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Determinants of household willingness to pay for improved waste disposal in Paynesville, Liberia

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***Abstract*---**This study examined the determinants of willingness-to-pay for improved waste management systems by urban households in Paynesville, Liberia. A multistage random sampling technique was used in selecting 377 households. The data that were obtained were analysed through the use of binary logit model. The result of the analysis showed that four variables significantly influenced households' willingness-to-pay. These include sex and education of the household head and income. These were positive and significant at $P < 0.05$. Household size was positive and significant at $P < 0.01$ level. This study implies that households have some critical socio-demographic attributes that affect their willingness-to-pay for improved waste disposal schemes. The study recommended vigorous public education campaigns via mass media; putting income status of households into consideration when setting waste collection levies; decision makers being responsive to household size and gender of the household heads in their policy making. These would to enhance environmental health and improve household livelihoods.

***Keywords*---**willingness-to-pay, waste management, urban households, Paynesville.

Introduction

There is no segment of the economy that do not produce wastes. Every one is a prospective manufacturer of wastes, from individuals to households and industries. Wastes are as old as the existence of human beings. From inception, in order to curtail the environmental hazards of wastes, conveying wastes out of households has been a major worry of authorities of various countries. At the conclusion of the World War II, there was significant increase in population and urbanization rates. Consequently, there was a raise in the demand for metropolitan waste management and waste disposal land space. The industrialized nations have discovered and applied quite a lot of devices for waste management. On the other hand, the situation is not the same in unindustrialized states (Lindell, 2012). In less developed countries, wastes are discarded either at nearby unoccupied space, open unrestricted space, brooks, rivers, or simply burn it within their vicinities (Medina, 2010).

According to Rathi (2007), the bulk of solid waste produced in large municipalities have been growing at an alarming rate. This upsurge was mainly accredited to high rate of urbanization as a result of urban migration and increase in standards of living. Increase in consumption, usage of disposable products and too much packaging cause complications of waste management in major cities in developing nations. Households produce huge quantities of waste; the nature of the wastes varies with time and place. Moreover, continual technological advances at household level with respect to electrical appliances necessitates households to have huge volume of outdated devices with no prescribed disposal mechanisms. These devices have high quantity of noxious substances like mercury and lead. In less developed countries, sites of waste disposal metamorphose into springs of environmental pollutions as a result of development of flies, mosquitoes, and rodents. These serve as vectors of infectious diseases that cause deteriorations in the health of the populace (Abul, 2010). Consequently, Mary and Adelayo (2014) opined that wastes are major concerns of the governments of developing countries due to incongruous designs, derisory governance, resource limitation and administrative inefficiency.

Subsequently, the deprived and underprivileged people in the society usually feel pain from the effects of pitiable waste management practices (IUCN (2009). The threats of infectious diseases has potentials of reducing productivity of workers, increasing numbers of out-of-school children, and depressing resistance to economic shocks. Ultimately, the poor are perpetually become victims of grievous financial pressure, with deprivation of prospects for better living standard. In the long run, inappropriate waste management has very great economic, environmental and social costs that require serious consideration by all stakeholders. Like the other developing countries, solid waste management is a serious challenge in Liberia.

Statement of the Problem

The attempt to alleviate the problem of waste management in Paynesville and others towns in Liberia, requires strong commitment on the part of all stakeholders. It is essential to study local communities, especially households'

interests to contribute towards attaining improved waste management. It was indicated by Mary and Adelayo (2014) that the development of waste management has always been measured by service providers' performance. This notion has constrained the achievement of the enhancement of waste management system because little or no consideration is being given to the demand side. Conversely, the involvement of resident communities who form the service recipients is critically indispensable, if effective decisions making and provision of adequate solutions to environmental problems would be achieved. In light of this, the study aims to analyze the socio-demographic determinants of household willingness to pay (WTP) for improved waste management in Liberia, using Paynesville as case study.

