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Article

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An Analysis of Households' Demand for Improved Solid Waste Management in Birendranagar Municipality, Nepal

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ABSTRACT

There is rapid urbanization in Birendranagar municipality. Due to which, the municipality is facing the problem of solid waste management (SWM). If the solid waste is not managed properly on time, it may create problem on human health and environment. This study was designed to estimate the households' willingness to pay (WTP) for improved SWM in Birendranagar municipality, Nepal. To elicit the WTP, single-bounded dichotomous choice contingent valuation method was employed. Study was based on cross-sectional survey of, randomly selected, 300 households. Out of total respondents, 91.33% respondents were interested for the improved SWM service offered whereas 51.67% respondents were willing to pay for offered bid amounts. The mean WTP was Rs. 90.12 per household per month. Result reveals that bid amount, level of education, present waste collection service and level of income are the factors determining the households' WTP for the improved SWM in Birendranagar municipality. Currently, municipality is not charging for the solid waste collection service whereas the private service provider is charging Rs. 50 per household per month. Thus, present garbage fee is far below the mean WTP of households. So, there is the opportunity of collecting sufficient funds for the provision of better SWM service in the municipality.

Keywords: Birendranagar Municipality, Dichotomous Choice, Single-bounded Contingent Valuation Method, Willingness to Pay, Solid Waste Management
JEL Classifications: Q5, R2

1. INTRODUCTION

Solid waste management (SWM) is one of the major environmental problems in densely populated cities of developing countries (Nas and Bayram, 2007; Asian Development Bank [ADB], 2013). Increasing size of population, rapid urbanization, booming economy and increased living standard of people are accelerating the generation of solid waste in such countries (Altaf and Deshazo, 1996; Minghua et al., 2009). Migration of people from rural areas to urban areas is also contributing to the SWM problem. With the increasing size of solid waste, municipalities are facing the challenge to provide an effective and efficient SWM service to the inhabitants (Guerrero et al., 2013). Lack of infrastructure, inefficient administrative system and lack of financial resources are fueling the problem of SWM in developing and least developed countries. SWM is one of the services that need to be provided to ensure the urban environment conducive to the well-being and productivity of residents (Banga et al., 2011). The improper disposal of solid waste causes negative impact on environment, human health and quality of life for urban residents (Altaf and Deshazo, 1996; Gupta et al., 1998; Singh & Singh, 1998; Kansal et al., 1998; Kansal, 2002; Jha, Sondhi, & Pansare, 2003; Ray et al., 2005; Rathi, 2006; Sharholy et al., 2008). Despite these facts, SWM is still getting less addressed and focused from the academicians and policy makers than other urban contemporary environmental problems, like air pollution and wastewater treatment (Medina, 2010).

In Nepal, the bodies, like municipalities are responsible, according to the SWM act of 2011, for construction, operation and management of infrastructure for collection, treatment and final disposal of municipal solid waste but due to higher demand for other services in the municipalities, SWM has been accorded a low priority as in cities of other developing countries (ADB, 2013). Birendranagar municipality is not exception to this. It is a growing

municipality of Nepal, which is facing the problem of SWM. Data suggest that total municipal waste generation is 9.12 tons per day whereas estimated waste collection is 1.0 ton per day (ADB, 2013). Thus, only 10.96% of total waste is collected every day, which shows the disappointing situation of SWM in the municipality. There is unequal distribution of SWM service in the municipality. There are 25 wards in the municipality. The municipality is providing waste collection service in 24 wards without charging any garbage fee. It is not providing the service in ward number 6. The service provided by municipality is not frequent. It lacks the sufficient resources to manage the generated waste. There are no enough infrastructures like permanent dumping site, roads, waste collection vehicles and human resource. A private organization named "Green City" has got permission to collect and manage the waste. It is providing service in ward number 6. Despite the presence of private sector, the garbage is not properly managed in this ward and most of the people were not satisfied with the service provided. There is no safe and permanent dumping site at all. Waste collected in municipality is finally disposed in the community forest nearby Ratna high way, which is near to the source of water. In this scenario, it is vital to study the situation of SWM in Birendranagar municipality. More specifically, the objectives of the study are: To know the current situation of SWM in Birendranagar municipality, to estimate the willingness to pay (WTP) of households for improved SWM in the municipality and to identify the factors determining households' WTP for improved SWM in the municipality. Clearly, most of the efforts of municipalities, to improve the performance of SWM, are directed towards supply-side issues, like collection and disposal capacity but have not yielded significant results (Altaf and Deshazo, 1996). But, this study is based on the demand-side issues of SWM.

