Willingness to Pay for Solid Waste Management System in Dhaka City, Bangladesh: A Socio-Economic Analysis

Basanta Kumar Barmon*[1], Kazi Mohiuddin*, Gazi Esha Islam[2] & Nawshin Laila*

Abstract

The present study attempts to analyze the relationship between socio-economic factors and willingness to pay (WTP) for solid waste management in Dhaka city. Primary data were randomly collected from 120 households through comprehensive questionnaire. Four areas with varying income levels – Mirpur, Mohammadpur, Banani and Khilgaon - were purposely selected, because this study aimed to find a relationship between WTP and income of the households. Compared to Mirpur and Khilgaon, households with higher income reside in Banani and Mohammadpur. The findings of the study show that there is a positive relationship between household income and WTP for waste management. The residents in all four areas showed concern about solid waste management and the negative impacts waste accumulation has on the environment. Residents in unison also expressed their dissatisfaction with the quality of the existing solid waste management system. The study concluded that residents indeed are willing to pay more for better waste management, and this higher payment can then be used to enhance the existing solid waste management system - resulting in cleaner and more hygienic environment in Dhaka city.

1. Introduction

Rapid urbanization has made solid waste management a serious problem in poor and developing counties (Bahauddin and Uddin, 2012).

[1] Correspondence: Dr. Basanta Kumar Barmon, Associate Professor, Department of Economics, East West University, Main Road, Jaharul Islam City, Aftabnagar, Rampura, Dhaka-1212. Email: bkbarmon@yahoo.com

[2] MBA student, East West University

*Department of Economics, East West University, Bangladesh

Most of the municipalities in both developed and developing countries allocate and spend a huge amount of budgets for collection, transportation, and disposal of solid waste (Altaf and Deshazo, 1996). In most cities of developing countries, municipal authorities spend about 20-50% of municipal revenues for solid waste management. However, level of collection service remains low with only 50-70% of residents receiving the service and most of the disposals being treated in an unhygienic way (Cointreau, 1984; 1994).

In Dhaka, solid waste generation amounts to 4000 ton/day, of which 2500 tons are collected and dumped by the DCC, 700 tons end up in backyards and informal landfills, 500 tons end up on roadsides or open space, 200 tons are recycled by the *Tokais*[3], and 100 tons go through informal recycling at the point of generation (DCC, 2011). The increasing volume of solid waste and the complex variety of these, including hazardous waste from hospitals and other sources, have become issues of concern to both urban authorities and the citizens. Solid waste consists of all sorts of solid leftover from households, offices, factories, markets, public institutions, construction debris and rubbish, street sweeping and garden trimmings. It has been also reported that about 78% solid waste is coming from residential sector and 20% from commercial sector, 1 % from the institutional sector and the rest from other sectors (Rahman, Shams and Mahmud, 2010).

In Dhaka city, two types of waste collection methods exist - primary waste collection method and secondary waste collection method. NGOs and private sectors provide waste management services like door to door collection, vehicle arrangement, waste transportation etc. There are a few local and International NGOs like Japan International Corporation Agency (JICA), who are working on better solid waste management in Dhaka. But their number is not sufficient to cover all the areas of Dhaka city. Dhaka City Corporation (DCC) manpower is not at all sufficient for the solid waste management. DCC with its limited resources, technical know-how, and inadequate policy framework is facing a mounting task to keep the city clean at an acceptable level. Also, city corporation budget for waste management is not adequate in amount. Currently Dhaka city has two city corporations - North and South City Corporations. Recently many different approaches are taken for better solid waste management services.

[3] Destitute slum children acting as scavengers

Dhaka North City Corporation (DNCC) has come up with the concept of Public Private Participation (PPP) and fully privatizes its conservancy works in Uttara, Gulshan, Banani, Baridara, Mohakali and Tejgaon areas. On the other hand, Dhaka South City Corporation (DSCC) is providing logistical and technical supports to a NGO named Sheltech Consultant Pvt. Ltd to introduce a pilot project named "Solid Waste Management in Dhanmondi Residential Area". The main activities of this pilot project includes door to door garbage collection from concerned houses at a particular time notified earlier by the NGOs, disposal of waste in DSCC's nearest dustbin/ container, segregation of organic, inorganic and clinical waste, promoting public awareness campaign etc. Though several strategies are adopted by DNCC and DSCC, still there is no satisfactory result. This is because there is lacking in the conventional system of solid waste management.

