

EVALUATING SOLID WASTE MANAGEMENT SYSTEM IN PAKISTAN: A Regional Analysis

**Usama Ehsan KHAN,*
Shabbir AHMED** and Ambreen FATIMA*****

Abstract

Solid waste management is becoming a major concern area in Pakistan – having considerable health consequences. According to annual report of Social Policy and Development Centre [SPDC (2016)] 38 per cent population of Pakistan belongs to urban areas whereas remaining 62 per cent population belongs to rural areas, this unbalanced growth of population has affected the delivery of basic social services, solid waste management is among the top. A wide-range of research is needed in order to assess the problem, especially to evaluate people willingness to pay to solve the problem. Pakistan Social and Living Standards Measurement Survey (PSLM) 2013-14, first time has published a module on solid waste collection system in Pakistan. The report takes into account both household and neighborhood collection mechanism. Data shows that 584 households are currently paying average amount of Rs80.24 per month on garbage disposal. Among these, rural households are paying around Rs84.51 per month while on average urban households are currently paying an average amount of Rs79.48 per month – lower than their rural counterpart. Furthermore, data also shows that only 1,799 households are currently paying for collection of solid waste from neighborhood, on average Rs87.77 per month. It is interesting to note that rural households are paying 6.6 per cent more as compare to their urban counterparts. On average rural households are paying Rs92.77 per month as compare to urban households – Rs86.99 per month. The objective of the paper is to estimate the household willingness to manage the solid waste, specifically their willingness to pay for the garbage disposal. To evaluate, Contingent Valuation Approach (CVM); applied and Heckman's two-step procedure is followed to estimate the household willingness to pay empirically. Heckman's two step procedure is commonly applied in order to deal with the expected problem of sample selection bias. Results reveal is that region, income, service provider (public or private), education and ages of the primary contributors in a household affects WTP for the disposal of household solid waste and SW disposal from the neighborhood.

I. Introduction

Uncontrolled Population growth and rapid urbanization are important factors generating solid waste in developed and developing countries. Developed and developing countries alike are facing similar challenges for the management of solid waste due to scarcity of resources, lack of awareness and lack of interest by the public and concerned authorities.

* Ph.D. Scholar, ** M.Phil. Scholar, ***Associate Professor, Applied Economics Research Centre, Univrsity of Karachi, Pakistan.

In Pakistan the system of solid waste management (SWM) is worst and hence becoming environmental hazards. In urban areas of Pakistan only 57 per cent household have a formal system of disposal of SW while in small cities only 40 per cent of household have a formal system for garbage collection [SPDC (2015)]. In the absence of formal system of SW collection and its disposal a huge amount of disposal left open in grounds, streets, ponds and rivers. The lack of number of disposal sites is further creating the stacks of waste. The World Bank reported that, the annual cost of environmental and resource degradation in Pakistan is nearly 6 per cent of country's Gross domestic product [Mustafa, et al. (2007)]. With this view the primary objective of this paper is to make assessment of the present system of solid waste management in Pakistan. In addition the paper also evaluates the household willingness to pay for the disposal of waste from the household and from the neighborhood. The literature from the empirical site in Pakistan is very scanty while international evidences highlighted that in developing countries due to inappropriate planning, poor delivery of services and governance and lack of management are the main obstacles in SWM [Schubeler, et al. (1996)]. Sharholly and Trivedi (2008) highlighted that in case of India, the improper management of SW is creating problems to public health and the environment, 90 per cent of solid waste in India is dispose unscientifically in open places.

On the empirical side Hagoes, et al. (), using limited dependent variable model, analyzed the factors that improves WTP for SWM in Ethiopia. They concluded that low income and less awareness of environmental hazards are the main factors that influence WTP for solid waste management although, existing fee in Ethiopia for SWM is below the WTP of the residents. Bel and Fageda (2009) highlighted those factors that determine solid waste service cost by using sample data in Galician municipalities. Their findings showed that Public delivery is cheaper than private delivery in case of SWM. Moreover the higher the size of economies the lower will be the cost of Service management. Joel, et al. (2012) estimated WTP by using contingent valuation method (CVM) and multiple regression technique in case of Kenya. The determinant of WTP includes income, age, education and disposable method available to the household's. Results highlighted that residents are willing to pay on average Kshs363 per month for solid waste management. Anjum (2013) used the logistic regression to estimate WTP for solid waste management by conducting a sample survey, 65.4 per cent of the total respondents are willing to pay. Further results revealed that highly educated persons have higher WTP for SWM. However, monthly mean willingness to pay is Rs289.15.