There is increased concern that waste management in several cities of Liberia is of poor quality, while collection of refuse is not consistent. This is demonstrated by raw sewage flowing down streets, and presence of uncollected refuse in most residential locations and commercial centers. These pitiable waste management practices result in series of health hazards to urban households. Hence, waste management is critical environmental and health factor in major cities in the country. Urban households in many parts of Liberia adopted informal waste disposal arrangements at their own personal costs. This unlawful waste disposal practices are the chief causes of human health and environmental degradation in many urban centers. As a result, the concerned municipal authorities must improve their waste management program.

Undoubtedly, delivery of waste management services in cities is a costly enterprise with colossal financial burdens on the local governments (Pacione, 2005). Barbereyie (2009) clarify that local governments and waste management service providers must have a dependable and viable sources of funds for covering service costs if they want to the waste management to be efficient. Hence, Aggrey and Omortor (2010) opine the importance of timeliness in the sharing of cost of waste management by households. In order to do this, the question of demand must be analysed for improved solid waste management. Also, it is vital to discern that sustainability of funds for waste management is dependent on the willingness of the public to pay for the improved waste disposal services. Households' willingness to pay is a dynamic concept that need to be studied to identify factors affecting willingness to pay and thus draw rational deductions for policy guidelines. Therefore, this study aims at investigating the factors that influence households' willingness to pay for improved waste management in Paynesville, Liberia.

Literature review: determinants of households WTP for improved waste management

Waste management is a most serious global issue, predominantly in less developed countries. This has resulted in the acknowledgement of improved waste management as a principal theme in global environmental sustainability and development. A number of studies have been conducted to examine the demand side or households' willingness to pay for improved waste management system. In India, Roy et al (2013) studied the WTP for sustainable solid waste management. They used binary probit regression for the study. It was discovered that monthly

average household expenditure, household size, average education, environmental awareness and number of working woman present in the household were directly related with WTP for solid waste management scheme. In Pakistan, Anjum (2013) used logistic and multiple regression to detect that willingness to pay for solid waste management is significantly influenced by age, household income, education and environmental awareness. Similarly, Khattak and Amin (2013) intended to find out public WTP for the management of environmental hazard caused by solid waste.

They employed binomial logit model, and established that household income, family disease history, education and household size were key elements that influence household's WTP. Mustafa et al (2014) demonstrate that education, income, awareness, location and household size influence WTP. In order to discover household's willingness to pay for waste management in Peshawar, Pakistan, Naeem et al. (2013) made use of binomial logit regression model. They specify that income, education, awareness, households size and diseases history had substantial impact on household's willingness to pay. Thirumarpan (2015) used binomial logistic regression to establish that household willingness to pay for improved waste management in Batticaloa, Sri-lanka, was positively affected by average household income and expenditure, household size. Nevertheless, magnitude of generated waste, number of times of waste disposal and gender had negative effects on willingness to pay for improved waste management.

In Ghana, Alhassan and Mohammed (2013) investigated demand of households for better waste disposal services by employing contingent valuation method. Their study shows that the most significant factors that influence WTP are the environmental safety concern, level of satisfaction of current waste disposal services, level of education, household size, length of stay in the current residence, walking time to public dump site, and sex of respondent. Similarly, Addai and Danso-Abbeam (2014) disclosed that willingness to pay for improved waste management is significantly associated to level of education, gender, household size and age of the household head. Amfo-Otu et al (2012) show that sex, level of education, income, level of expenditure, payment frequency, collection frequency and satisfaction with the present waste management system do not have any significant influence on the willingness to pay for waste collection in semi-rural towns of Ghana. On the other hand, mode of collection, occupation and age reportedly had significant effects on willingness to pay. Nkansah et al. (2015) used tobit regression to estimate the determinants of willingness to pay for improved waste management in Tema Metropolis. It was revealed that income, level of educational, number of dependants, and household size influences the willingness to pay for sanitation improvements.

