BMC Public Health

RESEARCH

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Factors influencing willingness to pay for improved solid waste collection services among households in urban cities in Uganda: empirical evidence from Lira City

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Abstract

Waste management in Lira City, Uganda faces significant challenges, particularly in the area of waste collection. Pollution and health risks from uncollected waste are rampant, posing serious threats to human health and the environment. This persistent problem demands urgent attention and effective solutions to improve waste collection and safeguard the well-being of the community and the natural surroundings. This study aimed to assess households' willingness to pay for improved waste collection services, examine their waste management practices, and identify influencing factors. We employed a multistage sampling technique to randomly select 585 household heads and conducted key informant interviews with city officials and private waste collectors. Data analysis was conducted with STATA 17 and results showed that 48.12% of households were willing to pay an average of UGX 3012 ($0.84) per month for better services. Factors including education level, occupation, distance to waste collection sites, and environmental awareness significantly influenced this willingness. The study highlights a significant gap in public awareness and understanding of efficient solid waste management practices and concludes that enhancing public awareness is crucial for improving environmental health and safety in Lira City.

Keywords Willingness to pay, Solid waste, Lira city, Northern Uganda

Introduction

As global populations grow, urbanize, and become more affluent, waste production has surged tenfold and is expected to double by 2050 [1, 2]. Solid waste generation is outpacing other environmental pollutants, posing significant management challenges for both national and local governments [3, 4]. Uncollected waste is common in many areas, leading to environmental pollution, public health risks, and general inconvenience [5–7].

In Africa, approximately 125 million tons of solid waste are generated annually, with sub-Saharan Africa contributing 65% of this and yet the average waste collection rate remains low at 67%, despite the involvement of private waste collectors [8]. Moreover, nearly half

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of the municipal solid waste is disposed off improperly, contributing to environmental and health hazards [7, 9, 10]. Rapid urbanization and economic development have exacerbated solid waste production, posing significant hurdles to effective waste management [11, 12]. Many cities and municipalities across the region struggle with insufficient waste infrastructure, compounded by limited financial resources and technical expertise [9, 13, 14]. These challenges contribute to environmental degradation and public health risks, necessitating urgent intervention in waste management practices [15].

In Uganda, residential households contribute to approximately 53% of all urban solid waste emphasizing the need for effective waste management and cities like Kampala, waste collection coverage stands at 65.2% [9, 16] while the overall national coverage is 39% [17]. However, in newly established cities like Lira, waste generation data is not documented. The challenge of solid waste management persists, with unsorted waste adding to the burden on local authorities [18] and inefficient collection methods result in littered urban centers, posing health risks and environmental hazards [6, 19, 20]. Uganda, like many other African countries, is grappling with mounting challenges in solid waste management. These challenges manifest in practices such as open dumping and burning due to insufficient waste collection services and poor disposal habits among residents [20, 21]. Despite efforts by local authorities to enforce regulations and privatize waste management services, significant gaps remain in understanding households' perspectives and behaviors towards waste collection and disposal.

In Lira, only about 70% of waste reaches designated disposal sites, with the remainder being disposed of unsafely, according to the City Environmental Officer. Traditional funding through general revenues for waste collection and disposal has proven inefficient, leading to persistent waste accumulation [5]. Effective waste management strategies, such as the polluter pays policy, have shown promise in some countries like Nigeria [21], highlighting the need for a deeper understanding of consumer behavior and willingness to pay for waste management services [22].

Privatizing waste management services is seen as a viable solution to address inadequate solid waste collection and maintain environmental cleanliness [23, 24]. However, hasty implementation without considering technical feasibility and social acceptance can lead to failure [24]. This study therefore assessed the level of households' willingness to pay for improved waste collection services and explored factors influencing this willingness. Additionally, it evaluated current waste management practices in Lira City, providing valuable insights for policy development to enhance waste management in Lira City.

The conceptual framework

A number of determinants influence households' WTP for enhanced solid waste collection services as seen in Fig. 1. Household WTP is used as the dependent variable in this study, and it is represented as a categorical dummy variable with two measures (willing to pay vs. not willing to pay). As a result, the study's conceptual framework centered on how to elicit households' WTP in order to improve Solid Waste collection services in the study area. And, for better Solid waste collection services, institutional, household sociodemographic factors, and sociocultural factors are independent variables that have been postulated to directly influence willingness to pay for waste collection services or indirectly influence willingness to pay through environmental policy.

Materials and methods

Study design

We employed a cross-sectional study design incorporating both quantitative and qualitative methods of data collection. This design enabled the collection of data on willingness and associated factors among residents of Lira City at a single point in time. We integrated both quantitative and qualitative approaches to achieve triangulation, corroboration and in-depth investigation. Various scholars have employed cross-sectional designs, integrating quantitative and qualitative methods to explore willingness across different contexts; For instance, mixed methods was used in the United Arab Emirates to study willingness to receive the COVID-19 vaccine [25], showcasing the benefits of triangulating data for robust findings whereas in Bahir Dar city, Ethiopia a contingent valuation method in a cross-sectional study to assess urban households' willingness to pay for enhanced solid waste management services [26].

