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Solid Wastes Management and its Willingness to Pay in Mingora, Swat

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Abstract
Solid waste is one of the major environmental dilemmas of Pakistan which causes environmental degradation. There is no proper management system for the collection and disposal of solid wastes. The current study is design to highlight solid wastes and willingness to pay (WTP) for its management in Mingora Swat, Pakistan. The objective of the study is to identify factors effecting solid waste management (SWM) activities and to evaluate the relationship of income, house hold size and diseases with WTP for SWM. The study is based on primary and secondary data. The value of WTP is taken as dependent variable while income, house hold size and diseases are independent variables. Survey questionnaire incorporated the opinion of local people and Tehsil Municipal Administrators (TMA), about solid wastes as primary data. According to the current survey, the average household per day solid wastes is 1.55 Kg while the total solid wastes generated in Mingora are 45.59 Ton/day. The study found out that lack of resources and landfills, least government/community interest and lack of awareness are the main factors contributes to solid wastes mismanagement in Mingora Swat. The study also investigated that bank of river is used for disposal of solid wastes by the TMA while most people used near places as a storage for solid wastes. According to 85% of respondents, installation of solid wastes to energy plant is the most appropriate method for the management of solid wastes in Mingora Swat. According to the current survey 83% of the respondents are agree to pay for the improvement of solid wastes management system. About 44% of the respondents have willingness to pay 100 rupees per month for solid wastes management system. The statistical analysis shows 0.888 correlations between WTP and income per month.
Key words: Solid wastes, Management of solid wastes, Willingness to Pay, Mingora Swat.

1. INTRODUCTION

Any discarded material which comes from domestic, commercial and industrial sources and which can be used as a valuable raw material is called solid waste (Shaful and mansoor 2003). Solid waste can be defined as material that no longer has any value to the person who is responsible for it, and is not intended to be discharged through a pipe. It is generated by domestic, commercial, industrial, health care, agricultural and mineral extraction activities and accumulates in streets and public places. The words garbage, trash, refuse and rubbish are used to refer to some forms of solid waste. (Baig 2013). “Municipal solid waste” (MSW) is a term usually applied to a heterogeneous collection of wastes produced in urban areas, the nature of which varies from region to region. The characteristics and quantity of the solid waste generated in a region is not only a function of the living standard and lifestyle of the region's inhabitants, but also of the abundance and type of the region's natural resources (Luis et al. 2005). Improper solid waste management is one of the major causes of environmental degradation and cause hazards to human being and environment. Management of solid waste reduces or eliminates adverse impacts on the environment and human health and supports economic development and improved quality of life (UNEP 2005). Solid wastes management problems are growing in developing countries because of growing population (Ejaz and Sadiq 2012). According to the Pakistan Environmental Protection Agency only 51-69% of the generated waste is collected and the rest remains in the streets or collection points (masood 2013). The municipalities in developing countries have no proper funds and resources to control the problem of solid wastes mismanagement on sustainable manner (Qadis 2006). It is estimated that presently, 56,000 tons per day of solid waste is generated in Pakistan. No weighing and disposal facilities are installed at any disposal sites. Open burning of waste is estimated from 51-69 % in Pakistan. Much of the uncollected waste poses serious risk to public health through clogging of drains, formation of stagnant ponds, and providing breeding ground for mosquitoes and flies with consequent risk of malaria and cholera (Baig 2013).

The current study is conducted to assess the SWM system, WTP for better SWM and its impacts on health and environment in Mingora, Swat. Swat is an administrative district in the Khyber Pakhtonkhva of Pakistan, located at 34^0-40’ to 35^0-55’ North Latitude and 72^0-08’ to 74^0-6’ East Longitude. It is one of the districts of KPK and is bounded by Chitral and Ghizer districts in the North, Kohistan and Shangla districts in the East, Buner district and Malakand protected area in the South and by the districts of Upper and Lower Dir in the West. Topographically, Swat is a mountainous region, located among the foothills of the Hindu Kush mountain range. This range runs in the general direction of North and South and has a varied elevation within the Swat area, beginning from 600 meters above sea level in the South and rising rapidly up towards the North, to around 6,000 meters above sea level. The Swat region, containing the meandering Swat River, is also home to lush green

valleys, snow-covered glaciers, forests, meadows and plains (Online 2014). The total land area of district Swat is 5,337 square kilometers. This total area is divided in two tehsils, namely Matta and Swat, having areas of 683 sq. km and 4654 sq. km, respectively. About 242, 296 areas are under cultivation. (Agriculture Report 2007).

