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Public Demand for Improved Urban Water Supply Services in Multan

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Abstract

Governments in developing countries face financial constraints to ensure the supply of clean drinking water. They may benefit from increasing water charges for those who are willing to pay a little extra instead of their demand for improvement in water quality and service. To check the plausibility of this proposal, we investigated drinking water supply and quality, and well-off consumers' demand for improved service delivery in Shah-Rukun-e-Alam and Mumtazabad towns in Multan city of Pakistan. Qualitative data obtained through a questionnaire survey was analyzed using descriptive and regression techniques. Qualitative information obtained through semi-structured interviews helped design survey questionnaires and elaborate quantitative results. Results reveal that the respondents accord high importance to the provision of safe drinking water than to other daily household needs. The demand for improvement in water supply parameters exceeds the demand for improvements in water quality parameters, with the reliable supply being the most demanded improvement. The majority realize the government's budget constraints in improving service delivery. Most respondents would pay PKR 100 in addition to what they are paying now. Their willingness to pay (WTP) this amount correlates with their awareness of water and health nexus and depends on household income, number of children under 14 years of age, and awareness of actual water quality tested through the laboratory. Besides recommending raise of water charges by PKR 100 per month per household in both towns, the service quality improvement may consider interventions such as mobile water testing laboratory and awareness campaigns to motivate citizens to pay for safe drinking water.

Keywords: *Water services, Utility functions, Quality & Supply of water services, Household's Income, and Household's willingness.*

JEL Classification: *D1, D4, R2*

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1) INTRODUCTION

Water is one of the fundamentals for human survival on the earth. Safe drinking water for human consumption has been an enduring challenge for development policy and practice in developing countries. In the last century, against a three-fold increase in global population, nevertheless, a six-fold growth in human water consumption has been observed (Cosgrove & Rijsberman, 2000). Globally, almost one billion people still aspire for safe drinking water. Every year nearly 3.4 million die due to waterborne diseases (WHO, 2001). These deaths have been resulting partly from intake of water contaminated with viruses, bacteria and parasites (Hussainy, 2007). However, most these deaths can be prevented through better and improved water services. For instance trachoma disease (leading cause of preventable blindness) does not exist in the areas where the basis services of water supply, sanitation and hygiene are available (WHO, 2001).

This phenomenon pertains mostly to the developing nations who often fail to make adequate investments in proper water and sanitation services for their citizens (Demena et al., 2003). Due to such urgency, the United Nations (UN) since its Water Conference in Mar de Plata in 1977 till the Millennium development Goals and more recently through its Decade for Action declarations (Water for Life, 2005–2015), has been urging governments to ensure that their citizens have sufficient, safe, and physically accessible drinking water as a basic human right. The SDG has also allocated a complete goal on access to quality water (SDG, 2017).

Although the developing countries continuously strive to improve to improve water and sanitation services, the progress against such goals remains inadequate due to limited financial space within which they usually operate. The demand of funds in provision of these services is so high that even foreign aid and national and international nongovernmental organizations initiatives fall short of what is actually required. Hence, in order to address these problems, the Demand Driven Approach (DDA) has been in fashion for quite a while. Under this approach, those who demand safe drinking water and sanitation services are supposed to pay for it. Nevertheless, it is not possible for all segments of society to self-finance their drinking water. Therefore, the revenue obtained from those who can afford, can be reinvested to meet the cost of providing the services to those who are unable to pay. In other words, rich financing water services for poor.

This apparently straightforward solution is however difficult to implement due to various reasons such as socioeconomic, educational and cultural standing of people. For example, studies such as Haq et al., (2008), Ahmad et al., (2010), Asim & Lohano (2014), Fissha (2006) found peoples' financial commitment against their demand for improvement safe drinking water services is dependent on their ability to pay based on income and education, and family size. Beside these generally considered variables include satisfaction, household (HH) size, rural/urban location (Akram and Olmstead, 2011), added water treatment cost, awareness, and actual water quality. Such variables and alike are generally (Zhang, 2011) incorporated into the WTP models for clean drinking water.

While the above studies have provided deep insights on the issue in hand, there are two fundamental problems limiting our understanding of the causality between people's willingness to pay for any public service delivery. Most models of WTP have been detached from the context and rarely provide adequate description of the community views of their existing water supply both for its quality and quantity. For example a research conducted in 28 districts of Pakistan found that two-third of the households considered the odorless and transparent water drinkable, despite the fact that it was contaminated and could cause them various waterborne diseases (Ministry of Environment, no date). In such cases, despite being able to pay, people may not pay as they consider it unnecessary due to their myth of using clean drinking water.

Similarly, considering education as a determinant of WTP is problematic because of strong assumption that educated people may have used it for obtaining information about their health. However, not only awareness of the waterborne diseases (Wang et al., 2008), but also the perception [no matter right or wrong] of water quality is important to be considered as it motivates or discourages citizens' demand for improved drinking water services. Furthermore, almost no one has studied citizens' trust in different institutional arrangements for the supply of safe drinking water (apparently except Ahmad (2010) who did a comparison for Municipal Corporation versus private sector as the service providers for safe drinking water). Therefore, the current study was initiated to apply the proposed conceptual modification by investigating the willingness to pay by urban well-off customers in Multan City, located in Punjab Province of Pakistan. This study gathered customer views about the importance of safe drinking water, its quality, demand for improvement in the service delivery and their willingness to pay for it.

