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Whether Households are Willing to Pay for Clean Water Supply in Sialkot, Pakistan? An Elucidation

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A B S T R A C T

Waterborne diseases due to contaminated water remain a severe problem in most of the developing world. The situation is serious in Sialkot the district of Punjab where groundwater is contaminated due to effluents' improper disposal. The current study is designed to find the determinants of willingness to pay (WTP) by households for clean drinking water supply in the affected area. A contingent valuation survey approach and a stratified random sampling technique have been applied. A double bounded dichotomous choice question followed by an open-ended question format has been used to elicit WTP and maximum willingness of the respondents for clean drinking water supply. Logit and Multiple Linear Regression Model is used as an econometric tool to analyze the data. The results reveal that as the income of the respondent increases, the WTP for the clean water supply also increases. While multiple regression reveals a monthly mean WTP of Rs. 234.54 which is greatly affected by age, household income, education, and environmental awareness i.e. respondents with higher household income and a higher level of education are willing to pay more for a clean water supply. Residents who are living closer to the tanneries are more affected and their WTP is higher

Introduction

Throughout history, the fate of human societies has often been determined by infectious diseases, many of which are mediated by the environmental situation in which people live (Barrett *et al.*,1998; Hanley *et al.*, 2019; Pattanayak *et al.*,2018). As the world gets more crowded and natural resources become increasingly stressed, problems of infectious diseases have, and will, become increasingly salient. In recent years the relationships between environmental change and the spread of infectious diseases have become more apparent as large-scale environmental changes have become more widespread (Daszak *et al.*, 2000; Phaneuf & Requate, 2016).

For the developing world, seeking edible and cheap water for all its population has become a difficult task indeed, and this task belongs to goal number 6 of SDGs. Water is an essential part of daily life, whether for domestic or commercial purposes (Ali *et al.*, 2013; Wu *et al.*, 2017); contaminated water is hazardous for hygienic life (Hunter et al. 2010; Ramesh & Thiru, 2014; Dey *et al.,* 2015). Water demand is increasing rapidly due to population growth and resultant hyper domestic and business activities. The problem becomes more severe when clean water is considered hygienic, but it contains unseen particles dangerous for health. So the safety of water is also necessary, along with cleanliness.

Internationally, 80% of people without access to drinking water live in rural areas (WHO and UNICEF, 2015). Regional and socioeconomic disparities in access to hygienic water exist in Pakistan (Dey & Rabbi, 2013). Still, Pakistan is unable to provide safe water to all of its people. Different national and international institutions show figures for water availability. The government of Pakistan (GoP, 2016) reported 87.6% of people to have access to water, whereas the WHO and UNICEF (2015) said only 77%. Provision of safe and hygienic water is affected by contamination of tanning chemicals and pollution to natural and human-made disasters (Dey *et al.*, 2016). In many Pakistan regions, groundwater has been depleted, and replenishment is very slow (Ahmad, 2000; Dey *et al.*, 2017). Wastage dumping is also increasing the water pollution beneath the ground. Dumping facilities are not built with concrete, hence pouring hazardous particles into the groundwater reservoirs. (Qadir*et al.,* 2008; Dey *et al.,* 2016).

Since the discovery that groundwater has increasingly been contaminated with tanneries waste, hesitation for using groundwater has also increased (Batool *et al.,* 2012; Flanagan *et al.,* 2012). The first contamination of tanneries waste was witnessed in district Sialkot(Ullah*et al.,* 2009). The drinking water of Sialkot was considered the best in Pakistan before 1990 (Kang *et al*., 2010; Rafique*et al*., 2010; Siddique *et al.,* 2009; Khan *et al*., 2012; Juniad *et al.,*2017). Dumping of wastewater in an inappropriate way ultimately polluted the groundwater (Aydi, 2018; Dermatas*et al.*, 2010). The leather tanning industry is one of the oldest industries in Sialkot; almost 48 percent of Pakistan's tanneries are situated in Sialkot (GOP, 2011). Tanning industry uses a large number of chemicals in tanning process and discharge toxic wastewater into the streams or dump into the groundwater which pollutes the groundwater [Gupta *et al.,* 2019; Rafique *et al.,* 2010; Saxena *et al.,*2016).

There is an acute shortage of drinking water in the tanning zone of Sialkot. UNEP, (2002) estimates that almost 1.1 billion people live without access to clean drinking water, and 2.2 million are dying because of diarrhea every year. Out of the 2.2 million, 1.6 million are from developing countries, including Pakistan. There is a 200 % increase in waterborne diseases in Sialkot City during the last four years. UN (2002) conclude that if clean drinking water provides to the citizen, the death rate can be lower by 75 %. (UN, 2006).