There are a large number of researches conducted on the impacts of solid waste management on environment and health using contingency valuation methods (CVM) in poor and developing countries (Mitchell and Carson, 1989; Bahauddin and Uddin, 2012; Amin et al., 2006; Caplan, et al., 2002; Adamowicz, et. al., 1994; Alberini, 1995; Carson, et. al., 1996; Carson, et. al., 2001; Cooper, 1993; Jin, et. al., 2006; Kassim and Ali, 2006; Nilanthi, et. al., 2007). Some studies also focus on the solid management system of different cities in Bangladesh (Salam, 2000; Sinha, 1993; Enayetullah, 1995; Yousuf, 1996; Hasan, 1998; Bhuiyan, 2000; Hasan and Chowdhury, 2005; Ahsan, and Alamgir, 2010; Afroz, 2011). However, the socio-economic analysis of willingness to pay (WTP) for solid waste management has received less attention. Therefore, the present study attempts to analyze the relationship between socio-economic factors and willingness to pay (WTP) for solid waste management system in Dhaka city in Bangladesh.

This research paper is organized into five sections. Following the introduction, methodology of the study (household surveys and data collection method, and analytical techniques) is discussed in section two. Section three contains results and discussions that briefly explain solid waste management system in Bangladesh based on the household survey data, whereas conclusions are made in section four. Finally, recommendations are drawn based on the results and discussions.

2. Methodology of the Study

(i) Sources of Data

In the study areas of Dhaka city, solid waste can be categorized into (i) domestic waste (ii) commercial waste (iii) institutional waste (iv) industrial waste (v) street sweepings (vi) clinical waste and (vii) construction and demolition waste. The present study considered only the management system of domestic wastes because domestic waste constitutes the major proportion (captures about 90%) of total wastes in the study areas. Based on the objectives, primary data were used in this study. Primary data were collected through comprehensive questionnaire. A total of 120 samples were randomly collected of which 30 samples were collected from Mirpur, 30 from Mohammadpur, 30 from Banani and 30 from Khilgaon in Dhaka Municipal. Descriptive statistics and econometric analysis techniques were used in this study. To depict the reliability of the overall situation of the population, the selected sample should contain a sufficient number of households. Therefore, to reduce costs, simplify management and maintain quality of the interviews, the sample size was kept within reasonable limits.

(ii) Analytical Technique

A model is said to be an analysis of variance (ANOVA) dummy variable technique if a multiple regression analysis technique contains quantitative variable as explanatory variable and dummy variables are independent variables. ANOVA dummy variable is a powerful technique in social research (Gujarati, et. al., 2012). In this study ANOVA dummy variable technique is used to test whether willingness to pay for solid waste management is significantly different among Mirpur, Mohammadpur, Banani and Khilgaon areas. This technique seems to be the best fit for this study as the objectives of this paper is to find out the difference in willingness to pay (WTP) among the different areas of Dhaka city. In this study WTP is considered as dependent variable (quantitative variable) and area is considered as independent variables (dummy variables). The following ANOVA type model has been used:

$$Y_i = b_0 + b_1 D_1 + b_2 D_2 + b_3 D_3 + u_i$$

Where,

Y=Willingness to pay (WTP) of the respondents

b_0 = intercept

b_1, b_2, b_3 = regression coefficients

D_1= 1, for Mirpur and '0' otherwise

D_2= 1, for Mohammadpur and '0' otherwise

D_3= 1, for Banani and '0' otherwise

u_i = random error which is normally, independently and identically distributed.