Giatsu, et al. (2012), highlighted the generation, collection and disposal of solid waste in Public institutes in Kenya. The solid waste is mainly composed of vegetables and food in Kenya, generating almost 23 tons of waste per week. The cost of planning and managing the waste ranged from Ksh0.13 to 0.59/week/student while per capita waste generation ranged from 0.28 kg/week/student to 0.71 kg/week/student. However, in Kenya, collection system is inefficient and disposal systems are not environmentally friendly. 30 to 40 per cent of all solid waste generated in urban areas remained uncollected and less than 50 per cent of the population is served [Otieno 2010]]. He argued that if the issue of sustainable

solid waste management in Kenya is not considered urgently, all the towns in Kenya will be gulfed in waste. The situation is not different then the situation of SW in large cities of Pakistan. Hence, in the light of the literature the study is specifically endeavors to evaluate the mechanism of collection, disposal and household willingness to pay for the SW in Pakistan. To evaluate, Contingent Valuation Approach (CVM) is applied and Heckman’s two-step procedure is followed to estimate the household willingness to pay empirically.

The paper is organized as follows; Section II assesses the SWM system in Pakistan descriptively; Section III outlines the methodology for the empirical assessment of WTP for SWM. Sections IV and V discuss the results; specifically factors influencing WTP for SW collections form household and neighborhood, respectively. The final section concludes and highlights some policy suggestions.

II. Assessment of SWM System in Pakistan: Descriptive Analysis

1. Socio-Economic Background and WTP

Figure 1 explains the sample under consideration. Over all 1,799 households are willing to pay for the SW collection while 17,406 household are not interested in paying for the garbage collection from the household. The maximum amount household WTP for the collection within the household is Rs500 monthly only. As far as WTP for the collection from the neighborhood is concerned only 1,799 households have shown their willingness to pay; they are willing to pay maximum Rs600/- only.

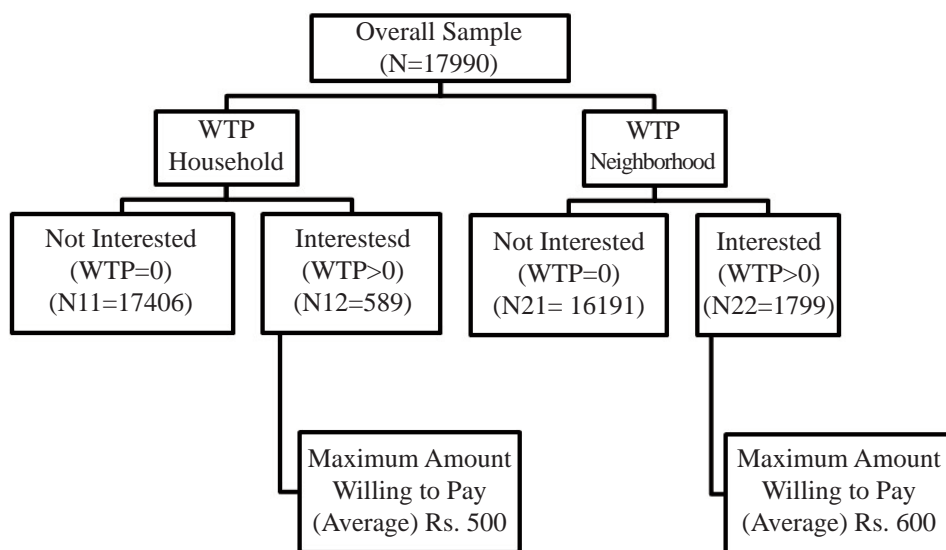


FIGURE 1
Break Down of Sample Size

Table 1 highlights the socio-economic characteristics of urban/rural household and the amount they are willing to pay for the solid waste collection from the household. In this context, literature has often explored the role of head of the household in making decision especially regarding the expenditures made. But the traditional view is now shifting. Recently literature is exploring the role of individuals contributing in household income in decision making. In this study instead of focusing on head of the household, study has also explored the role of age, education and gender of the primary economic contributors in the household. First, proportion of

