SOLID WASTE MANAGEMENT IN MAIDUGURI METROPOLIS: HOW MUCH ARE HIGH-INCOME HOUSEHOLD WILLING TO PAY FOR IMPROVED COLLECTION?

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Abstract

This study analysed households' willingness to pay for improved solid waste collection among high-income households in Maiduguri metropolis, Borno state, Nigeria. The data were gathered through structured questionnaires using the Kobo Toolbox. The research employed a stratified sampling approach in a multistage manner. In the initial stage, Maiduguri's wards were categorised based on income levels. Subsequently, two out of the three high-income wards were randomly chosen. The Contingent Valuation Method (CVM) was utilised to determine the willingness-to-pay values, and the probit model was employed for result analysis. The study revealed some issues related to solid waste as highly important, with varying degrees of urgency assigned to specific concerns such as erosion, pollution, climate change, and habitat loss. Results from the analysis indicated that several factors such as gender, level of education, age category, employment status, household size, income category, house ownership, number of rooms, and duration of stay significantly influence respondents' willingness to pay for improved household collection management services. The study also revealed that households within the study area were willing to pay ₦5,795 monthly for improved solid waste collection. The study recommends private companies devise focused approaches aimed at optimising community involvement and collaboration to attain efficient household collection management. The government should also launch educational campaigns to inform residents about the environmental and health risks associated with "Local dump facility" and "Burning" methods.

Keywords: Contingent Valuation Method, Solid Waste, Higher Income Households, Willingness to Pay
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Introduction

Waste management has remained a global concern, leaving developing countries with a greater part of the challenge unaddressed. The problem is ever-increasing as a result of rapid population growth, urbanisation and the quest for an increasing standard of living which has greatly accelerated the consumption of natural resources that resulted in the addition of economic management costs (Song *et al.*, 2015). The generation of municipal solid waste (MSW) is one of the important contemporary environmental problems in urban areas (Pattnaik & Reddy 2010). It is indeed one of the developmental challenges facing city authorities worldwide, especially in most developing countries (UNEP 2013). Although a man cannot live without generating waste, evidence has shown that the global population of urban residents has continued to grow significantly within the last decades. It was reported that, with about 55 per cent of the world's population living in urban areas in the 1950s, the figure is projected to reach 68 per cent by the year 2050 (United Nation, 2018). Begun *et al* (2007); Ayenew *et al,* (2019) also assert that; cities in developing countries are

facing an increasing generation of waste. It is currently estimated that solid waste generation is growing faster in urban areas than in rural urbanisation (Hoomweg & Bhada-tata, 2012; Ayenew *et al* 2019). As pointed out by Mukhtar and Akan (2018), the problems of poor waste management are mainly associated with poor funding and lack of awareness. Furthermore, it is mostly perceived that developing countries in Africa are unable to come up with a proper waste management system. This has indeed posed a threat to their standard of living as some cities practice either the traditional method of waste disposal (landfill and or Burning) or unhealthy waste disposal practices such as; dumping waste on waterways, indiscriminate dumping and poor nature of dumping facilities. This region amongst other things lack adequate recycling facilities, poor treatment of wastes and little collection coverage and these put together may increase health risk and environmental pollution. These challenges, if not addressed may lead to serious health hazards, environmental problems and poor societal outlook.

Lack of proper collection and disposal of municipal solid waste has been a contributor to air, soil and water pollution and this could be because nearly 2 billion people worldwide still could not access solid waste collection services, with the lowest collection rates observed in low-income countries (Rodic & Wilson., 2017). This contributes to worsening environmental degradation (Marshall & Farahbakhsh., 2013) and Sub-Saharan Africa with a waste generation of about 62 million tons per year ranging from 0.09 to 3.0 kg per person per day, with an average of 0.65 kg/capita/day (Hoornweg & Bhada-Tata, 2012; Mombo & Bigirwa, 2017).

Nigeria is the most populous nation in Africa with over 170 million people (NPC, 2016) and there is no doubt that this large population will generate a huge amount of waste which mostly comes from the urban areas. This has brought about an increase in the stretch of urban infrastructural facilities. Hence this development has also affected the existing facilities because they could not meet the current predicament. Moreover, the country has not been particularly apprehensive about waste management. Solid waste is not managed properly; due to inefficient collection, inappropriate disposal of the waste and no enough coverage of the collection amongst others. Open dumping as well as open burning in unapproved locations has been a norm.

Maiduguri Metropolis, located in Borno state, Nigeria, faces challenges in managing its solid waste due to increasing urbanisation, population growth, and inadequate waste management infrastructure. In this context, the effectiveness of waste management services, especially among high-income households, is of particular interest. Despite its significance, the willingness of high-income households in Maiduguri Metropolis to financially contribute to improved solid waste collection remains a crucial yet understudied aspect. Understanding how much high-income households are willing to pay for enhanced waste collection services is essential for designing sustainable waste management strategies that align with the preferences and priorities of this demographic group.