ANCOVA is a statistical procedure that enables one to compare groups on some quantitative dependent variable while simultaneously controlling quantitative independent variables. Thus, ANCOVA combines both qualitative and quantitative independent variables. ANCOVA is used because inclusion of the covariate in the model can (a) increase power to detect group differences and (b) precision of estimates. In this study WTP is considered as dependent variable (quantitative variable), area is considered as independent variable (dummy variable) and income level of the respondents is considered as explanatory variable (quantitative variable). The following ANCOVA type model has been used:

$$Y_i = b_0 + b_1 X + b_2 D_1 + b_3 D_2 + b_4 D_3 + b_5 (XD_1) + b_6 (XD_2) + b_7 (XD_3) + u_i$$

Where,

Y= Willingness to pay (WTP) of the respondents

X=Income level of the respondents

b_0 = intercept

b_1, b_2, …….b_7= regression coefficients

D_1= 1, for Mirpur and '0' otherwise

D_2= 1, for Mohammadpur and '0' otherwise

D_3= 1, for Banani and '0' otherwise

u_i = random error which is normally, independently and identically distributed.

Khilgaon area has been considered as a base area dummy in this model.

3. Results and Discussions

The socio-economic characteristics and attitudes towards the environment and waste management of the respondents are briefly discussed in this section.

3.1 Socio-Economic Characteristics of the Respondents

Socio-economic status of people affects their attitude towards the environment and waste management. The educated people are usually more concerned about their health and the quality of their surrounding environment as they continuously get updated information from television, newspaper etc about the effects and impacts of unplanned solid waste management and dumping of wastes here and there. Occupation of people also plays a major role. Usually, high income people are more health conscious and prefer a better standard of living - they are even willing to pay more for receiving better services for proper solid waste management.

The socio-economic characteristics of the respondents are presented in table 1. The selected samples are the representative of the entire population in all metropolitan cities in Bangladesh. The gender distribution in the samples was 63.33% (76) male and 36.67% (44) female. Male respondents are much more enthusiastic and conscious about waste management compared to their female counterpart. Since mostly males are the ones who pay for the waste collection service - they are more concerned about the quality of service provided. The majority of the respondents had a university degree 55.83% (67), followed by 20.83% (25) with a various diploma degree, 12.50% (15) with a Higher Secondary Certificate (HSC). Only 8.33% (10) had a Secondary School Certificate (SSC), 0.83% (1) had primary education and 1.67% (2) had no formal education. As most of the respondents are educated, they are more conscious about household waste management as well as their surrounding environment - they are aware of the adverse impacts of unplanned waste management on environment and on their health. Bhattarai (2002) in his paper 'Household behavior on solid waste management: A case of Kathmandu Metropolitan city' found that education has a negative effect on waste generation. It means that if education level of the households is high, waste generation falls as educated household members work in the office and stay outside of the house for a long time. That is why the waste generation remains low.

Table 1. Descriptive statistics of socio-economic characteristics of the respondents

Characteristics	No. of respondents	Percentage
Gender:		
Male	76	63.33
Female	44	36.67
Education:		
No formal education	2	1.67
Primary education	1	0.83
Secondary school certificate (S.S.C)	10	8.33
Higher school certificate (H.S.C)	15	12.50
Diploma	25	20.83
University	67	55.83
Occupation:		
Business man	30	25.00
Service man	77	64.16
Housewife	8	6.67
Retired	5	4.17
	Mean	Standard Dev.
Age (Year)	41.46***	11.6
Family size	4.04***	1.22
Income (Taka/month)	43458.30***	16950.2

Notes: (i) *** indicate statistically significant at 1% level.

(ii) Sample size 120.

Occupation is one of the important factors for better solid waste management as well as willingness to pay for better solid waste management. A negative relationship is found between income level and solid waste generation (Nilanthi et. al., 2007). People with a higher income want to maintain a better standard of living and are more health conscious - they want better solid waste management sytem and are willing to pay more for this. Most of the respondents were engaged in public and private service (64.16%), followed by business man (25%) and only 8% respondents were housewives and 5% were retired persons. Income and family size are the key variables to determine a household′s willingness to pay for better solid waste management. So it can be assumed that most of the respondents were highly educated with high income.

