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Willingness to Pay for Improved Solid Waste Management in Itahari, Sunsari, Nepal

Umesh Khadka[1]

Abstract

Solid waste management (SWM) is a widespread problem in urban areas of developed and underdeveloped countries. Unplanned urbanization, rapid population growth, and migration of people from rural to urban areas are the leading causes for the problem of SWM in the major cities of Nepal. Inadequate services for solid waste collection can lead to environmental problems, pollution, health risks, and economic burdens for the society. Understanding the willingness to pay (WTP) of residents for improved solid waste collection is crucial for deciding effective pricing policies and waste collection techniques. In this context, the main aim of the study is to examine the WTP for the services of improved SWM in the study area. Using simple random sampling method, 377 households were taken as a sample to estimate the WTP for SWM through the Contingent Valuation Model (CVM) and Tobit regression. A field survey was conducted to collect the required data and information related to the WTP of households through the structured questionnaire. The study found that 83.55 percent of respondents would pay for improved SWM services, and the willingness to pay varies from NRs. 50 to NRs.500 per month. Tobit regression results identified the factors influencing WTP for improved SWM in the study area. The factors of gender, ownership of the house, education, profession, income level, and service satisfaction are statistically significant in determining the WTP for SWM.

Keywords: *Solid waste management, Willingness to pay, Contingent valuation method, Tobit model, Survey design.*
JEL Classification: Q52, Q53, C24, H41

Introduction

Estimating the demand for public goods involves assessing the preference and WTP of individuals for the provision of goods that are non-rivalrous and non-excludable in nature (Anomaly, 2015). Non-market goods and services, which are not traded in the market, require the calculation of the total economic

[1]**Mr. Khadka** is an Assistant Lecturer in Economics, Janta Multiple Campus, T.U., Itahari, Sunsari, Email: umeshkhadka91@gmail.com; ORCID: https://orcid.org/0009-0001-7042-1420.

welfare (Kim & Kim, 2023). The information derived from the measurement of WTP for SWM is crucial in determining potential market demand and service improvement, which is vital in pricing strategies (Tassie & Endalew, 2020). SWM encompasses the entire process of controlling the generation, storage, transportation, management of dumping sites, and disposal of solid waste (Abdulrasoul & Bakari, 2016). It is a pervasive problem in urban areas of both developed and developing countries (Abdel-shaft & Mansour, 2018). The high rate of population growth, lack of financial resources, ineffective management, poor collection services, and unplanned rapid urbanization are the major factors that exacerbate the solid waste issue in city areas (Minghua et al., 2009; Balasubramanian, 2019). Our study underscores the increasing waste generation through consumption and excessive use of plastics for food packaging as significant challenges in SWM in developing countries (Julius et al., 2017).

Nepal is confronting a drastic challenge concerning the SWM. It has sharply increased with the rapid urbanization and population growth of the country inextricably. However, with inadequate infrastructure and resources, disposing of solid waste in an environmentally sound manner has become an arduous task (Maharjan et al., 2019). Most municipalities need proper waste collection, transportation, and disposal facilities. The existing infrastructure needs to be improved to scientifically manage the increasing waste generation due to the rapid ongoing urbanization process (Pokhrel & Viraraghavan, 2005). Unfortunately, there is a lack of general public awareness regarding the proper handling of solid waste, resulting in unlawful disposal, such as burning waste, littering public areas, and dumping in water bodies (Shahzadi et al., 2018).

A lack of awareness about the environmental and health hazards of solid waste has exacerbated the situation. Limited resources have made it difficult for municipalities to provide adequate services of SWM. Budgetary constraints, inadequate staff, and a lack of equipment have challenged efforts to provide effective SWM services (Rehman et al., 2009). SWM is a tremendous challenge to the local government because it creates environmental degradation and worse effects on human health. The poor system of SWM ranging from unavailability of collection service to ineffective disposal system causes air pollution, water, and soil contamination (Bharadwaj et al., 2020). In the areas where the waste is not properly managed, people may resort to open burning, which produces toxic substances. Improperly disposed of waste can produce leachate, which contaminates groundwater and nearby surface water and poses serious risks to human health and the ecosystem (Kumar & Nandini, 2013).