The contingent valuation method (CVM) was used to elicit the WTP for improved SWM. This method has been applied by several researchers in their analysis to analyze WTP for improved SWM in several countries around the globe. Bhattarai (2015) analyzed the households' WTP for improved SWM in Banepa municipality, Nepal by applying single-bounded dichotomous choice CVM by taking a sample of 220 households. The study found that 83% respondents were willing to pay for improved SWM. The mean WTP was found to be Rs. 166 (USD 1.69) per household per month. The factors determining WTP for improved SWM were bid amount, age of respondent, sex of the respondent, household size, level of education of respondent, present waste collection service and household income. Zen and Siwar (2015) analyzed the household acceptance of curbside recycling scheme in selected residential areas of Kuala Lumpur, Malaysia by taking a sample of 460 households. Study found that 90% respondents were willing to separate the recyclable items if curbside recycling facilities are provided. But, only 41% respondents supported the curbside recycling scheme and agreed to pay extra charges. The maximum WTP was Malaysian Ringgit 7.40 (USD 2.47) per household per month. The factors influencing WTP for curbside recycling service were active recycling area, age of respondent, father or husband and adult, Chinese respondents who perform recycling and respondents' attitude that recycling is important. Ezebilo (2013) estimated the WTP for improved residential waste management in Kwara state, Nigeria by taking a sample of 236 households. Researcher found that 61% respondents were willing to pay 3,660 Nigerian Naira (USD 24) per household per year for improved waste management service. The price, income, education, dwelling type, activities of sanitary inspectors, gender of respondent, household size and whether the respondent is satisfied with private sector participation in the provision of waste management service were the factors influencing the WTP for improved waste management service.

2. METHODOLOGY

2.1. Theoretical Framework of CVM

CVM is a technique to elicit the WTP for non-market values. It is survey-based method. Under CVM, there are different approaches to assess the WTP, viz., open ended questions, payment card approach, iterative bidding approach and dichotomous choice approach. Among these different types of approaches dichotomous choice method is most popular among the researchers (Calia and Strazzera, 2000), which is based on random utility theory. It assumes that people make choices on the basis of utility comparisons of available alternatives and choose that alternative which gives highest utility (Banga et al., 2011; Louviere et al., 2000; McFadden, 1997). This method involves asking respondents directly whether they would prefer to pay a certain given amount of money for the item being evaluated (Boyle, 1990). Under dichotomous choice CVM, two widely used methods are single-bounded and double-bounded methods. This study was based on single-bounded CVM, where respondents are asked whether they are willing to pay a fixed amount of money for the item under evaluation and if the response is yes, follow-up question is asked for the maximum amount they are willing to pay whereas if the answer is no, follow-up question is asked to know what amount of money they are willing to pay for the item being evaluated.

The CV data are modeled as follows (Hanemann and Kanninen, 2001):

The CV responses assume a finite number of values which can be indexed as j = 1,…, M. The probability that i^{th} observed response takes a particular value is given by,

$$\Pr\{\text{response}_i=j\}=H_j(A_i, Z_i, \gamma) \quad (1)$$

Where A_i is bid on that occasion, Z_i represents other covariates describing the subject, the item being valued, or any other pertinent aspect of the survey and γ is a vector of parameters to be estimated from the data.

In binary response models, equation (1) reduces to:

$$\Pr\{\text{response is "yes"}\}=H(A; Z; \gamma)=H(A)$$

$$\Pr\{\text{response is "no"}\}=1-H(A; Z; \gamma)=1-H(A) \quad (2)$$

$$\text{The function } H(\cdot) \text{ can be written as } H(A; Z; \gamma)=1-F[T(A;Z; \gamma)] \quad (3)$$

$$\text{So, response = yes if } T((A; Z; \gamma)-\tau \geq 0, \text{ no otherwise} \quad (4)$$

Where T(·) is some real valued function of A and Z, τ is some random variable with cumulative distribution function (CDF) F(·) and γ represents both coefficients associated with T(·) and parameters of the CDF.