On an average, the monthly household income of the respondents was about 43,458 taka with a standard deviation of 16,950 taka. The average family size of the respondents was 4.04 with a standard deviation of 1.22 which is close to average family size in urban areas (4.4) in Bangladesh (BBS, 2011). According to a study conducted by Sivakumar and Sugirtharan (2010), residential solid waste generation has shown positive relationship with family income and size.The average age of the respondents was 41.46 years with a standard deviation of 11.6 years. Niringiye and Omortor (2010) in their research paper concluded that age of respondents has a significant negative effect on willingness to pay - when people grow old their willingness to pay for waste management deteriorates.

3.2 Attitudes of the Respondents towards the Solid Waste Management and Environment

Attitudes of the respondents towards the solid waste management system and environmental problems in Dhaka city are discussed in this section.

3.2.1 Extent of Interest about Solid Waste Management

Respondent's extent of interest about solid management is presented in table 2. It shows that about 42%, 40%, and 20% respondents reported that they were very much concerned, somewhat concerned and slightly concerned about solid management system in Dhaka city, respectively. Only 1.67% sampled households informed that they were not at all concerned about solid waste management. Therefore, it can be concluded that almost all households in Dhaka city are more or less concerned about waste management in Dhaka city. This is because most of the respondents are educated and know the adverse impact of unplanned waste management on their health and environment.

Table 2. Extent of interest about solid waste management in Dhaka city

Category	No. of respondents	Percentage
Very concerned	50	41.67
Somewhat concerned	48	40.00
Slightly concerned	20	16.67
Not at all concerned	2	1.67

Source: Field survey, 2013.

3.2.2 Collecting and Placing of Wastes for Disposal

In general, males of the households remain busy with outdoor work for their daily livelihoods. There is no such specification about who collects the waste and places it in the right place. The collection and placement of solid waste for disposal is shown in table 3. The table shows that all the family members in a family are engaged in collecting and placing of waste in Dhaka city. About 52% respondents reported that usually female maid servants are engaged in collecting and placing household waste, followed by wife/mother (31%). Only 13% and 4% households reported that children and husband/father take part in placing the household solid waste in the right place,respectively. Only 4 % husband/father take part in placing household waste because most of the households of our society are dominated by males and wastes are generally collected during day time when most of the males remain at their work. Generally, female maid servants (52%) are responsible for placing the household solid waste in Dhaka city.

Table 3. Persons responsible for collecting and placing of wastes for disposal

Members	No. of respondents	Percentage
Husband/father	5	4.17
Wife/mother	37	30.83
Child	14	13.33
Maid	60	51.67
Total	120	100.00

Source: Field survey, 2013.

3.2.3 Packages of Solid Waste Discharge from Households

Table 4 presents the amount of solid waste discharge from households. About 59% and 39% respondents reported that on an average, a household discharges 1-2 packages and 3-4 packages per day, respectively and only 1.67% respondents informed that a family discharges 5-6 packages in a day. Usually a household discharges solid waste once in a day in Dhaka city because wastes are collected by the waste collectors once in a day.

Table 4. Amount of solid waste discharge from households

Discharge	No. of respondents	Percentage
1-2 packages	71	59.17
3-4 packages	47	39.17
5-6 packages	2	1.67
Total	120	100

Source: Field survey, 2013.

Amount of waste generation largely depends on the size of the households. More family members mean more leftovers produced by each member whether it is kitchen waste or other solid wastes. Table 5 shows the response of households about whether the amount of solid waste discharge depends on household size. About 95% respondents reported that amount of solid waste discharge (package/day) depends on the family size and only 5% households claimed that amount of waste does not depend on the family size in Dhaka city.

Table 5. Response of households about whether amount of solid waste discharge depends on household size

Category	No. of respondents	Percentage
Yes	114	95
No	6	5
Total	120	100

Source: Field survey, 2013.

3.2.4 Satisfaction with the Existing Quality of Waste Collection Service

A city wide survey was conducted by Islam and Khan in 2011 where they found that households had lower level of satisfaction with issues like clearance of the dump bins, sweeping of roads, clearance of garbage from open space and addressing complaints but the most commonly reported reasons for dissatisfaction with garbage service were garbage bins not being cleaned properly, irregular road sweeping and overflow of garbage in dustbins.