Measuring WTP for SWM can help efficiently allocate local resources to meet the needs of the public (Tarfasa, 2017). Municipalities can prioritize investments in SWM infrastructure based on the WTP of people. Understanding consumer preferences about the current service and WTP for SWM is crucial for

pricing decisions (Subhadarsini, 2015). Municipalities require huge monetary investments to provide citizens with efficient and reliable waste management services. Introducing a user charge-based WTP for service users can generate revenue to cover these costs and reduce the economic burden on public budgets. How users ascribe value to municipal SWM services is an essential factor in determining how municipalities choose to invest in improvements to their system, like - introducing recycling, composting, and even anaerobic digestion of waste-to-energy conversion (Matter et al., 2015). Although local authorities have an economic incentive to adopt these user-centric practices, there is also an environmental pay-off for citizens. Measuring the cost of such services reveals how people are willing to pay for them, making them available regardless of socio-economic status.

Itahari sub-metropolitan has made several attempts to manage solid waste efficiently, which is on the rise due to the population increase and urbanization growth. However, the level of achievement is very poor, as there are still piles of waste on the streets, market centers, and homes. So, this study ensures that the most vulnerable communities can benefit from sustainable waste management tactics. Streamlining various components of the waste management infrastructure can result in quality waste disposal options while allocating available funds more cost-effectively.

In this context, the main aim of this study is to examine WTP for improved SWM services and the factors affecting it in the study area.

Research Methodology

Study Area

In the first stage, Itahari Sub-metropolitan City was selected purposively. This city was strategically chosen due to the observed trend of increasing population and rapid urbanization accompanied by high solid waste generation. Moreover, high migration rates from rural areas induced problems for effective SWM management.

The cross-sectional study was conducted within the urban center of Itahari Sub-metropolitan situated in the Sunsari District of Koshi Province.

Geographically, the municipality is located at 26°39’44”N latitude and 87°16’30”E longitude and about 30 kilometers north of the province headquarters, Biratnagar Metropolitan City. The Itahari Sub-metropolitan city has an estimated area of 93.78 sq. km, and it is surrounded by Duhabi Municipality in the south, Sundarharaicha in the east, Dharan Sub-metropolitan City in the north, and Ramdhuni Municipality in the west [Appendix – I]

Population, Sample, and Sampling Procedure

According to the population census 2021, the total number of households in Itahari Sub-metropolitan City is 50,350. In the second stage, wards 1, 5, 6, and 20 were selected purposively due to the dense population and higher observed solid waste. The selection was made based on the more observable solid waste. The total households of selected wards like 1, 5, 6, and 20 are 2684, 5500, 1846, and 3320 households, respectively. So, the total households of these selected wards were the size of this study's population (i.e., 13,350). The following formula developed by Cochran (1977) has been used to determine the sample size.

$$n = \frac{N * X}{(X + N - 1)} \qquad Where, \qquad X = \frac{Z^2_{\alpha/2} * p * (1 - p)}{MOE^2}$$

Where n is the sample size, and $Z_{\alpha/2}$ is the critical value of the normal distribution at α / 2. For a confidence level of 95 percent, α = 0.05, and p = proportion of the target population estimated to use SWM service, set at 60 percent, i.e., 0.6; and q = 1-p = 0.4; MOE is the margin of error, set at 5 percent and N is the population size.

$$X = (1.96)^2 \times 0.6 \times 0.4 / (0.05)^2 = 368.79 \sim 369$$

Now sample size (n) = 13350 × 369 / 369 + 13350 - 1 = 359

Non-responses error 5 percent, i.e., 359 × 5 / 100 = 17.9 ≈ 18.

Thus, the sample size taken for the study was (359 + 18) = 377. Hence, 377 households (2.8 % of the total population) are the sample size of this study.

After determining the sample size, a stratified random sampling approach was applied to ensure equal representation from each ward, and each ward was treated as an individual stratum. Then, 2.8 percent of households from each ward, i.e., 77, 159, 54, and 87 households are taken proportionately from wards 1, 5, 6, and 20 respectively. Sample households are taken randomly by using systematic random sampling techniques. For this, the sampling interval becomes k = N / n = 13350 / 377 = 35. Then, the data was collected using systematic random sampling at an interval of 35 households. So, a multistage sampling technique was employed in this study. The study involved the head of households in the study area.

Tools and Techniques of Data Collection

The cross-sectional data required for this study were acquired from primary sources, employing the semi-structured questionnaire administered to the household head. The questionnaire was completed by the representative of the investigator during the field visit. The first section of the questionnaire consists of the socio-economic and demographic characteristics of households, including

age, gender, household head, education level, profession, and household income. The second part consists of the existing condition of the services in SWM in the study area, where the questions were related to the waste collection problem, priority concern about the SWM, types of solid waste generated by the households and the practice of storage, etc.