This case study may be illustrative for other developing countries as well because like other developing nations, Pakistan also faces threats of water safety and scarcity. Besides, it is a semi-arid country (Majeed & Piracha, 2011) that also houses world's sixth largest nation (Government of Pakistan, 2013). An average Pakistani who could enjoy ~6000 cubic meters of water availability in the early 1950s has to adjust to mere 1,100 cubic meter of water in 2000s (Habib, 2008 cited in Tahir et al., 2011). An often quoted WHO report reveals that ~85 million Pakistanis lack access to safe drinking water (PCRWR, 2009) and even the Government of Pakistan (2011) confirms these figures. Therefore, the findings of the study will not only serve as useful guide for the improvement of drinking water supply in Multan City but will also serve as an important conceptual framework for similar studies in Pakistan and elsewhere.

2) METHODOLOGY

2.1) DESCRIPTION OF STUDY AREA

Punjab is the most populated province in Pakistan. This province is more developed in water sector since more than 55 percent of people in this province enjoy improved water services. Surface and groundwater are the main sources. Even for this province, the situation of safe drinking water is more alarming at villages and semi-urban areas where majority has yet to connect to the piped water supply. Multan is the

oldest city of subcontinent Indo-Pak and lies on fertile belt suitable for agriculture (Figure 1). The stream of the area is river Chenab and is main source of recharge of the ground water and surface water in that area. The depth of fresh ground water is about 10 meters. However, the water table is dropping by approximately one foot (0.3m) per year (Government of Punjab, 2006).

Figure 1: Map Pakistan – Study Area also shown

2.2) EXISTING WATER SUPPLY AND SANITATION NETWORK OF MULTAN CITY

As per 2017 census, the population of the area is 2,258,570 persons (PBS, 2017) which are organized in 352,900 households/families with an average of 6.4 persons per household (MICS, 2018). In Multan district 10 to 11 percent population have access to piped water (Table 1). Water supply and sanitation services in the urban like Multan City are provided by Water and Sanitation Agency (WASA). They currently charge per month PKR 60 or 0.30 ¢ for domestic supply of drinking water. WASA has installed deep tube wells at 400-600 meter for getting safe water and serve some 70 percent of urban population in Multan City. However, shallow water tables of the City's is reportedly contaminated with arsenic, viruses and bacteria whereas the infiltration of contaminated water into the distribution lines is also reported.

Table 1: Drinking Water Sources in Multan District

Sources of Drinking Water	Urban	Rural	Overall
Tap Water	19	4	10
Motor Pump	70	58	63
Hand Pump	1	33	21
Dug Well	0	0	0
Others	10	4	7
Total	100	100	100
Source:	PBS (2016)		

2.3) DATA ACQUISITION

Primary data required for this study came through multiple sources including households, key informants and institutions responsible for water services. To understand the customer side of story, a structured questionnaire was administered at household level. Whereas, the service providers view was obtained through interviews from the officials of the institutions responsible for providing drinking water. Since customers and service providers have their own views, they could show only the aspects of their own interests in their attempt to legitimize their answers. In order to cope with this issue, key informant interviews were also considered in an attempt to get impartial view of the water supply issues in the study area.

2.4) SAMPLE SURVEY THROUGH STRUCTURED QUESTIONNAIRE

Customer context of drinking water supply and demand was inquired through execution of a survey and data collected through structured questionnaire. Besides demographic information of the households, other key parameters included: the information on household's priority for drinking water, household's awareness of the importance of safe drinking water, satisfaction with the quality of existing water supply, demand for need of improvement in the quality and supply of drinking water, willingness to pay for the demanded improvements and trust in the ability of different institutions to provide quality drinking water service.

Altogether 38 parameters/questions were investigated mostly by using Likert scales, but a few were also open-ended (asking reasons and explanations) or were obtaining information ratio and ordinal scales. The willingness to pay was judged by asking multiple bound questions designed by following the methodology adopted by Loomis and Ekstrand (1997), Welsh and Poe (1998) and discussed in Alberini and Cooper (2000). Before conducting the survey, questionnaire was pretested with 20 respondents.

2.5) SAMPLING AND SELECTION OF THE RESPONDENTS

In order to get the general understanding of the demand and supply for improvement water services, the questionnaire was administered among a sample of 210 households. The sample size was determined using stratified sampling technique at 95 per cent confidence and ±7 percent percesion. Two towns namely Shah Rukun Alam and Mumtazabad are considered as posh areas of Multan City; whereas, remaining four towns are inhabited by lower income groups. Therefore, as per main theme of the research, both of the above mentioned towns were selected. As these towns house almost equal population, therefore, the sample was distributed equally between both towns. Snowball sampling technique was used to find relevant respondents in the survey area.