Satisfaction of the surveyed households with the existing quality of waste collection service is presented in table 6.

The table shows that about 68% respondents claimed that they were not satisfied whereas about 21% households claimed they were satisfied with the existing quality of waste collection service and only about 12% respondents expressed their satisfaction with the existing quality of waste collection service in Dhaka city. Most of the respondents are not satisfied with the existing waste collection system as the waste collectors sometimes do not come to collect the waste, mostly in time of holidays such as Eid holidays. Some waste collectors even do not collect wastes from door to door and in that case the households themselves have to go to the vehicles to dump their wastes. Moreover, some waste collectors dump the wastes collected from the households in nearby dustbins very unsystematically resulting in noxious and unbearable odor.

Table 6. Satisfaction about the existing quality of waste collection service

Satisfaction	No. of respondents	Percentage
Yes	25	20.83
No	81	67.5
Average	14	11.67
Total	120	100

Source: Field survey, 2013.

3.2.5 Interest in Environmental Problem

Extent of level of interest in environmental problems is shown in table 7. The table shows that about 43% respondents reported that they were very much interested in environmental problems followed by 45% respondents who reported to be somewhat interested and aware about environmental problems and only 15% reported that they were slightly interested in environmental problems when they disposed waste in disposal places. Therefore it can be concluded from table 7 that almost all residents were more or less concerned about environmental problems caused by solid waste in Dhaka city. Most of the respondents are more or less conscious about environment when they dispose waste as they know that directly or indirectly they will be the ones who will be affected by this unsystematic waste disposal in future, be it in a form of environmental degradation or in a form of health hazards.

Table 7. Extent of interest in environmental problems

Level of interest	No. of respodents	Percentage
Very interested	51	42.5
Somewhat Interested	54	45.0
Slightly interested	15	12.5
Total	120	100.0

Source: Field survey, 2013.

3.2.6 Adverse Impact of Unplanned Waste Management on Health and Environment

Unplanned solid waste management has adverse impact on human and animal health and environment. Solid waste from households and the community are a serious health hazard and lead to the spread of infectious diseases. Unattended waste lying around attracts flies, rats, and other creatures that in turn spread diseases. Normally when the wastes decompose they release a bad odor and harmful gases which are very harmful for human and animal health. Solid waste affects climate change through landfill methane emission. Emission of methane gas occurs when organic wastes are left to decay in an open landfill which produces methane gas, hence upsetting the natural atmospheric balance of GHGs and directly increasing global temperature. Saha (2013) in a case study on Pabna city stated that health problems such as asthma, diarrhea and even skin diseases were affecting people of Pabna city due to uncollected disposal of waste on streets and other public areas, drainage congestion by haphazardly dumped wastes and contamination of water resources near uncontrolled dumping site.

Poor solid waste management is a severe issue that threatens the public health and reduces the quality of urban residences in most municipalities (Foo, 1997; Snigdha, 2003). The comments of respondents on the adverse impact of unplanned solid waste management are presented in table 8. Table 8 shows that about 35%, 33% and 25% sampled households respectively reported that unplanned waste management system triggered skin diseases, respiration problem and allergy. Only 7% respondents claimed that all types of diseases were caused due to unplanned waste management in Dhaka city. Thus it may be concluded that almost all sampled households reported that the present solid waste management system is unplanned and it causes various types of diseases.

Table 8. Types of diseases the respondents suffered from because of unplanned solid waste management

Diseases	No. of respondents	Percentage
Skin disease	42	35.00
Respiration problem	40	33.33
Allergy	30	25.00
Above all	8	6.67
Total	120	100.00

Source: Field survey, 2013.