Similarly, the third section includes questions related to the current services getting by the households for solid waste collection, causes of satisfaction and dissatisfaction with available services, the price paid by the households for existing services, and the WTP for improved SWM services. The respondents were first asked if they would be willing to pay an additional amount for improved SWM services. The response was 'Yes' or 'No'. If the answer is 'Yes' to pay an additional amount, the question was followed where the respondents select NRs.100 to 200 NRs. 200 to 400 and above NRs. 400. Examples of recent applications of CVM for improved SWM include Subhan et al. (2014), Julius et al. (2017), and Boateng et al. (2019). In these studies, the age of the respondents, income, household size, collection service, education level, etc., are found to influence household WTP for SWM services.

Empirical Model

CVM is a technique used in economics to estimate the value of goods or services that do not have a market price. In economics, the CVM helps estimate demand for goods and services that are not traded in the market. The CVM of measuring WTP for SWM is useful in the theory of microeconomic welfare where the consumer maximizes utility subject to income constraint or minimizes their expenditure subject to utility constraint (Gebreeyosus, 2018). Similarly, the estimated WTP through CVM allows the calculation of consumer surplus, which is an essential concept in microeconomics for understanding the welfare effect (He, 2023). The CVM technique uses the questions to elicit the preference of people for non-market goods like SWM by asking them how much they would like to pay for improved SWM (Sumukwo, 2012). The CVM is commonly used to estimate the economic value of environmental goods and services such as clean air, clean water, wildlife habitats, and recreational area (Gürlük, 2006). These goods and services are typically not sold in markets, and their value is not reflected in conventional economic indicators.

Tobit Model

This study used the 'Tobit model' to identify the relationship between WTP of households for improved SWM and explanatory variables. Tobit regression analysis provides unbiased and consistent parameter estimates and allows the inclusion of more information than Logit and Probit regression (Tobin, 1958). The Tobit regression model assumes that the dependent variable WTP for improved SWM has a number of its values clustered at a limiting value usually zero (Girma

et al., 2022). Tobit regression analysis examined the relationship between stated WTP for improved SWM, demographic, and socio-economic characteristics of households (Getachew & Fufa, 2018). In the case of open-ended WTP questions and the nature of the dependent variable, which is continuous with censoring at zero, the most appropriate estimation technique is Tobit regression analysis (Halstead et al., 1991). The reason for using the Tobit model is that they are designed in such a way that it captures the full effects of the variables (Personal et al., 2010).

James Tobin developed the Tobit model in 1958 to describe the relationship between non-negative and independent variables. In the Tobit model, our interest is determining how much money a person or family is willing to pay for SWM in terms of socio-economic variables. Statistically, the Tobit model can be expressed as:

$$Y_i = \beta X_i + u_i = 0 \text{ if RHS} > 0$$

$$\text{Otherwise} \quad i = 1, 2, 3 \ldots\ldots n$$

Where,

RHS = Right-hand side;

n = Number of observations;

Y_i = Dependent variable, i.e. WTP of maximum amount of money by respondents,

X_i = Vector of independent variables,

β = Vector of unknown coefficients, and

u_i = An independently distributed error term assumed to be normal with zero mean and constant variance σ^2.

The observed Y_i counterpart of Y_i^* can be expressed as:

$Y_i = 1$ if $Y_i* > 0$, for WTP for improved SWM.

$Y_i = 0$ if $Y_i^* \leq 0$, for not willing to pay for improved solid waste management, and Y_i^* is a latent (unobservable) variable for WTP_i.

The log-likelihood function for the Tobit model is given by:

$$\log L = \sum_{Y_i>1} -\frac{1}{2}\left[log(2\pi) + log\sigma^2 + \frac{(Y_i - X_i\beta)^2}{\sigma^2}\right] + \sum_{Y_i=0} log\left[1 - \phi\left(\frac{X_i\beta}{\sigma}\right)\right]$$

(Gujarati & Porter, 2011)

Where, ϕ is the standard normal cumulative distribution function.

