pollution, ineffective waste collection service and unsafe waste disposal are among the major environmental concerns of the residents of TAC (Elorm 2013). Contrary to this asserted notion, attitudes towards waste disposal are so abysmal that people discard waste besides waste containers even though these containers may be empty. The notable waste management service in the municipality is primarily offered by a private company, Zoom lion Ghana Limited, on behalf of the TNM Assembly. The employed waste collection method is basically secondary type using communal skip containers that are placed at central points within the beneficiary communities.



**Figure-1:** Tarkwa Area Council (TAC) (Source: Elorm 2013)

### 3. METHOD USED

The accessible population considered for this paper encompassed male and female household heads (landlords and landladies) in Tarkwa Area Council (TAC). The five (5) suburbs within TAC that were purposively selected for this research were Cyanide, Government Hill, Kamponasi, Market Circle and Tamso. In all, two hundred and sixty-five (265) household heads were interviewed from randomly selected houses using a questionnaire. Respondents were generally asked the questions on the questionnaire verbally and their answers were transcribed. However, respondents who wanted to fill in the questionnaire by themselves were permitted to do so and then the questionnaire was taken instantly.

There are situations in real life where it may not be expedient to assume a normally distributed population so as to be able to fit linear models. For cases where the response variable is categorical, transformation is not effective in assuming error to be normal and therefore, it might be better to model the actual data rather than data that are transformed (fitted) to meet assumptions. Fundamentally, Logistic Regression Model (LRM) which is a type of the Generalized Linear Model (GLM) is appropriate in this paper since the linear relationship between predictors ( $x_i$ ) and the probability that a household will pay for waste management services ( $p$ ) need not be of a simple linear form or the response variables (factors influencing willingness to pay) have distribution other than the normal distribution.

Logistic Regression (LR) predicts the probability of occurrence of an event. However, with LR, the researcher predicts a dichotomous outcome. The logistic regression model with the logit link function that was used in this study is specified in equation 1.

$$\text{logit}(p) = \log_e \left( \frac{p}{1-p} \right) = \hat{\beta}_0 + \hat{\beta}_1 x_1 + \hat{\beta}_2 x_2 + \dots + \hat{\beta}_{13} x_{13} + \varepsilon_i \quad (1)$$

Where the  $\text{logit}(p)$ , a household willingness to pay (WTP), is set as binary and represents the event of interest (response variable). The dependent variable (WTP), takes the value of 1 if a household is willing to pay and 0 if the household is not willing to pay.  $p$  is the probability that a household will pay and  $(1-p)$  is the probability that a household will not pay whereas  $\left( \frac{p}{1-p} \right)$  is the odds of success or the odds ratio. In similar manner as in OLS model,  $\hat{\beta}_0$  is the intercept and  $\varepsilon$  is the random error,  $\hat{\beta}_1 - \hat{\beta}_{13}$  are the regression coefficients and  $x_1 - x_{13}$  are the explanatory variables. The fitted probability model is given in equation 2.

$$\text{wtp} = \hat{p} = \frac{e^{\hat{\beta}_0 + \hat{\beta}_1 x_1 + \hat{\beta}_2 x_2 + \dots + \hat{\beta}_{13} x_{13} + \varepsilon_i}}{1 + e^{\hat{\beta}_0 + \hat{\beta}_1 x_1 + \hat{\beta}_2 x_2 + \dots + \hat{\beta}_{13} x_{13} + \varepsilon_i}} \quad (2)$$

The explanatory variables ( $x_i$ , where  $i = 1, 2 \dots 13$ ) of the model are;