2.6) IN-DEPTH INTERVIEWS

To obtain in depth understanding of drinking water issues and possible quality improvements, key informant interviews were conducted with authorized

representatives, from Water and Sanitation Agency (WASA), Multan, representatives of Public Health Engineering Department (PHED), Environmental Protection Department (EPD) and Pakistan Council of Research in Water Resources. In addition, 10 household heads, each from both towns were also interviewed for in depth understanding attitude of households towards water supply system, and their perception of water service and quality.

2.7) METHODS OF DATA ANALYSES

Descriptive analysis and weighted average indexes
In order to make meaningful and generalized conclusions, frequencies of five-point Likert scales were converted into Weighted Average Indexes by using the methodology adopted by a previous study (Miah, 1993). These indexes were constructed for the parameters like, priority of different services in household need basket, status of current water supply and quality, satisfaction and similar kind of variables.

THEORETICAL BACKGROUND FOR ESTIMATING WTP

Before going into further details, it is important to be confident about the economic underpinning of the WTP data as a meaningful figure representing preferences and that these represent a meaningful proxy of the market value. This could be achieved by discussing a theoretical model as presented at Haq et al., 2008 and Asim & Lohano, 2014 and adopted for this study.

Consider a household whose preferences are represented through utility function. Assuming that the household's attempt to maximize its utility has a resource consent, its utility function can be modelled as:

$$U = f(p, q, y) \qquad (1)$$

Where p denotes price vector of all marketed goods consumed by a household, q denotes to quality and supply of water services that the household acquires, while y denotes household's total income.

Let's q0 and q1 denote existing and the improved water services, respectively. Households can be exposed to a hypothetical sketch or description of improved service following their willingness to obtain these services in lieu of some rise in existing water fee. The below given Hicksian demand function may capture and express such changes in monetary terms:

$$V(p, q1, y - C) = V(p, q0, y) \qquad (2)$$

Graduation from q0 to q1 reflects the improved in the service delivery and thus raises the household's utility level, hence C represents the household's willingness to pay (WTP) which they are ready to allocate in order to get improved services and Equation (3) provides the desired function. Accordingly:

$$V(p, q1, y - WTP) = V(p, q0, y) \quad (3)$$

Now it is of great importance to know the factors that influence the HH's WTP:

$$WTP = f(p, y, q0, q1, z) \quad (4)$$

For Equation (4) WTP is a function p, y (explained underneath Equation 1), q0 and q1 (explained underneath Equation 2). Additionally, there may be some other important HH's characteristics that influence their WTP as discussed in the next section.

Econometric analysis for the determinants of WTP

The determinants of WTP for clean drinking water were brought forward through Logit model. For that reason, the willingness to pay was conceptualized as a function of per-capita income of a household, expenditure on water, number of children in the family, water quality consciousness, satisfaction with the existing water supply, and water quality test results). The effect of explanatory variables on the dependent variable is modeled as under:

Where:

Table 2: Variable Descriptions

Legend and caption of the variables		Unit	Expected signs
X1=	Per-capita monthly income of family	PKR	+
X2=	Monthly expenditure on drinking water	PKR	+
X3=	Under 14 year members in family	Number	+/-
X4=	Consciousness of drinking water quality	Likert scale	+
X5=	Years of schooling	Number	+
X6=	Satisfaction with drinking water supply and quality	Likert scale	–
=	Constant		
=	Coefficient of an explanatory variable		
=	Error term		

3) EMPIRICAL RESULTS

3.1) CONSUMER PRIORITY OF SAFE DRINKING WATER IN THE HOUSEHOLD NEED BASKET

The demand pattern for different services was almost similar in both of the towns, mainly due to their socioeconomic and locational characteristics and service provisions. The population of both towns was educated and belonged to the upper middle class. As both of the selected towns were adjacent, this was also one of the reasons for similarity in the behavior of the residents.

The respondents ranked the services which affect their everyday living such as Safe drinking water, hospital, Solid waste and sanitation services higher than others like the recreational facilities such as parks and playground, comfort and amusement including paved streets and streetlights (Table 2). However among these services the safe drinking water got the highest rank in both of the towns indicating the top priority among all of the public services.

When asked about the reasons behind such tendency, majority of the respondents revealed that it is the essentials of life and if drinking water is not safe, they cannot live a healthy life. For some respondents, the reason for ranking the drinking water at the highest priority was their practical sufferings from waterborne diseases. Hence, for these households, demand for safe drinking water was actually a strategy to preempt waterborne disease.

The above understanding can be crosschecked even if taken a broader look of the information on the household's ranking of different basic services (Table 3). A closer look at the top four priorities reveals these are directly related to health and hygiene issues. The top ranking of Safe Drinking Water implies the communities' preference for prevention compared to curative tendencies. The preliminary cross-tabulation of the survey information revealed some of the important insights on the tendency to keep drinking water as the top priority. Survey results reveal that the number of males ranking safe water as their top priority is relatively higher than the number of female. Respondents family status shows the tendency to rank water at top was higher in earning respondents than those who were dependent.