The maximum likelihood estimates of the parameters are calculated by maximizing the likelihood function with respect to β and σ. In the case of open-ended questions, the mean value of WTP can be calculated by averaging the total amount that the households are willing to pay, which is given by:

$$\textbf{Mean WTP} = \frac{1}{n}\sum_{i=1}^{n} Y_i \qquad \text{(Mitchel \& Carson, 1989)}$$

Where, n is the sample size, and each Y is a reported WTP.

Definition and Selection of Variables for the Tobit Model

Many factors can influence the willingness to pay households for improved SWM. The explanatory variables used in the Tobit model were based on the significant variables used in similar studies of WTP for services. SWM. The explanatory variables used in this study are described in Table 1.

Table 1: Variables and Definitions

Variables	Description	Value
Dependent Variable: WTP = Willingness to pay for improved SWM		
Independent Variables: ***Household Characteristics***		
Age	Farm household head age	Years
Gender	Farm household gender	1 = Male; 0 = Female
HH size	Number of family members	Number
Ownership	Ownership of house (own or not)	1= Own house; 0 = In rent
Period stayed	Period stayed in the area	1 = Less than 1 year, 2 = 1-to-5-year; 3 = More than five years
Education level	Education of respondents	0 = Illiterate; 1 = Basic level; 2 = Secondary, 3 = Bachelor; 4 = Master
Profession	The profession of household head	1 = Govt; employee; 2 = Private employee; 3 = Business; 4 = Agriculture; 5 = Housewife; 6 = Retired
Household income	Income of the household in a month	In Nepali Rs.
Service Characteristics		
Solid waste problem	The problem of solid waste collection	0 = There is no problem, 1 = Yes, there is problem.
Seriousness of problem	The seriousness of the problem of solid waste collection	1 = Very serious; 2 = Serious, 3 = Somewhat serious, not serious
Collection service	Households currently receiving waste collection service	1 = Yes; 0 = No

Use of service	Use of current service by HH	1 = Yes; 0=No
Frequency of collection	Frequency of collection service	1 = Once a day; 2 = Three times a week, 3 = Two times a week; 4 = Once a week
Satisfaction	Level of satisfaction with current collection service	1 = Very satisfied; 2 = Reasonably satisfied, 3 = Not satisfied
Dissatisfaction	Reasons of dissatisfaction	1 = High collection charge, 2 = Service frequency too long; 3 = Far pickup point; 4 = Collection workers are rude

Source: Author's creation.

Based on the given variables discussed in the table 1, the final regression model can be expressed as:

$$WTP_i = \alpha + \beta_1 Age_i + \beta_2 Gender_i + \beta_3 HH\ size_i + \beta_4 Ownership\ of\ house_i + \beta_5 Period\ of\ stay_i + \beta_6 Education\ level_i + \beta_7 Profession_i + \beta_8 HH\ income_i + \beta_9 Solid\ waste\ problem_i + \beta_{10} Collection\ service_i + \beta_{11} Frequency\ of\ collection_i + \beta_{12} Service\ satisfaction_i + \beta_{13} Dissatisfaction_i + u_i$$

Results and Discussion

Socio-Demographic Characteristics of Respondents

Since the data are collected from household heads, more male respondents are than females. This sample distribution is similar to the study of (Song et al., 2016). The socio-demographic characteristics and whether the respondent is willing to pay for improved SWM are presented in table 2.

Table 2: Socio-economic Characteristics and WTP of Households

Variables	Description	WTP		Total
		No	Yes	
Gender	Female	41 (66.1%)	109 (34.6%)	150 (39.8%
	Male	21 (33.9%)	206 (65.4%	227 (60.2%)
Ownership of house	In rent	48 (77.4%)	49 (15.6%	97 (25.7%)
	Own	14 (22.6%	266 (84.4%)	280 (74.3%)
Stay at this place	Less than one year	50 (80.6%)	67 (21.3%)	117 (31%)
	1 to 5 years	3 (4.8%)	68 (21.6%)	71 (18.8%)
	More than 5	9 (14.5%)	180 (57.1%)	189 (50.1%)