- Sex ( $x_1$ ) entered the model as a dummy variable, 1 represents a male and 0 represents a female. Its effect can be positive or negative.
- Age ( $x_2$ ) is how old a respondent is. For this study, age was coded as 0 for those below 25 years, 1 for those within 25–40, 2 for 41–60 and 3 for those above 60. Its effect can be positive or negative.
- Marital status ( $x_3$ ) entered the model as a dummy variable with 1 for married and 0 for single. Again, its effect can be positive or negative.
- Educational level ( $x_4$ ) was ranked as 0 for no education, 1 for primary, 2 for basic education (JSS and Form Four), 3 for secondary, 4 for tertiary and 5 for post graduate.
- Household size ( $x_5$ ) entered the model as the number of people in a particular house.
- House help ( $x_6$ ) was also a dummy variable, 1 for yes and 0 for no.
- Level of wealth ( $x_7$ ) entered as a dummy variable where yes was 1 and no 0.
- Monthly income in GH¢ ( $x_8$ ) was ranked as 1 for income less than 450, 2 for 500 – 950, 3 for 1000 – 1950, 4 for 2000 – 3500 and 5 for 3600 and above.

- Do you pay for the current SWM ( $x_9$ ) entered as a dummy variable where 1 is "I pay" and 0 for "I don't pay".
- Satisfaction with the current SWM ( $x_{10}$ ) entered as a dummy variable where yes is 1 and 0.
- Desire or wish for better SWM ( $x_{11}$ ) also entered as a dummy where yes is 1 and no is 0.
- Mode of collection ( $x_{12}$ ) was also a dummy variable where 1 is for secondary and 0 for primary.
- Monthly WTP potential ( $x_{13}$ ) was the amount respondents were willing to pay for the management of their waste.

A Logistic Regression model for analyzing WTP was run using a 3.0.2 version of R (an open-source statistical software package).

#### 4. DISCUSSION OF RESULTS

Out of the two hundred and sixty-five (265) respondents, 30.2% were males and 69.8% were females. The average household size was ten (10) and 62.3% of the respondents were married whereas 37.7% were single. Whilst 35.5% of the respondents were traders, the unemployed, who comprised of house-wives and pensioners, recorded 14.3% of the total respondents. Detailed analyzes of the demographic and socio-economic characteristics of respondents are vividly presented in Table 1.

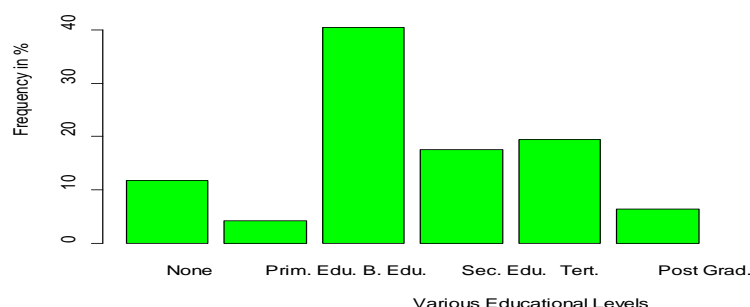
Majority of respondents were basic school (JSS and Form Four) graduates and this is a confirmation of what Elorm (2013) found in her paper "Municipal Solid Waste Management in Tarkwa Area Council". A graphical view of the educational levels of respondents is shown in Figure 2.

When asked about the place of solid waste disposal, 38.7% of the respondents indicated open refuse dumps in the suburbs. Field visits to Kamponasi, Market Circle and Cyanide confirmed this. Figure 3 is a pictorial graph of some common place of waste disposal in TAC.

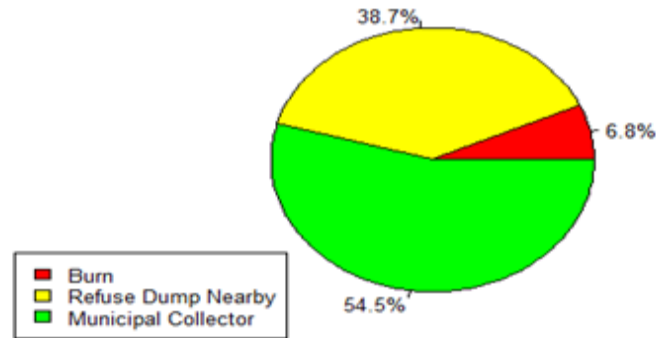
**Table-1:** Demographic and Socio-Economic Characteristic of Respondents