Study area

The study was conducted in Lira City, located in the Northern region of Uganda. It is located approximately 337km by road, north of the capital city Kampala. The coordinates of Lira city are 2014'N 32054'00.0" E (Latitude: 02.2472; Longitude: 32.9000). Lira City is experiencing rapid growth and has an estimated population of 119,323, according to the World Population Review (2021). The city is divided into Lira city East and City West. Lira City east have four city wards (i.e., Central, Railways, Adekokok and Angetta) with 28 parishes/wards and 153 villages while Lira City West have three city wards (i.e., Ojwina, Lira and Adyel) with 21 parishes/wards and 83 villages. Agriculture and trading are the main economic activity within the city. There are two main types of waste collection services are provided in the city i.e. the communal and house to house collection methods done by either formal private company or

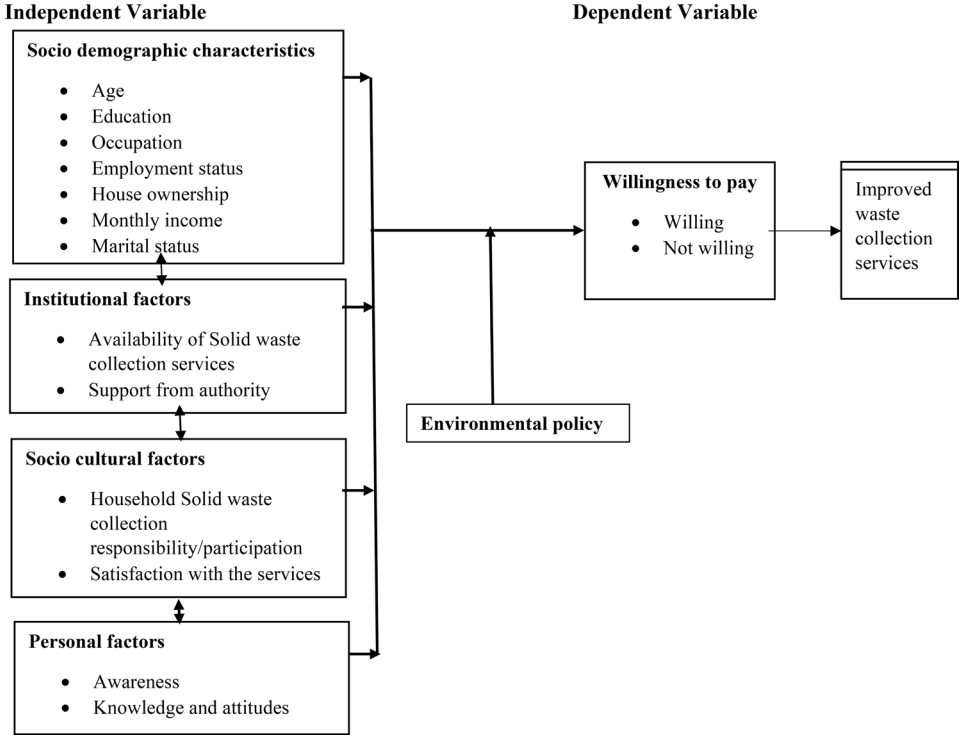

Fig. 1 Conceptual framework showing hypothesized links of factors influencing Households'Willingness to Pay for Solid Waste collection Services. *Source* adopted from Tassie & Endalew (2020) and domesticated by researcher (2021)

private informal waste collectors. The solid waste collection is managed by public and private individuals contracted by City council. Figure 2 shows the study area in Lira City.

Study Population

All selected household heads living in Lira city, including both divisions; City West and City East divisions were considered as the source population. The target population was all the household heads in Lira city. However, the study population was the household head in the selected households in Lira city.

Sample size estimation

The sample size was calculated by using single population proportion formula by Kish Leslie (1965) defined as follows;

$$n = deff * \frac{Z^2\,(pq)}{d^2}$$

Where; Z is critical ratio corresponding to 95% confidence level=1.96, p is proportion of people reportedly willing to pay for solid waste collection services which was 64% according to a study conducted in Kampala [27], q *is* the proportion of people not willing to pay for solid waste collection services, d is precision of +/-0.05, n is the required sample size and $deff$ is the design effect due to multistage sampling=2.

Hence, $n = 2 * \frac{1.96^2 * 0.64 * 0.36}{0.05^2} = 768$ household heads.

Sampling procedure

A four-stage sampling procedure was used to select the study participants as shown by sampling framework in Fig. 3. Firstly, four city wards were purposively sampled from the seven wards in Lira city. In the second stage, 25 parises/wards from 49 wards/praises were sampled by purposive sampling, selecting 8 from Adyel, eight from Ojwina, four from Railways and five from Central to ensure representativeness. The purposive sampling was essential to capture a diverse representation of urban areas within the city, taking into account variations in socioeconomic status and community characteristics. In the third stage, 64 administrative cells were randomly selected from the chosen parishes, with at least selected from each ward. Finally, to ensure that each household within the selected administrative unit had an equal opportunity to be included in the study, a systematic random sampling technique with sampling interval (k=5) was used to select households as the unit of analysis and the household heads were interviewed. Additionally, sampling proportionate to size of parish population was used to distribute the sample of 768 among the selected parishes.