The absence of comprehensive research focusing on the willingness of high-income households to pay for improved waste collection services in Maiduguri Metropolis presents a knowledge gap. This research aims to address this gap by investigating the factors that influence the willingness of high-income households to financially support improved solid waste collection services, thereby contributing valuable insights to the sustainable development and effective waste management of the metropolis.

The objectives of this study were to assess the socioeconomic characteristics of households in the study area, estimate the factors influencing willingness to pay for improved solid waste collection and estimate the amount that high-income households are willing to pay for the improved solid waste collection. In light of these considerations, this research seeks to answer the following question: What are the socioeconomic characteristics of households in the study area, what are the factors influencing willingness to pay and how

much are high-income households in Maiduguri Metropolis willing to pay for improved solid waste collection?

By addressing this problem, the research aims to inform policymakers, waste management authorities, and relevant stakeholders about the preferences and priorities of high-income households, ultimately contributing to the development of tailored waste management strategies that enhance the overall quality of life and environmental sustainability in Maiduguri Metropolis.

Methodology

The study focused on Maiduguri metropolis, the capital city of Borno state, which is known for its cosmopolitan nature and economic activity. The population of high-income households in Maiduguri Metropolis according to Yarwa Primary Health Care (2022) was reported as 210,708. The sample size determination was based on Mitchell and Carson's (1989) formula and a sample size of 399 was obtained, with an additional 10 per cent for a total of 402. To ensure an equal distribution of responses among questionnaire versions, each version received an equal number of questionnaires (134 copies for each version).

Initially, a multi-stage sampling technique was employed to categorise the wards into income groups, from which two high-income wards (Maisandari and Bolori 2) were randomly chosen. The selection of respondents followed a random approach, using the Yarwa Primary Health Care Clinic Immunisation register for households within the Maiduguri metropolis. This involved utilising an Excel random number generator to select 402 households of respondents from the chosen two high-income wards. It is important to note that all participants provided verbal consent to participate in the study before the questionnaire was administered. The administration of questionnaires to the selected households was facilitated by enumerators and immunisation ad hoc staff. The questions were presented to respondents in the language they felt most comfortable with, ensuring effective communication and understanding. The research adapted a questionnaire from Adam *et al*. (2015) which was modified to suit the purpose of this study. The research employed the dichotomous choice contingent valuation method to collect data. At the outset, respondents were presented with a scenario that detailed the attributes of the enhanced waste collection service along with an associated service fee. For the initial fee (initial bid), respondents were asked if they would accept it. In the event of an affirmative response, a higher bid was introduced, whereas a negative response prompted the presentation of a lower bid (Bateman *et al*., 2001). The bid values incorporated into the survey questionnaire were deliberately varied to encompass a broad spectrum of potential WTP values. The study featured nine bid values that reflected the proposed enhancements in solid waste collection services.

In the double-bounded dichotomous choice model, we typically model the probability that the respondent will accept a bid BB to acquire a good or service. The following probability was modelled using the logistic function:

$B_{initial}$: for the initial bid,
B_{lower}: for the lower bid in the second round,
B_{higher}: for the higher bid in the second round.

The probability that a respondent *i* with specific characteristics accepts a bid B can be modelled using the logistic function:

$$Pi(B) = \frac{1}{1+e^{-\partial+\beta B}} \quad (1)$$

where:

- B: any of the bid amounts: $B_{initial}$, B_{lower} or B_{higher}
- α and β: are the model parameters to be estimated.

The respondent will accept the bid if a random draw "U_i" from a standard uniform distribution (ranging from 0 to 1) is less than p_i(B):
Acceptance i = (U_i<p_i(B))

The likelihood of observing the responses for a set of respondents can be written as the product of the individual probabilities of acceptance for each bid amount:
$L(\alpha,\beta)= \pi \prod_{i=1}^{n}[p_i(B_{initial})^{Acceptance_{i,initial}} \times pi(B_{lower})^{Acceptance_{i,lower}} \times pi(B_{higher})^{Acceptance_{i,higher}}]$ (2)

To estimate the parameters α and β, the log-likelihood function would be maximised. The log-likelihood would sum the log probabilities of acceptance for each bid amount:

$L(\alpha,\beta)= \sum_{i=1}^{n}[In(_{pi}(B_{initial})) + In(_{pi}(B_{lower})) + In(_{pi}(B_{higher}))]$ (3)

The bids of double-bounded dichotomous choice contingent valuation, are typically denoted as follows

- Initial Bid (B): The starting bid presented to respondents.
- Upper Bid (UB): The higher bid is presented to respondents in the second stage if they reject the initial bid.
- Lower Bid (LB): The lower bid is presented to respondents in the second stage if they accept the initial bid.