The indirect utility function is ϑ (q, y, ε), where q is non-market item, y is individual's income and ϵ is stochastic component of preferences.

Under single-bounded CVM, an individual confronts the possibility of securing a change from q^0 to $q^1>q^0$ so that ϑ (q^1, y, ε)≥ϑ (q^0, y, ε). Individual is informed that such change will cost $A and is then asked whether the individual would be in favour of it at that price. The individual will answer "yes" only if ϑ (q^1, y-A, ε)≥ϑ (q^0, y, ε) and no otherwise.

Hence, Pr{response is "yes"}=Pr{ϑ(q^1, y-A, ε) ≥ ϑ(q^0, y, ε)} (5)

2.2. Logistic Regression

The relationship between explanatory variables (i.e., bid amount, age of respondent, household size, level of education of respondent, present waste collection service and household income) and WTP of households for improved SWM was modeled by using logistic regression. The description of explanatory variables is given in Table 1. The logistic regression can be estimated by the method of maximum likelihood, where the log-likelihood function is (Hanemann and Kanninen, 2001):

$$L(\theta/y_1,\ldots,y_n,\ x_1,\ \ldots,\ x_n) = \sum_{i=1}^{n} \ln P(yi/xi,\ \theta) \qquad (6)$$

Where, vector x_i represents all exogenous variables for i^{th} respondent, vector y_i represents the responses that was observed for i^{th} observation and θ is the vector of unknown parameters.

Under single-bounded approach, the log-likelihood function can be expressed as a series of Bernoulli trials:

$$L=\sum_{i=1}^{n} yi\ln Pi+(1-yi)\ln(1-Pi)$$

Where, $P_i=P(y_i/x_i,\theta)$ is the i^{th} individual's response probability.

The mean WTP was calculated based on the procedure explained by Krinsky and Robb, along with 95% confidence interval, by using "wtpcikr" command as explained by Jeanty (2007).

Both skewness and kurtosis were found to be significantly different if residuals were to be normally distributed so that the assumption of probit model could not be satisfied. Due to which, the logistic regression was used to analyze the relationship between variables. Multicollinearity, among the explanatory variables, was tested by estimating variance inflation factor (VIF). As the VIF values, for each variable, are <10 and mean VIF is 1.23, there was no multicollinearity among the explanatory variables.

2.3. Study Area and Sampling Method

The study was carried out in Birendranagar municipality, which is located 600 km west of Kathmandu, the capital of Nepal. The area of Birendranagar municipality is 169 square KM. Every year people, from different hilly areas, migrate to this small town. Due to which there is problem in the provision of drinking water and SWM in the municipality. In Birendranagar municipality, the number of households is 22,277. There are 25 wards in the municipality. Data were collected from 300 households of 25 wards. For this, the record of households was taken from the municipality office. The sample size of each ward was proportionate to the household size of the ward. From each ward, data were collected by applying random sampling technique.

2.4. Survey Design and Questionnaire Design

To meet the requirement of study, the survey instrument designed by Bhattarai (2015) was employed with some modifications, which was pre-tested in the pilot survey of 25 households. From the result and feedback of pilot survey, questionnaire was finalized. Based on the pilot survey, five different bid prices were determined as Rs. 60, Rs. 70, Rs. 80, Rs. 90 and Rs. 100. Here, Rs. represents for "Rupees", which is currency of Nepal.

CV scenario was very important part of the questionnaire. In CVM, it is through this scenario that researcher elicits the WTP of respondents. The study used the scenario employed by Bhattarai (2015), which was: "The waste would be collected by using truck/tractor. Truck/tractor would come in your locality 3 times a week. The days on which waste would be collected would be predetermined. Truck/tractor will park for few minutes at each block or road junction in your locality. Then, the waste collectors would come to every house and take the container/plastic bag and put the waste on the vehicle. If you are storing waste on the container, they would empty that container and return it back to curbside neatly but plastic bag would not be returned. Thus, you need not to go to empty the waste on the vehicle. You need to just leave the solid waste at the curbside. To get service you have to pay monthly fee to the service provider".