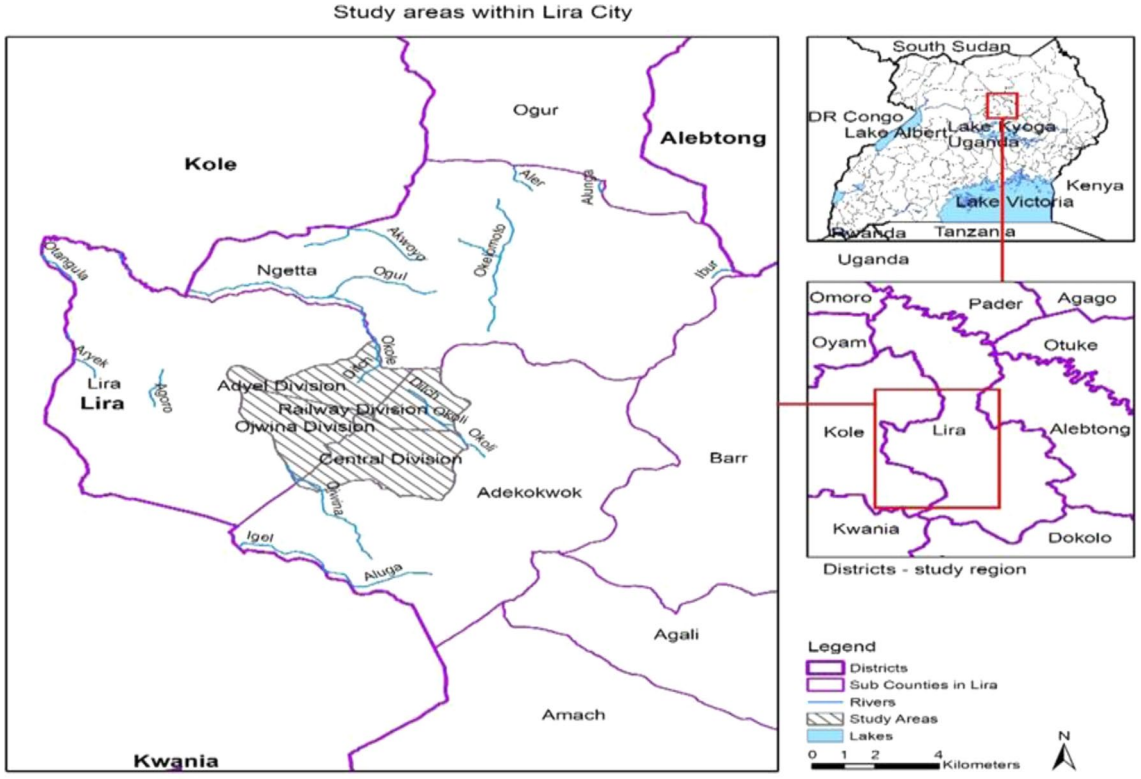

Fig. 2 Study areas located within Lira City

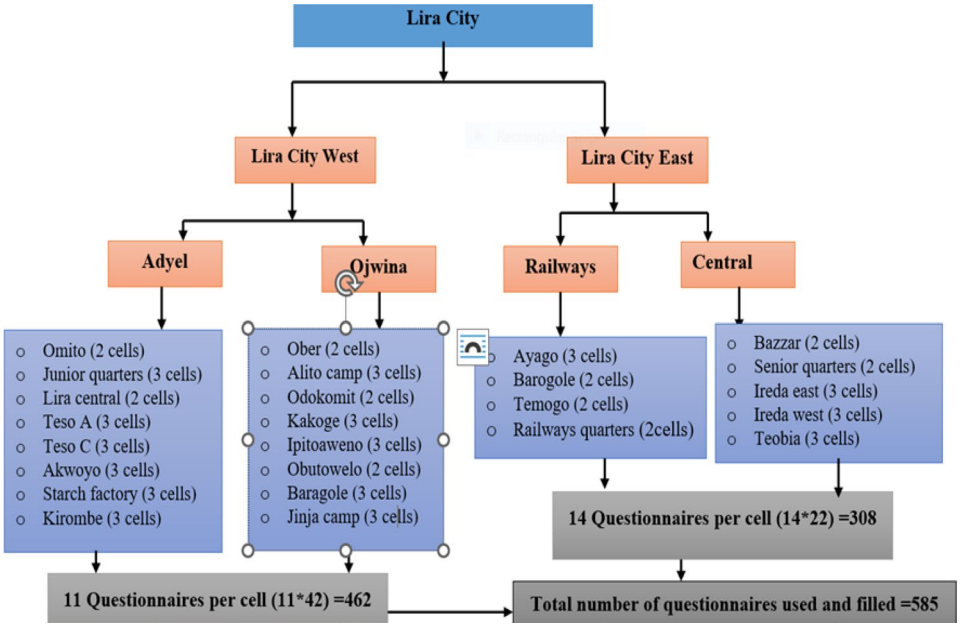

Fig. 3 Sampling framework for the study

Data collection methods & tools

The study relied on primary data that was collected through household survey. The quantitative data were gathered using an interviewer administered questionnaire developed after extant review of literature. The questionnaire was developed in English and translated to Leb Lango, the local language of most people in area. Literature indicates the factors influencing willingness to pay as socio-demographic (age, gender, marital status, highest educational level, occupation, family size,

household ownership, wealth status), solid waste management practices, service-related factors (quantity of waste generated, satisfaction with current service, and distance from waste disposal site), and finally information about the willingness to pay for solid waste collection services. We conducted key informant interviews using an interview guide with city environmental officers, city clerks, city division health inspectors, and managers of private garbage collection companies to complement the quantitative data obtained through questionnaires.