2. METHODS

The current study is based on the primary and secondary data which has been collected from 240 respondents excluding 60 respondents of TMA Mingora, Swat in May 2014. For this purpose, two type questionnaires were developed to investigate about solid waste, management services, its impacts on health and environment, and to find WTP value for SWM in Mingora Swat. Questionnaires were discussed with experts and were pre-tested before finalizing it. By using systematic sampling, a sample of 240 questionnaires was distributed among residents of Mingora while the remaining 60 questionnaires were given to employees of TMA Mingora, Swat. To distribute 240 questionnaires in best way, the mention area was divided into 10 imaginary fragments and from each fragment 24

respondents were selected. Secondary data regarding the available services was collected from the district offices and internet. For the statistical analysis of the survey Microsoft Excel and SPSS was used to find regression, coefficient, correlation, standard deviation, sum, Mean, Mode, Median, Standard error, Sample variation, Kurtosis, Skewness, Range, Maximum value, Minimum value, Number of respondents, Percentages, etc. Four variables were taken for data analysis, in which one variable (WTP) was taken dependent variable and three variables (Income, House hold size and diseases) were taken as independent variables. The results are shown by the Bar graphs, Pie charts and Tables The model used for determination of household WTP for better solid waste management services is

$$\mathbf{WTP}_i = \beta_0 + + \beta_1 I + \beta_2 HHS + \beta_3 DH + \mathbf{u}_i$$

WTP= Willingness to Pay
I=Income of household
HHS=Household Size
DH=Disease History

Table No: 1 Statistical summary of the study:

Statistics	Willingness To Pay	Income/month	House hold size	Disease History
Mean	**83.54**	**21853.75**	**7.16**	**1.56**
Standard Error	**4.10**	**306.21**	**0.11**	**0.08**
Median	**100**	**21500**	**7**	**1**
Mode	**100**	**2100**	**8**	**1**
Standard Deviation	**63.55**	**4744**	**1.81**	**1.28**
Sample Variance	**4027.15**	**22504839**	**3.28**	**1.65**
Kurtosis	**2.05**	**3.52**	**-0.34**	**0.02**
Skewness	**1.15**	**1.34**	**0.37**	**0.72**
Range	**300**	**28000**	**8**	**5**
Minimum	**0**	**12000**	**4**	**0**
Maximum	**300**	**40000**	**12**	**5**
Sum	**20050**	**5244900**	**1720**	**376**
Total Respondents	**240**	**240**	**240**	**240**

3. RESULTS AND DISCUSSION

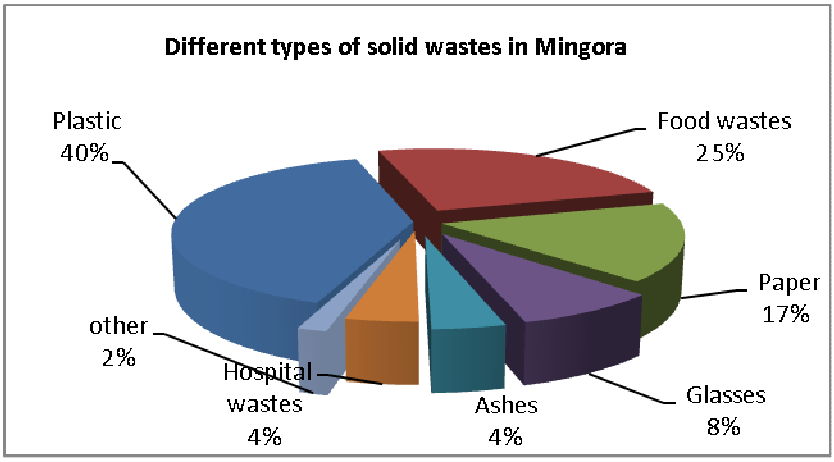

Figure 1: This figure shows us different types of solid wastes and its proportion in percentage, which is based on the information of 240 respondents.