In Nigeria, Ojo et al (2015) evaluated improved household waste management system. They used multiple regressions model and identified that age, income, environmental awareness and household expenditure have a positive association with the willingness of households to pay for waste disposal. But household size has negative association with households' willingness to pay. Also, Mary and Adelayo (2014) show that households' willingness to pay is influenced by price of the service, age of the respondents, level of education and household size. Adebo and Ajewole (2012) disclosed that willingness-to-pay for waste disposal is

significantly influenced by gender, nature of primary occupation, marital status, level of education and average monthly income. Yusuf, Salimonu and Ojo (2007) established that price of the service, age, educational level, household size and household's monthly expenditure significantly influenced household's willingness to pay. In Uganda, Ojok et al (2015) studied households' willingness to pay (WTP) for improved municipal waste management using logit linear regression model. The determinants of WTP are gender, age, household size, education level, income level, marital status and migration status of household respondents. However, Niringiye and Omortor (2010), discovered that the age of the household head is negatively related with the willingness to pay for waste management. They concluded that there would be little chance of success if waste collection service charges were introduced.

In Ethiopia, Dagnew et al (2012) show that WTP for improved waste management is significantly connected to income and awareness of environmental quality. Tewodros and Samson (2009) show that WTP is significantly influenced by household income and current access to waste disposal containers. However, demographic features such as education, age, household size and gender have no significant impact on improved services of waste collection. Similarly, Birtukan (2013) displays that households' WTP is influenced by level of education, family size, number of children, length of time of stay in the community, income and household work. Family size was found to be inversely related with WTP. The remaining variables have a positive effect on WTP. Haile (2011) used logistic regression analysis to show that sex of the household head, education level of household head, distance of household from the main road, household's willingness to pay, household's access to private waste collectors' services and awareness on waste management are the main determinants of effective solid waste management.

Methodology of the study

Study area

Paynesville is a suburb east of Monrovia. It is geographically larger than the city of Monrovia and is expanding eastward along the Robertsfield Highway and northeastward beyond Red Light Market, one of the largest market areas in Liberia. Paynesville is often considered a part of the Greater Monrovia area. It is located in Montserrado, Liberia. Its geographical coordinates are 6^0 16'32" North, $10^0$43'4" West (Wikipedia, 2022). Paynesville has several neighborhoods, called "communities". These communities include A.B. Tolbert Community, Duport Road, ELWA, Gobuychop, Grayja, Kendeja, Kenny Town, King Gray Town, Nizohn, Parker-Paint, Plofe, Police Academy, Red Light Market, Rehab Road, Peace Island, SD Cooper Road, Sinda Town, SKD Boulevard, Stephan Tolbert Estates, Wamba Town and GSA Road. Liberia has a population of 5.3 million, with 2.44% growth rate (Knoema, 2022; World Population Review, 2022). About 1 million are resident in the capital Monrovia (Worldometer, 2022), of which Paynesville forms a greater part.

Research Design and Methods

Primary data are used to obtain required information on the study area. The data are collected from the household heads, and household key informants by the aid of questionnaire and interview. The study made use of multi stage sampling techniques. Firstly, two communities (GSA Road and Duport Road) were purposively selected out of 21 communities in Paynesville. These two communities were purposively selected because they are the most populous communities in Paynesville. Secondly, 377 households were randomly selected from the two sampled communities. Questionnaire was administered to gather information on households' demographic characteristics and willingness to pay for improved waste collection services. The study used both descriptive statistical tools and inferential statistics. Binary logistic model was applied to identify the demographic and socio-economic determinants of households' willingness to pay for improved waste management. The collected data through household survey were analyzed using SPSS software version 20.

Model specification

Data collected from survey was analyzed by logit model. The household willingness to pay (WTP) question was a dichotomous choice, i.e. Yes / No; hence the study applied a binary logit model as suggested by Green (2003). A binary willingness to pay was regressed against a vector of socioeconomic characteristics of households and their respective heads. This enables the study to identify the factors that influence willingness to pay for improved waste management by households. The probability P that the respondent will be willing to pay for improved waste disposal is given by:

$$Pr(WTP = 1/0) = X_i \beta_i + \varepsilon \ldots\ldots\ldots\ldots\ldots (1)$$

Where β_i = vector of parameters to be estimated and
X_i = Vector of independent variables
WTP is a function of monthly household income, sex of household head, age of household head, household size, education of household head, occupation of household head, and environmental awareness.
Then for willingness to pay (=1/0) is given by:

$$\log(Pr(WTP) / (1 - WTP)) = \beta_0 + \beta_1 Sex + \beta_2 Hhs + \beta_3 Age + \beta_4 Edu + \beta_5 Occu + \beta_6 MAI + \beta_7 EA + \varepsilon \ldots (2)$$