A pilot survey was carried out by interviewing 30 respondents and key informant interviews were conducted in Lira Sub County which was not part of target population to avoid duplication. The outcome of the interview helped to correct the mistake in data collection tools. The key informant interviews were used to determine the bid for valuation and hence the final Contingent valuation questionnaire to determine level of willingness. The bid amounts were established basing on the propositions from key informant and pilot survey that had been conducted. In bid to reduce bias inherent in CVM, respondents were asked if they were WTP for improved solid waste collection services. Those that said no, were asked whether they were willing to pay half of the suggested amount, and those that said yes were subjected to the higher bid and later asked the maximum amount they were willing to pay.

Data management and analysis

Data was entered into SPSS and cleaned. The validated data was then exported to STATA version 17 for analysis. Descriptive statistics were used to summarize the socio-demographic variables and also to analyze waste management practices and level of willingness to pay. While categorical data were presented as percentages and frequencies, continuous variables were reported as mean and standard deviation. Using the Pearson Chi-square test with a significance level of 5%, tests were conducted to determine whether there were any independent relationships between willingness to pay and predictor variables. Variables deemed plausible based on prior knowledge and those yielding a p-value of less than 0.2 in bivariate analysis were included in the multivariate logistic regression analysis to determine the significant independent factors influencing willingness to pay while adjusting for potential confounders. Adjusted odds ratios (AOR) at 95% CI were reported for this multivariate logistic regression. Variables with the p-values less than 0.05 were considered to be statistically significant with the outcome variable, willingness to pay.

Qualitative data analysis

Qualitative data was recorded in narratives, sorted, categorized and arranged according to themes. The themes derived from the responses on each of the variables were then be sorted and triangulated with quantitative findings according to the research objectives.

Ethical approval and consent to Participate

Ethical approval for this study was sought from National council of science and technology through Gulu University Research Ethics Committee–GUREC. A letter of permission to collect data in the households was sought from the Lira University, department of Public Health. Identification numbers not names were captured for each household head to make the participants anonymous. Written Informed consent was sought and participation was voluntary and data collected was used for this study only. The data collection tools (questionnaire) was translated into *'leb Lango'*, the native language and back to English before data collection is commenced. Privacy during data collection was assured by interviewing each participant singly in an isolated place within the household. Participants could decide to withdraw their participation any time, and their decisions were respected without any punishment or threat. To minimize the spread of Covid-19, all the standard operating procedures (SOPs) by the Ministry of Health (MoH) were followed during data collection.

Results and discussion

Socio-demographic characteristics

Out of the 768 participants targeted for the study, 585 responded to the questionnaire items, resulting in a response rate of 76%. Table 1 displays the distribution of respondents across various socio-demographic characteristics, including age, gender, marital status, monthly income, education level, occupation, home ownership, household size, and length of residence. Accordingly, 52.31% (306) of the respondents were female, reflecting a higher presence of women likely due to their availability at home during the interviews. The largest proportion (40%, 232) of respondents belonged to the 18–30 age group. Regarding marital status, the majority (75.8%, 442) were married, and 88.16% (514) reported a monthly income of 0-500,000 Uganda shillings (0-138.89 USD).

The common type of waste generated at household were; left-over food (34%), ash/solid remains (33.5%) and plastics (27.8%) and metals (4.1%). Table 2 shows details.

Solid waste management practices of residences in Lira City

Out of the 585-respondent interviewed, 46.7% of households reported sorting their waste into different categories. This practice is essential for effective recycling and waste management, as it facilitates the separation of recyclable materials from general waste. However, this finding contrasts with information obtained from key

Table 1 The distribution of Socio-demographic characteristics

Variable	Category	Frequency (n)	Percentage (%)
Age group	<=30	232	40
	31–40	190	32.76
	41–50	109	18.79
	51 and above	49	8.45
Marital Status	Married	442	75.68
	Not married	142	24.32
Monthly Income	0-500,000	514	88.16
	500,001–1,000,000	52	8.92
	1,000,001–1,500,000	14	2.4
	1,500,001&above	3	0.51
Gender	Male	279	47.69
	Female	306	52.31
Education Level	No education	54	9.23
	Primary	189	32.31
	Secondary	171	29.23
	Tertiary	171	29.23
Occupation	Peasant	132	22.6
	Civil Servant	129	22.09
	Business	295	50.51
	Housewife	12	2.05
	Boda-boda	16	2.74
Home Ownership	Owns a house	318	54.73
	Renting	263	45.27
Working Status	Government	113	20.04
	Private	451	79.96
Household Number	<=5	340	58.12
	6–10	221	37.78
	11 and above	24	4.1
Length of stay in the Area	<=5years	279	47.69
	Over 5 years	306	52.31

Source Author's computation from survey data

Table 2 Solid Waste Management Practices of Residences in Lira City

Variable	Frequency (n)	Percentage (%)
Backyard		
Yes	446	77.84
No	127	22.16
Satisfaction with waste collection services		
Yes	369	63.18
No	215	36.82
Think is their responsibility to collect waste		
Yes	492	84.1
No	93	15.9
Ever received information on waste		
Yes	445	76.46
No	137	23.54
Aware of health and environmental Concerns of waste		
Yes	543	93.46
No	38	6.54
Sorting of waste		
Yes	272	46.66
No	311	53.34
Distance to waste disposal point		
<=200 m	361	74.59
> 200 m	123	25.41
Types of waste generated at household[a]		
Food Leftover	490	34.51
Ash/Solid Remains	476	33.52
Plastics	395	27.82
Metals	59	4.15
Solid Waste Collection Methods of the Households[a]		
Dust Bins	107	18.29
Backyard	176	30.09
Rubbish Pit	158	27.01
Burn It	88	15.04
Throw It Away	56	9.57

[a] = Multiple Response

Source Author's computation from survey data

informant interviews, which indicate that most households do not sort their waste, with the exception of metal waste, which is sold to scrap dealers. The discrepancy suggests a possible gap between reported behaviors and actual practices.