Public concern about environmental problems, in general, and groundwater contamination, is causing health issues, particularly Hepatitis, Diarrhea and Typhoid. Policymakers must know how the public perceives a particular environmental problem and how much support the public is willing to offer to solve that problem. Empirical analyses of the public awareness, WTP and perception of groundwater contamination by leather tanneries and public support are few (Mustafa *et al.,* 2007; Fasakin *et al.,* 2010; Lohano & Asim, 2014; Sun, 1990). While research is ongoing regarding the effects of leather tanneries on drinking water quality, most research has explored how leather tanneries generate different chemicals which ultimate pollute the ground water. Few studies have yet to be conduct which are interdisciplinary or have a substantial economic component.

Pricing of water is the critical component of an appropriate incentive for efficiency. With this backdrop in mind, there is a need to assess the demand and WTP for enhanced drinking water services in the Sialkot where tanneries polluted the groundwater according to income to help policymakers design a suitable water tariff composition and generate sufficient revenue to cover up the cost of water services (Asim *et al.,* 2015). WTP also gives an economic value to the benefits acquired from increasing access to safe drinking water, which is of tremendous use to policymakers in decision-making concerning cost-benefit ratios for expanding access to safe drinking water. In such a way, clean drinking water can be provided to households by using their willingness to pay. the objectives of this study are: i) to find the households WTP for a clean water supply system ii) to analyze the determinants of WTP for a clean water supply system.

Data Description

This section discusses the sample selection and survey methodology adopted for the study. The collected data's descriptive analysis is organized based on offered bid prices to different respondent's samples. STATA software is used to analyze the data through cross-tabulation of the variables to check the variables' responses.

Profile of the Study Area

Sialkot is one of the biggest industrial cities of Punjab as well as Pakistan. The city's population was 999449 peoplein 2019, and it covers an area of 3016 km^2. The city dominated the male population (52percent).

The Sialkot city has its administrative authority known as Tehsil Municipal Administration (TMA) Sialkot, having co-units and managing the different departments. TMA's key responsibility is to enforce all Municipal law and adequately dispose of liquid waste of industries and provide water supply and development of water sources. This household survey was conducted in all clusters of leather tanneries and nearby residential areas. This study showed that only 3percent of total leather tanneries in Sialkot meet the international standard of tanning rest of the tanneries do not follow the international standards and dispose of contaminated water in groundwater andopen spaces.

Sample Selection and Survey Methodology

Sialkot has four tehsils, namely"Sialkot", "Daska", "Sambrial" and "Pasrur". The household survey was conducted in all clusters of leather tanneries and nearby residential areas in 2020.A stratified random sampling technique was adopted for the collection of data. Two hundred and sixty-nine households, which consist of 1622 'households' members, were interviewed at their premises through well-structured and pre-tested questionnaires.

This study applies Contingent Valuation Method (CVM) to estimate the household's WTP per month for the clean water supply. Qualitative choice questions were asked to all respondents like "are you ready to pay for a new and better water supply system?" if the respondent accepts the starting bid, we offered a new "bid" that is higher than the previous bid. If respondents are not WTP for the first "bid", we asked an open-ended question "what is the maximum amount you are willing to pay for this service?" the highest amount that the respondent gave us was the maximum amount of WTP for services. Three different bids wereoffer, which are Rs. 100, Rs. 200 and Rs. 300. The discrete choice analysis is done through logit regression, and for the maximum amount of WTP, we used multiple linear regression.

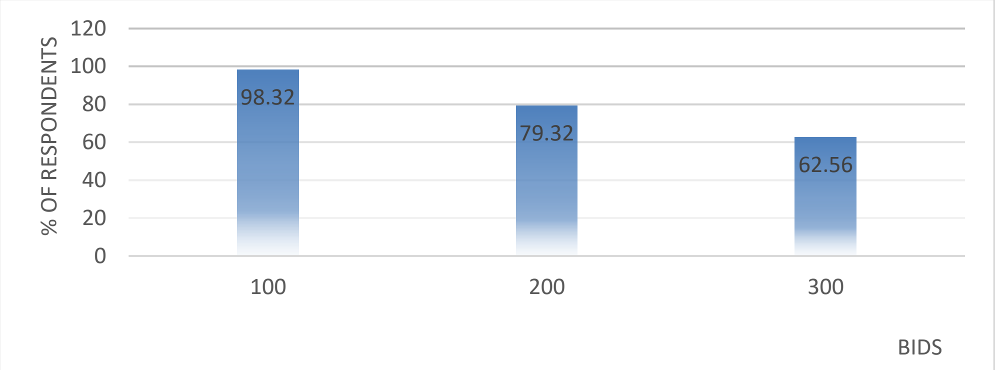
Data Analysis

The data of two hundred sixty-nine householdswere collected to analyze the variable's responses to the corresponding socio-economic characteristics.