Let us use the given values for the initial bid, upper bid, and lower bid for different income groups and versions:
For a particular income group and version (A, B, or C), we have the following bid values:

- Version A:
  - Initial Bid (B_1) = ₦2,000
  - Upper Bid (UB_1) = ₦2,500
    Lower Bid (LB_1) = ₦1,500
- Version B:
  - Initial Bid (B_2) = ₦2,500
  - Upper Bid (UB_2) = ₦3,000
  - Lower Bid (LB_2) = ₦2,000
- Version C:
  - Initial Bid (B_3) = ₦3,000
  - Upper Bid (UB_3) = ₦3,500
  - Lower Bid (LB_3) = ₦2,500

If a respondent accepts the initial bid (B), they pay the amount of the initial bid. If they reject the initial bid, they are then presented with the choice of paying the upper bid (UB) or not purchasing the item. Similarly, if they decline the upper bid, they are presented with the choice of paying the lower bid (LB) or not purchasing the item.
The mathematical expressions for the bidding process, considering acceptance or rejection at each stage, can be represented as follows:

- If the respondent accepts the initial bid:
  - Payment (P) = Initial Bid (B)
- If the respondent rejects the initial bid and accepts the upper bid:
  - Payment (P) = Upper Bid (UB)
- If the respondent rejects both the initial and upper bids and accepts the lower bid:
  - Payment (P) = Lower Bid (LB)

Results and Discussion

Socioeconomics characteristics of respondents

Table 1: Socioeconomics Characteristics of Respondents

Variables	Category	Frequency (%)
Gender	Male	322 (80.1)
	Female	80 (19.9)
Age	20-30	42 (10.5)
	31-40	121 (31.1)
	41-50	113 (28.1)
	51>	126 (31.3)
Higher Education	Yes	321 (79.8)
	No	18 (20.2)
Employment	Employed	351 (87.3)
	Unemployed	51 (12.7)
Households Size	1-4	129(32.1)
	5-8	193(48.0)
	9>	80 (19.9)
Income Category	₦0-₦50000	47 (11.7)
	₦51000-₦100000	117 (29.1)
	₦101000-₦150000	86 (21.4)
	₦151000-₦200000	84 (20.9)
	₦200000 and Above	68 (16.9)
House Ownership	Owners	292 (72.6)
	Rent	110 (27.4)
House Rent	0- ₦100,000	328 (81.6)
	₦101,000-₦200,000	30 (7.5)
	201,000>	44 (10.9)
Numbers of room	1-3	299 (74.4)
	4-6	100 (24.9)
	7>	3 (0.7)
Duration of stay in current location	1-6	81 (20.1)
	7-12	170 (42.3)
	13>	151(37.6)

Source: Field Survey, 2022

The result from socioeconomic data (see Table 1) revealed that the majority of the respondents were male constituting 80.1 per cent and were above the age of 40 years (59.4%). Age can affect perceptions of the personal benefits derived from enhanced waste collection services. Maskey and Singh (2017) reported that older individuals might prioritise cleanliness and sanitation for their families, while younger individuals might emphasise environmental preservation and health. The findings also indicated that 79.8 per cent possessed advanced educational qualifications. Individuals with higher education levels are often more exposed to environmental issues, leading to greater awareness and consciousness. Educated individuals often have better access to information, including the potential consequences of inadequate waste management. This access might drive a higher willingness to pay for improved collection services. The findings also revealed that the majority (87.3%) of the high-income households were employed. Employment status can directly affect income levels. Employed individuals might have a higher income, which can influence their ability and willingness to pay for enhanced waste collection services. Employment might lead to time constraints, which can affect waste management practices. The findings correlate with the study of Wegedie *et al*., (2020) who stated that employed individuals might be more willing to pay for services that save them time and effort in waste disposal.

Furthermore, the results also unveiled that a significant proportion of the respondents have a household size ranging from 5 to 8 individuals and 59.2 per cent have a monthly income of over one hundred thousand

naira. Larger households tend to generate more waste compared to smaller ones. High-income households with larger household sizes might be more motivated to pay for improved collection services to manage their waste effectively. These findings are in line with the work of (Song, 2016) who argued that household size can affect income distribution within a family. High-income households with larger family sizes might allocate more funds for waste management services due to their greater economic capacity (Ndau & Tilley, 2018). Furthermore, a significant portion of the households, comprising 42.3 per cent, have resided in the present area for a duration ranging from 7 to 12 years. Longer-term residents might feel a stronger sense of community and a greater desire to invest in the betterment of the locality. This could translate into a higher willingness to pay for enhanced waste management services. The findings are similar to the study of (Huynh *et al*., 2022) who reported that households that have been in the area for several years might have witnessed changes in waste generation, collection, and disposal. If they perceive an increased need for improved waste management, they might be more willing to pay for such services.