Table 3: Ranking of different services in the basic need basket of a household

Services	SRA (n=105)		Mum (n=105)		Both (N=210)	
WAI	SD	WAI	SD	WAI	SD	
Safe drinking water	4.18[I]	0.896	3.95[I]	1.204	4.07[I]	1.065
Hospital	3.16[II]	1.682	3.08[II]	1.900	3.12[II]	1.790
Sanitation service	2.70[III]	1.819	2.21[III]	1.708	2.45[III]	1.777
Solid waste management	1.61[IV]	1.334	1.50[IV]	1.526	1.55[IV]	1.431
Park	1.27[V]	1.476	1.46[V]	1.670	1.36[V]	1.575

Playground	0.91[VI]	1.367	1.14[VI]	1.614	1.03[VI]	1.496
Paved streets	0.62[VII]	1.004	0.88[VII]	1.174	0.75[VII]	1.097
Streetlights	0.53[VIII]	0.867	0.80[VIII]	1.060	0.67[VIII]	0.975
Library	0.00	0.000	0.03[IX]	0.293	0.01[IX]	0.207

Note:
- Figures are weighted average indexes (WAI) and standard deviations (SD).
- High WAI value indicates the high importance of a service in basic need basket
- SRA= Shah Rukun Alam town; Mum= Mumtazabad town
- I, II, ..., IV represent the ranking of different sources of information

The findings reveal that awareness to the importance of safe drinking water change people mindset. The working (breadwinners) respondents shared their preference for provision of safe drinking as an important household need. The household survey further reveals that families having children were more conscious about safe drinking water than those having only adult members. However, with increasing number of children, safe drinking water slips down the priority list. Cross-tabulation of the information with number of children reveals that 52 percent of the families having one child gave top priority to drinking water as the corresponding figure for those having two children was 46 percent, three children was 36 percent and with four children it was only 23 percent. Besides, the survey results also reveal that 57 percent of households who managed to get laboratory tests of their drinking water ranked safe drinking water as their first priority and 24 percent ranked it as the second priority. Nevertheless, 39 percent of those who had never got tested their drinking water from laboratory also ranked safe drinking water as their first priority public service.

3.2) CUSTOMER VIEW OF EXISTING DRINKING WATER QUALITY

Laboratory testing of the drinking water for its fitness for human consumption was not a common practice in the study area. Less than one third of the surveyed households reported to have obtained the laboratory reports on the quality of their drinking water. Among these, only about two fifth have found it fit for human consumption. Majority lacked awareness of the chemical and bacterial content of the drinking water. They relied on their sensory appraisal of the drinking water that they were using in their family. Therefore, they never sent the samples of their drinking water to laboratory for quality tests and consider it as fit for drinking (Table 4). Among the five parameters of drinking water quality, they thought their water quality was good due to its odor-freeness, low turbidity, colorlessness, taste and hardness (Table 4). No difference was found among both of the towns except that overall quality of drinking water was perceived slightly better in Mumtazabad compared to Shah Rukn-e-Alam (Table 4).

Table 4: Drinking water quality based on the sensory appraisal by customers

Quality parameters WAI	SRA (n=105)		Mum (n=105)		Both (N=210)	
	SD	WAI	SD	WAI	SD	
Taste	3.65[G]	0.820	3.83[G]	0.740	3.74[G]	0.784
Free of turbidity	3.84[G]	0.709	3.91[G]	0.761	3.88[G]	0.735
Colorlessness	3.90[G]	0.854	3.81[G]	0.952	3.85[G]	0.903
Free of hardness	3.42[G]	0.907	3.49[G]	0.889	3.45[G]	0.897
Free of odor	4.23[VG]	0.835	4.14[VG]	0.937	4.18[VG]	0.887
Overall Quality	3.81[G]	0.825	3.836[G]	0.8558	3.82[G]	0.8412

Note:
- Figures are weighted average Indexes and their standard deviations. Higher values of WAI indicate better state of water quality parameter.
- See (Appendix A 3) For further details on the interpretation of WAI values
- SRA= Shah Rukun Alam town; Mum= Mumtazabad town
- G=Good; VG= Very good

3.3) CUSTOMER'S AWARENESS OF HEALTH AND WATER LINKAGES

High priority to drinking water in the household need basket (Table 3) was probably because of the impressive level of knowledge about waterborne diseases among the surveyed households (Table 5). About two third of the respondents could correctly identify the diseases caused by unsafe drinking water. While identifying some of the diseases correctly, a little more than one fifth of the respondents mis-identified a disease as waterborne. Only 15 percent of the respondents could be viewed as completely unaware as none of them could correctly identify even a single disease associated with the intake of unsafe drinking water. Hence, the overall trend of responses indicate significantly high level of awareness on water and health linkage in both of the towns as is reflected form their knowledge of diseases caused by the intake of unsafe drinking water.