The current study determined that plastic such as polythene bags, food wastes, papers and glasses are the major types of solid wastes in Mingora as shown in **Figure 1**. According to the 40% of respondents, the main solid wastes in Mingora are plastics which are followed by food wastes.

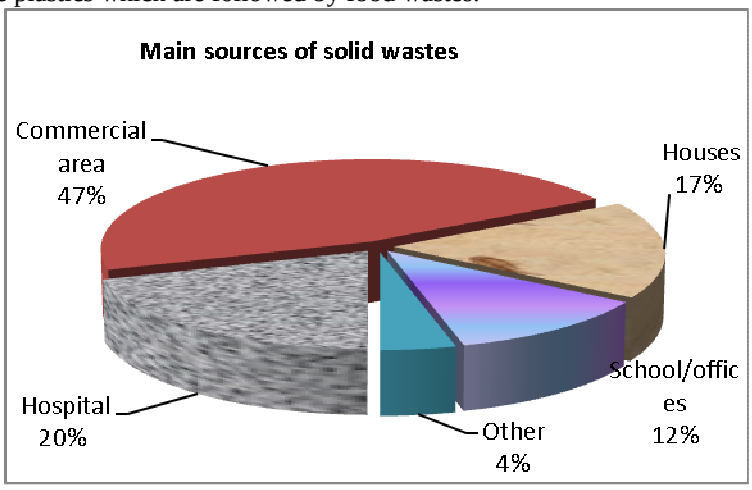

Figure 2: The data obtained from 240 respondents, shows us different sources of solid wastes in Mingora, Swat. The percentage value shows us the agreed respondents for specific source of solid wastes.

The current study investigated that main source of solid wastes in Mingora are commercial sites, hospitals, houses and schools as shown in **Figure 2**. According to 47% of respondents the main source for solid wastes in Mingora are Commercial sites. Similarly hospitals and household wastes are responsible for plastic and food wastes, for which 20% and 17% respondents are agreed. An inline study found that plastic and food wastes from commercial sites and houses are the main sources of solid wastes (Zhang *et al.* 2010). Similarly another inline reported that in Malaysia household and commercial wastes are the primary sources of solid wastes. On daily basis about 0.5 to 0.8 Kg/capita solid wastes generated in Malaysia (Manaf *et al.* 2009).

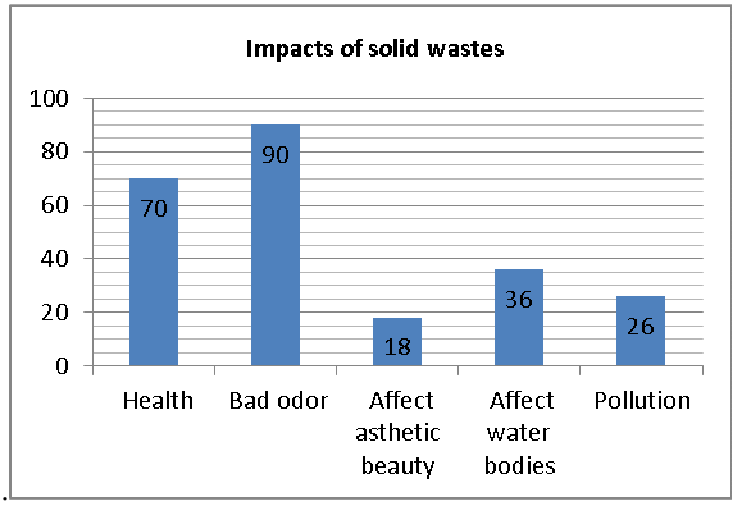

Figure 3: The figure show us various impacts of solid wastes in Mingora, Swat. The vertical axis show the strength of respondents agreed to specific type of impact. The data obtained from the 240 respondents.

The current study informed that solid wastes have adverse impacts on health and environment in Mingora, Swat. The adverse impacts of solid wastes are bad odor, diseases, soil and water pollution as shown in **Figure 3**. The most adverse impacts of solid wastes are bad odor and disease to which 38% and 30% of respondents agreed. An inline study claimed that Improper solid waste management is a great cause of environmental damage in Pakistan and creates a serious threat to human health and environment (Mahar *et al.* 2007). Another inline study reported that wastes in opened space are responsible for water pollution, soil pollution, biodiversity loss, bad smell, diseases and other environmental resources degradation (Ejaz and Sadiq 2012).