Attitude and opinion about the environment

Respondents' attitudes about environmental importance determine their choice of solid waste disposal practice.

Table 2 Attitude and Opinion about Environment *(n=402).*

Variable	Response Scale	Frequency (%)
Solid Wastes Problem	Yes, very important	217 (54.0)
	Yes, rather important	123 (30.6)
	No, not important	38 (9.5)
	No, not important at all	24 (6.0)
Erosion Flood and Land Subsistence	Most Critical	226 (56.2)
	Moderately Critical	106 (26.4)
	Least Critical	70 (17.4)
Industrial Pollution	Most Critical	107 (26.6)
	Moderately Critical	190 (47.3)
	Least Critical	105 (26.1)
Climate Change	Most Critical	234 (58.2)
	Moderately Critical	125 (31.1)
	Least Critical	43 (10.7)
Water Air and Land Pollution from Solid Wastes	Most Critical	141 (35.1)
	Moderately Critical	176 (43.8)
	Least Critical	85 (21.1)
Haze	Most Critical	137 (34.1)
	Moderately Critical	186 (46.3)
	Least Critical	79 (19.7)
Loss of Fauna and Flora	Most Critical	80 (19.9)
	Moderately Critical	178 (44.3)
	Least Critical	144 (35.8)
Our landfills are fast filling which will take more of our land	Yes	300 (74.6)
	No	102 (25.4)
Landfills increase the price of land in the Future	Yes	305 (75.9)
	No	97 (24.1)

Source: Field Survey, 2022

In the Attitude and Opinion about Environment section (see Table 2) a significant majority of households, comprising 54 per cent, indicated that the concern regarding the solid waste problem holds high importance. The acknowledgement of the importance of the solid waste problem implies that households are conscious of the challenges associated with waste management. This heightened awareness can lead to a greater willingness to support solutions that address the issue, such as improved collection management. More so, when households recognise a problem as significant, they might also perceive it as requiring immediate

attention and resolution. This sense of urgency could translate into a greater readiness to invest in measures that enhance waste collection management. These findings intersect with the study (Ndau & Tilley, 2018) which supported that if households deem the solid waste problem to be of high importance, they are more likely to prioritise it when allocating resources. This alignment of priorities can result in a willingness to allocate funds for improved waste management services.

The findings also indicated that a substantial majority of households, accounting for 56.2 per cent, expressed that the issue of Erosion Flood and Land Subsistence is of utmost critical. When households recognise the importance of environmental issues such as erosion, flood, and land subsistence, they might also extend their concern to related matters like waste management. This shared concern for the environment can lead to a greater willingness to invest in practices that mitigate environmental challenges, including improved waste collection. According to (Marshall & Farahbakhsh, 2013) a perception that environmental issues are critically important can foster a sense of responsibility for the well-being of the community. This sense of responsibility might extend to various aspects of community improvement, including waste management.

The results also revealed that a significant proportion of households, constituting 47.3 per cent, conveyed that Industrial Pollution is of moderate significance. In addition, Climate Change was deemed the most critical concern (58.2%), while Water Air and Land Pollution from Solid Wastes (43.8%) was considered moderately critical. Haze (46.3%) and the loss of Fauna and Flora (44.3%) were both viewed as moderately critical issues. The acknowledgement of multiple environmental concerns indicates a comprehensive awareness of various challenges. This awareness might extend to waste management issues, encouraging households to invest in solutions that enhance waste collection and contribute to overall environmental well-being. Understanding the interconnectedness of various environmental issues can lead to a perception that addressing one challenge positively impacts others (Maskey & Singh, 2017). This perspective can encourage households to invest in solutions that have wide-ranging benefits, including improved waste management (Buba, 2016).

Methods of waste disposal

To prevent the spread of diseases while enhancing the environmental outlook, it is important to describe households' methods of waste disposal in the study area.

Table 3Households Methods of Wastes Disposal *(n=402)*

Variables	Response	Frequency(%)
Waste Disposal Method	Local dump facility	122 (30.3)
	Burning	105 (26.1)
	Roadside	12 (3.0)
	Riverside	2 (0.5)
	Burying	44 (10.9)
	BOSEPA	42 (10.4)
	Confer cleaners	34 (8.5)
	Non-formal waste collection	33 (8.2)
	Open space	8 (2.0)
	Railside	0 (0)
Disposal frequency	Twice weekly	46(11.2)
	Weekly	163(40.5)
	Fortnight	53(13.2)
	Monthly	140(34.8)
Disposal satisfaction	Yes	144(35.8)
	No	258(64.2)

Source: Field Survey, 2022.