3.2.7 Types of Pollution due to Unplanned Solid Waste Management System

Various types of pollution such as water pollution, air pollution, land erosion, and odor pollution are caused due to unplanned solid management system in Dhaka city. When water comes in contact with decomposing solid waste, it dissolves together with soluble inorganic and organic wastes producing polluted liquid known as leachate or waste juice. If toxic metals are present in the solid waste, this can lead to chronic toxin accumulation in organisms and may consequently affect humans if they feed on these organisms (e.g. fish, prawns, crabs etc.). Air is polluted with hazardous gases such as methane and carbon dioxide that comes out of the landfill sites. Some household wastes such as plastics, metals and aluminum cans, broken computers and car parts do not easily decay, so they mix with the soil and degrades the soil quality resulting in problems like land erosion and reduction in the productivity of the agricultural lands. Odor pollution occurs with the unbearable stench from the decomposing solid wastes that affects the community's quality of life.

Table 9 shows that almost all sampled households claimed that unplanned solid waste management pollute water, air, land and odor in Dhaka city. Almost 80% of the respondents claimed that all the above mentioned pollution occurs due to unplanned solid waste management, 4.16% claimed that only water pollution occurs, 12.5% respondents claimed that only air pollution occurs, 2.5% respondents claimed that land erosion occurs and 1.67% respondents claimed that only odor pollution occurs due to unplanned waste management. Thus, this pollution level will be low if properly managed solid waste management system exists in the society.

Table 9. Types of pollutions due to accumulation of solid waste in the society

Pollution	No. of respondents	Percentage
Water pollution	5	4.16
Air pollution	15	12.50
Land erosion	3	2.50
Odor pollution	2	1.67
Above all	95	79.17
Total	120	100

Source: Field survey, 2013.

Usually a systematic waste management system depends on the sufficient number of dustbins. Due to insufficient number of dustbins, people place their waste here and there. Table 10 shows that about 86% respondents reported that there is insufficient number of dustbins in their areas whereas only 14% respondents claimed that there is sufficient number of dustbins in Dhaka city. This factor determines the WTP value of a society. Because, if dustbins are available then their willingness to pay for the waste mangement service will be lower as they can dump the wastes themselves in nearby dustbins. But unfortunately in Dhaka, the number of dustbins are quite low compared to the population level of each particular area. Shuvo et.al. (2013) carried out a research on 'Quantitative Analysis of Spatial Pattern of Dustbins and its Pollution in Dhaka City'. The research analyses show that, in the study area the number of the dustbins is inadequate and the existing dustbins are not distributed uniformly. Therefore, all the dustbins remain congested with wastes causing pollution to the environment. Since, the wastes stored in the dustbins are collected after 3 consecutive days, the situation becomes abysmal.

Table 10. Sufficient number of dusbins in the study areas

Sufficient no. of dustbins	No. of respondents	Percentage
Yes	17	14.16
No	103	85.83
Total	120	100

Source: Field survey, 2013.

3.3 Analysis of Descriptive Statistics of Willingness to Pay

The descriptive summary of statistics of the dependent and independent variables used in the regression model are presented in Table 11. The table shows that the mean monthly willingness to pay (WTP) of the sample respondents in Mirpur, Mohammadpur, Khilgaon and Banani areas in Dhaka city were 82 taka, 116 taka, 58 taka and 101 taka, respectively, and their corresponding standard deviation were 47.3 taka, 46 taka, 10 taka and 25.8 taka. It is observed from table 11 that the WTP of the residents of Mohammadpur area is comparatively higher than the other study areas in Dhaka city. The WTP of Banani area is higher than that of Mirpur and Khilgaon areas. The intended maximum willingness to pay (taka/month) was also shown in table 11. On an average, the monthly intended maximum willingness to pay (in taka) is comparatively higher in Mohammadpur than in other study areas such as Mirpur, Khilgaon and Banani in Dhaka city.

Table 11. Descriptive statistics of existing willingness to pay (WTP) and intended maximum willingness to pay (MWTP)

Area	Willingness to pay (WTP) (Taka/month)				Intended maximum willingness to pay (Taka/month)			
	Mean	Min	Max	SD	Min	Max	SD	Mean
Mirpur	82.0***	40.0	200.0	47.3	100.0	1000.0	199.0	423.0***
Mohammadpur	116.0***	60.0	200.0	46.0	100.0	2000.0	297.0	452.0***
Khilgoan	58.0***	100.0	200.0	10.0	100.0	1000.0	258.0	365.0***
Banani	101.0***	40.0	200.0	25.8	100.0	1000.0	262.0	422.0***

Notes: *** indicates statistically significant at 1% level.