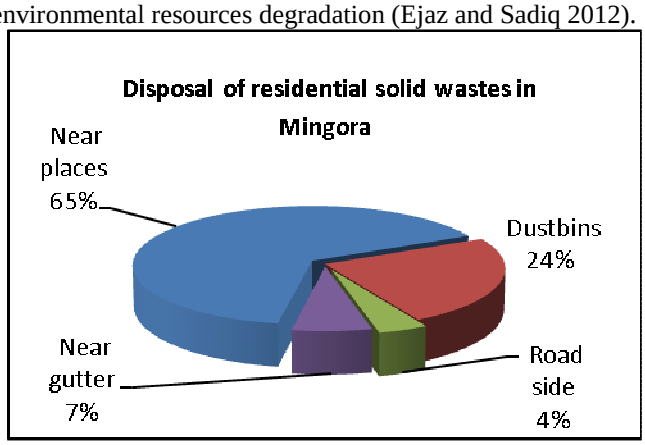

Figure 4: This figure is also based on the information of 240 respondents and show us different sites using for the disposal of solid wastes in Mingora, Swat. The percentage value show us the agreed respondents to specific site used for disposal of solid wastes in Mingora, Swat.

The current study declared that near places, dustbins, gutters and road sides are used for the disposal of solid wastes as shown in **Figure 4**. According to 65% of the respondents the main disposal site used by the people of Mingora for the solid wastes is nearby open places. These wastes which are mostly found in opened space which is responsible for environmental degradation. These results were in line with the study of (Ejaz and Sadiq 2012; Batool and Chaudhry 2009; Henery 2006).

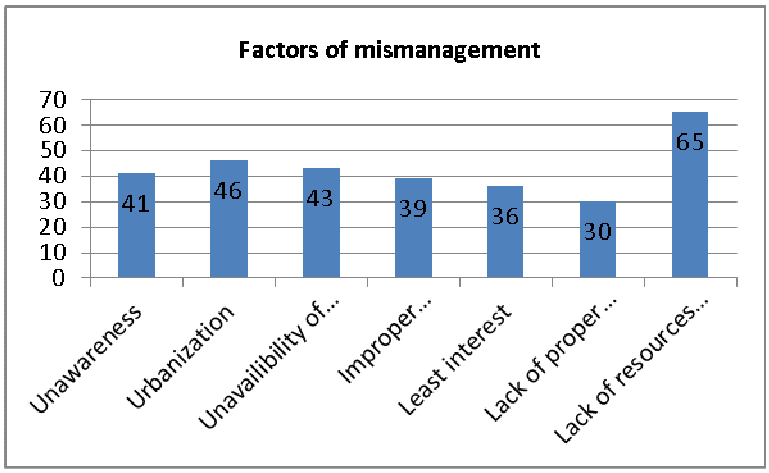

Figure 5: This figure is based on the data obtained from total 300 respondents. The figure show different factors which hindered the management system of solid wastes in Mingora, Swat. The vertical axis show the number of respondents agreed to hinder factor for solid wastes management in Mingora, Swat.

The current study investigated that lack of resources, urbanization, unavailability of space, unawareness, improper management system, least interest of community and lack of effective regulation are the factors which hinder the solid wastes management system as shown in **Figure 5**. According to 22% 16% of respondents, lack of resources /facilities and urbanization are the two main factors which are responsible for mismanagement of solid wastes in Mingora, Swat. Mingora is the capital and main city of district swat and an attractive and growing market not only for businessman but other professionals also. So immigration and urbanization is one of the major causes of solid waste in mingora which is in line with (Zhang *et al*. 2010). In Mingora improper management of solid waste, least community interest and unawareness are the other contributing factors which is similar to the previous study of (Ejaz and Sadiq 2012).