Table 5: Awareness of waterborne diseases

Diseases		SRA (n=105)		Mum (n=105)		Both (N=210)	
English Name	Local Name	*F*	%	*f*	%	*F*	%
Correctly reported Diseases							
Diarrhea	Ashal	54	51.4	45	42.9	99	47.1
Hepatitis	Warm jigar	28	26.7	28	26.7	56	26.7
Arsenicosis	Gurdy, Jildi sartan	30	28.6	13	12.4	43	20.5
Hydatidosis	Phe-phola	24	22.9	17	16.2	41	19.5
Cyanotic	Yarqan	47	44.8	32	30.5	79	37.6

Campylobacteriosis	Shikam been	31	29.5	23	21.9	54	25.7
Incorrectly reported diseases							
Measles	Khasra	00	00	2	1.9	2	1.0
Other Diseases		44	41.9	51	48.6	95	45.2

Note:
- A correctly reported disease is the one when a disease reported as a waterborne was indeed a waterborne disease; the incorrect answer is the otherwise.
- SRA= Shah Rukun Alam town; Mum= Mumtazabad town

3.4) SOURCES OF AWARENESS ON HEALTH AND WATER LINKAGE

While it was interesting to see that communities in both of the towns had impressive levels of awareness on the linkage between safe drinking water and health, it was more important to understand how they obtain such information. Unquestionably, the formal education appears to be the most important source of awareness in both towns. However, the remaining sources of awareness have almost common pattern across both of the towns in their relative importance in terms of raising awareness in the study area (Table 6).

It was observed that in addition to education, television and their interaction with doctors and hospitals was the second and third important sources of awareness. Although like television, newspapers were also a kind of media but its importance was ranked at fourth. Low effectiveness of newspapers in spreading awareness regarding the importance of safe drinking water compared to television was obviously because of the frequent interaction with the latter. However, most surprising finding is the low ranking of self-observation at fifth in Shah Rukun-e-Alam town and sixth in Mumtazabad town (Table 6). Informally, it was noticed that self-observation was not a source of awareness but was more like a verifying element. Once informed of the importance of safe drinking water for their everyday healthy life from other sources, people could formally observe and validate it through self-observations.

Table 6: Sources of awareness about the importance of safe drinking water

Sources	SRA (n=105)		Mum (n=105)		Both (N=210)	
WAI	SD	WAI	SD	WAI	SD	
Formal Education	4.49^{I}	1.539	4.33^{I}	1.758	4.41^{I}	1.650
Television	4.24^{II}	1.229	4.14^{II}	1.244	4.19^{II}	1.234
Doctors & hospitals	4.09^{III}	1.744	4.00^{III}	1.721	4.04^{III}	1.729
Newspaper	3.17^{IV}	1.672	3.20^{IV}	1.678	3.19^{IV}	1.668

Friends and Relatives	2.44^{VI}	1.358	2.78^{V}	1.467	2.61^{V}	1.421
Self-observation	2.56^{V}	1.544	2.51^{VI}	1.563	2.54^{VI}	1550

Note:
- Weighted average index, the highest value shows the highest ranked source.
- Super script on WAI shows the rank of that product in the relevant town.
- I, II, …, VI represent the ranking of different sources of information
- SRA= Shah Rukun Alam town; Mum= Mumtazabad town

3.5) SATISFACTION WITH THE EXISTING WATER SERVICES

Perception about the quality of existing drinking water (Table 7) itself is a good proxy of understanding community's satisfaction with drinking water. However, besides the quality of drinking water, satisfaction may have other parameters such as the quantity and duration of water supplied, reliability in terms of scheduling, and convenience in water collection such as water tap available inside or outside home and cost of water supply. The survey clearly indicates that all parameters of water supply were considered satisfactory. It is interesting, however, to see that the existing water cost is quite low because the respondents have communicated higher degree of satisfaction with cost (Table 7). This implies that, at the current cost structure, the existing arrangements of quantity, duration, reliability and convenience of supply were satisfactory.

Table 7: Overall satisfaction with different aspects of existing water supply

Water Supply Parameter WAI	SRA (n=105)		Mum (n=105)		Both (N=210)	
	SD	WAI	SD	WAI	SD	
Quantity	0.56^{S}	0.553	0.64^{S}	0.593	0.60^{S}	0.664
Duration	0.50^{S}	0.615	0.27^{S}	0.677	0.39^{S}	0.705
Reliability	0.02^{S}	0.621	0.00^{N}	0.856	0.01^{S}	0.846
Convenience	0.49^{S}	0.640	0.33^{S}	0.860	0.41^{S}	0.866
Cost	1.11^{HS}	0.827	1.05^{HS}	0.872	1.08^{HS}	0.866
Overall Satisfaction	0.54^{S}		0.46^{S}		0.50^{S}	

Note:	- Figures in table are weighted average indexes. Higher values indicate higher satisfaction. - For construction and interpretation of index values and superscripts see (Appendix A 5). - N= Not satisfied; S= Satisfied; HS= Highly satisfied - SRA= Shah Rukun Alam town; Mum= Mumtazabad town

It was further revealed that there were flat rate water charges according to plot size and has nothing to do with the quantity of water consumed. Reportedly, water charges varied between PKR 36 per month (USD 0.33) to PKR 250 per month (USD 2.40) per household. Among the latter four parameters, the satisfaction with reliability appears to be the lowest. From the in-depth inquiry, it emerged that uncoordinated load-shedding of electricity leading to different timings of water supply was one of the major reason. . As a result, sometimes the customers are unable to catch up with the changes in the timing of water supply.

