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Willingness to pay and its determinants for improved solid waste management: a case study

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Abstract: This study aimed to find out the probability of willingness to pay for an improved system to manage solid wastes generated in an Indian municipality using the contingent valuation method. To determine the socio-economic factors that affect the probability of willingness to pay, binary logistic regression was applied. Most of the residents are willing to pay extra money in form of direct donation or tax to get better waste management facilities and services. Although it is found that year of effective schooling, income, awareness of Swachh Bharat Abhiyan, and distance of community bin from households have positive and statistically significant effect on residents' willingness to pay, while gender played a negative and significant role in determining willingness to pay. The findings of this study could contribute to design a more sustainable system for residential waste management.

Keywords: willingness to pay; WTP; improved solid waste management; SWM; binary logistic regression; Swachh Bharat Abhiyan.

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1 Introduction

Wastes are unavoidable byproduct of human activities. In earlier times, the disposal of human and other wastes did not pose significant difficulties since the population was small and the area of land available for assimilation of waste was large. Waste disposal has become challenging with the increasing number of towns and cities as a result of rapid economic growth and overpopulation. Urban areas in Asian countries like India face several health, environmental and aesthetic problems (Zhu et al., 2008) which are associated with the improper management of the solid wastes generated in municipal areas (Reddy, 2011) and it has become a challenge to the urban authorities in developing countries (Bhuiyan, 2010). According to Census of India (2011), India is the second largest country in the world with a population of 1.21 billion accounting for nearly 18% of world's population and the population density is 382 persons/sq. km which was 324 persons/sq. km in 2001. The proportion of population residing in urban areas has also increased from 27.8% in 2001 to 31.80% in 2011 (Census of India, 2011). With time, due to changing lifestyles of people coupled with unplanned developmental activities, urbanisation and industrialisation, the waste quantity and characteristics have dramatically changed, and as a result, managing solid wastes has become torturous (Ogawa, 1989; Reddy, 2011). Solid waste management (SWM) i.e., collecting, processing, transporting and disposition of wastes is one of the obligatory responsibilities provided by urban local bodies (ULBs) in India (The Constitution Act-243w, 1992) but lack of implementation of rules at ground level, financial shortage, resistance for notification of landfill site, awareness to enhance segregation, unscientific treats of wastes, lack of political willingness enhanced the problems associated with SWM (Bhanu and Kumar, 2014; Joshi et al., 2013; Kumar et al., 2009; Rushbrook and Pugh, 1999). Although several policy instruments that have been governed for minimising the most visible form of pollution (Pearce and Turner, 1994) i.e., 'solid waste' in the municipalities of developing countries, yet, it has often been directed at the waste management service providers and less attention is often given to the demand side of the

problem (Ezebilo, 2013). In larger urban areas in India, waste management consumes a considerable part of annual budget and availability of basic infrastructures and accessibility to modern technologies are evident. But in case of small urban areas there are some specific deficiencies regarding waste management. Improvement of worsening environmental state is not only necessary for better life quality but also a moral duty to preserve the environment for upcoming generations. In this respect, understanding people's willingness to improve the existing degraded environment and its services makes it an important aspect for policy making and implementation.

Waste management is one of non-market services that belong to more immediate human environment and its economic benefits are not easily inferred from ordinary market (Pearce and Turner, 1994) unless and until all types of wastes generated at household as well as industrial level which have economic potential are recycled or reused. The benefits of waste management services are typically estimated by non-market valuation method and in this respect contingent valuation (CV) is most frequently used method (Mitchell and Carson, 1989). The validity of CV method to estimate monetary valuations for environmental goods and services have been adequately established in the literature for developing countries including India (Majumdar and Gupta, 2009; Seth et al., 2009; Venkatachalam, 2015; Whittington, 1998). The main objectives of the present study are to elicit the probability of willingness to pay (WTP) for an improved SWM system and to determine the socio-economic factors that affect the likelihood for them to be willing to pay.