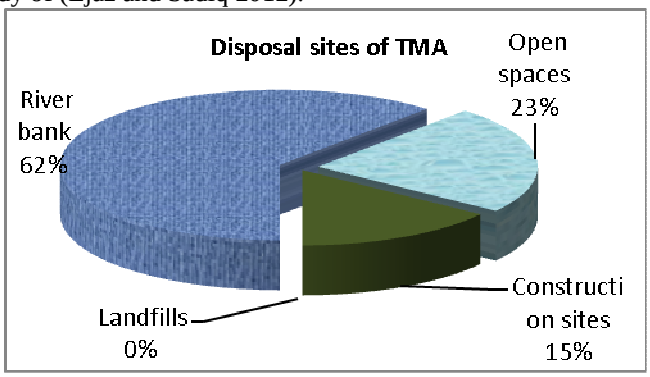

Figure 6: The data obtained from 60 employees of TMA department. The figure shows the sites using for the disposal of solid wastes by the TMA. The percentage value show the strength of employees agreed to specific site for the disposal of solid wastes in Mingora, Swat.

The current research study carried out that TMA department of Mingora, Swat used bank of river, open spaces and construction sites for the disposal of solid wastes as shown in **Figure 6**. According to 62% of the respondents river is used as a disposal site for solid wastes in Mingora while 23% and 15% of respondents are agreed for open spaces and construction sites respectively, as disposal sites of solid wastes. The disposal of solid wastes into river badly affects the aquatic life and also the main cause of many water born disease in these area. An inline study shows that mismanagement of household wastes and non-official dumping of solid waste on the bank of water created major environmental and health problems (Henery *et al*, 2006).

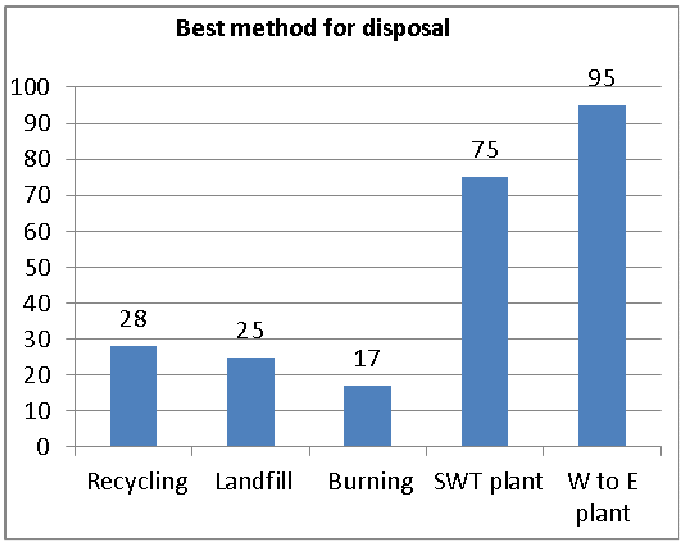

Figure 7: The figure is based on information obtained from 240 respondents. The figure investigated the best solution of solid wastes disposal in Mingora. The vertical axis shows the number of respondents who want the specific method for the disposal of solid wastes.

The current study also informed about the best possible method for the treatment of solid wastes in Mingora, Swat. According to the current survey the efficient methods for the solid wastes disposal in Mingora are the installation of waste to energy plant, waste treatment plant, recycling and landfills as shown in **Figure 7**. According to 40% of respondents the best method for the solid wastes is the installation of wastes to energy plant while 31% agreed for the wastes treatment plant. An inline study reported that solid waste management in developing countries is not good while a lot of municipal budget is spend on household waste management (Altaf 2006). It is also emphasized that new institution and law should be prepared for proper solid waste management and clean environment (Manaf *et al.* 2009). The 3Rs concept is use in high income countries while this are not generally applied in developing countries (Shekhdar 2009). Another inline study reported that recycling activities can save 65000,000 Rupees per year, save energy and provide employment (Batool *et al*. 2008). However landfill and incineration are also most feasible technologies for the treatment in Pakistan and these are best methods to tackle the problem of solid wastes in Pakistan (Masood 2013).