3.6) DEMAND FOR IMPROVEMENTS IN DRINKING WATER QUALITY AND SUPPLY

Though communities thought their water quality and supply services were highly satisfactory, there still prevailed some demand for improvements. Out of five improvements suggested by respondents, three were related to supply including installation of generators, customer care and increase in water supply timing. While installation of filters, and chlorination suggestions were related to quality of water (Table 8).

However, the demand for improvement in water supply parameters has been on higher side as compared to parameters related to quality of water. The reasons behind higher demand for improvement in supply side can be partly linked with lower level of satisfaction with the reliability of water supply and occasional failure to catch up changing water supply schedule. It was also observed during the consultation with stakeholders that the complaint redressal mechanism of the government sponsored water supply service needs improvement.

Table 8: Demanded improvements in drinking water quality and supply

Proposed Improvements	SRA (n=105)		Mum (n=105)		Both (N=210)	
WAI	SD	WAI	SD	WAI	SD	
Installation of generators	3.70^{I}	1.501	3.62^{I}	1.631	3.66^{I}	1.564
Efficient Customer Care	3.34^{II}	1.399	3.04^{II}	1.441	3.19^{II}	1.425
Increased service timing	2.90^{III}	1.467	3.00^{III}	1.461	2.95^{III}	1.462
Installation of filters	2.27^{IV}	1.318	2.26^{IV}	1.468	2.26^{IV}	1.391
Chlorination	1.93^{V}	1.423	1.99^{V}	1.418	1.96^{V}	1.417

Note:	-	Figures in table are the weighted average indexes (WAIs) and standard deviations (SD).
	-	Higher WAI reflect high demand for an improvement, shown through superscripts
	-	SRA= Shah Rukun Alam town; Mum= Mumtazabad town

Low ranking of demand for improvement in quality of water can be understood in the context of customers' high degree of satisfaction with the quality of their existing water supply that demonstrated through the sensory appraisals (Table 7). Nevertheless, there was still a feeling that the quality of water could be improved through filtration and chlorination (Table 8).

However, the findings of the interviews with officials and other knowledgeable persons revealed that the installation of filters would not be a practical solution as water would be re-contaminated during its course through pipelines which are leaked at many places and could mix-up with sewage. According to them, filters at drinking water taps within household would be much better option and is something that each household needs to install on individual basis. According to the official schedule, the chlorination is used once a year for cleaning the pipelines' in rainy season. Because, over chlorination may lead to adverse impact on the health of customer due to carcinogenic and environment effects.

As we know that water is a scarce resource, for which no market exists being an environmental goods. Therefore, to find out the demand for improvements in the supply and quality of drinking water, certain techniques need to be used. This study adopted the contingent valuation technique that is based on the preference approach for environmental valuation. Under this technique, respondents are directly asked about their willingness to pay for certain environmental good i.e. improved water supply system. Hence, once the public willingness to pay is approximated, the funds generating potential in this sector can help the government to take new initiatives and shift a portion of the burden on consumers. This burden can be decided in accordance with their willingness to pay bids so as to realize the improvements needed by consumers. With this premise, households were asked for their willingness to pay (WTP) for the provision of improved water supply system of good quality.

Results revealed that an overwhelming majority were ready to pay for the demanded improvements in the water supply and its quality (Table 9, also see Table 8). In response to various bids ranging between PKR 50 to 250, respondents demonstrated variation in their WTP. It was observed that increase in bid amount was negatively associated with WTP. Statistical parameters give confidence that majority would pay addition 100 rupees for the said improvements in the service. Given the structure of questioning, one cannot determine exactly which service account for bulk of the additional payment. However, information in Table 9 shows that most of this additional payment will pertain to improvement in reliability of supply and establishment of customer care.

Table 9: Demand for improved drinking water services

Willing to pay f(%)	SRA (n=105)		Mum (n=105)		Both (N=210)	
	Sureness	f(%)	Sureness	f(%)	Sure-ness	
Not at all	89 (84.7)		85 (81.0)		174 (82.8)	
PKR 50	89 (84.7)	1.96^{SS}	83 (79.0)	1.88^{SS}	172 (81.9)	1.92^{SS}
PKR 100	76 (72.4)	0.90^{S}	63 (60.0)	0.69^{S}	139 (62.2)	0.80^{S}
PKR 150	55 (52.4)	0.28^{S}	39 (37.1)	0.02^{S}	94 (44.8)	0.16^{S}
PKR 200	38 (36.2)	0.11^{S}	27 (25.7)	0.15^{S}	65 (31.0)	0.13^{S}
PKR 250	15 (14.3)	-0.55^{NS}	12 (11.4)	-0.46^{NS}	27 (12.9)	-0.51^{NS}

Note:
- Respondent's willingness to pay at different package.
- Sureness is the WAI of the level certainty that a respondent would actually pay
- SRA= Shah Rukun Alam town; Mum= Mumtazabad town
- SS= Strongly sure; S= Sure; NS= Not sure

3.7) TRUST IN INSTITUTIONS FOR SUPPLYING IMPROVED DRINKING WATER

Different institutions were engaged in water supply to the citizens. However, the Water and Sanitation Agency (WASA) was the major public institution, responsible for managing water supply in the city. Additionally, the Tehsil Municipal Administration, (TMA) was also engaged in the supply of drinking water through filtration plants. It is however important to understand the differences in the service provision by both of the agencies. The WASA supplies water through pipeline connections that is used for drinking, cooking as well as washing purpose. On the contrary, TMA supplies water through filtration plants at central locations in hamlets. The water provided through TMA filter plants is used only for drinking and cooking purposes. The private sector water services include the bolted water and water dispensers which is also supplied door to door to the households. It was found that though people preferred to have better quality of drinking water but cost is an important constraint that restricts its demand.