2 Theoretical concept of CV

The CV is a simple, flexible and direct non-market technique of environmental valuation based on sample survey to elicit the willingness of respondents to pay for a hypothetical program (Portney, 1994). To elicit households' WTP in CV studies questions can be structured in a number of ways like dichotomous (Bishop and Heberlein, 1979; Mitchel and Carson, 1989), bidding games (Amin and Khondoker, 2004), payment cards (Boyle and Bishop, 1988) or open ended questions (Mansfield, 1998). CV method involves six stages, namely: preparation of hypothetical market, survey, calculation, estimation, aggregation and appraisal (Hanley et al., 2006). It uses survey questions to provoke people's preferences for non-market goods by asking them how much they would pay for specified improvements or to avoid decrements in them or whether they are interested or not to pay (Mitchel and Carson, 1989). Valuation is done in money terms as in any other normal good, because of the way in which preference revelation is sought to maximise their utility. Solid waste has evident economic potential if it is systematically and scientifically handled and processed. Therefore, valuation of SWM using CV method is based on the assumption that SWM service is a normal economic good (Banga et al., 2011; Fonta et al., 2007) which can be expressed as arguments in a well behaved utility functions (Joel et al., 2012). WTP can be expressed as (Navrud and Ready, 2007):

$$WTP_{ij} = f\left(G_j, H_i\right)$$

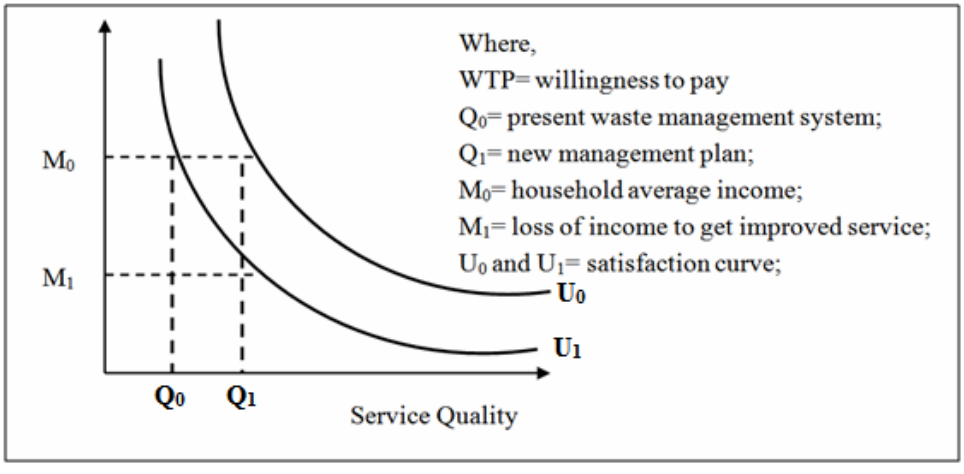
where

WTP_{ij} WTP of household 'i' towards environmental management in place 'j'

G_j characteristics of the environmental management in place 'j'

H_i characteristics of household 'i'.

Figure 1 Theoretical concept of CV



Source: Modified from Field and Field (2012)

3 Study area

Cooch Behar Municipality is the district headquarter and only Class-II census town of Cooch Behar district covering an area of 8.29 sq. km with 20 civic wards. The population strength of the town was 71,215 in 1991, 76,812 in 2001 and 77,935 in 2011 (Census of India, 2011). The town is situated on the foothills of Eastern Himalayas in northern part of West Bengal on 26°22'N latitude and 89°29'E longitude. This historical town is densely populated within 2 sq. km of its central periphery. Cooch Behar is primarily a residential town with very little industries. Due to the natural characteristics of its soil (clayey), big ponds are found in this town which stores water year long. Most of the wetlands become the store house of wastes and largely affected by eutrophication due to lack of proper management (Ray, 2015). A major portion of land of this town is under the control of Ministry of Defence, Govt. of India and a big area on the north-eastern side has air strip. Considering very little industrial growth the municipality is planning to increase more area under secondary economic activities especially small and medium scale industries to accelerate development in the area (Ray and Sar, 2017).