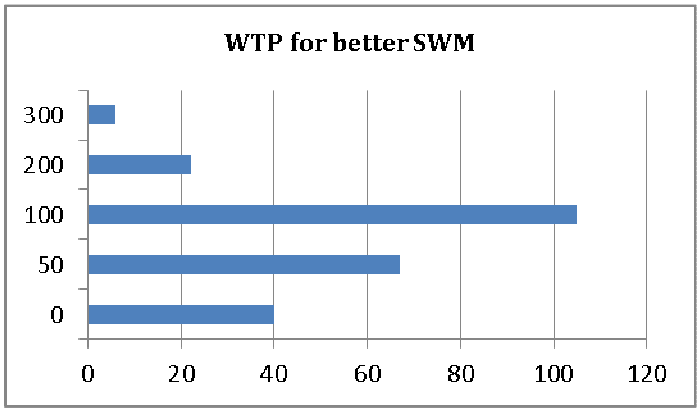

Figure 8: The data obtained from 240 respondents which show different amount of money as willingness to pay for the disposal of solid wastes in a better way. The x axis values are the agreed respondents for specific amount (y axis) to pay for disposal of solid wastes.

The current study found that 83% of the respondents have willingness to pay for solid wastes management in Mingora, Swat. The remaining 17% respondents are not agreed to pay for solid wastes management. The average value of willingness to pay is 84 Rupees per month. According to the current survey 44% of respondents have willing to pay 100 rupees per month 28% of respondents are agreed to pay 50 rupees per month for solid wastes management in Mingora, Swat as shown in **Figure 8**. According to an inline study conducted in Peshawar, 29% and 26% of respondents are agreed to pay 100 and 200 rupees per month respectively, for the improvement of solid wastes management system (Khattak *et al*. 2009).

Table No: 2. Required & available resources for solid waste in Mingora Swat.

S.No	Equipments	Available	Required
1	Dustbin	0	1000
2	Hand cart	150	150
3	Tractor	03	03
4	Skip loader	03	03
5	Truck	03	03
6	Road sweeper	46	120
7	Street sweeper	84	200
8	Khwarh sweeper	0	80

Source: TMA Office Mingora, Swat.

Table No:3 Correlations

		Willingness to pay	Income	House hold size	Disease
Pearson Correlation	Willingness to pay	1.000	0.888	-0.123	-0.031
	Income	0.888	1.000	-0.149	-0.075
	House hold size	-0.123	-0.149	1.000	0.062
	Disease	-0.031	-0.075	0.062	1.000
Sig. (1-tailed)	Willingness to pay	.	0.000	0.028	0.314
	Income	0.000	.	0.010	0.123
	House hold size	0.028	0.010	.	0.171
	Disease	0.314	0.123	0.171	.
Respondents	Willingness to pay	240	240	240	240
	Income	240	240	240	240
	House hold size	240	240	240	240
	Disease	240	240	240	240

The correlation (see **Table No 3**) shows that there is strong positive correlation between willingness to pay and income which is 0.888 in line with the study of Khattak *et al*. 2009. This show us that income strongly affect the value of WTP for better SWM in Mingora, Swat. There exist weak negative correlation (-0.123) between house hold size and willingness to pay. There is also slightly negative correlation (-0.031) between WTP and diseases.

Table No: 4 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.889[a]	0.790	0.788	29.23221

a. Predictors: (Constant), Disease, House hold size, Income

The model summary (see **Table No 4**) shows that the three independent variables explain 78% variation in the dependent variable.

Table No:5 ANOVA[b] Model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	760822.309	3	253607.436	296.783	.000[a]
	Residual	201667.274	236	854.522		
	Total	962489.583	239			

a. Predictors: (Constant), Disease, House hold size, Income
b. Dependent Variable: Willingness to pay

The ANOVA model (see **Table No 5**) is significant because its significance value is 0.000 which lies in the acceptance range of 0.005.

Table No: 6 Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-181.864	12.826		-14.179	.000
	Income	.012	.000	.892	29.539	.000
	House hold size	.264	1.056	.008	.250	.803
	Disease	1.734	1.477	.035	1.174	.241

a. Dependent Variable: Willingness to pay

The coefficients analysis (see **Table No 6**) is the most important part of the study where the value of income show that it has significant impact on the willingness to pay but the remaining two variables don't show any significant impact on the willingness to pay because its values are not statistically significant.

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