Where,
WTP = willingness to pay for improved waste management
Sex = sex of household head
Hhs = household size
Age = age of household head
Edu = highest level of education for household head
Occu = occupation of household head
MAI = monthly average income
EA = environmental awareness
The parameters were estimated using maximum likelihood estimation.

Results and Discussion

Socio-demographic characteristics of the respondent households

Table 1 shows the socio-demographic characteristics of the selected households in Paynesville, Liberia. It shows the frequencies, percentages and mean values of their characteristics.

Table 1
Socio-demographic characteristics of the selected households

Socio-demographic characteristics	Frequency	Percent (%)	Average
Sex			
Male	339	90.0	
Female	38	10.0	
Total	377	100.0	
Age			42.5
20-29	45	11.9	
30-39	94	24.9	
40-49	135	35.8	
50-59	72	19.1	
≥ 60	31	8.2	
Total	377	100.0	
Household size			6.8
1-5	91	24.0	
6-10	158	42.0	
> 10	128	34.0	
Total	377	100.0	
Education level			
None	17	4.5	
Primary	107	28.4	
Secondary	192	50.9	
Vocational	36	9.5	
Tertiary	25	6.6	
Total	377	100.0	
Major Occupation			
Farming	99	26.3	
Civil servant	143	37.9	
Trader	50	13.3	
Unemployed	85	22.5	
Total	377	100.0	
Monthly income (USD)			201.83
1-100	52	13.8	
101-200	110	29.2	
201-300	149	39.5	
301-400	30	8.0	
401-500	22	5.8	
> 500	14	3.7	
Total	377	100.0	

Awareness of availability of improved waste management	234	62.0
Aware	143	38.0
Non-aware	377	100.0
Total		
Willingness to pay for hygienic waste management services	264	70.0
Willing	113	30.0
Non-willing	377	100.0
Total		

The socio-demographic characteristics distribution of the households and their respective heads are shown in Table 1. Male-headed households accounted for the majority (90%). This is due to the fact that men are mostly in charge of decision making of household expenditures in various homes within the study area. Most of the household heads (35.8%) were within the age range of 40 to 49 years. The average age was 42.5 years. The age distribution of respondents indicates economic active population. This implies that the household heads of the selected households could work to earn income to pay for waste disposal services. All except 4.5% of the household heads had some formal education; 67% had between secondary and tertiary education. This suggests that the respondents can understand and appreciate the importance of paying for waste disposal services. The household size distribution showed that 24.0% of the respondents had between 1 and 5 household members, 42.0% had between 6 and 10 household members, and 34.0% had above 10 members.

The average household size of respondents was approximately 7. This suggests that households would generate more waste and this calls for effective waste disposal services within their communities. The responses on income distribution showed that 43.0% had average monthly income below USD200 and 9.5% had average monthly income above USD400. The rest had average monthly income between USD200 and USD400. Considering the average monthly income of the selected households and the household size, it could be inferred that an average household member lives below USD1.00 per day poverty line. This implies that the selected households might have difficulties in paying for improved waste disposal services. Majority (62%) of the selected households claimed to have awareness of environmental hazards attributable to poor waste disposal services within their communities, while the rest claimed to be unaware. Most (70%) of the selected households disclosed to be willing to pay for improved waste disposal services, while 30% showed no interest in payment for such services.

Determinants of households' willingness to pay for improved waste disposal services (Binary Logistic Output)

Table 2 shows the significant variables that influenced households' willingness to pay for improved waste management.