TABLE 1
Regional Comparison of WTP for SWM Collection from Household

Characteristics:	Average Amount Willing to Pay	
Gender of Primary Contributors	Urban Areas	Rural Areas
<u>Male Ratio</u>		
From 0 to 25	62	100
From 26 to 50	72	115
From 51 to 75	76	51
From 76 to 100	78	89
<u>Female Ratio</u>		
From 0 to 25	72	89
From 26 to 50	70	98
From 51 to 75	81	117
From 76 to 100	66	100
<u>Ages of Primary Contributors</u>		
10 years to 14 Years	38	0
15 years to 64 Years	79	92
65 years and above	55	100
<u>Education of Primary Contributors</u>		
No Education	75	89
Matriculation	77	84
Graduate	108	200
Post Graduate	100	300
<u>Total Income (Annual)</u>		
0 – 150000	79.89	91.04
150000 - 230000	44.4	104.57
230000 - 370000	63.11	45
above 370000	93.03	115
<u>Service Provider</u>		
Municipality	68.44	131.25
Private	87.43	91.4
No formal	62.34	23.69

Source: Authors' estimated by using PSLM, 2013-14.

male contributors in the household shows that as their proportion increases in the household the willingness to pay increases from around Rs62 to Rs78 per month. However, in rural areas as the male proportion increases the amount household willing to pay first increases but afterward it declines. It varies from Rs100 to Rs89 per month. Further, if the proportion of female contributors increases in the household the willingness to pay decreases from Rs76 to Rs66 per month in urban areas while it increases from Rs89 to Rs100 per month in rural areas. Though females are often considered as responsible for the cleanness of the household but our data for the urban areas predicts opposite. Second, ages of primary contributors shows that willingness to pay is higher among the people in working age group i.e., 15-64 in urban areas whereas in rural areas willingness to pay is higher in case age of primary contributor's is 65 years and above. Third education of the contributors indicates that people with higher education are willing to pay more for solid waste management in rural areas whereas in urban areas the graduates have higher willingness to pay for solid waste management service. Finally, household income variable shows that the higher the income the higher will be the WTP.

Table 2 highlights the socio-economic characteristics of urban/rural household and the amount they are willing to pay for the solid waste collection from the neighborhood. The situation presented in Table 2 is different as was presented in Table 1. The proportion of female contributors willing to pay slightly higher as compared to male contributors; however the amount they are willing to pay shows variation as proportion of earners increases in the household. Further individual belonging to working age group are willing to pay higher than individuals in other age brackets. As far as education of the primary contributors are concerned, it indicates that people with lower education are more willing to pay for solid waste management if they live in urban areas whereas in rural areas individuals with higher education are more willing to pay for solid waste management. Finally household income again shows that higher the income the higher will be the WTP for SWM.

III. Assessment of SWM System in Pakistan: Empirical Analysis

1. Estimation Technique

Valuation method for non-marketed goods can be classified into direct and indirect valuation method. The current study involves the estimation of the economic value of the solid waste management services in Pakistan. The term economic value can be defined as the change in overall well-being of the people. The Contingent Valuation Method (CVM) is used to gauge the corresponding economic value. It involves directly asking people, in a survey, how much they are willing to pay for the service rather than inferring values from the actual choices. CVM because of this can be referred as "stated preference" approach.