Owned House Response for WTP

In figure 3.1, the X-axis shows that the amount of bid offered for the clean water services amount starts from 100 and increases to 200 and then increases to 300. While on the Y-axis shows that the percentage of households who have their own house, and they are also WTP for clean water services.

Figure 3.1. *Owned House Response for Willingness to Pay*



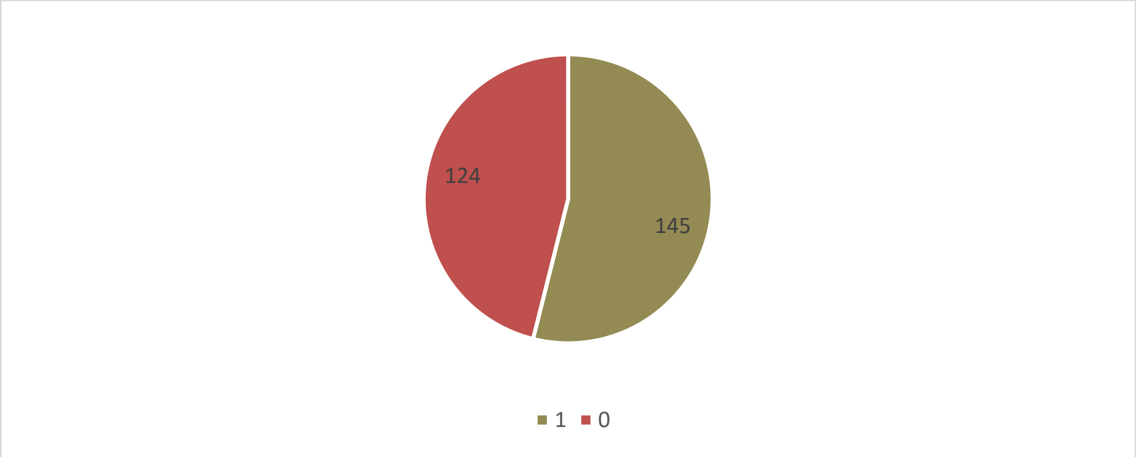
Source:*Field Survey by Author*

For the bid of Rs. 100, which is the lowest bid, 98 percent have their own houses and are willing to pay for clean water services, and there are only 2 percent responses who have their own homes but are not willing to pay. For the bid of Rs. 200, almost 80 percent of responses have their own houses and are WTP Rs. 200 for clean water services. Nearly 63% of respondents are willing to pay Rs. 300.

Environmental Awareness

Figure 3.2 pie chart illustrates the environmental awareness about the impact of tanneries on water and shows the number of respondentswho are not environmentally aware.

Figure 3.2. *Environmental Awareness*



Source:*Field Survey by Author*

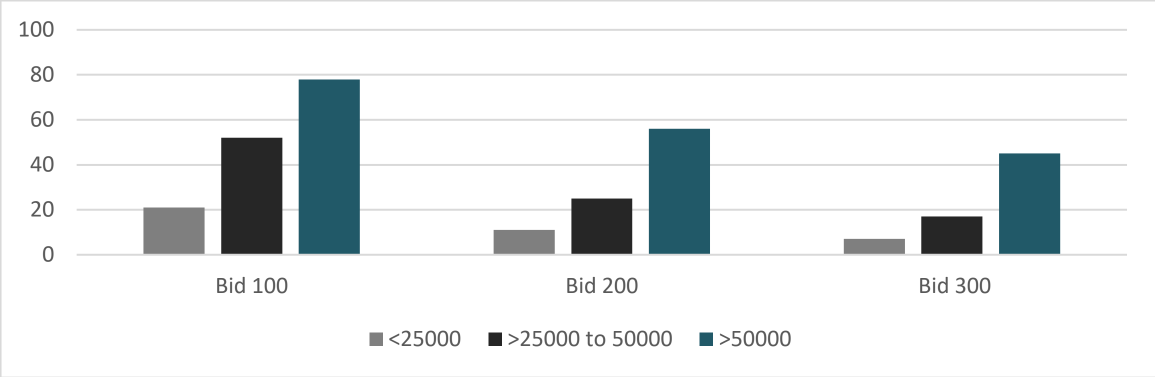
We depict this variable through binary response questionnaire '0' and '1'. '1' is taken if the respondent is environmentally aware and '0' if the respondent is not environmentally aware. This graph shows that 145 out of the 269 respondents are ecologically aware. While 124 out of 269 equals 46 percent, respondents don't know about tanneries' impact on water resources.