The findings regarding household methods of waste disposal indicated that a significant majority of participants, accounting for 30.3 per cent and 26.1 per cent, employed local dump facilities and burning as their waste disposal methods, respectively. The prevalence of local dump facilities and burning as disposal methods might indicate a lack of proper waste management infrastructure. Local dump facilities and burning are often associated with health and environmental risks. Households that utilise these methods might become more open to investing in safer and more sustainable waste collection practices. A study done by Wegedie *et al*., (2020) reported if households are using less effective or potentially harmful waste disposal methods, they might express a desire for better alternatives. This desire could increase their willingness to pay for improved collection management services. More so Mulat *et al*., (2019) stated that households might be more willing to invest in improved waste collection management if they recognise the benefits of proper disposal methods, such as reduced health risks and a cleaner environment. The realisation that local dump facilities and burning can negatively impact the local community might motivate households to support initiatives that enhance waste collection management for the overall well-being of the community (Ke et al., 2022).

The results also indicated that a significant majority of households, accounting for 40.5 per cent, carried out waste disposal weekly. Accordingly, this finding is similar to that of Stanley *et al.,* (2012) as 44.4 per cent of people living in Sabon Gari Zaria disposed of their waste weekly. Households that dispose of waste weekly are likely to have a more immediate and frequent interaction with waste management issues. This ongoing engagement could make them more attuned to the benefits of improved collection management and more willing to invest in such services. Frequent waste disposal might be perceived as an inconvenience (Anjum, 2013). Households that routinely manage waste might be more open to investing in services that enhance the convenience and efficiency of waste collection (Yasin, 2021).

The findings also revealed that a significant majority of households, constituting 64.2 per cent, expressed dissatisfaction with their initial waste disposal method. Household dissatisfaction with current waste disposal methods implies that they recognise inefficiencies or drawbacks in their current practices. This recognition can make households more open to investing in improved collection management solutions. Expressing dissatisfaction indicates a desire for better waste disposal alternatives. Households that are dissatisfied might be more willing to pay for improved collection management services that offer more convenience and effectiveness. The finding is in line with the study of Ndau and Tilley (2018) who pointed out that households that acknowledge their dissatisfaction might also be more willing to embrace change. This adaptability can extend to adopting new waste management practices and investing in services that offer improvements.

Table 4: Probit Regression on Factors Influencing Willingness to Pay for Improved Solid Waste Collection

					95% conf. interval	
Parameter	Coefficient	Std. Err	Z	P-value	Lower	Upper
Initial bid	-0.0006	0.0002	-2.77	0.006	-0.0010	-0.001
Gender						
Male	1.8059	0.3459	5.55	0.000	1.1279	2.4838
Age category						
Greater ≥ 41	-0.2739	0.2168	-1.26	0.206	-0.6989	0.1510
Higher Edu						
Yes	0.7056	0.2664	2.65	0.008	0.1834	1.2278
Employment						
Employed	0.0961	0.3184	0.30	0.763	-0.5279	0.7202
Household Size	-0.0143	0.0347	-0.41	0.680	-0.0825	0.0538
Income Category						
51000–100000	0.4867	0.3990	1.22	0.223	-0.2953	1.2689
101000–150000	0.8359	0.4238	1.97	0.049	0.0052	1.6666
151000–200000	0.9458	0.4284	2.21	0.027	0.1060	1.7856
200000 and above	1.2888	0.4603	2.80	0.005	0.3865	2.1910
House Ownership						
Owners	0.8897	0.4847	1.84	0.066	-0.0603	1.8398
House Rent	2.38e-06	1.75e-06	1.36	0.174	-1.05e-06	5.81e-06
No. Room	0.3605	0.1090	3.31	0.001	0.1467	0.5743
Duration	0.0658	0.0185	3.55	0.000	0.0295	0.1021
Constant	-3.5325	0.8259	-4.28	0.000	-5.1514	-1.9136
log likelihood(α)	-274.150					
Log-likelihood(β)	-141.747					
LR chi2(14)	264.81					
Prob > chi2	0.0000					
Pseudo R2	0.4830					

Source: Field Survey, 2022

Table 5: Model Diagnostics:

Diagnostics	Value
log likelihood (α)	-274.150
Log-likelihood(β)	-141.747
LR chi2(14)	264.81
Prob chi^2	0.0000
Pseudo R^2	0.4830

Source: Field Survey, 2022

Table 5 presents the Diagnostics of the Probit regression model. LR, Prob, Pseudo R^2, Unrestricted log-likelihood and restricted likelihood were used to observe the fitness of the model. The log-likelihood shows that the model has a good fit because the values of the unrestricted log-likelihood (-274.150) are closer to zero compared to the restricted log-likelihood (-141.747) while the p-value (0.0000) indicates that the model is statistically significant. The Pseudo R^2 (0.4830) indicates that the model is good in explaining the influence of the independent variables on the households' willingness to pay for solid waste collection in high-income areas.