Based on this stated preference approach we used an open-ended question about how much a household is actually willing to pay. An open-ended question followed “How much do you pay per month for garbage collection from your household and from your neighborhood?” So the response can be classified into multiple ways. Firstly, whether respondent is willing to pay or not and if he/she is willing then what is the actual amount (in Rs) they prefer. This study analyzes the willingness for the collection from the household and from the neighborhood separately. The estimation technique employed here is Heckman two-stage procedure; specified by a Selection equation as:

TABLE 2

Regional Comparison of WTP for SWM Collection from Neighborhood

Characteristics:	Average Amount Willing to Pay	
Gender of Primary Contributors	Urban Areas	Rural Areas
<u>Male Ratio</u>		
From 0 to 25	81	107
From 26 to 50	83	92
From 51 to 75	92	65
From 76 to 100	85	94
<u>Female Ratio</u>		
From 0 to 25	85	94
From 26 to 50	87	85
From 51 to 75	69	82
From 76 to 100	87	114
<u>Ages of Primary Contributors</u>		
10 years to 14 Years	0	105
15 years to 64 Years	95	86
65 years and above	73	79
<u>Education of Primary Contributors</u>		
No Education	82	87
Matriculation	85	89
Graduate	125	128
Post Graduate	158	300
<u>Total Income (Annual)</u>		
0 – 150000	91.02	84.29
150000 – 230000	72.47	62.29
230000 – 370000	83.75	74.34
above 370000	140.43	115.5
<u>Service Provider</u>		
Municipality	74.24	122.72
Private	94.5	92.16
No formal	92.05	27.69

Source: Authors' estimated by using PSLM, 2013-14.

$$\begin{aligned}
 Z^* &= \alpha' X + u & u &\sim N(0,1) \\
 Z &= 1 \text{ if } Z^* > 0 \\
 Z &= 0 \text{ if } Z^* < 0
 \end{aligned}$$

Regression or observation Equation

$$WTP_{hh/nh} = \beta' X + e \quad e \sim N(0, \sigma^2)$$

where, wtp_{hh} = willingness to pay for the services for household, Wtp_{nh} = willingness to pay for the services for neighborhood. WTP is observed only if $Z = 1$. X is the vector of independent variables modeled to hypothesize the influence on the willingness to pay. The demand for the willingness to pay is hypothesized to be the function of household's socio-economic conditions (i.e., income and occupancy status), demographic factors (household size, education, gender, and age of the primary contributor-primary contributor are those who assume to have more decision making power than the other members of the family as they are supporting the household economically), solid waste management related variables (service provider i.e., municipality, private or no formal system).

The key problem in regressing willingness to pay for the solid management services on socio-economic characteristics is that we are not observing the whole population. Because response against open-ended questions tends to have great proportion of household reporting zero willingness to pay, Hence, there could be a problem of sample selection bias. Earlier researchers have intensively used logit/probit or tobit model in order to mitigate zero responses. However, in our study we have applied Heckman's two-step selection procedure to correct the sample selection bias. Heckman (1979) approach this as an omitted variable problem, he proposed that an estimate of omitted variable would solve this problem of the sample selection bias. Therefore, Heckman two-step procedure is used to control the selection bias of the sample. The selection equation is estimated by maximum likelihood approach as an independent probit model. The variable inverse Mills ratio is generated from the parameter estimates. The willingness to pay (amount) is observed only when the selection model equals 1 and is then regressed on the explanatory variables and inverse Mills ratios by ordinary least square (OLS). The lambda is introduced in the second stage as an additional variable. If the coefficient of lamda is significant then we reject the null hypothesis of no selection bias.

2. Construction of Variables and Data Source

All variables are taken from Pakistan Social and Living standard Measurements (PSLM) for the period 2013-14. In this study the willingness to pay (WTP) is used to analyze solid waste management issue. WTP has its own significance and in the

essence of CVM, this amount can be referred as economic value of the services.¹ The independent variables (determinants) are generated from the same data set. We have computed the age, education and gender of the individuals contributing in the household income – primary contributor's age education and gender. Primary contributors are those who assumed to have more say in the family's decision, our case they are earners of the family. After identifying the primary contributors the median age and education of the primary contributors in a house are estimated. Proportion of male and female earners in the household is computed by aggregating the number of female contributors and male contributors and then dividing the aggregated numbers with the total number of earners in the house. We assume that the higher the proportion of female earners – female contributors in a house higher will be the amount household willing to pay. Other control variables include occupancy of household, dwelling type of house and excess to piped water – indicating the housing conditions.