Income Groups Response for Willingness to Pay

The descriptive analysis of income groups and willingness to pay for water services has a vital position in the study because we are dealing with the price of service offered, and respondents show their willingness regarding their income position and other characteristics.

In this graph, per month income of the respondents are divided into three different levels[1], those earning less than or equal to 25 thousand are included in the first income level, the respondents making more than 25 thousand and less than or equivalent to 50 thousand are included in the second income level. Those earning more than 50 thousand are included in the third income level.

Fig. 3.3. *Income Groups Response for Willingness to Pay*



Source:*Field Survey by Author*

Nearly 21 respondents from the first income level are willing to pay Rs 100 for the services. There are 52 respondents from the second income level willing to pay for these services. Regarding the third income level, the elite class of the society 78 respondents of this income level is willing to pay this price. The second bid price offered of Rs 200 per month the response from the first income level respondent received as 11 respondents are willing in this group. From the second income level, 25 respondents are willing to pay, and the 56 respondents of the third income level are willing to pay this price.Other socio-economic characteristics of respondents are presents in table 3.1.

Table 3.1. *Socio-economic Characteristics of Respondents*

Variables	Frequency	% of Respondents	Mean
Male	260	96.65	-----
Female	9	3.35	-----
Employed	215	79.92	-----
Student	38	14.13	-----
Retired	13	4.83	-----
Unemployed	3	1.11	-----
Age	-----	-----	33.37
Monthly Income	-----	-----	27215.38
Household Size	-----	-----	6.03
Diarrhea	47	17.47	-----
Hepatitis	42	15.61	-----
Typhoid	34	12.63	-----
Education	-----	-----	10.31

Source: *Field Survey & Computed by Author*

[1]First income group: Earning less than or equal to 25 Thousand.
Second income group: Earning more than 25 Thousand to 50 Thousand.
Third income group: Earning more than 50 Thousand.

There are 260 male respondents, while the rest are female in our survey. Two hundred fifteen were employed, 38 were students, 13 were retired, and only three are unemployed. The average age of respondents is approximately 33 years, and the average household income is around 27000.There are 47 people are facing diarrhea disease, 42 are hepatitis patients, and 34 faced typhoid disease. The respondents' average education is 10.31 years, which is equal to matric and the average household size is approximately six.

Methodological Framework

To fulfill this study's primary objective, socio-economic factors are included in calculating the mean willingness to pay and determinants of willingness to pay. Consideration of respondents' socio-economic characteristics increases the reliability and validity of CVM results and improves these results' practical application.

Logit Model

The logit model is used by many studies like Khan *et al.*, (2010) to elicit WTP in Hayatabad Peshawar. Fillipis (2005) also used the logit model to find the determinants of willingness in Greece. Lal and Takau, (2006) used to estimate willingness to pay in Tonga and (Arene & Mbata, 2008; Chuen-Khee & Othman, 2010) used logit regression analysis for capturing the effects of determinants of the farmers for their willingness to pay for the use of metropolitan organic waste as manure Logit regression model is specified bid as dependent variable and "bid" is the function of other variables such as household size, household income, owned house, distance from the tannery, environmental awareness of the respondent, use of electric filter in a home for drinking purpose, boiling of water, education of the respondent, and age of the respondent and marital Status of the respondent.

$$\boldsymbol{WTP = f\,(household\ size, household\ income, own\ house, Distance\ from\ tannery,}\\ \boldsymbol{electric\ filter, Environmental\ awareness, Boiling\ of\ water, education, age, Marital\ status)}$$

Where;(WTP) willingness to pay, the dichotomous choice of the respondents taking value "1" for yes otherwise "0". The other variables are considered independent variables. These include household size. This variable contains the total number of family members in the house.Household income consist of total earnings by all family members in a month, and it is expected that as household income increase, WTP for such services also increases. House ownership, used as a dummy variable value "1" for owing a house otherwise "0".The tannery's distancetakes value "1" for living in the radius of 500 meters to the tannery otherwise "0". Electric filter, value "1" for households used electric filter of water and "0" for not using. This variable shows that the respondent is environmentally aware or not as value "1" for environmentally conscious and "0" for environmentally unaware. Boiling water, specify as "1" for the use of boiling water for drinking purposes otherwise "0".The respondents' education has been taken in years andages of respondents recorded in years,whereasthe respondent's marital status value "1" for being married and "0" for single.