Table 6: Post-Estimation Prediction from the Estimated Probit Regression

	Delta-method				95% conf. interval	
Parameters	dy/dx	Std. Err.	Z	P-value	Lower	Upper
Initial bid	-0.0001	0.0000	-2.84***	0.005	-0.0002	-0.0000
Gender						
Male	0.4269	0.0688	6.20***	0.000	0.2920	0.5618
Age Category						
Greater ≥ 41	-0.0521	0.0393	-1.32	0.186	-0.1292	0.0250
Higher Edu						
Yes	0.1562	0.0624	2.50**	0.012	0.0338	0.2785
Employment						
Employed	0.0193	0.0649	0.30	0.766	-0.1079	0.1466
Household Size	-0.0028	0.0068	-0.41	0.680	-0.0163	0.0106
Income Category						
51000–100000	0.1184	0.0978	1.21	0.226	-0.0733	0.3101
101000–150000	0.1978	0.1030	1.92*	0.055	-0.0041	0.3997
151000–200000	0.2211	0.1040	2.12**	0.034	0.0171	0.4251
200000 and above	0.2875	0.1086	2.65***	0.008	0.0746	0.5004
House Ownership						
Owner	0.2023	0.1180	1.71**	0.087	-0.0291	0.4337
House Rent	4.72e-07	3.43e-07	1.37	0.170	-2.02e-07	1.14e-06
No. Room	0.0714	0.0208	3.43***	0.001	0.0306	0.1122
Duration	0.0130	0.0035	3.68***	0.000	0.0060	0.0199

Source: Field Survey, 2022.

Note, *, **, and *** denote 5%, 10% and 1% levels of significance respectively.

Note: dy/dx for factor levels is the discrete change from the base level.

Initial Bid: The coefficient for the initial bid variable is -0.0001, with a standard error of 0.0000. This variable appears to have a statistically significant effect since its p-value is 0.005, which is less than the common significance level of 0.05. The negative coefficient suggests that as the initial bid increases, the likelihood of a positive response (willingness to pay) decreases. In simpler terms, respondents who are presented with higher initial bid amounts are less likely to express a willingness to pay for improved household collection management services. This suggests that the amount proposed as the initial bid plays a role in influencing respondents' decisions regarding their willingness to pay for these services. The Pseudo R^2 (0.4830) indicates that the model is good in explaining the influence of the independent variables on the households' willingness to pay for solid waste collection in study areas. The inverse relationship between the initial bid and households' willingness to pay for solid waste collection further shows that the demand for waste collection services is a normal good such that a unit increase in waste collection services fee will reduce the probability of respondents' willingness to pay by 0.0001 per cent. Ayenew *et al*, (2019), Wegedie *et al.,* (2020) and Huynh *et al*., 2022 all reported a negative correlation between WTP and initial bid.

Gender (Male): The coefficient for the "Male" category of the gender variable is 0.4269, with a standard error of 0.0688. The p-value is 0.000, indicating that gender has a statistically significant effect on the likelihood of a positive response. In this case, being male increases the likelihood of a positive response (willingness to pay). Males in the study may have stronger environmental attitudes or values that lead them to be more willing to invest in sustainable waste management practices. Males might have different levels of awareness and education about the benefits of proper waste management, influencing their willingness to pay for improved services.

Higher Education (Yes): The coefficient for the "Yes" category of the higher education variable is 0.1562, with a standard error of 0.0624. The p-value is 0.012, indicating that higher education has a statistically significant effect. Respondents with higher education are more likely to have a positive response. Education

can enhance a sense of civic responsibility, leading individuals to be more proactive in contributing to community well-being. Higher education might promote sustainability values and an understanding of the broader social and environmental implications of waste management.

Income Category (Multiple): The coefficients for various income categories are provided. Income categories "101000–150000," "151000–200000," and "200000 and above" have statistically significant positive effects on the likelihood of a positive response (p-values of 0.055, 0.034, and 0.008 respectively). High-income households have more financial resources available to them. This financial capability could make them more willing and able to invest in improved waste collection services. Furthermore, High-income households might prioritise a clean and well-maintained living environment. Improved waste collection services can contribute to a higher quality of life and overall comfort.