Socio Economic		Frequency	(%)
SEX	Male	80	30.2
	Female	185	69.8
AGE	< 25	2	0.8
	25-40	142	53.6
	41-60	92	34.7
	> 60	29	10.9
OCCUPATION	Civil Service	67	23.4
	Trading	94	35.5
	Farming	4	1.5
	Artisans	62	25.3
	Unemployed	38	14.3
MONTHLY INCOME (GH¢)	≤ 450	158	59.6
	500-950	55	20.8
	1000-1950	32	12.1
	2000-3500	12	4.5
	≥ 3600	8	3.0

(Source: Author's Construct, March, 2014)



**Figure-2:** Educational Levels of Respondents (Source: Author's Construct, March, 2014)



**Figure-3:** Common Place of Waste Disposal (Source: Author's Construct, March, 2014)

**Table-2:** Logistic Regression Parameters of WTP for SWM in TAC.

VARIABLE	COEFFICIENT	ODDS RATIO	STANDARD ERROR	Pr(>  Chi  )
Constant	-0.273317	0.7608512	0.808109	
Sex	0.043219	1.0441663	0.428420	0.476060
Age	-0.304100	0.7377869	0.238682	0.022085 *
Marital Status	-0.002884	0.9971205	0.360670	0.710330
Education	0.051427	1.0527723	0.151322	0.993861
Household Size	-0.007321	0.9927056	0.014569	0.447888
House Help	-0.159899	0.8522301	0.589901	0.628790
Wealthy Level	0.150859	1.1628323	0.439360	0.802099
Monthly Income	-0.021423	0.9788048	0.194928	0.642098
Do you Pay for Current SWM	1.117630	0.9788048	0.549071	0.048649*
Satisfaction	-0.176870	0.8378888	0.399655	0.001264 **
Desire for Better SWM	2.163153	8.6985192	0.470134	7.09e-08***
Mode of Collection	-0.262022	0.7694941	0.341766	0.405751
Monthly WTP Potential	0.019148	1.0193327	0.016162	0.208695

\* Significance level at 10%, \*\* Significance level at 5% and \*\*\* Significance level at 1%

Variables like age, satisfaction with the current SWM, desire for a better SWM and whether respondents pay for the current SWM were seen to have significant effect on WTP. The fact that age is significant and negative at 10% significance level confirms the works of both Amfo-Out *et al* (2012) and Aggrey and Douglason (2010) in Akuapem North in Ghana and Kampala in Kenya respectively. Both authors stated that age had negative effect on WTP because older respondents were accustomed to free government services in the past years, unlike the younger people who have been exposed to cost sharing. It could also be attributed to the fact that older people have high financial commitments or such people are preparing for their retirement life and therefore, will like to cut down their expenditure by not paying for the management of their solid waste.

The desire for better SWM service and whether respondents pay for the current SWM were both positive at 1% and 10% levels of significance respectively. This indicates that once respondents desire for better SWM services, the WTP probability will be higher than those who do not desire for any better SWM services. Also, those who pay for the current SWM services are more likely to pay for the said services, most especially, when it is improved.

Contrary to the study of Amfo-Otu *et al* (2012) in Akuapem North, satisfaction with the current SWM services was negative and significant at 5%. This suggests that those who are satisfied are less likely to pay for a better service as compared to those who are not satisfied.

## 5. CONCLUSION

The importance of WTP for the delivery of every social service including solid waste collection, management and its disposal cannot be overemphasized. This study has revealed beyond every reasonable doubt that the people of TAC are much concerned with their waste management practices and are willing to contribute for better management of their generated waste. This is obvious since 75.8% of the respondents indicated their willingness to pay (WTP) for the management of the waste they generated. It was also observed that payment for waste disposal is not absolutely new in TAC. A considerable percentage of people leaving at Tamso and Government Hill pay for the management of the waste they generate.