$$\boldsymbol{WTP = \frac{1}{1 + e^{\ln z}}}$$

$$\ln z = \beta_0 + \beta_1 HHS + \beta_2 HHI + \beta_3 H\_OWN + \beta_4 DFT + \beta_5 E\_FIL + \beta_6 E\_AWA + \beta_7 B\_W \\ + \beta_8 EDU + \beta_9 AGE + \beta_{10} M\_STA + u_i$$

Multiple Regression Model

Following the (Chodhury, 1999; Begum*et al.*,2006), this study used the multiple linear regression model to estimate the maximum WTP. The maximum amount a household is willing to pay for clean water supply is the function of other independent variables described below.

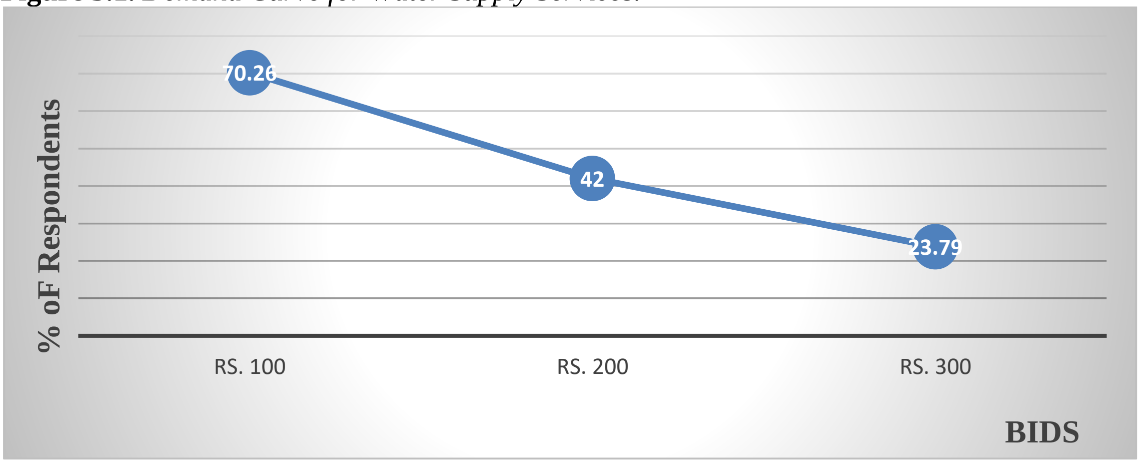
$$\max wtp = \beta_0 + \beta_1 HHS + \beta_2 HHI + \beta_3 H\_OWN + \beta_4 DFT + \beta_5 E\_FIL + \beta_6 E\_AWA \\ + \beta_7 B\_W + \beta_8 EDU + \beta_9 AGE + \beta_{10} M\_STA + u_i$$

Max_{WTP}=Maximum willingness to pay, this variable is described as the maximum amount that the respondent is willing to pay.

Results and Discussion

In this section, the results are discussed in detail and demand for water services also derived. Results reveal that 70% of householdswere agreed to pay for this new service. The second bid to get the response of ‘YES’ or ‘NO’ offered to the respondent was Rs. 200, and 42% of respondents are willing to pay.The third and last bid wasRs. 300, and approximately 24% of respondents are willing to pay for clean water supply services. Moreover, figure 5.1 alsoshows a negative relationship between the bid and the number of respondents.

Figure 5.1. *Demand Curve for Water Supply Services.*



Source: Field Survey by author

Determinants of WTP Using Logit Model

In our empirical findings, the household Size shows the value - 0.0136, which postulates thatby increasing the household size,the WTP will be decreased by the probability of 0.013 %.Similar results were found by (Moffat *et al.*, 2011; Lema *et al.*, 2012).

Household income has a coefficient value for Rs. 300 is 0.00001,which shows that household income statistically affects the household’s WTP for clean water supply services.The findings are consistent with (Lema *et al.*, 2012; Moffat *et al.*, 2001;Khan *et al.*, 2010;*Mehraraet al.*, 2009; Whittington *et al.*,1991; Kenneth *et al.*, 2005).

The owned house also hasa positive (0.0975) relationship with dependents variables that indicate that if a respondent has its own home, there is a chance of a 0.0975 % increase in the WTP for Bid Rs. 300.Similarly,(Anjum, 2011; Yasuoa 2005) found the same results.

The distance of the house from the tannery coefficient is 0.1239 for the bid Rs. 300. Result suggests if a respondent livesin500 meters radius of a tannery, then WTP decreases by the probability of 0.1239 than those who live outside the radius of 500 meters.