The study also found that the waste collection services being used by household includes; informal private waste collectors (39.1%), collection at communal sites (36.6%) and formal private waste collectors (12.1%). This is probably because the services provided by formal sectors are not reliable. This study is in contrast with a study done in Ghana which indicated that house-to-house collection accounts for 53% of waste collected [28].

The findings on solid waste collection methods at household revealed that the significant number (30.1%) dispose their waste at the backyard and other common methods were, dumping in rubbish pits, dustbins, and burning. Most households probably use the backyard because they have space around their home as the findings shows that about 77.8% of household had backyard. This findings is supported by several studies from various African countries that highlight the prevalence of indiscriminate household waste disposal, including dumping in streets, rivers, and drainages, especially during rainy seasons and burning of waste as a major disposal practice [9, 10, 28, 29]. This practice not only blocks drainage systems and causes flooding but also spreads diseases and emits offensive odors. Further Open dumping and burning of waste in unauthorized sites further exacerbate environmental pollution and pose health hazards [15]. In Central Uganda a significant portion of households (35.9%) disposed of general waste through open dumping whereas 27% dispose of plastics

by burning and only 8.8% of households composted their waste, whereas 55% separated some types of decomposable garbage [20] and most popular method of storing waste before disposal is collecting it in plastic containers, polythene bags, paper bags, or metallic [7, 30]. Efforts to promote recycling and improve waste collection infrastructure are crucial to mitigate these challenges and foster sustainable waste management practices. In places like Asella town, Ethiopia, inadequate knowledge about waste management and lack of door-to-door collection services contribute to improper waste disposal practices [19] and this could also be the case in Lira City where only 36% had ever received information on waste management practices.

Level of willingness to pay for improved waste collection services in Lira City

The results from Table 3 revealed that, only 48.12% (281/585) of the household heads were willing to pay for improved solid waste collection services. The above finding is line with response from a key informant who stated that;

> *"People are not willing to pay for improved solid waste collection services because the leaders are corrupt and besides, they have been paying taxes that can be used for waste collection" (R8).*

Another respondent noted that;

> *"I am willing to pay for the service but the information about waste collection services have not been availed to us in this area" (R4).*

According to the study, Table 3, 48.12% of Lira City residents portrayed willingness to pay for enhanced solid waste collection services and the average amount household heads were willing to pay was UGX 3,012/= (USD 0.84) per month. The reasons highlighted for unwillingness to pay for the services in question included; waste collection service being unreliable, the interval between collections being too long, persistent squalor at communal containers and the pickup point is unsatisfactory. Further, Willingness to pay was lower in our study probably because citizens think the city council (government) is responsible for managing the city solid waste. During an interview, respondents also claimed that leaders do not take the issue of waste collection services seriously. However, this study findings are consistent with a study conducted in Kampala, Uganda, to evaluate families' willingness to pay for improved garbage services, which found that approximately 48% of households were willing to pay, with an average monthly amount UGX 5,382 (USD 2.91) [31]. In contrast, the level willingness to pay is significantly lower compared to findings in Ethiopia, where over 83.5% of residents expressed willingness to pay for improved door-to-door waste collection services [32]. Comparatively, in Kawempe, a majority of the households (64%) showed willingness to cooperate with the city council in co-financing solid waste collection activities to improve waste management and average amount they were willing to pay was UGX 3000 (USD0.83) per month [27] while in Gorkha Municipality, Nepal, the majority of households (61%) were willing to spend an average of USD 0.72 per month [33]. Another study in Bahir Dar, Ethiopia, 86.3% of sampled families were willing to pay more for better solid waste management services [26] imply the need for proper waste management, and a systematic review indicated willingness of people to pay for better urban solid waste management to range from 55 to 85.5% [34]. In a different study conducted in the Banepa municipality of Nepal, 83% of respondents were prepared to pay more for improved solid waste management services with 51.67% WTP for offered Bid amount and solid waste collection services were available in 50% of residences, with a mean willingness to pay (WTP) of USD 24 per household [35].

Table 3 Level of willingness to Pay for Improved Waste Collection Services in Lira City

Willingness To Pay (WTP)	Frequency (n)	Percentage(%)
Yes	281	48.12
No	303	51.88
Total	584	100

Source Author's computation from survey data

Table 4 Reasons for unwillingness to pay

Responses	Frequency (n)	Percentage (%)
Interval between collections is too long	72	20.06
Persistent squalor at the communal containers	65	18.11
Service is unreliable	107	29.81
pickup point is unsatisfactory	62	17.27
Waste collection vehicles take too long	53	14.76

Source Author's computation from survey data

Reasons for unwillingness to pay

According to the findings from Table 4, the reasons for not WTP assessed through multiple response questions revealed that a good proportion of respondents (29.81%) were not WTP for waste collection because the service was believed to be unreliable and a significant number (14.76%) attributed their decision to waste collection vehicles taking too long to collect waste.