Variables	*Coefficients*	*P-value*
Intercept	1.495	0.216
Sex	2.471	0.011**
Household size	3.344	0.007***
Age	-0.418	0.323
No formal education	-0.313	0.642
Primary	0.360	0.418
Secondary	1.142	0.287
Vocational	2.053	0.025**
Tertiary	2. 363	0.018**
Occupation	0.125	0.376
Income	2.436	0.015**
Awareness	-0.1498	0.463
Cox and Snell R^2	0.529	
Nagelkerke R^2	0.734	
Chi-square	85.37	
P-value	0.001	

The significant variables include sex of the household head, household size, level of education of household head and monthly income. The result shows that a female-headed household is twelve times ($e^{2.471} = 11.83; p=0.011$) more willing to pay for improved waste disposal compared to the household headed by a man. From Table 2, larger household size significantly influences household's willingness to pay for improved waste disposal. A large size household was twenty eight times ($e^{3.344} = 28.33; p=0.007$) more willing to pay for improved waste disposal services than a smaller size household. This is because larger households generate more wastes and require improved waste disposal services more than small size households.

Educational level is critical in determining willingness to pay for improved waste disposal services. The willingness to pay for improved waste disposal services was not statistically significantly different among households that were headed by individuals with no formal education, basic education, or secondary education. However, there was statistically significant difference in willingness to pay for improved waste disposal services between households headed by individuals that have vocational or tertiary education and others that did not have such level of education. A household that have a head with tertiary education was eleven times ($e^{2.363} = 10.62; p=0.018$) more willing to pay for improved waste disposal services than a household that have a head without tertiary education. Also, a household that have a head with vocational education was eight times ($e^{2.053} = 7.79; p=0.025$) more willing to pay for improved waste disposal services than a household that have a head without vocational education. This is because a household head with tertiary or vocational education had job(s) that could easily generate income to pay for improved waste disposal services as compared to those with no such type of education. This is consistent with findings from other studies (Addai and Danso-Abeam, 2014, Aggrey and Douglason, 2010 and Oteng-Ababio, 2010) that people with higher education are well able to understand and appreciate improved waste disposal services. Thereby, they would be more willing to pay for improved waste disposal services.

Income had a significant positive impact on willingness to pay for improved waste disposal services. Households were eleven times ($e^{2.436}=11.43;\ p=0.015$) more willing to pay for improved waste disposal services with an increase in their income. This is similar with the observations of Awunyo-Vitor *et al.* (2013), Oteng-Ababio (2010) and Adepoju and Salimonu (undated). This implies that a proportionate rise in income would result in a more than proportionate rise in willingness to pay for improved waste disposal services, ceteris paribus. The Cox and Snell's R^2 and Nagelkerke's R^2 were obtained to measure the strength of the association between the willingness to pay for improved waste disposal services and the explanatory variables. These two estimated R^2 s were found to be high, accounting for 0.529 and 0.734 for Cox and Snell's R^2 and Nagelkerke's R^2 respectively. These indicate high explanatory power of the model. The Omnibus test of the model coefficients, as revealed by the value of Chi-square test- statistic (85.37), implies that willingness to pay for improved waste management is related to each specified explanatory variable. It also infers that the overall model is statistically significant.

Conclusion and Recommendations

Household waste management is a serious problem that confronts Liberia urban centers. Waste management in Liberian cities has not been carried out in a suitable and appropriate manner. As a result, the quality of environment in cities has become more deteriorated on daily basis; hence, residents suffer from living in such worsened conditions. This study shows that sex of household head, formal education of household head at vocational and tertiary levels, household size, income are the most important factors associated with households' willingness to pay for improved waste management. The majority of the households were willing to pay for improved waste disposal services. Based on the findings the following recommendations were made to improve waste management in Paynesville, Liberia:

- Public education campaigns through the mass media could be embraced with the aim of properly informing the populace about the need to utilize the services of waste disposal managers.
- When setting waste collection levies, the concerned authorities should pay attention to income regimes of the affected households.
- Waste disposal managers should be more responsive to household size and gender of the household heads when making decisions towards improved waste management services.

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