Education	Illiterate	35 (56.5%)	37 (11.7%)	72 (19.1%)
	Basic level	16 (25.5%)	121 (38.4%)	137 (36.3%)
	Secondary level	9 (14.5%)	85 (27.0%)	94 (24.9%)
	Bachelor	1(1.6%)	47 (14.9%)	48 (12.7%)
	Master and above	1(1.6%)	25 (7.9%)	26 (6.9%)
Age	25 to 39	32 (51.6%)	90 (28.6%)	122 (32.4%)
	40 to 49	17 (27.4%)	124 (39.4%)	141 (37.4%)
	50 to 59	9 (14.5%)	26 (8.3%)	35 (9.3%)
	Above 60	4 (6.5%)	75 (23.8%)	79 (21.0%)
Income level	Below 15000	21 (33.9%)	26 (8.3%)	47 (12.5%)
	16000 to 35000	20 (32.3%)	111 (35.2%)	131 (34.7%)
	36000 to 60000	15(24.2%)	93 (29.5%)	108 (28.6%)
	61000 to 100000	4 (6.5%)	59 (51.6%)	63 (16.7%)
	Above 100000	2 (3.2%)	26 (8.3%)	28 (7.4%)
Profession	Business	8 (12.9%)	67 (21.3%)	75 (19.9%)
	Govt. employee	12 (19.4%)	55 (17.5%)	67 (17.8%)
	Housewife	6 (9.7%)	48 (15.2%)	54 (14.3%)
	Private employee	17 (27.4%)	75 (23.8%)	92 (24.4%)
	Student	12 (19.4%)	39 (12.4%)	51 (14.5%)
	Retired	7 (11.3%)	31 (9.8%)	38 (10.1%)
Total		62 (16.4%)	315 (83.6%)	377 (100%)

Source: Author's calculation, 2023.

In the table 2, the gender distribution shows that among the males, 65.4 percent of respondents are ready to pay, whereas only 34.6 percent of female respondents are ready to pay for SWM programs.

This result shows that the male respondents are more likely than females to pay for SWM in the city. The study found that 25.7 percent of respondents live in rented houses, and 74.3 percent own a house. Among those living in a rented house, 77.4 percent responded no, and 15.6 percent responded yes based on WTP for SWM. Similarly, 84.4 percent of respondents are ready to pay for SWM among those who own a house. This result is consistent with the study of municipal SWM in Kalimpong Town (Khati, 2015). Based on the year of stay, respondents who have stayed for more than five years have higher responses, i.e., 57.1 percent yes for WTP.

The WTP for SWM is different at each education level; the response 'Yes' to WTP increases as the education level of respondents increases. Table 2 shows that most respondents have completed the basic level (up to class 8), followed by the secondary level. The study survey of household solid waste management and waste minimization in Malaysia conducted by Abdullah et al. (2017) also has a similar result regarding the education status of respondents. The frequency of respondents having an income of NRs.16000 to NRs.35000 is 34.7 percent,

and only 7.4 percent of respondents have a monthly income of more than 1 lakh. The response 'Yes' to WTP varied among the different income levels; the respondents having income NRs. 61,000 to NRs.10,0000 responded 'Yes' to WTP, which is greater, i.e. 51.6 percent, than the other income group. The profession of respondents also makes a significant difference in 'Yes' to WTP.

Service Characteristics

WTP varies depending on the availability of service and its quality. If the available service is efficient, reliable, and satisfies the residents, individuals are more likely to pay increasing WTP. The frequency of collection services can influence an individual's perception of the service value and their WTP for SWM. Regular and frequent collection services are preferred to ensure a clean environment and fewer health issues. The service characteristics and whether the respondents have WTP or not are presented in Table 3.

Table 3: WTP and Service Characteristics

Variables	Description	WTP		Total
		No	Yes	
Seriousness of problem	Not serious	14 (30.4%)	32 (69.5%)	46
	Somewhat serious	16 (15.8%)	85 (84.1%)	101
	Serious	17 (14.4%)	101 (85.5%)	118
	Very serious	15 (13.4%)	97 (86.6%)	112
Collection service available	No	12 (10.7%)	100 (89.3%)	112
	Yes	51 (18.1%)	230 (81.9%)	281
Use of service	No	11 (11.5%)	85 (88.5%)	96
	Yes	50 (18.9%)	215 (81.1%)	265
Satisfaction with service	Not satisfied	29 (17.7%)	135 (82.3%)	164
	Reasonably satisfied	24 (17.1%)	117 (82.9%)	141
	Very satisfied	9 (12.5%)	63 (87.5%)	72
Reasons to not satisfy	Far pickup point	9 (11.8%)	67 (88.2%)	76
	High collection charge	16 (17.4%)	76 (82.6%)	92
	Rude behavior of workers	21 (30%)	49 (70%)	70
	Service frequency too long	16 (11.5%)	123 (88.5%)	139