2.5. Data Collection and Analysis

Study was conducted by using, basically, primary data. However, depending on the necessity of study, secondary sources of data, like research report and research articles were also used. Data were collected from June to July 2016. Permission was taken from the municipality office to collect data. For the purpose of data collection structured questionnaire was used. Data were analyzed by using statistical package 'Stata 13'.

3. RESULTS

3.1. Socio-economic and Demographic Features of Respondents

Out of 300 respondents, 49.33% were male whereas 50.67% were female. Among the male respondents, 93.24% were interested for improved SWM service whereas among female respondents 89.47% were interested. The average household size was almost 5. The largest household size was 14 whereas the smallest household size was 2. The average age of respondent was found to be 41.46 years and highest age was 78 years, while lowest age was 18 years. 95% respondents were found to be married. Only 5% respondents were unmarried. The average monthly income

was Rs. 36,714.33. The highest monthly income of respondent was found to be Rs. 620,000 and lowest monthly income of respondents was Rs. 3,000.

One hundred forty eight respondents had no any educational degree, which is 49.3% of sample size. The respondents having the secondary education were 52, which is 17.3%. Only 43 respondents had the intermediate degree, which is 14.3% of total respondents. Respondents having Bachelor degree were only 38. This is 12.3%. Similarly, there were only 19 respondents, who had completed the master degree. This was 6.3% of total sample size. No respondent were found to have M. Phil and Doctorate degree.

3.2. Current Situation of SWM

Study found that 26.7% households were receiving the SWM service. Similarly, 59.3% were burning waste on fire, 2% were making the compost and 12% were managing through other methods. Figure 1 shows the current situation of solid waste management in Birendranagar municipality. Respondents who answered that they were managing waste through other methods were found to be throwing waste in open place, throwing on nearby stream, etc. 20% were getting the SWM service from municipality and only 6.7% were getting SWM service from private service provider. Remaining 73.3% households were not receiving SWM service. There were different types of solid waste formed in the survey area, like plastic bags, rotten food and vegetables, peels of fruits and vegetables, old slippers and shoes, old clothes, covers of groceries, old papers and pencils, old books, different types of bottles, damaged electronic goods, old tooth brushes and paste, broken glasses, empty bottles of pesticides, etc.

Among the respondents who were getting SWM service, 1% were getting service daily, 4% were getting service 3 times a week, 24% were getting service once a week and 1% respondents reported that there was no fixed frequency of providing such service. Furthermore, out of remaining 70% respondents different respondents were getting service in different ways, like once in 10 days, once in 15 days and once in a month. The maximum distance moved to get the service was 150 m whereas the minimum distance moved was 5 m. Among the households getting SWM service, 94% were willing to pay for improved service whereas remaining 6% were not willing to pay for improved service.

Respondents were asked whether they were satisfied with the current solid waste collection service. Only 1% respondents were highly satisfied. 94% respondents were moderately satisfied whereas 5% respondents were not satisfied at all. Households were found to be using different types of materials to store the solid waste. 26% respondents were using durable metal or plastic container, 27% respondents were using basket or carton, 29% respondents were using plastic bags and 16% respondents were using other means to store the solid waste. The study shows that 67% respondents were environmentally aware and remaining 33% were environmentally unaware. Among environmentally aware, 94% were interested for improved SWM service while among environmentally unaware respondents 59% were interested for such service.

94% respondents reported that SWM is one of the major problems of Birendranagar municipality. Regarding the intensity of problem, 2% respondent reported that it was very high whereas 7% said that it is high. Similarly, 86% respondents reported that the intensity of problem is moderate whereas 5% respondents said that it is low. Regarding the level of satisfaction of households, who were getting SWM service, from existing waste collection service, 1% respondents were highly satisfied, 94% respondents were reasonably satisfied and 5% were not satisfied at all. The reason behind being not satisfied at all was that service was not frequent.