Findings above are supported by revelations from the staff engaged in solid waste noted during the interview where one of them described that:

"Collection of solid waste in the Lira City is not good because there is an irregularity in collection. No specified timetable has been set and strictly followed by the city council. They just provide the service at their convenience despite the truth that we are paying for it" (R2).

The above assertion is supported by a vendor who reported;

"There is a scarcity of tools/equipment which helps to store solid waste at the market. The supplied buckets or containers are not enough as compared to the rate and the quantity of solid wastes generated at the market. This causes a lot of solid wastes to be scattered within the market premises especially on windy and rainy days" (R3).

Another official reported;

"While Solid waste management strategies exist, the city waste management authorities are less effective in controlling solid waste generation, collection, storage, and disposal. Leaders do not strongly stand for them as a result, the Lira City is very dirty, people dispose of solid waste roughly, there are a lot of flies and bad smell and its worst around collection site and Market" (R4).

In addition to that, other officers were quoted saying that;

"The existing solid waste management policy, strategies, and rules used are dormant because they are not strictly implemented. It could be better if they were changed or alternated with other rules, or else the leader be charged or changed regularly" (R6).

Findings were supported by some responses, which were collected during an interview in which one vendor said:

"Solid waste collection in the market is done by the city council because we normally pay them for the service. They have a special motor vehicle that helps them to provide the service that I, as an individual vendor, cannot afford to do" (R7).

The lack of sufficient public waste bins at specific collection points leads residents to dispose of waste indiscriminately.

"We have solid waste management problems in the City, because of the inadequate amount of equipment for collecting and disposing of waste" (R8).

Another key informant said;

"Some of the urban residents will intentionally litter solid waste, and say that if they don't litter solid waste, the waste official who are responsible for managing solid waste would not have work to do" (R9).

"Weak enforcement of existing laws by local authorities tend to hamper our work as implementers in the field of managing waste. Often, we also face political interferences when we try to take legal action against residents or institutions not adhering to state laws on environmental sanitation" (R8).

The monthly amount of money respondents are willing to pay for improved waste collection services

From Fig. 4, it could be noted that close to 36% of the households who are currently paying for solid waste management services are willing to pay about UGX 1,800 (USD0.5) or more for the hypothetical situation described for waste Collection services. Very few were willing to pay more than UGX 2,000(USD 0.56). Thus, the majority of the respondents are willing to contribute at least UGX 1,800(USD 0.5) or more in support of the improvement in the waste collection services within the Lira City. The mean or average amount of money the respondents were willing to pay per month was UGX 3,012 (USD 0.83).

Bivariate analysis of factors associated with willingness to pay

The results of bivariate analysis of factors associated with WTP in Table 5, revealed that the household head's employment status (χ^2 =21.7, $p<0.001$), education level (χ^2 =9.81), distance to the waste disposal facility (χ^2=15.09, $p<0.001$) implementation of waste law (χ^2=13.03, $p<0.001$), the amount of amount of waste generated (χ^2=10.79, $p<0.001$) and awareness of environmental concern (χ^2=11.08, $p<0.001$) were factors influencing one's willingness to pay for waste collection services.

Multivariate analysis of factors associated with willingness to pay

Table 6 shows the results of the logistic regression analysis after adjusting for factors such as education level and occupation. The factors significantly associated with the willingness to pay for improved waste collection services include education, occupation, the role of the government, and distance to disposal sites. Specifically, individuals with secondary education (aOR=2.04, $p=0.032$, 95% CI=1.03–4.45) and tertiary education (aOR=2.23, $p=0.027$, 95% CI=1.33–5.37), as well as civil servants

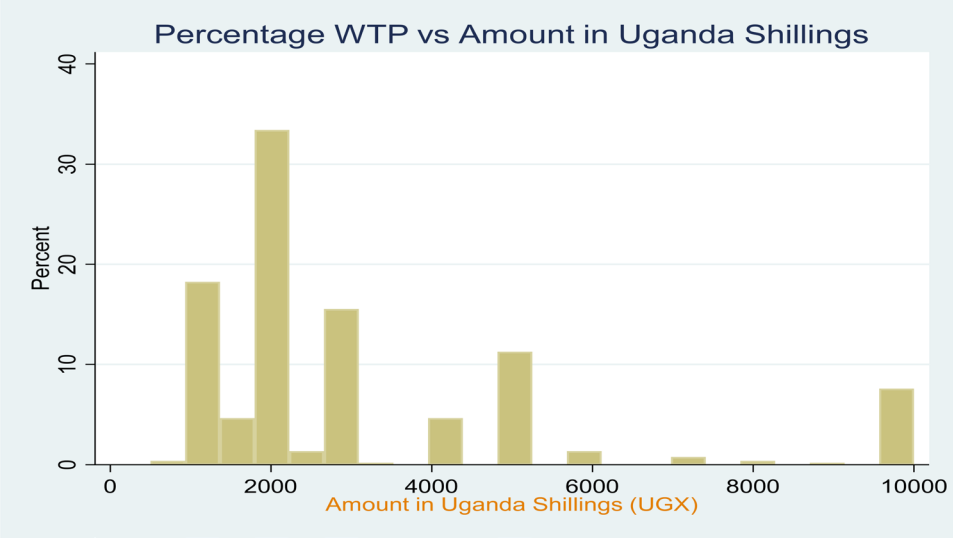

Fig. 4 The amount of money respondents are willing to pay for improved waste collection services