Figure 2 Location map of the study area (see online version for colours)

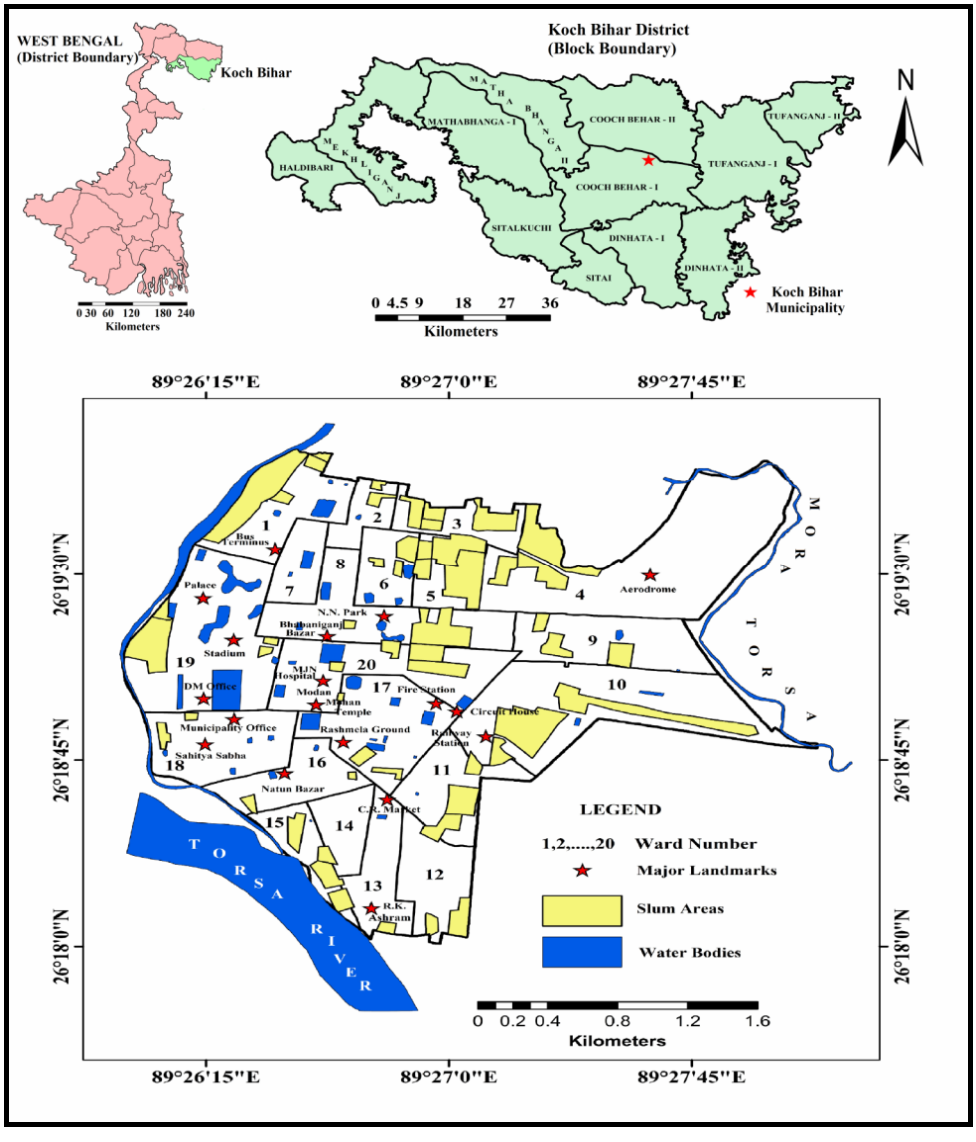


Table 1 Land use and land cover of Cooch Behar Municipality, West Bengal

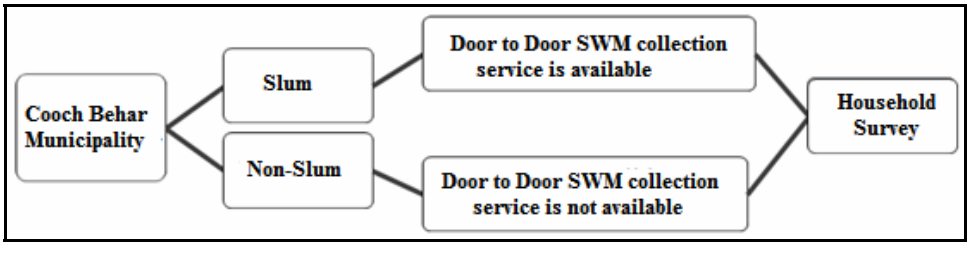
Land use/land cover type	*Area (sq km)*	*% of total area*
Commercial	0.07	0.84
Institutional	0.13	1.57
Mixed	0.46	5.56
Open unused land/undeveloped land	0.39	4.70
Public parks, squares and garden	0.30	3.61
Public and semi-public	0.32	3.86
Residential	5.37	64.78
Transportation and communication	0.47	5.67
Water body	0.34	4.10
Agriculture	0.41	4.95
Green belt	0.03	0.36
Total	8.29	100.00

Source: Office of Cooch Behar Municipality (2017)

4 Methodology

In CV survey, construction of a hypothetical market with improved management services is an integral part (Bishop and Heberlein, 1979). Furthermore, comprehensive presentation of the CV scenario to the respondents is important to familiarise themselves to the supposed SWM services (Portney, 1994). In this manner, they will be able to state their preference in the right context and within the assumptions of the CV methodology. In this respect the present scenario of SWM including associated problems and previous year's expenditure in SWM are the key contents of consideration. Questionnaire for the present study prepared and modified based on two focus group survey and pilot survey of 15 residents of Cooch Behar Municipality. The instrument had three sections: the first section included items related to household identity, the second section comprised items related to socio-economic characteristics of the households and the third section was for CV survey. The bid value of dichotomous choice question followed by an open ended question for CV method was structured. Face to face interview was also conducted among 304 residents adopting stratified random sampling as it is convenient, preferable and most reliable for WTP study (Arrow et al., 1993).

Figure 3 Sample design