IV. Results: Collection from Household

The factors responsible for willingness to pay and maximum amount in (rupees) willing to pay for solid waste management are depicted in the subsequent section. Variables and their significance level are shown in Table 3 and Table 4 for willingness to pay for solid waste management if services are available for collection from household and if services are available for collection from neighborhood respectively. First stage of both model has dichotomous dependent variable (i.e., 1 if they are willing to pay otherwise 0), while the dependent variable of second stage is the actual amount households are willing to pay. In Table 3 coefficient of Urban (region) has value of 0.173, which shows that WTP for the people living in urban areas are significantly different to that of their rural counterparts, since the coefficient is statistically significant at 1 per cent level of significance. In other words, a respondent from urban region, versus a respondent from rural region (reference group), increase the WTP by 0.173, Further, primary contributor's education has statistically significant but only marginal effect. It can be interpreted as if years of education increase by one year then WTP increase by 0.009 point. This variable shows the positive relationship between education of primary contributor and household willingness to pay, as it also accords to the economic theory.

Similarly, occupancy status also matters, which is supported by the results that WTP for tenants differs significantly from those who have their own house (benchmark category), however for those who are paying subsidize rent or paying zero rent have same WTP to that of benchmark group which in fact is not surprising. Dwelling type also differs significantly i.e. coefficient for those who are living in apartments is lower by 0.023 with those who are living in houses (reference group). Also age of the primary contributors have significant effects on WTP. Sources of water supply showing housing

¹ In absence of the specific question regarding the amount they are willing to pay the study has hypothesized that the amount they are actually paying is the amount they are willing to pay.

condition also has significant effect for WTP, if supply of water within their houses then WTP is higher by 0.1 units to that if they have supply of water outside the house. The Second stage results of regression shows that age of the primary contributors has negative relationship with amount household willing to pay. If age of the primary contributor increased by one unit WTP decreased by 0.017 rupees. Moreover, service provider also has significant effect on amount household willing to pay. If compare with municipality (reference group), people are willing to pay 0.9 unit higher for private services and 1.37 unit lower for private system. It gives the impression that people are

TABLE 3
Heckman Two-Stage Model for Collection from Household

Willing to Pay for Solid Waste Management	Coefficients	P-Value
<u>Region</u>		
Urban	0.173	0.000***
Education of Primary Contributors (years)	0.009	0.000***
<u>Occupancy Status</u>		
Tenants	0.061	0.000***
SubsidizeRent Free	0.023	0.174
<u>Dwelling Type</u>		
Apartment	-0.023	0.013**
Age of Primary Contributors (years)	0.013	0.000***
Amount Willing to Pay for Waste Management (Rs)	Coefficients	P-Value
Age of Primary Contributor	-0.017	0.026**
<u>Service Provider</u>		
Private	0.919	0.000***
No Formal System	-1.37	0.000***
<u>Dwelling Type</u>		
Apartment	-0.04	0.195
Total Income of Primary Contributor	1.04E-07	0.002***
Female Earning Ratio (Primary Contributor)	-0.027	0.046**
<u>Occupancy Status</u>		
Tenants	0.182	0.000***
Subsidize Rent Free	-0.125	0.015**
<u>Housing Condition - Source of Water</u>		
Outside the House	-0.101	0.000***
Education of Primary Contributors (years)	-0.009	0.037**
Constant	-1.65	0.000***
<u>Mills</u>		
Lambda	0.187	0.000***
wald Chi2(6)	28.54	
Prob>Chi2		0.000***
<u>Number of Observation</u>		17990

Note: Significance level: 1% (***), 5% (**), 10% (*).

more willing to pay for private system of solid waste management than others. Education of primary contributors show an unexpected negative relationship. One unit increase in years of education of primary contributor leads to 0.017 units decrease in amount household willing to pay. Since coefficient of inverse mills ratio is significant at 5 per cent suggesting that the Heckman-selection model is appropriate.