(aOR=1.97, p=0.016, 95% CI=1.75–5.17), were likely willing to pay for waste collection services. This finding is consistent with the hypothesis that higher education levels correlate with a greater understanding of the necessity for effective waste management. As individuals become more educated, their capacity to comprehend the intricacies of solid waste collection increases, making them more likely to invest in improved SWM services [35–37]. These findings are consistent with survey study done in Gweru city, Zimbabwe which revealed that respondents with higher education exhibited a greater willingness to pay for solid waste collection services [38]. Similarly, in Gorkha municipality, Nepal, educated individuals are more likely to understand the adverse effects of waste on human health and the environment [33]. Furthermore, in Uyo Metropolis, Nigeria, the educational level of the household head significantly determined household income and readiness to pay for enhanced SWM services [39]. Contrarily, other studies revealed that educational levels were statistically insignificant in influencing WTP [32, 40]. In another instance, Occupation, particularly being a civil servant, also emerged as a significant factor influencing WTP for waste collection services. Civil servants, have stable income sources, making them more likely to pay for such services. This study corroborates with findings in Jigjijga, which also found occupation to be statistically significant at the 5% level [40].

Conversely, those who were not aware of environmental concerns (aOR=0.58, p=0.046, 95% CI=0.30–0.91) and those living 200 m or more from disposal sites (aOR=0.49, p=0.004, 95% CI=0.30–0.79) were less likely to be willing to pay for waste collection services. This inverse relationship is likely due to the increased financial and time costs associated with waste disposal over greater distances. Specifically, the study indicated that individuals are 51% more likely to be willing to pay for better waste management services with every kilometer decrease in distance to disposal sites [32, 41]. In contrast, strategic placement of disposal sites closer to residential areas positively influences household willingness to pay for waste collection services [26, 32]. Proximity enhances accessibility and reduces the perceived burdens of waste disposal, thereby encouraging greater community participation in sustainable waste management practices.

The study also demonstrated that awareness of the environmental and health risks associated with improper waste disposal positively influences WTP. Households aware of these risks tend to be more concerned about maintaining a clean environment and thus show a greater willingness to invest in improved waste management services. Several studies in Low and Middle income Countries corroborate with the positive correlation between environmental awareness and WTP for improved waste management services [40, 42]. These studies suggest that households with higher awareness of environmental and health risks are more likely to invest in better waste management services. Similarly in Pakistan, and Nakuru, Kenya, awareness of health risks due to improper waste disposal significantly boosted households' WTP for improved services [41, 43].

Conclusions and recommendations

The study revealed that nearly half (48.12%) of households were willing to pay for improved services in Lira City. Some of the reasons given for the unwillingness to pay were lack of; waste management services in some areas; unreliable services; lengthy intervals between collection times; Persistent squalor at the communal containers; unsatisfactory pick-up points. The study found that the commonest methods of solid waste management

Table 5 Bivariate Analysis of Factors Associated with willingness to pay (N=585)

Variable	*n*	Household's WTP		χ^2(*p*-value)
		Willing	Not willing	
Age group				
<=30	232	103(44.40)	129(55.60)	3.94
31–40	189	89 (47.09	100(52.91)	(*p* = 0.268)
41–50	109	60(55.05)	49(44.95)	
51 and above	49	26(53.05)	23(46.94)	
Marital Status				
Married	441	221(50.11)	220(49.89)	2.65
Not married	142	60(42.25)	82(57.75)	(*p* = 0.103)
Income				
0-500,000	513	246 (49.95)	267 (50.05)	
500,001–1,000,000	52	25(48.08)	27(51.92)	0.006
1,000,001 and above	17	8(47.06)	9(52.94)	(*p* = 0.997)
Gender				
Male	278	140(50.36)	138(49.64)	1.07
Female	306	141(46.08)	165(53.92)	(*p* = 0.301)
Education Level				
No Education	54	20(37.04)	34(62.96)	9.81
Primary	188	88(46.81)	100(53.19)	(*p* = 0.02) *
Secondary	171	75 (43.86)	96(53.14)	
Tertiary	171	98(57.31)	73(42.69)	
Occupation				
Peasant	132	62(46.97)	70(53.03)	21.77
Civil Servant	129	83(64.34)	46(35.66)	(*p* < 0.001) *
Business	294	129(43.88)	165(56.12)	
Housewife	28	7(25.00)	21(75.00)	
Home Ownership				
Yes	317	167(52.68)	150(47.32)	5.43
No	263	113(42.97)	150(57.03)	(*p* = 0.02) *
Number of people				
<=5	339	150(44.25)	189(55.75)	5.09
6–10	221	117(52.94)	104(47.060	(*p* = 0.078)
Above 10	24	14(58.33)	10(41.67)	
Length of stay in the Area				
<=5 years	279	128(45.88)	151(54.12)	0.027
Over 5 years	305	153 (50.16)	152(49.84)	(*p* = 0.869)
Distance to waste disposal site				
< 200 m	360	193(53.61)	167(46.39)	15.09
Above 200 m	123	41(33.33)	82(66.67)	(*p* < 0.001) *
Waste laws implemented				
Yes	425	224(52.71)	201(47.29)	13.03
No	157	56(35.67)	101(64.33)	(*p* < 0.001) *
Quantity of waste generated (kg)				
<=5 kg	513	234(45.61)	279(54.39)	10.79
Above 5 kg	69	46(66.60)	23(33.40)	(*p* = 0.001) *
Awareness of environmental concerns				
Yes	542	265(48.89)	277(51.11)	11.08
No	38	13(34.21)	25(65.71)	(*p* = 0.001) *
Received information				
Yes	398	215(54.02)	183(45.98)	18.04
No	185	65(35.14)	120(64.86)	(*p* < 0.001) *
Employed in government or private				