Binary logistic regression was then used to find out the socio-cultural and economic characteristics that determine residents' WTP (yes/no) for improved system of SWM. Based on the literature some background variables (age, gender, income, place of residence, marital status, and distance of community bin from households) were selected (Afroz et al., 2009; Altaf and Deshazo, 1996; Awunyo-Vitor et al., 2013; Niringiye, 2010). But at the same time one new explanatory variable i.e., awareness of Swachh Bharat Abhiyan was also considered. The logit regression model specified below was used to obtain the WTP of the households for an improved SWM (Khati, 2015; Rahji and Oloruntoba, 2009).

The basic model is:

$$P_i = E\left(Y = \frac{1}{x_i}\right) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_i)}}$$

where

P_i is a probability that $Y_i = 1$

E is the natural logarithm base

β_0 is the intercept which is constant

β_1 is the line gradient

Y is the dependent variable

X_i is a set of independent variables and it predicts the probability of Y.

To identify the factors influencing WTP for improved waste management by households, the household responses to the WTP question was regressed against the households WTP potential and other socioeconomic characteristics of the household. The model for the present study can be written as:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \varepsilon$$

where

Y_i	WTP (1 = yes and 0 = otherwise)
β_0	intercept
$\beta_1, \beta_2, \ldots, \beta_8$	coefficients of the explanatory variables
X_1	age of the respondent (discrete variable)
X_2	gender of the respondent (binary, 0 = if male 1 = otherwise)
X_3	household's monthly income (discrete variable)
X_4	number of years spent in formal education (discrete variable)
X_5	place of residence (binary, 0 = if non-slum 1 = otherwise)
X_6	marital status (binary, 0 = if married 1 = otherwise)

X_7 awareness of Swachh Bharat Abhiyan (binary, 0 = if yes 1 = otherwise)

X_8 distance of the community bin from the household (continuous variable)

E the well behaved error term.