3.3. Valuation Results

This study revealed that among 300 households 274 (i.e., 91.33%) respondents were interested for the improved SWM service offered whereas 155 (i.e., 51.67%) respondents were willing to pay for offered bid amounts. Hence, majority of households in Birendranagar municipality were willing to pay for the improved SWM service. Similar results of WTP for improved SWM was found by different researchers in different countries, like Banga et al. (2011) found that 79.8% households were willing to pay for the improved solid waste collection service in Kampala city, Uganda. Similarly, Ezebilo (2013) found that 61% households were willing to pay for improved residential waste management service in kwara state, Nigeria. The mean WTP of households for improved SWM in Birendranagar municipality was found to be Rs. 90.12 per household per month. The respondents who were not willing to pay for improved SWM reported different reasons behind their choice, including as they were paying tax to the municipality, it is the responsibility of municipality to provide SWM service, they have open space around their house so that they can manage solid waste in that area, they can throw the waste in local stream without paying any charge and they do not have sufficient income to pay for SWM.

When the bid amount was Rs. 60, 41 respondents were willing to pay. With the increase in bid amount to Rs. 70, 32 respondents were willing to pay. Similarly, with the bid amount of Rs. 80, 31 respondents were willing to pay. With the bid amount of Rs. 90, 25 respondents were willing to pay. But, for the highest bid of Rs. 100, 26 respondents were willing to pay for improved SWM service. In general, there is negative relationship between bid amount and percentage of yes response (Figure 2), which is consistent with economic theory.

4. DISCUSSION

Table 2 shows the logistic regression result. The likelihood ratio has chi-squared statistic of 43.12, which is statistically significant at 0.01%. Similarly, the P value of Hosmer-Lemeshow statistic is 0.2095. Thus, the analytical model is well fitted.

The result shows that bid amount, level of education, present waste collection service and level of income are the determinants of households' WTP for improved SWM service in Birendranagar municipality.

Bid amount has negative and significant effect ($P < 0.01$) on WTP. It shows that WTP decreased with the successive increase in bid

Table 1: Description of explanatory variables

Variable	Description	Mean	VIF
Bid amount	Respondents were offered monthly garbage fee of Rs. 60, Rs. 70, Rs. 80, Rs. 90 and Rs. 100	80	1.01
Age	Age of respondent in years	41.46	1.19
Household size	Total number of people living in respondent's household	5.32	1.01
Education	Highest level of education attained by the respondent measured on 7 points scale: No degree=1, secondary education=2, intermediate education=3, bachelor degree=4, master degree=5, M.Phil. degree=6 and doctorate degree=7	2.09	1.22
Present waste collection service	Waste collection service received by respondent; yes=1, otherwise=0	0.27	1.03
Income	Monthly household income (Rs.)	36,714.33	1.02
Mean VIF			1.08

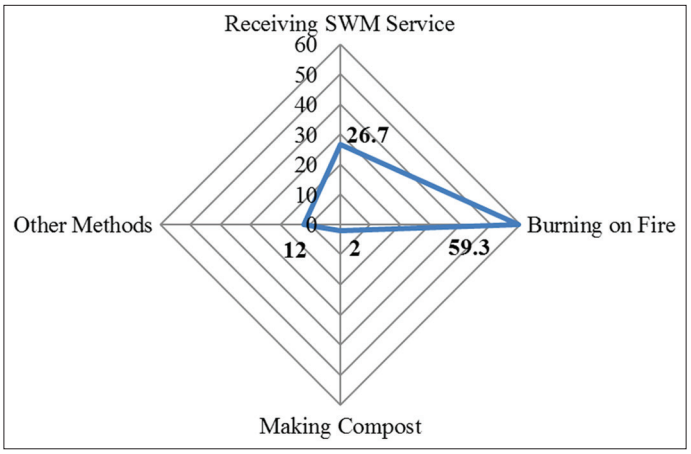
Source: Authors' computation from survey data, 2016