3.3.1 Analysis of the Regression Model

The estimates of willingness to pay (WTP) for solid waste management were briefly discussed in the regression model presented in Table 12. The coefficient of determination (R^2) was about 71%, indicating that the dependent variable willingness to pay (WTP) for solid waste management (Y) was explained or accounted for about 71% by the independent variables.

Table 12. Estimates of willingness to pay (WTP) for solid waste management in Dhaka city

Variables	Coefficients	t-statistic
Intercept	144.83***	30.25
	(4.787)	
Dummy (D_1)	-94.83***	-14.13
	(6.713)	
Dummy (D_2)	-93.83***	-14.13
	(6.713)	
Dummy (D_3)	-85.16***	-12.69
	(6.713)	
R^2	0.71	

Notes: (i) *** indicate statistically significant at 1% level.
(ii) The figures in parentheses indicate standard errors of estimates.
(iii) Sample size was 120.

Table 12 shows the results of stability test of willingness to pay (WTP) (taka/month) in the four areas of Dhaka city. It appears from the table that all the coefficients of the slope dummies of Mirpur (D_1), Mohammadpur (D_2) and Banani (D_3) are statistically significant at 1% level. This indicates that significant differences in willingness to pay (taka/month) existed in the four study areas of Mirpur, Mohammadpur, Banani and Khilgaon of Dhaka city. It was observed from the field survey that the waste management system in terms of waste collecting and placing the dustbin was different in different study areas. Better waste management system was found in Mohammadpur area followed by Banani, Mirpur and Khilgaon area of Dhaka city. As the residents of Mohammadpur and Banani areas pay higher amount of money for waste management, they receive better waste management services than those of other study areas. The main reason is that the waste collectors of Mohammadpur and Banani areas receive higher wages than these of the waste collectors of other areas – Mirpur and Khilgaon. Moreover, as DNCC has privatized the waste collection task in Mohammadpur and Banani areas, residents of those areas receive more efficient services than these of the other study areas.

Based on this better service, the residents of Mohammadpur and Banani areas are willing to pay more money in future if they get better waste management service further. The same conclusions were also found in the regression model of willingness to pay (WTP) for solid management system in Dhaka city.

3.3.2 Test of Structural Break of the Willingness to Pay (WTP) among the Regions

The analysis of covariance (ANCOVA) technique is used to find out whether willingness to pay for solid waste management is significantly different depending on the income level of the respondents of Mirpur, Mohammadpur, Banani and Khilgaon area. The estimates of the ANCOVA model is presented in table 13. It appears from the table that the differential slope coefficients of Mohammadpur (0.0106) and Banani (0.0071) were significant at 5% and 10% level, respectively. This indicates that the willingness to pay (WTP) for solid waste management was significantly higher for the residents of Mohammadpur and Banani areas than these of Mirpur and Khilgaon areas considering the monthly income of the residents. This shows a positive relationship between income and WTP for solid waste management. The differential slope coefficient of Mirpur (0.0077) was statistically insignificant, which indicates that statistically there was no significant difference in willingness to pay (WTP) between Mirpur and Khilgaon area. The field survey also found similar conclusion regarding willingness to pay (WTP) between Mirpur and Khilgaon areas in Dhaka city.

Table 13 also shows that the intercept dummy (437.7, which was statistically significant at 1% level) and slope dummies of Mirpur (-350.9), Mohammadpur (-400.40) and Banani (-499.30) are statistically significant at 10%, 5% and 1% level, respectively. Thus, one may accept the hypothesis that there was definitely a structural break in willingness to pay (WTP) in the study areas in Dhaka city. The level of significance of dummies implies that the willingness to pay (WTP) for Mohammadpur and Banani area was higher than that of Mirpur and Khilgaon areas in Dhaka city as income level is higher in Mohammadpur and Banani areas compared to Mirpur and Khilgaon areas.