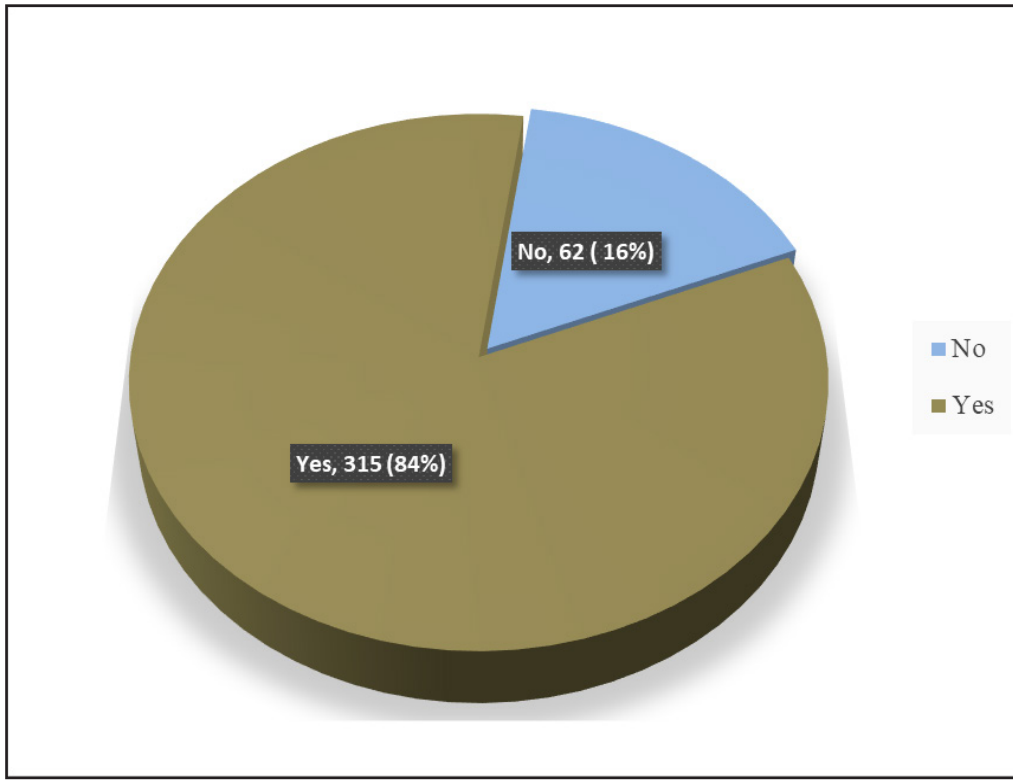
Source: Author's calculation.

The study found that most of the respondents responded that there is a severe problem in SWM and they also have the WTP for the efficient management of solid waste. Two hundred eighty-one respondents said they are getting collection services, and 265 use this service to manage solid in the locality. The data reveals that most respondents are unsatisfied with the existing solid waste collection services. The main reason behind the dissatisfaction is the frequent unavailability of collection services.

Willingness to Pay for Solid Waste Management

Out of 377 respondents, about 83.35 percent are ready to pay for improved SWM services. Only 16.45 percent of respondents are unwilling to pay for improved solid waste collection services (Table 3). This frequency distribution regarding additional WTP for improved SWM is similar to the studies (Maskey & Singh, 2017). They studied the households' willingness to pay for improved SWM in Gorkha Municipality, and their results show that 82 percent of respondents are ready to pay an additional price for improving solid waste collection services.

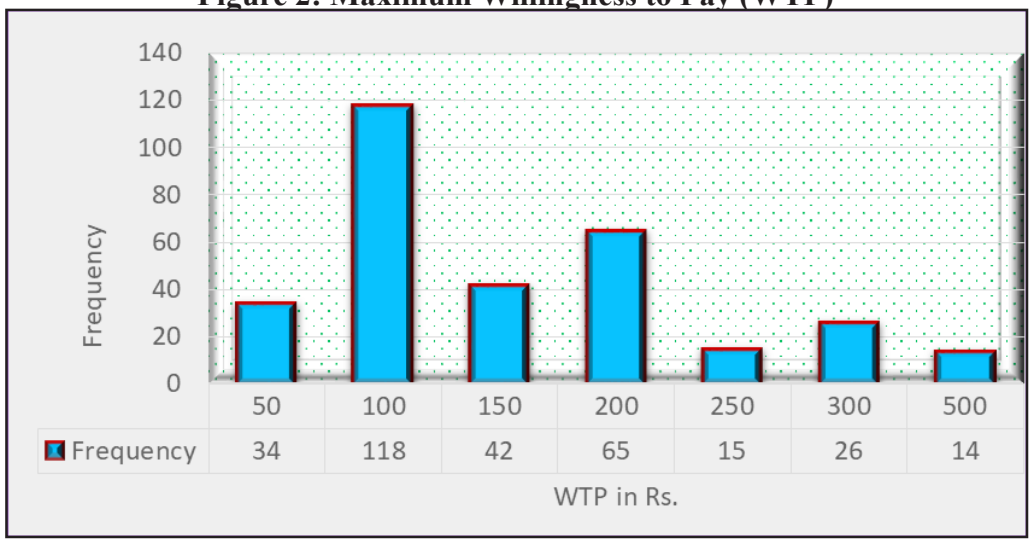
Figure 1: Frequency Distribution of Additional WTP