Table 5.1. *Logit Results of bids for the Determinants of WTP.*

Method: Binary Logit				
Independent Variable	**Dependent Variable: Bid Rs. 300**			
Variable	**Coefficient**	**Standard Error**	**z-Statistic**	**P-value**
H_SIZE	-0.0136	0.0077	-1.77	0.077
HHI	3.25e-06	0.0000	3.09	0.002

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H_OWN	0.0975	0.0364	2.67	0.007
DFT	0.1239	0.0486	2.55	0.011
E_FIL	0.1687	0.0798	2.11	0.035
E_AWA	0.0001	0.0009	0.14	0.887
B_W	0.1112	0.0734	1.52	0.130
EDU	0.0107	0.0044	2.42	0.015
AGE	-0.0214	0.0325	-0.66	0.509
M_STAT	-0.0181	0.0308	-0.59	0.556
Pseudo R^2	**0.5616**			

Electric Filter for the purification of water coefficient value is 0.1687, which reveals thatthose respondents are using an electric filter to purify water for drinking purposes are more likely to be willing to pay than those who don't use an electric filter. Environmental awareness also has a positive association with the bid. The results are inline with(Anjum,2011; Mustafa *et al.*,2014) also found the positive relation of environmental awareness.

Households who boil water for drinking purpose are more likely to pay for such service than those who don't boil water. Likewise, Khan *et al.,* (2010) found the same results of boiling of water.

Education of the respondent coefficient value has0.010, indicating a positive relationship between education and WTP. Coefficient value suggests that if education level increases by a year, WTP is also increased by 0.010.If the respondent's education increases,WTP also increase for this service, respondents know the benefits of these services, and the respondent is environmentally aware because of education. Same results found by (Moffat *et al.,* 2001; Khan *et al.,* 2010; Hite *et al.*,2002).

Marital Status of the respondent coefficient value has -0.0181, which suggests that if the respondent is married, they are less likely willing to pay for such services than unmarried.(Adenike, 2009; Anjum, 2011;Amoah & Adzobu, 2013) also found similar results of this variable.

Determinants of Maximum WTP using Multiple Linear Regression Model

A multiple regression model is used to estimate the maximum amount ofWTP for clean water supply services in Sialkot (Table 5.2).

The regression coefficient of household size is -7.95, which indicate that as household size increases, the maximum WTP will be decreased by 7.95 unit. Otsetswe (2001);Torero *et al.,* (2003) found the same results in their studies.Household income shows a positive relationship with maximum WTP. If income increase, the maximum WTP will increase by 0.0034 unit. However,this variable effect is minimal as we can see from the coefficient value, which proves that WTP is not dependent only HHI. There could be other variables affecting the maximum WTP.(Sidrat & Lohano, 2014; Noor *et al.*,2010) results are consistent with the result of this study.

House ownership has the coefficient value of 39.350, indicatinga positive relationship and this variable is statistically significant at 10% level.

Table 5.2. *Multiple Linear Regression results for the determinants of Maximum WTP.*

Dependent Variable: MAXIMUM WILLINGNESS TO PAY				
Method: Least Square				
Observations: 269				
Variable	**Coefficient**	**S.E**	**t-statistic**	**P-value**
H_SIZ	-7.951	4.885	-1.63	0.104
HHI	0.003	0.0006	5.23	0.000
H_OWN	39.350	22.343	1.76	0.080
DFT	35.950	18.659	1.92	0.055
E_FIL	92.735	33.935	2.73	0.007
E_AWA	8.011	15.183	0.53	0.596

B_W	49.335	24.81	1.99	0.048
AGE	-0.209	0.719	-0.29	0.769
EDU	4.842	2.924	1.66	0.098
M_STAT	14.963	17.600	0.85	0.398
CONSTANT	-68.922	47.364	-1.45	0.147
R-SQUARED	0.599	**Mean Dependent Variable**		234.54
ADJR-SQUARED	0.581			

The coefficient value of the distance from a tannery is 35.950shows a positive relationship with maximum WTP. Similar results were found by (Kanayo*et al.*,2013).

Use of electric filter for purification of water coefficient is 92.735 showing a positive relationship with the maximum WTP, and this variable is statistically significant at one % level.

Environmental awarenessresults show that if environmental awareness increase then maximum WTP also increases by 8.011 unit showing a positive relation with maximum WTP, but this variable is statistically insignificant.Spash (2006)also suggest the positive link of environmental awareness and WTP because the people who are environmentally aware are also more aware of the results of pollution and contaminated water.