Table 2: Logistic regression result

Variable	Coefficient	Standard error	Marginal effect
Constant	2.04233	1.004659	
Bid amount	−0.0342522***	0.009638	−0.0083037
Age	−0.0032937	0.0110601	−0.0007985
Household size	−0.0690592	0.0656395	−0.016742
Education	0.3748542***	0.1168346	0.0908757
Present waste collection service	0.6870622**	0.3129009	0.1599955
Income	0.0000143**	5.91e-06	3.48e-06
Log likelihood	−165.99287		
LR Chi-squared	43.12		
Prob>Chi-squared	0.0000		
Pseudo R^2	0.1149		
Hosmer-Lemeshow Chi-squared	5.86		
Prob>Chi-squared	0.2095		
Iteration	4		
Mean WTP	Rs. 90.12		

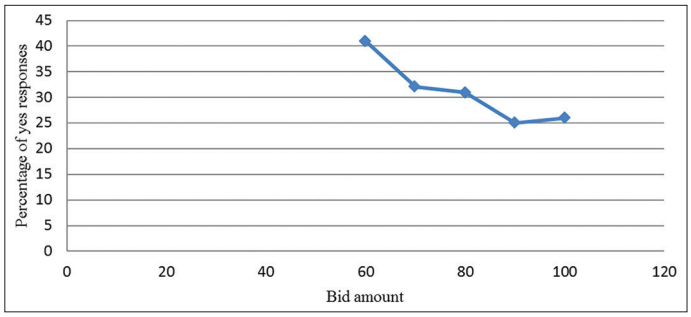
***P<0.01, **P<0.05

Figure 1: Current situation of solid waste management (percentage)



Source: Authors' computation from survey data, 2016

Figure 2: Percentage of yes responses to different bid amounts



Source: Authors' computation from survey data, 2016

amount. Such result was also found by Bhattarai (2015) and Afroz et al. (2009). The marginal effect shows that an increase in bid amount by Rs. 10 reduces the probability of WTP by 0.83%.

Age has negative but insignificant effect on WTP. Similar relationship between age of respondents and WTP was also found by Hagos et al. (2012). Similarly, household size of respondents has negative and insignificant effect on WTP. Hagos et al. (2012) found similar result.

Education has positive and significant effect ($P < 0.01$) on WTP. It shows that as the level of education increases, WTP for improved SWM service also increases. This result seems reasonable because educated people are aware of the environmental quality. So, WTP of respondents increases with increase in level of education. The marginal effect shows that as the educational attainment increases by one level, the probability of WTP increases by 9.09%. Similar result was found by Bhattarai (2015) and Hagos et al. (2012).

Present waste collection service has positive and significant effect ($P < 0.05$) on WTP. It shows that households that were getting waste collection service currently were willing to pay more than the household that were not getting the solid waste collection

service. The reason might be that people who were getting the service were aware of the importance of improved solid waste collection service. The marginal effect shows that respondents who were getting waste collection service were almost 16% more likely to pay for improved SWM service that of who were not getting such service.

Income has positive and significant effect ($P < 0.05$) on WTP. It shows that as the level of income increases, WTP for improved SWM also increases. The marginal effect shows that as monthly household income increases by Rs. 1,000, the probability of WTP increases by 0.35%. The positive relationship between level of income and WTP of respondents was supported by the result of Bhattarai (2015) and Hagos et al. (2012).

5. CONCLUSION

The study found that 91.33% households were interested for the improved SWM service offered, while 51.67% households were willing to pay for offered bid amounts. The mean WTP of households was Rs. 90.12 per household per month. Currently the municipality is providing the waste collection service without fee and a private organization is charging Rs. 50 per month per household. Clearly, present waste collection fee is lower than the mean WTP of households. The household welfare can be increased by providing solid waste collection service. The cost of providing such service can be covered by tapping WTP of households. Such service may be provided by municipality itself or by the private organization. As only 26.7% households were getting waste collection service, there is the necessity of increasing coverage of service to all households of the municipality. Similarly, the environmental awareness program should also be conducted by the municipality. Waste collection fee need not to be exactly equal to the mean WTP, however it may work as a guide to the municipal authority to determine appropriate waste collection fee. Bid amount, level of education, level of income and present waste collection service are the determinants of the households' WTP for the improved SWM service in the Birendranagar municipality.

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