Table 10: Trust in institutions to supply safe drinking water

Institutions WAI	SRA (n=105)		Mum (n=105)		Both (N=210)	
	SD	WAI	SD	WAI	SD	
WASA	3.55^{I}	0.832	3.43^{I}	0.853	3.49^{I}	0.843

Local Community	3.46[II]	0.941	3.25[II]	0.830	3.35[II]	0.891
NGO	3.27[III]	0.669	3.09[IV]	0.681	3.18[III]	0.679
Private Organization	3.02[IV]	0.990	3.15[III]	0.907	3.09[IV]	0.950
TMA	0.00[V]	0.000	0.08[V]	0.549	0.04[V]	0.389

Note:
- Weighted average index, the highest value shows highest priority.
- Superscript over WAI shows the ranking of institutions
- SRA= Shah Rukun Alam town; Mum= Mumtazabad town

Given the current socioeconomic status in the study area, the WASA provided pipeline is the primary source of drinking water followed by TMA filtration plants (Table 10). Respondents highly trusted in WASA followed by) local Community, NGO and Private Organization for providing quality drinking water. One of the main reasons behind such tendency is that government agencies have the capability to initiate big projects and conduct larger level operations. This thereby reduces the cost of supply, an advantage missing to the private suppliers in the sector. However, some of the respondents highlighted the issues such as carelessness, negligence and corruption in government sector, nevertheless, the costs were no matching to that offered by the private organizations. Engagement of communities in drinking water supply did not get much approval as community perceived high transition costs for them in managing these services.

3.8) DETERMINANTS OF WTP FOR IMPROVED WATER SERVICES

Income is positively associated with the WTP for improved drinking water services and is statistically significant across all models of high amount of bid (Table 11). Nevertheless, given the small values of elasticity in all models, increase in income will increase the likelihood of willingness to pay. As the WTP amount arises across the models the elasticity of WTP toward income arises, as 1% increase in income will cause the 0.08% rise in overall WTP Model 1 but it causes 0.10% rise at Model 2 and 0.31 % rise in WTP in Model 3 (Table 11). This indicates that increase in income will cause the high WTP at higher amounts. Almost similar is the case with expenditure on drinking water except that the variable is statistically insignificant in all models of WTP as a dependent variable. The reason behind very small marginal effects of income and expenditure is due to the fact that people spend very small percentage of their incomes on drinking water. Initially the expenditure on drinking water has negative relations to WTP but with the increase the WTP level the marginal effect level rises and at Model 3 this show the positive relation. This corroborates the findings of studies such as conducted in Korea (Um et al., 2002), Bangladesh (Ahmad et al., 2003) and China.

Increase in the number of children under the age of 14 years increase the likelihood of willingness to pay. Despite positive association, the coefficient of this variable is significant only in Model 3 (WTP 150-250) (Table 11). The most plausible explanation for this variable is the fact that children are more vulnerable to waterborne

diseases compared to adults (Buchanan, M.K., 2006 cited in Changa Pani, 2011). Therefore, parents prefer preempting such diseases through precautionary measures through provision of safe drinking water. Among all variables, however, the most important variable is the households' quality consciousness of drinking water, which is not only statistically highly significant across all models but has also higher coefficient. The relation of households' quality consciousness of drinking water to WTP is positive that is quite reasonable, because as the consciousness increases respondents WTP rises.

TABLE 11: DETERMINANTS OF WTP IN LOGIT REGRESSION

WTP (Y/N)	Model 1	Model 2	Model 3
	WTP 50-100 (Y/N)	WTP 150-250 (Y/N)	
Per capita income^	0.08052**	0.10550***	0.31148***
Water expenditure^	-0.00089	-0.00151	0.02088
No of Children under 14 years of age	0.01725	0.01861	0.06243[b]
Quality conscious^^	0.10141***	0.10217***	0.20382***
Years of schooling	-0.00977	-0.00934	-0.00104
Satisfaction with existing water quality^^	-0.16465**	-0.19835**	-0.13097
Pseudo R^2	0.1502	0.1622	0.2768
Chi square	27.38	31.07	71.33
P value	0.03	0.01	0.00

Note:
- Entries are Logit Marginal effects.
- Superscript '***, ** & * denote the significance at 1%, 5% & 10% levels, respectively.
- Number of cases (N) is 210
- ^ in Natural Log; ^^ in Scale measurement unit

Two other variables, which are also important, are the years of schooling and satisfaction of household with the quality of their existing drinking water. As expected, the higher levels of satisfaction with existing water quality decrease households' demand for further improvements in the services. Conceptually, those already satisfied with quality of something may find it insignificant to demand further improvements. However, despite the theoretically consistent signs of coefficients, it is significant only in Model 1 and Model 2. Which indicates the

moving toward next satisfaction level reduce the WTP for improved drinking water by 0.164% at Model 1 and 0.198 at Model 2 (Table 11). The years of schooling shows negative and insignificant relation to WTP.