The boiling of water for drinking purposecoefficient is 49.335, which showsa positive association with willingness to pay. Furthermore, this variable is statistically significant and has a substantial relationship with maximum WTP.

The respondent's age has the coefficient value is -0.209showing a negative relation however this variable is statistically insignificant, but theory suggests that it is proven a negative association with maximum WTP. (Anjum, 2011; Noor *et al.*, 2010; Amoah, 2013) results are consistent with this study results.

Education has got the coefficient of 4.842, which shows education increase by a year, maximum WTP will increase by 4.84 unit. Similar results were found by(Sattar & Ahmad, 2007; Yacob *et al.*, 2013; Mustafa *et al.*,2014).

Marital Status has the 14.963 value,which means if a respondent is married, his WTP will also increase by approximately 15 units showing a positive relation with maximum MAX_WTP. However, this variable has an insignificant effect in this study. Theresults of this are consistent with (Adenike, 2009).

The adjusted R-squared is 0.58 indicate that the model is good, and explanatory variables explain 58 % variation in maximum willingness to pay.This study applied the Breuch- Pagan test to check the heteroscedasticity and results[3] showing the presence of heteroscedasticity, but we removed heteroscedasticity using robust regression.

Moreover, the VIF method has been adopted to check the multicollinearity among the variables. The results[2] indicate no multicollinearity because tolerance value approaches to one.

[2] See Appendix

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The model estimated the mean maximum willingness to pay is Rs. 234.54 per month per household.The computed mean value is converted to US$to compare with available international literature. Our mean estimated willingness is Rs. 234.54 which is equals 1.42 USD per month and the values quoted by some international literature as (Moffat *et al.*,2011) found mean WTP 3.56 USDin Maun. Fujita (2005) estimated mean WTP for water services in 1.46 USD in Iquitos city. Otsetswe (2001) calculatedaverage willingness to pay is 6.86 USD per month in Vietnam. Martin, (1997) assessed aWTP in the western United States and compared the four cities mean WTP and found 4.43 USD per household per month. Wei *et al.,* (2007) used a contingent valuation method to measure the mean WTP value in China and calculated 0.20 USD per household per month. Noor *et al.,* (2010) conducted a study in Lahore and found 1.41 USD per month per house for new water services. Sidrat & Lohano (2014) estimated 6.03 USD per month per household WTP for improved tap water. Olajuyigbe *et al.*, (2010) estimated WTP in medium-sized Western Nigeria cities and found mean WTP is 2 USD per household per month.

Conclusion

This research has been doneto determine the determinants of WTP for safe drinking water in district Sialkot. A Contingent valuation methodology (CVM) was employed following the logit model, and a multiple linear regression model is used for econometrics analysis. The significant results of this research are given as, the mean age of the respondents is 33 years, monthly income average is Rs. 27 thousand, and the mean education of the respondent is ten years in other words matriculation. The average household size of this sample size is 6.03. Almost 54% of respondents are aware of the consequences of these leather tanneries in residential areas.The mean willingness to pay is Rs. 234 per month per house. The respondents are less willing to spendwith the larger household size. The household's monthly income has a positive association with WTP, whereas education is also positively relatedto the WTP.

The Logit model results indicate that the respondents living in their place are positively related toWTP. The households are using an electric filter and more WTP because of the high cost of electric filters and other associated costs.

Concerning the impact of WTP determinants, the variables align with the economic hypothesis such as age shows a negative association with WTP for clean water supply because the older respondent thinks it should be the government’s duty to provide a clean water supply doorstep.

Policy Implications

- The multiple regression model results gave mean WTP is Rs. 234 per house per month. The government can generate Rs. 8.6 million per month if charge Rs234 from each home for water. If this amount is collected by the government and provides safe and clean water to households, the services' cost can quickly be recovered.
- This studyshowed a positive association of the individual’s education level, awareness of the environment, and the monthly total household income with WTP for a clean water supply system. If any governmental or non-governmental organization wants to enhance the WTP, they should address these variables to achieve the desired results.
- Through a participatory approach, the cost of transportation can be reduced. Timely collection of charges and operational costs will be minimal because this will be a community's shared responsibility.
- The government should move all of the tanneries near the residential areas to the far away open area.
- The government should implement the environmental standards, rules and regulation on these tanneries, and there is a need for checks and balances.
- The government should impose fines on the tanneries polluting the ground water and invest this amount in installingwater filtration plants.
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Appendix

Vector Inflation Factor used to detect Multicollinearity in Maximum Willingness to pay regression, and the results are presented below.

Table 1: Test Results of Multicollinearity.