Table 13. Estimates of willingness to pay (WTP) for solid waste management in Dhaka city

Variables	Coefficients	t-statistic
Intercept	437.7***	2.92
	(150.20)	
Income (X)	0.00093	0.28
	(0.00333)	
Dummy (D_1)	-350.9*	-1.67
	(210.20)	
Dummy (D_2)	-400.40**	-1.95
	(205.30)	
Dummy (D_3)	-499.30***	-2.57
	(194.10)	
D_1X	0.0077	1.58
	(0.0049)	
D_2X	0.0106**	2.21
	(0.0047)	
D_3X	0.0071*	1.78
	(0.0039)	
R^2	0.64	

Notes: (i) ***, ** and * indicate statistically significant at 1%, 5% and 10% level, respectively.

(ii) The figures in parentheses indicate standard errors of estimates.

4. Conclusions

Rapid urbanization in each metropolitan city in Bangladesh has made solid waste management a serious issue. Poor solid waste management is a severe problem that threatens public health and reduces the quality of urban environment in most municipalities. But as Dhaka is the fastest growing city in terms of population, poor waste management becomes an alarming issue .For lack of manpower and sufficient budget, Dhaka City Corporation is not able to provide quality services.

This problem can be somewhat minimized if residents' WTP for providing quality services in each area is measured and residents of each area are charged according to their WTP. The WTP for better services will be certainly higher in most of the areas than the amount they pay for the existing waste collection services because most of the residents in Dhaka city are more or less concerned about the environmental and health hazards that can stem out from the mismanagement of the waste collection system. So, City Corporation can charge a higher amount from the residents for providing a better and efficient waste management service.

The findings of the study indicate that willingness to pay varied widely in the study areas of Dhaka city. The residents of Mohammadpur and Banani areas pay comparatively higher money for solid waste management than Mirpur and Khilgaon areas. As a result, waste management system is comparatively better in Mohammadpur and Banani areas than Mirpur and Khilgaon areas. The study also found a positive relationship between household income and their willingness to pay for better waste management service. The residents of Mohammadpur and Banani areas are willing to pay more money for better solid waste management system in future compared to residents of Mirpur and Khilgaon areas because they have higher income compared to households of Mirpur and Khilgaon area. The residents of the study areas are more or less concerned about solid waste management and understand the negative impacts of accumulation of solid waste on environments. However, most of the residents are not satisfied with the quality of the present solid waste management system. Thus it can be concluded that if the residents pay more money for better waste management, the waste management system can be improved by allocating more fund for hiring more manpower for transporting waste quickly to the final dumping sites and for recycling wastes from the final disposal sites.

5. Recommendations

As pointed out several times in the discussion above the present SWM system in Dhaka is less than adequate. Organizational strengthening, better management of the conservancy section would certainly help to change this grim scenario of SWM and bring it to acceptable standards. Manpower, number of vehicles, tricycles and rickshaw vans could be increased. Adequate supervision and management is imperative to ensure that wastes are collected properly and on time every day.

Public awareness campaigns could be initiated by the government so that people and community are better aware of the health and environmental hazards that improper SWM poses. Not only in media and newspapers SWM issues could be introduced in textbooks so that children grow up learning about it and as responsible citizens they themselves look for ways to solve the problem. Community involvement is the key towards solving this burning issue.

Biogas plants are already used by many factories in and around Dhaka to generate electricity from solid wastes. Government could make it mandatory for factories/poultries/farms generating a certain amount of solid waste to have biogas plants. Certain tax incentives could also be given to those complying with these new regulations.

This paper confirmed that some areas or localities of the city are willing to pay more to get better waste disposal services. Government could easily take this opportunity to charge higher municipal tax in those areas which would not only improve the service but help to maintain a cleaner hygienic city - which is a win-win situation for everyone.

There are many future prospects, recommendations and ideas for SWM but ultimately everything trickles down to proper implementation. NGOs, communities, donors and Government have to work together hand in hand to implement better service and new technologies to properly manage solid waste. Because it is doable and the residents of this mega city deserve a more hygienic and healthier environment.

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