House Ownership (Owner): The coefficient for the "Owner" category of the house ownership variable is 0.2023, with a standard error of 0.1180. The p-value is 0.087, suggesting that house ownership has a marginally statistically significant effect. The positive coefficient indicates that households that own their homes are more likely to express a willingness to pay for improved household collection management services compared to households that do not own their homes. House owners often have a long-term commitment to their property. They might view investments in services that enhance their living environment as a way to protect and enhance the value of their property over time. More so, house owners typically have a stronger sense of ownership and responsibility for their property and its surroundings. This sense of ownership might lead them to prioritise cleanliness, hygiene, and waste management

Number of Rooms: The coefficient for the number of rooms is 0.0714, with a standard error of 0.0208. The p-value is 0.001, suggesting that the number of rooms has a statistically significant positive effect. Concurrently, an increase in the number of rooms in a house will increase the probability of the household's head's willingness to pay for solid waste collection to the tone of 0.0714 per cent and this could be explained by the fact that the more the number of rooms in a house the higher the volume of waste generated as such, those households' will be more demanding of a proper waste collector to enhance the serene and beauty of the environment

Duration: The coefficient for duration is 0.0130, with a standard error of 0.0035. The p-value is 0.000, indicating that duration has a statistically significant positive effect. Nonetheless, it is generally observed that a year increase in households' stay in a particular environment will increase their probability of paying for solid waste collection by 0.0130 per cent. This agrees with the findings of Yasin (2021) but is contrary to the study of Murad and Raquib, (2007) as they found time life in the present environment was negative but significant at 1 per cent level.

Willingness to Pay Value: The findings regarding the willingness to pay for enhanced solid waste collection services revealed that a significant portion of respondents express a willingness to pay a minimum of ₦3500 per month for the service. Nearly 57.5 per cent of respondents accepted the higher bid amount, while 73.4 per cent agreed to the lower bid. The result revealed that household heads in the study area were willing to pay approximately ₦5,795.816 monthly based on the Probit Model estimate.

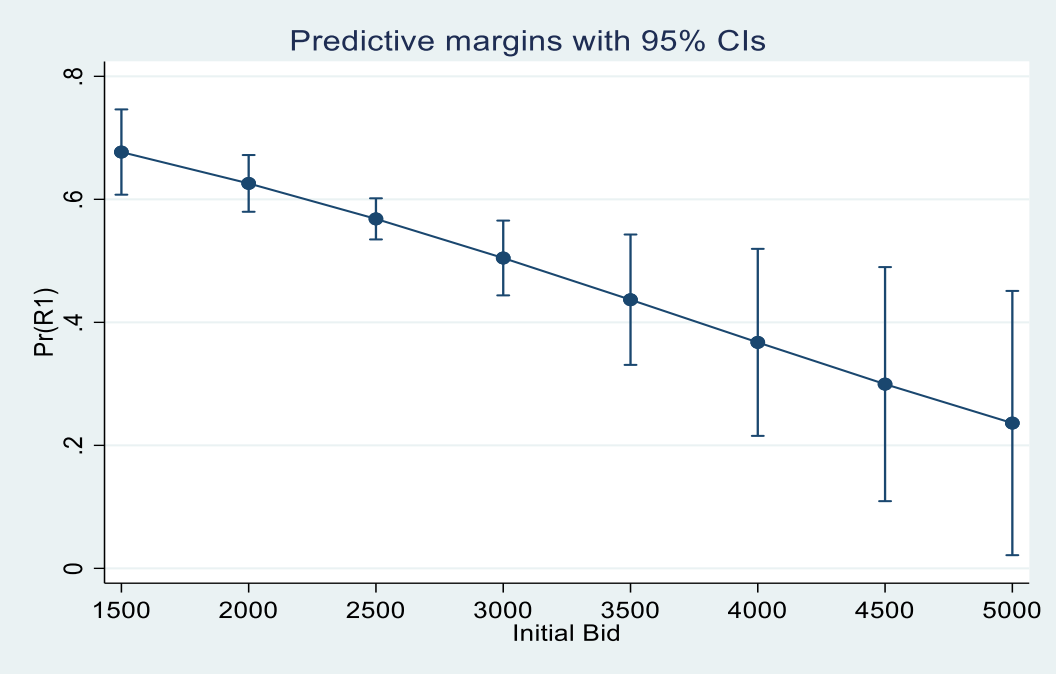

Figure 1 Prediction of the effect of Bid on household's probability to pay for improved SWC

The predictive margin illustrated in Figure 1 displays the relationship between responses to the Initial bid and R1 (response to the initial bid). The graph indicates a decrease in the probability of willingness to pay as the prices for solid waste collection increase from ₦1500 to ₦5000. This trend suggests that higher prices for solid waste collection could lead to a reduction in the demand for such services in the study area.