V. Results: Collection from Neighborhood

In contrast to the services provided to the household, Table 4 provides evidences related to services to the neighborhood. Coefficient of urban (region) is again significant and positive which suggest that people of urban areas are willing to pay an amount of 0.219 units to that of people of rural region. Education of primary contributors also has positive effect on WTP decision. However, in the context of WTP for neighborhood, preferences according to occupancy status differs significantly, for instance tenants and those who are paying zero or subsidize rents are willing to pay more than those who have ownership of house (reference category) by 0.072 and 0.018 point respectively. Similarly, those who are living in apartments showed greater willingness for neighborhood services then those who live in flats.

Second stage shows that age of primary contributors has significantly positive effect on amount household willing to pay, if age increase by one year WTP increase by 0.005 rupees. People are more willing to pay more amounts for privately held system. Results also revealed that people prefer privately held system over municipality (benchmark category). Female earnings ratio shows that if ratio increases by 1 unit amount household willing to pay decrease by Rs0.178. Sources of water supply representing housing condition also show significant results. If water is available outside the house then amount household willing to pay Rs0.10. On the other hand, years of education is negatively related with amount household willing to pay. Inverse Mills ratio (λ) is again significant for neighborhood SWM services that guarantee the appropriateness of Heckman selection model.

VI. Conclusion

Due to the significant regional discrimination and modest disparities in income, people in urban areas are more aware and concerned about their waste disposal and environmental quality. However, there exist loop holes in the provision of services by the service provides. A contingent valuation method is used on data of PSLM 2013-14 to evaluate people's willingness to pay for the solid waste management services both if services are provided to the household and if the services are provided to the neighborhood. Results showed that more proportion of people is willing to pay for the neighborhood services than household services. From the sample 119018 respondents, 3591 respondents are willing to pay for household services

TABLE 4
Heckman Two-stage Model for Collection from Neighborhood

Willing to Pay for Solid Waste Management	Coefficients	P-Value
<u>Region</u>		
Urban	0.219	0.004***
Education of Primary Contributors (years)	0.008	0.000***
<u>Occupancy Status</u>		
Tenants	0.072	0.005***
Subsidize Rent Free	0.018	0.010***
<u>Dwelling Type</u>		
Apartment	0.032	0.005***
Age of Primary Contributors (years)	0.014	0.000***
Amount Willing to Pay for Waste Management (Rs)	Coefficients	P-Value
Age of Primary Contributor	0.005	0.000***
<u>Service Provider</u>		
Private	0.102	0.016**
No Formal System	-2.424	0.022**
<u>Dwelling Type</u>		
Apartment	0.179	0.021**
Total Income of Primary Contributor	6.65E-08	0.000***
Female Earning Ratio (Primary Contributor)	-0.178	0.011**
<u>Occupancy Status</u>		
Tenants	0.209	0.019**
Subsidize Rent Free	-0.239	0.038**
<u>Housing Condition - Source of Water</u>		
Outside the House	-0.101	0.000***
Education of Primary Contributors (years)	-0.009	0.037**
Constant	-0.4	0.031**
<u>Mills</u>		
Lambda	0.236	0.003**
wald Chi2(6)	34457.77	
Prob>Chi2	0.000***	
Number of observation	17990	

Note: Significance level: 1% (***), 5% (**), 10% (*).

with maximum amount of Rs600 while on the other hand, 10799 respondents favored neighborhood SWM services with maximum amount of Rs600. Heckman two-stage model revealed that region, income, age of primary contributor, service provider and education of primary contributor are the major determinants of the SWM services provided to the household. However region, occupation, age, service provider and income groups are those factors that significantly affect willingness to pay for the services provided to the neighborhood.

People living in apartments are more willing to pay for neighborhood services while owner of the house prefers for household services and are more willing to pay for that. Similarly, people with higher ages showed negative relationship with WTP for household and showed positive relationship if services are provided to the neighborhood. Moreover, primary contributors with urban settlements are more willing to pay for services of SWM either for household or for neighborhood. Also, WTP is higher for privately held system for both household and neighborhood.

*Applied Economics Research Centre,
University of Karachi, Pakistan.*

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