Table 5 (continued)

Variable	*n*	Household's WTP		χ^2(*p*-value)
		Willing	Not willing	
Government	450	201(44.67)-	249(55.33)	14.36
Private	-			($p < 0.001$) *
Length of stay in the area				
<=5 years	279	128(45.88)	151(54.12)	0.027
> 5 years	-	-		($p = 0.869$)

*Indicates significant variable at 5%, X^2= chi square statistics, n=number of cases

Table 6 Logistic regression Predicting willingness to pay for Improved Waste Collection services

Variable	WTP	Not WTP	aOR	*p*–value	[95% CI]
Education					
No Education	20(37.04)	34(62.96)	1.00	Reference	
Primary	88(46.81)	100(53.19)	1.94	0.091	0.90–41.8
Secondary	75 (43.86)	96(53.14)	2.04	0.032**	1.03–4.45
Tertiary	98(57.31)	73(42.69)	2.23	0.027**	1.33–5.37
Occupation					
Peasant	62(46.97)	70(53.03)	1.00	Reference	
Civil Servant	83(64.34)	46(35.66)	1.97	0.016**	1.75–5.17
Business	129(43.88)	165(56.12)	0.78	0.780	0.47–1.29
Housewife	7(25.00)	21(75.00)	0.49	0.490	0.09–2.64
Employed in gov't or private					
Government	201(44.67)	249(55.33)	1.00	Reference	
Private	65(64.60)	40(35.40)	1.48	0.390	0.61–3.67
House Ownership					
Yes	167(52.68)	150(47.32)	1.00	Reference	
No	113(42.97)	150(57.03)	0.92	0.676	0.61–1.38
Awareness of environmental concerns					
Yes	265(48.89)	277(51.11)	1.00	Reference	
No	13(34.21)	25(65.71)	0.58	0.046**	0.30–0.91
Received information					
Yes	215(54.02)	183(45.98)	1.00	Reference	
No	65(35.14)	120(64.86)	0.88	0.745	0.43–1.82
Laws and regulations implemented					
Yes	224(52.71)	201(47.29)	1.00	Reference	
No	56(35.67)	101(64.33)	1.18	0.617	0.61–2.31
Distance to disposal sites					
<=100 m	193(53.61)	167(46.39)	1.00	Reference	
> 100 m	41(33.33)	82(66.67)	0.49	0.004***	0.30–0.79

Source Author's calculation, *** $p < 0.01$, ** $p < 0.05$; aOR=adjusted odds ratio; CI=confidence interval

practice in Lira city were rubbish pits, backyards, use of dustbins and burning and the factors associated with willingness to pay were; education level, employment status, distance to waste disposal sites and awareness of solid waste environmental concerns.

Basing on the findings, the city council of Lira should do more to ensure that all families receive an equitable share of waste management services and Since households' awareness of the environmental impact is positively significantly related to both WTP, the government and concerned stakeholders should sensitize the households about adverse effects of indiscriminate disposal of waste on the environment in order to raise and improve practice of proper solid waste collection/management. Additionally, City Authority can use this information to create awareness to the public in order to improve on their willingness to pay for improved solid waste collection service.

Acknowledgements
We express gratitude to the Lira city residents who took part in the study, as well as Acon Joy, Abor Daniel, and Ojok Sam for their assistance and encouragement.

Author contributions
EA, ARA, AA, and BO contributed to study design, development, data collection monitoring and writing of the manuscript. EA, and B. O. participated

in data collection, data entry and data analysis. All authors contributed to manuscript editing and approval of the final version.

Funding
The author(s) received no specific funding for this work.

Data availability
There could be ethical or legal constraints regarding the public sharing of our data. Researchers seeking access to our data should contact the non-author representative of the Lira University Data Repository Team, who is the University Librarian, Andrew Ojulong. It is preferred that this contact information be conveyed through email at aojulong@lirauni.ac.ug.

Declarations

Ethics approval and consent to participate
Ethical approval for this study was sought from National council of science and technology through Gulu University Research Ethics Committee (GUREC). Permission to collect data within households was obtained from the Lira University Department of Public Health. Prior to participation, written informed consent was sought, and for illiterate participants consent was obtained from legal guardians and involvement was entirely voluntary. The collected data was exclusively utilized for this study, and participants were informed about the potential publication of the study results. To ensure clarity, the data collection tool (questionnaire) was translated into the native language, 'leb lango,' and then back into English before the commencement of data collection.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 12 January 2024 / Accepted: 23 July 2024
Published online: 07 August 2024

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