Variable	VIF	1/VIF
Household Size	1.63	0.613497
Household Income	1.72	0.580530
Owned House	1.72	0.581133
Distance from tannery	1.56	0.642007
Electric Filter	1.52	0.657154
Environmental Awareness	1.23	0.810285
Boiling of water	1.18	0.844107
Age	1.17	0.855741
Edu	1.10	0.907836
Marital Status	1.04	0.964425
Mean VIF	1.39	

Tanneries Clusters in Sialkot and total tanneries in each cluster is presented below in table 2.

Table 2. *Tanneries Clusters in Sialkot and Total Tanneries in each Cluster*.

Sr. No.	Cluster Name	Area	Total
1	Head Marala Road	Rural	55
2	Pul Aik & Haji Pura	Urban	37
3	Defence Road	Urban	28
4	Sambrial Road	Rural	37
5	Pasroor Road	Rural	18
6	Daska Road	Rural	17
7	Khadim Ali Road	Urban	28
8	S.I.E	Urban	16
9	Naika Pura	Rural	10
10	Bharath & Rhim Pur	Rural	18
		TOTAL	**264**

Source: *Sialkot Chamber of Commerce, 2019*

Population and sample size selection using stratified random sampling technique detail is presented below in table 3.

Table 3. *Projected Population and Sample Size.*

Sr. No.	Union Council	Town/ Village	Cluster	population	Household	Sample Size
1	Bharath	Bharath	Said Pur Gondal	12059	1723	12
2	Bharath	Rahim Pur	Said Pur Gondal	2698	385	5
3	Bharth	Habib Pura	Said Pur Gondal	2167	310	5
4	Pindi Arayian	Pindi Arayian	Naika Pura	9560	1366	10
5	Pindi Arayian	Naika Pura	Naika Pura	2901	414	5
6	Miani	Pakki Kotli	Daska Road	7463	1066	8
7	Miani	Shatabgarh	Daska Road	7304	1043	8
8	Bounkan	Malke kalan	Sambrial Road	7111	1016	8
9	Bounkan	Murad Pur	Sambrial Road	15196	2171	15
10	Jaurian Kalan	Chiti Sheikhan	Marala Road	6017	860	7
11	Gohad Pur	Gohad Pur	Marala Road	29227	4175	30
12	Gohad Pur	Kotli Behram	Marala Road	4321	617	6
13	Haji Pura	Block 1	Pul Aik	9276	1325	10
14	Haji Pura	Block 2	Pul Aik	12003	1715	12
15	Miana Pura	Block 1-3	Defence Road	14387	2055	14
16	Miana Pura	Block 4-5	Defence Road	13831	1976	14
17	Fateh Garh	Fateh Garh	Defence Road	11148	1593	12
18	Adalat Garh	Adalat Garh	Defence Road	16580	2369	16
19	Model Town	Block 1	Khadim Ali Road	11463	1638	12
20	Model Town	Block 2	Khadim Ali Road	10908	1558	11
21	Shahab Pura	Block 1	S.I.E	12319	1760	13

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22	Shahab Pura	Block 2	S.I.E	15857	2265	16
23	Naika pura	Block 1	Pasroor Road	11404	1629	12
24	Naika pura	Block 2	Pasroor Road	11069	1581	11
				Total	**36610**	**269**

Source:*DCO office Sialkot & computed by the author*.

Detail description of qualitative and quantitative variables is presented below in table 4.

Table 4. *Description of variables*

Variable	Description
Dependent variables	
Bid Rs. 100	1=if respondent is willing to pay the said amount, 0= otherwise)
Bid Rs. 200	1=if respondent is willing to pay the said amount, 0= otherwise)
Bid Rs. 300	1=if respondent is willing to pay the said amount, 0= otherwise)
Maximum willingness to pay	The maximum amount that the respondent is willing to pay for said services
Independent variables	
Household monthly income	Household monthly income from all sources
Gender	gender (1=if male, 0=otherwise)
Age	age of the respondent in years
education	education of the respondent in years
Water source	water source (1= if Source of Drinking-water Piped/Motor-pump, 0=Otherwise)
Water quality	water quality (1= if water quality is satisfactory, =0 otherwise)
The distance of tannery from house	The distance of tannery from house (1= if space of tannery from home is within 0.5km, 0=otherwise)
Use of Electric Filter	Use of Electric Filter (1= household use electric water filter,0=otherwise)
Water container cleanliness	water container cleanliness(1= if Water container cleanness done, 0=otherwise)
Boilng Water	Boiling Water (1= if household drink water after boil, otherwise 0)
Marital Status	1= if respondent is married, 0= otherwise