Table 2 Socio-economic characteristics of the respondents

Variable	*Category*		*Count*	*Percentage*
Gender	Male		147	48.36
	Female		157	51.64
Age	<20	Average age = 40.71 years	14	4.61
	20–30		67	22.04
	31–40		78	25.66
	41–50		76	25.00
	50 and above		69	22.70
Place of residents	Slum		85	27.96
	Non-slum		219	72.04
Household's monthly income	<5,000	Average income = Rs. 20896.37	50	16.44
	5,000–9999		47	15.46
	10,000–19,999		64	21.05
	20,000–29,999		56	18.42
	30,000–39,999		38	12.50
	40,000–49,999		25	8.22
	≥50,000		24	7.89
Occupational status of the head	Daily worker		85	27.96
	Business		84	27.64
	Service		101	33.22
	Others		34	11.18
Education	Illiterate		49	16.12
	Primary		43	14.14
	Secondary		92	30.26
	College/university		109	35.86
	Professional		11	3.62
Marital status	Married		251	82.57
	Single		53	17.43
Awareness of Swachh Bharat Abhiyan	Yes		245	80.59
	No		59	19.41
Average distance of the community bin from the household (metres)				122.56

Source: Field survey, September–December, 2016

5 Results and discussion

5.1 Socio-economic characteristics of the respondents

Socio-economic status of people affects their attitude and behaviour toward environment and waste management. The descriptive statistics of the selected socio-economic characteristics of the respondents are presented in Table 2. The sex distributions of the samples were 48% male and 52% female. As revealed in Table 2, average age of the respondents was 41 years. This implies that most of the respondents are in their active age. Therefore, they can work to earn and as an earning member of the household they can also participate in decision making process (Han et al., 2009). Almost equal distribution of respondents found in the age categories of 20–30 (22%), 31–40 (25%), 41–50 (25%) and 50 and above (22.70%); only 5% respondents were below 20 years old. According to place of residence 72% respondents lived in non-slum areas while only 28% were from slum areas. The mean income of the households was Rs. 20,896 per month. Income of the households ranges from Rs. 3,000 to Rs. 95,000 per month, thus the sample consists of both low income as well as high income households. Out of 304 respondents 16% had not received any formal education, 14% had completed primary education, 30% completed secondary education, 35% had college and university degree and only 6% had professional degree. Usually people with higher level of education are more concerned about their health and the quality of their surrounding environment. Because they continuously get updated information from books, television, newspaper etc about the effects and impacts of improper management and open dumping of solid wastes here and there.

In terms of awareness about Swachh Bharat Abhiyan most of the respondents (81%) were conscious and only 19% were unconscious. The average distance of community bin or primary collection site from the households was about 120 metres which results in open throwing and littering in every corner of the municipality.

5.2 SWM in Cooch Behar Municipality

Cooch Behar Municipality is a historical planning town with characterised by rapid urbanisation. This resulted in diversified and increasing waste generation. At present, about 39 MT solid wastes generated per day in the municipality. About 56% wastes generated from households; and remaining 44% generated from markets, hotels, trade and commerce, hospitals and pathological laboratories etc.

Table 3 Sources of solid wastes in Cooch Behar Municipality, West Bengal

Source	*Amount (MT/day)*	*Percentage*
Household	19.20	56.19
Market	3.5	10.24
Hotels	0.552	1.52
Agriculture	1.50	4.39
Trade and commerce	6.5	19.02
Hospitals and pathological laboratories	0.95	2.78
Others	2.0	5.85

Source: Office of Cooch Behar Municipality (2016)

Figure 4 Unhygienic handling of wastes by municipal workers (see online version for colours)

Figure 5 Location of dumping ground (see online version for colours)