Moreover, the results of the model showed that respondents' sex, level of education, monthly income, mode of collection and the monthly WTP potential do not have any significant influence on the willingness of the respondents to pay for waste collection. Nevertheless, variables like age, satisfaction with the current SWM service, desire for a better SWM service and whether respondents pay for the current SWM service have significant effect on willingness to pay.

## 6. RECOMMENDATIONS

It is, therefore, recommended that;

- The waste collection service rendered by University of Mines and Technology (UMaT) to its staff residing at Government Hill should be extended to all and sundry in this area as deploying good measures, this may be a viable venture.
- Programmes that will enable potential investors in solid waste management should be introduced.
- Payment for this service should be made affordable to encourage households that are willing to pay.
- Also, public education campaign through mass media should be adopted in order to adequately inform citizens on the need to patronize solid waste management service.

## REFERENCES

1. Ademola, S. A., Adzimah, K. S. and Karikari M. C. (2012), "Assessment of Solid Waste Management in Tarkwa Municipality Ghana: Time Series Approach", *Journal of Environment and Earth Science*, Vol.2, No. 10, pp. 139-147.
2. Adepoju, A. A., and Salimonu, K. K. (undated). "Household Willingness to pay for Improved Solid Waste Management in Osun State, Nigeria", <http://www.appropiatech.net/files>, Accessed: March 11 2014.
3. Aggrey N. and Douglass O. G. (2010), "Determinants of Willingness to Pay for Solid Waste Management in Kampala City." *Maxwell Scientific Organization, Current Research Journal of Economic Theory* 2(3): No. 2042-485X pp. 119-122.
4. Amfo-Out, R., Waife, D. E., Adjei, K. P. and Akpah-Yeboah, S. (2012), "Willingness To Pay for Solid Waste Collection in Semi-Rural Ghana: A Logit Estimation", *International Journal of Multidisciplinary Research*, Vol. 2, No. 7, pp. 40-49.
5. Ampofo-Ohene, B. (2011), "Households' Willingness To Pay for Private Solid Waste Management in the Cape Coast Metropolitan", *Unpublished BSc Project Report*, University of Cape Coast, Cape Coast, Ghana, 39pp.
6. Anarfi, W. (undated), "Solid Waste Management in Ghana", [www.wastemanagement.ghana.com](http://www.wastemanagement.ghana.com), Accessed: March 30 2014.
7. Banga, M. Lokina, R. B. And Mkenda, A. F.(2011), "Solid Waste Collection Services in Kampala City, Uganda" *The Journal of Environment Development*, Vol. 20, No. 4, pp. 428-448.
8. Ekere, W. Mugisha, J. and Drake, L. (2010). "Willingness to pay for solid waste management in urban and peri-urban areas of the Lake Victoria crescent region Uganda.", *2nd RUFORUM Biennial Meeting 20-24 September 2010*, Entebbe, Uganda.
9. Elorm, F. V. (2013), "Municipal Solid Waste Management in Tarkwa Area council (TAC), Ghana", *Int. J. Sus. Dev. Plan*, Vol. 8, No. 4, pp. 563-575.
10. Massito, J. G. (2009). "Willingness to pay for a garbage Collection Service at University of Dar es Salaam residential area", *Unpublished MSc Thesis Report*, The University of Dar es Salaam, Tanzania, 124p.
11. Rahji, M.A.Y. and Oloruntoba, E. O. (2009). "Determinants of households' willingness-to-pay for private solid waste management services in Ibadan, Nigeria", *Waste Manage Research*, Vol. 27, pp. 961-965.
12. Yusuf, S.A., Salimonu K.K. and Ojo, O.T., (2007), "Determinants of Willingness to Pay for Improved House Solid Waste Management in Oyo State, Nigeria", *Research Journal of Applied Sciences*, Vol. 2, pp. 233-239.

**Source of support: Nil, Conflict of interest: None Declared**

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