4) CONCLUSIONS AND RECOMMENDATIONS

Life is unimaginable without water. Clean drinking water is one of the major determinants of a healthy life and rightly held as fundamental human right. Governments attempt to provide it at nominal charges as can also be seen in case of Multan City and elsewhere in Pakistan. However, constrained by the lack of sufficient funds, governments often face difficulties in the provision of clean drinking water to everyone. In such situations, user payment for quality drinking water emerges out as one of the viable option. This study, while confirming the findings of similar studies elsewhere; supports the hypotheses that household income drives its WTP for improved drinking water services.

However, given the fact that everywhere expenses on water make just tiny portion of the overall household expenditures, increase in income after a certain level may play a significant role in household's WTP for improvements in drinking water quality and supply. Furthermore, the findings support the argument that health consciousness and awareness explains most of the variation in HH's WTP for drinking water. Household may be willing to pay for better quality and service of water delivery to avoid health consequences of unsafe water intake. For example, the number of family members aged below 14 year determined significant level of households' WTP as communities in the study area were aware that children are more prone to waterborne diseases compared to adults. However, possibilities of WTP increase with increase in level of knowledge at household and community level. The traditional sources of knowledge such as from formal schooling may be substantiated with other sources such as newspapers, family and friends. Doctors were also important source in creating such awareness.

Multan City represents common tendency which is not only common in other cities of Pakistan but throughout developing world where people consider water quality as "good" it feels good to their five senses. Thus, they remain unaware about the other water quality parameters such as chemical composition and microbes which cannot be observed through normal human senses. These people thereby remain in an illusion that they had been using safe drinking. Making laboratory tests accessible and ensuring public disclosure of local water quality would certainly make people willing to pay as emerged out of the results of this study. Regarding improvements in quality of drinking water in Multan City, there is certainly a need to raise the water charges as existing water charges at a flat rate are not only low but economically not feasible.

Based on the findings of the study following key recommendations can be offered. Since this study did not carry out economic analysis of the demanded improvement, it is suggested that the concerned agencies such as WASA and TMA must evaluate possible improvement which can be offered by raising existing water charges to PKR 100 per month. A viable option would be to attach the water charges to the

wealth of the HH. The size of house and price could be considered indicators for setting water charges. Hence sustainable improved water supply system can be ensured by charging those who can afford and subsidizing the poor.

5) BASED ON STUDY RESULTS AND ABOVE DELIBERATIONS, FOLLOWING RECOMMENDATIONS ARE OFFERED:

People at present have demonstrated high degree of satisfaction with government institutions on provision of clean drinking water. However, they shared their concern about the reliability which is essentially because of unreliable electricity supply due to power shortages. Government may improve reliability either by installing generators or devise a mechanism through which people can be informed about changing water supply schedules to face with unreliable electric supply.

The second and entirely missing aspect of government sponsored water supply is the customer care. People felt the need of customer care due to various reasons some of which were the information about changing schedule, supply of contaminated water due to mixing of water supply and sewage lines and other technical problems. A friendly customer care cell may increase faith of customers thereby increase their WTP.

6) RECOMMENDATIONS FOR IMPROVING WATER QUALITY

Despite being aware of the importance of water for a healthy life, people seemed to be satisfied with existing water quality based on their sensory appraisal of water they are using at the moment. There is a missing dimension of water quality that most of the respondent either do not know or do not bother much about it. This is the complete information about both observable and unobservable aspects of the quality of their water. Government may launch mobile water testing laboratory, visiting and testing in house water quality at source and provide on spot result of that test. Given the limited revenue from the water supply, government may consider alternatives such as providing people awareness about the non-observable aspects of water quality through television, newspaper and clinics.

7) DIRECTIONS FOR FUTURE RESEARCH

Although people seem to be willing to pay for quality top-ups, a however reported that even the recovery rate for meager water charges at the present is very low. Therefore, the future research may search for understanding the reasons for low recovery rate. Are their problems on the part of supplying agencies or customers themselves are not paying but they have just quoted the bids?

Given the nature of questions, this study cannot determine for which demanded improvement how much people are willing to pay. Therefore, it is suggested that if there are a couple of options for improvements, questions may be asked for different packages of improvement in order to determine exactly how much people are WTP for each of the improvements. The first package should start with the most demanded services while subsequent package should include an additional service.

Done in this way would make it possible to determine what percentages of bid pertain to the payment for any particular service.

This study selected two out of six towns in Multan City which are the poshest areas of the City. With a slight difference in the wealth status, both of towns were almost similar. Therefore, no significant variation in the responses could be observed. It could be good if rich and poor towns be included to portray a general picture of the WTP of the residents of Multan City.

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