Source: Author's calculation.

To elicit the WTP of respondents for improved SWM, yes or no questions were designed and asked the respondents. If the answer is yes, the open-ended question is asked to know the maximum amount the respondent is ready to pay for improved SWM.

Figure 2: Maximum Willingness to Pay (WTP)



Source: Author's calculation, 2023.

Figure 2 shows the WTP for improved SWM. The WTP of households for SWM varies from NRs.50 to NRs.500 per month. Many, i.e., 118 respondents, want to pay NRs.100 per month, followed by 200, 150, and 50. Similarly, only 14 respondents were willing to pay NRs.500 per month.

Factors Affecting Willingness to Pay for Solid Waste Management

A Tobit regression model was employed to explore the factors affecting WTP for SWM. At first, the respondents chose yes or no to pay for SWM, and if they answered yes, the next question was asked how much they wanted to pay. The definition of variables used in the Tobit model is given in Table 1. The Tobit regression was performed using STATA.

Table 4: Results of Regression Analysis

Maximum WTP	Coef.	St. Err.	t-value	p-value	95% Conf.	Interval	Sig.
Gender	31.53	10.31	3.06	0.002	11.25	51.81	***
Age group	5.57	4.03	1.38	0.168	- 2.36	13.50	-
Household size	- 1.56	3.17	- 0.49	0.622	- 7.81	4.68	-
Ownership of house	49.44	13.94	3.55	00.00	22.02	76.85	***
Stay year	15.05	6.87	2.19	0.029	1.53	28.58	**
Education	20.79	4.30	4.83	0.00	12.33	29.26	***
Profession	9.79	2.80	3.49	.001	4.28	15.31	***
Income level	18.26	4.37	4.18	0.00	9.66	26.86	***
Collection problem	- 5.19	9.57	- 0.54	.588	- 24.03	13.64	-
Seriousness problem	1.49	4.51	0.33	.74	- 7.37	10.36	-

Collection service	-19.21	9.69	- 1.98	.048	- 38.28	- 0.143	**
Service satisfaction	16.90	5.54	3.05	.002	6.07	27.80	***
Reason to not satisfy	1.35	4.20	0.32	.747	- 6.91	9.62	-
Constant	- 115.02	30.10	- 3.82	0.00	- 174.22	- 55.83	***
Mean dependent var	136.737			SD dependent var	110.351		
Pseudo r-squared	0.048			No. of observation	377		
Chi-square	223.301			Prob > chi2	0.000		
Akaike crit. (AIC)	4422.142			Bayesian crit. (BIC)	4481.125		
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$							

Source: Author's calculation, 2023.

Table 4 shows the results of Tobit regression which shows that the Gender variable is statistically significant at a 1 percent confidence level. As the male is coded one and the female is 0, the male respondents have more WTP for improved solid waste management than female respondents. The coefficient of the gender variable is 31.53, which denotes that as the male candidate increases by 1 unit, the WTP for solid waste management is increased by 31.53 units. This result is consistent with the findings of (Chinh et al., 2021).

The variables of household size and age of respondents are not statistically significant in this research. Nevertheless, house ownership is significant at a 1 percent confidence level with a coefficient of 49.44, which indicates that the increase in ownership by 1 unit increases the WTP for improved SWM by 49.44 units.

Similarly, the period of stay at the current location is statistically significant at a 5 percent significance level with a positive coefficient. This result indicates that when the period of stay increases, the WTP for solid waste also increases. The increase in the living year in the locality increases the feelings of responsibility to keep the environment clean and neat.