The functional element of solid waste collection system in Cooch Behar Municipality comprises gathering of wastes and their transportation, after collection, to the location where collection vehicle is emptied. This location is basically a transfer station or the landfill disposal site. Although collection and storage of waste should be executed at the doorstep, the service is not available in every corner of the municipality. 176 sweepers work permanently under Cooch Behar Municipality. Waste handling is done mainly manually and the present system of loading/unloading of waste is labour intensive and also time-consuming. As per available information, Cooch Behar Municipality has achieved more than 80% collection of municipal solid waste. The storage system for waste at source is also not scientific in Cooch Behar Municipality. Although community bin collection system is adopted, the bins for both decomposable and non-decomposable wastes are often the same one. Moreover, availability of community bin is insufficient and distribution is uneven. Cooch Behar Municipality has one dumping ground to dispose the wastes at Taltola-2 No. Guriahati. The total area of the dumping ground is about 6 acres and about 60% of its capacity is exhausted. In dumping ground, littering and open burning noticed and collection of recyclable and reusable materials from the dumping site

by the local residents and rag pickers is unhygienic. Moreover, it is clear from the Figure 5 that location of the dumping ground is also not eco-friendly. It is located almost on the bank of Torsa River. The minimum distance of dumping ground from water body should be 200 metres. Otherwise during the rainy season, a large amount of wastes mixed with river water through runoff and degrade the quality of water. In addition, due to open dumping pollution of groundwater also accelerated through leaching.

5.3 Satisfaction scenario with present waste management system

Table 4 presents the satisfaction status of the residents regarding existing quality of waste management system. About 80% of the residents are not satisfied while only 20% claimed that they are satisfied with the present system. The reasons behind the lower level of satisfaction are issues like clearance of dump bins, sweeping of municipality roads, clearance of garbage from open spaces, insufficient community bins and irregularity of door to door collection system.

Table 4 Satisfaction scenario with present waste management system

Satisfaction	*No. of respondents*	*Percentage*
Yes	63	20.72
No	241	79.28

Source: Field Survey, September–December, 2016

5.4 Interest in solving environmental problems

Table 5 shows the extent of level of interest of the residents in solving environmental issues. About 41% respondents reported that they are very much interested in solving environmental problems followed by 50% who reported to be somewhat interested and only 8% reported that they are slightly interested. Therefore, it can be said that most of the residents are concerned about problems caused by improper management of solid waste generated in the municipality. But no initiative has taken by the residents at community level to manage wastes properly.

Table 5 Extent of interest in solving environmental problems

Level of interest	*No. of respondents*	*Percentage*
Very interested	126	41.45
Somewhat interested	152	50.00
Slightly interested	26	8.55

Source: Field survey, September–December, 2016

5.5 WTP responses

The respondents' WTP for improved management system to deal with solid wastes generated in the municipality is presented in Table 6. The respondents were asked whether they are willing to pay anything (financially) or not to get better service. Most of the respondents (69%) were willing to pay some amount of money while 31% were not

willing to pay anything. Those who were not willing to pay anything gave following reasons:

1 proper waste management is the responsibility of the government and municipal authority

2 better waste collection and disposal services are of no direct economic benefit

3 they prefer disposing their waste either by burning or burying them directly

4 some of them were reported that they do not have sufficient income to pay extra money for the waste collection service.

Table 6 Willingness to pay

Satisfaction	*No. of respondents*	*Percentage*
Yes	210	69.41
No	94	30.59

Source: Field survey, September–December, 2016

5.6 Determinants of WTP

To study the factors that might have influenced the respondents' WTP for improved waste management system a binary logit model was used. Respondents' WTP was defined in two categories i.e., zero and one. Zero WTP depicted that respondent is not willing to pay while the one was showing that respondent is willing to pay. The responses were the dependent variable while other factors which influence WTP were the independent variables, including age, gender, marital status, awareness of Swachh Bharat Abhiyan, area of residence, number of years spent in formal education by the respondent, households' average monthly income. The results of regression after finalising the variables are presented in Table 7. In order to test the goodness of fit, the pseudo R square was used to measure of the explanatory power of the entire model and it was 0.627 that means approximately 62% of the variation in WTP is explained by the explanatory variables.

The coefficients associated with education, income, awareness of Swachh Bharat Abhiyan and distance of community bin from households has positive and statistically significant effects on WTP. On the other side, coefficient associated with gender has negative and statistically significant effect on WTP. The results show that age, place of residents and marital status of the respondents have positive coefficients but not statistically significant.