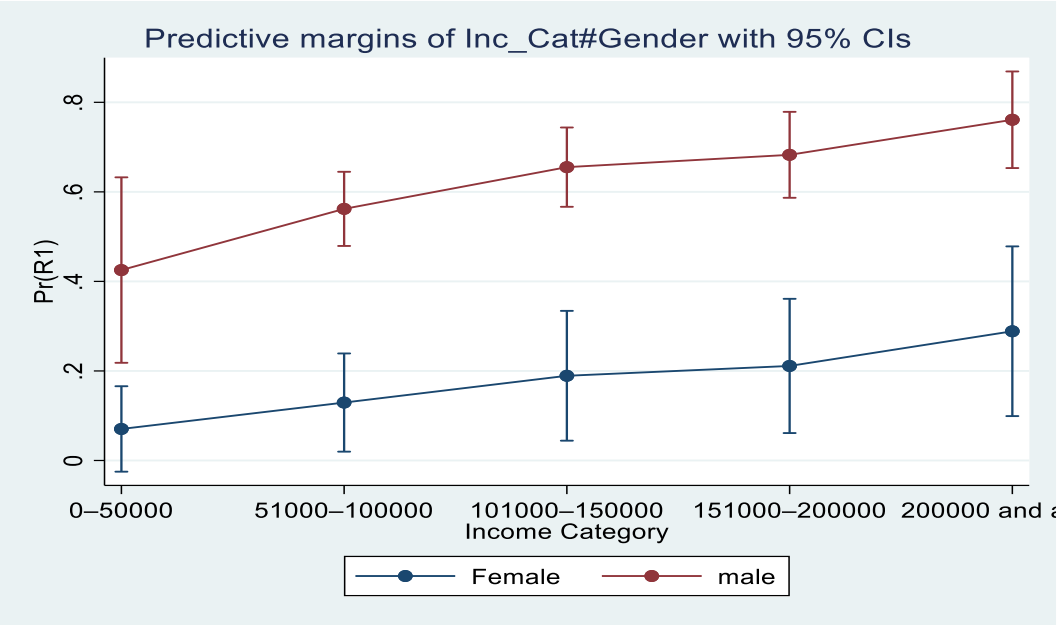

Figure 2 Prediction gender and probability to pay for improved SWC as income category increases

In Figure 2, the red line represents male household heads, while the blue line represents female household heads. The graph illustrates that as the income of household heads increases, their willingness to pay also

increases. Notably, male household heads exhibit a higher probability of willingness to pay compared to their female counterparts, despite the income level.

Conclusion and Recommendations

In conclusion, the majority of respondents consider problems related to solid waste as highly important, with varying degrees of urgency assigned to specific concerns such as erosion, pollution, climate change, and habitat loss. The study also highlights prevailing worries about landfills filling up and their potential impact on land prices. The majority of participants employ methods such as "Local dump facility" and "Burning," reflecting prevailing waste disposal choices. Notably, "Weekly" was the most common frequency for waste disposal. While a significant portion of respondents expressed dissatisfaction with their current waste disposal methods, a notable 35.8 per cent were contented.

The presented analysis concludes that several factors significantly influence respondents' willingness to pay for improved household collection management services. The initial bid amount exhibits a negative relationship with willingness to pay, indicating sensitivity to price changes. Gender emerges as a crucial determinant, with males showing a stronger inclination to pay. Higher education positively impacts willingness to pay, suggesting an awareness of the service's value. Other factors like age category, employment status, household size, income category, house ownership, number of rooms, and duration of stay also contribute to shaping respondents' willingness to pay. In conclusion, the study's findings highlight a noteworthy willingness among participants to pay for enhanced solid waste collection services. A substantial portion of respondents indicated their willingness to pay a minimum of ₦3500 per month for the service, with a majority accepting both higher and lower bid amounts. The Probit Model estimate further revealed that household heads in the study area were willing to pay ₦5,795.816 monthly for improved solid waste collection.

Tackling the urgent concerns regarding solid waste, erosion, pollution, and climate change requires a multi-pronged approach involving community workshops, awareness drives, and policy advocacy. Alleviating worries about landfills and their impact on land values involves innovative waste disposal solutions, such as recycling programs and alternative disposal methods. For those who prefer "Local dump facility" and "Burning," educating on the drawbacks and promoting environmentally friendly alternatives is crucial. Tailoring waste collection frequencies to align with the preference for "Weekly" disposal can enhance convenience and participation. Addressing dissatisfaction with current waste disposal methods necessitates implementing improved collection services and providing platforms for community feedback. Ultimately, the understanding of the factors influencing willingness to pay guides the development of targeted strategies that maximise community participation and cooperation in achieving effective household collection management.

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