The independent variable education level is also significant at a 1 percent confidence level. The educational level of respondents is coded as 0 for illiterate, 1, 2, 3, and 4 for basic, secondary, bachelor, and master or above, respectively. As the coefficient of the education level variable is 20.78, each higher education level obtained by the respondents leads to an increase in WTP for improved SWM by 20.78 units. This finding is reasonable because educated people are more aware and conscious of the challenges of the solid waste problem in society. Hence, the WTP for improved SWM increases as the education qualification increases.

Table 4 shows that respondents' profession was another variable found to be significant at a 1 percent significance level in influencing WTP for SWM. The survey result shows that the monthly income of respondents positively

impacts improved SWM and is found to be significant at a 1 percent level of significance. The Tobit model presented in Table 4 shows that when household income increases by a unit, the amount of money the household could pay for SWM is 18.26 units. The reason is that households with higher monthly incomes can afford more solid waste collection costs than lower-income people. This result is similar to the findings of the research conducted by Mulat et al. (2019) and Subhadarsini (2015).

Service satisfaction is another variable found significant at a 1 percent confidence level. There is a positive relationship between service satisfaction and WTP for SWM, indicating that higher satisfaction will increase the WTP for improved SWM service and vice versa.

Conclusion

These findings of the study indicate a willingness to pay for improved SWM in Itahari sub-metropolitan city. However, the amount of money a household is WEP depends on several variables. Education is important to manage solid waste, so the government should focus on the public awareness program and make the environment to send the child to school who are still out of school education. The income level also plays a significant role in determining the WTP for SWM. So, the income-generating programme in the localities will help to manage the city's solid waste problem. The household WTP for SWM also depends on the service quality. The government can charge high costs by improving the service facility.

The survey results imply that the households expect the government to make an effort to manage solid waste in the city. To manage solid waste, the local government must implement a comprehensive policy that includes improved infrastructure, public awareness campaigns, and more resources for municipalities. Similarly, policymakers should consider financial support for the collection service and disposal, which helps to manage solid waste efficiently. Local government should investigate the amount of WTP to implement the financial aid programmes.

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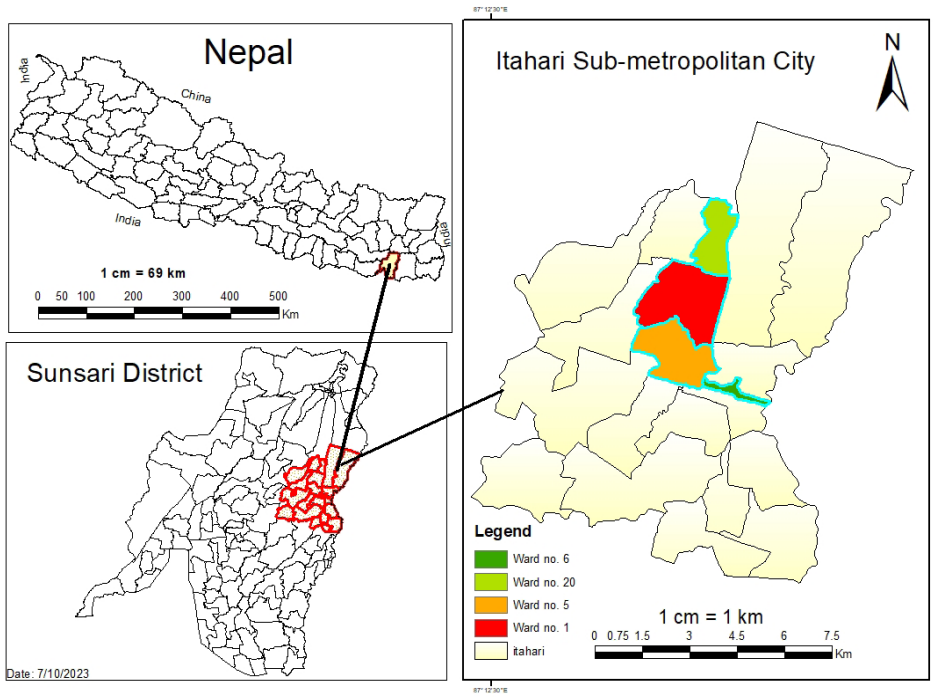
Appendix – I: Geographical Situation of the Study Area



Source: Derived using Arc GIS by the author.