Education was found to be positively associated with the WTP for improved SWM at a significant level of 1%. The higher the years of formal education received by the respondents, higher the probability of the person's WTP for waste management as education positively affects the public attitudes towards health and hygiene. Similar result has been reported in case of Peshawar City by Khattak and Amin (2013) where they found that as individuals receive higher education, they tend to understand the need for waste management better and are more willing to pay for waste management services.

Income level is always conceived as an important factor that would influence one's WTP. The residents of Cooch Behar Municipality expressed a positive and significant relationship between households' average monthly income and WTP at a significant level

of 1%. The finding on income is corroborated by others like Niringiye (2010), and Field and Field (2012). They reported that as everyone tries hard to earn their livelihood and to fulfil their household necessities, being at the lower income level household finds it hard to set aside any money for the improvement in the existing SWM and could not afford to set extra amounts to preserve the environment.

Table 7 Determinants of WTP

Variable	*Coefficient*	*Standard error*	*P value*
Age	0.162	0.117	0.137
Education	0.635	0.208	0.004***
Household's average income	1.683	2.097	0.006***
Distance of the community bin from the household	1.563	0.682	0.022**
Gender	–0.285	0.108	0.063*
Place of resident	0.250	0.454	0.596
Marital status	0.496	12.097	0.124
Awareness of Swachh Bharat Abhiyan	0.937	0.148	0.003***
Constant	0.526	0.149	0.000
Log likelihood function		–284.031	
Chi squared prob (chi squared > value)		0.000***	
Pseudo R^2		0.627	
Number of observation		304	

Notes: *statistically significant at 10%
**statistically significant at 5%
***statistically significant at 1%

The results of the study show that gender also plays a considerable role in determining the WTP at a significant level of 10%. Female residents are more likely to pay for improved SWM. This is not surprising because in the study area women are often involved in dealing with household's waste and they should be more affected by ineffective waste management than men. Therefore women have more incentive to pay for better service. Similar results have been found in other study by Ezebilo (2013) and Ichoku et al. (2009).

Moreover, distance of the community bin from the household is another determinant which has a significant impact on WTP. It has a positive relationship with the WTP for improved waste management services. As the distance of community bin or primary collection system increases, probability of households' WTP increases. Distribution of community bins is significantly insufficient and not equally distributed in all areas. The average approximate distance of community bin is 120 metres from the household while maximum is about 200 metres. Hence households with maximum distances are more likely to pay to avoid problems associated with dumping of residential waste. Distance of community bin is an important factor also in large urban areas. Nkansah et al. (2015) found that residents of Tema Metropolis who walk longer distance to dispose-off refuse have a higher a WTP than the residents who walk shorter distances.

Furthermore, awareness of Swachh Bharat Abhiyan campaign of the respondents found to be positively associated with the WTP for improved SWM services at a

significant level of 1%. The main objective of this widely popular campaign is to clean the roads, streets and infrastructure of the country. As a result residents who know about Swachh Bharat Abhiyan are more interested to take part in improved waste management system through financial aid.

6 Conclusions

The findings of the study revealed that as most of the residents of the study area are not satisfied with the present system, they want improvements and modifications. As a result, they are interested to pay something to get better facilities and services to manage their household wastes. This indicates that residents are also somewhat interested and aware in solving and minimising environmental problems. Among the selected socio-economic factors education, income, awareness of Swachh Bharat Abhiyan and distance of community bin from households were noted to positive and statistically significant effects on respondents' WTP on the one hand. On the other hand, gender had a negative and significant effect on WTP. Moreover, age, place of residents and marital status of the respondents although had positive effect, did not significantly influence decisions on WTP for improved SWM. As women are more interested than men and often play an important role in household waste management, women should be more actively involved in designing the waste management strategy. Since income level significantly influence one's WTP municipal authority can collaborate with private agencies to mange effectively the solid wastes generated in not only the municipal area but also in fringe areas. But there should be an adjustment of pay structure with economic conditions of the households. Finally it can be said that as education and awareness of Swachh Bharat Abhiyan play significant role, government should increase its involvement in education and awareness campaign.

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