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Willingness to Pay for Drinking Water Quality Improvements

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ABSTRACT. *Drinking water has been provided as an unpriced, socially defined public good in many developing countries. At present, with scarcity of investment funds, particularly in the public sector, decisions need to be made on efficacy of investments and possibilities to levy user charges. Where market prices do not exist, as in the case of drinking water in developing countries, non-market valuation techniques should be used to estimate prices.*

In this study, data from a survey of 140 households in Colombo were used to estimate peoples' willingness to pay for drinking water quality improvements. The contingent valuation method was used. Results showed that people on average are willing to pay additional 5.27 Rs./cubic metre if they are provided with reliable safe water with good pressure. This amounts to 554,680 Rs./month for Colombo, where the population is 2800 and average water consumption per household per month is 37.59 cubic metre. This estimate was validated by regressing willingness to pay with variable income, amount of water consumed, perception of water quality and reliability, type of water source, education and gender. Income, amount of water consumed, perception of water quality and reliability, type of water source, and gender variables were found to be significant.

Willingness to pay Rs. 5.27/cubic metre could therefore be accepted as a reasonable proxy for the levy that can be charged from the consumers. Currently water is priced at 8.67 Rs./cubic metre by the government. If a mechanism can be devised to improve the quality and reliability of the existing water supply at a cost less than the total willingness to pay estimated in this study, efficiency of the system can be improved, by charging a levy from the consumers.

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INTRODUCTION

Rapid urban population growth, and increased income have lead to a high demand for quality drinking water. Simultaneously the degradation of catchment areas and pollution of surface and ground water have lead to a reduction in quality water supply. With budgetary scarcities government is no longer able to provide sufficient amounts of quality water to residents as a free good. On the other hand, market forces cannot determine the right price for water, since markets for water does not prevail. The present policy of the government of Sri Lanka is to levy prices on water users to meet investment and operation cost, to the extent possible. The present water charges are based on the principle of cost recovery for recurrent expenditure. However, the optimum price of water for its suppliers and consumers is the price where marginal cost equals the marginal benefits to the consumers.

The objective of this paper is to provide estimates of marginal benefits of drinking water quality improvements to consumers. The specific objectives of the paper are:

1. to determine how much people are willing to pay for quality water, and
2. to determine the factors that influence the willingness to pay

The first objective is achieved using a contingent valuation method. The second objective is achieved by regressing willingness to pay as a function of a set of variables that are expected to be related to willingness to pay.

MATERIALS AND METHODS

Contingent valuation method uses a survey technique to estimate values people place on increments or decrements in a natural resource in the context of a hypothetical market. Literature on theoretical and empirical applications of the contingent valuation method is substantial (Bishop and Heberlein, 1979; Brookshire *et al.*, 1986; Henemann, 1994; Loehman and De, 1982; Mitchell and Carson, 1989; Sellar *et al.*, 1985, 1986). The contingent valuation method has been used to measure willingness to pay for water by a number of authors (Jordan and Elnagheeb (1993) and Edwards (1988). A study has been conducted to measure willingness to pay for natural resources in Sri Lanka (Kotagama, 1998). However, there has not been any studies to evaluate the willingness to pay for quality water in Sri Lanka.

DATA

In this study, primary data were collected from 140 households in Colombo 14 and 15 zones. Random sampling was done and 5% of the population was considered at the sample size[1].

Data were collected on willingness to pay for quality water, number of units of water consumed, household income, perception of water quality, type of water source and its reliability, gender and education level.

Willingness to pay was obtained as follows. Respondents were first asked to read the following statement in the questionnaire.

> Due to rapid growth in population, urbanization and unexpected local migrants in Colombo City an improved city water supply is essential. But scarcity of water sources, which could be utilized for the purpose, warns us to save the water. The government at present, due to budgetary limitations, is compelled to levy a water price, in order to continue investments and maintain the supply of quality water.

After reading the above statement, the respondents were asked to provide the amount they would be willing to pay. The question was stated as follows[2]:

> Being a consumer, if you are provided with 100% reliable, safe water with good pressure (*i.e.*, quality water supply) what is the amount you like to pay for water consumption of your household per month in rupees in addition to current payment?

The information on other variables were obtained as follows. Number of units of water consumed were obtained in cubic metres/month. Household income was obtained in Rs./month. Respondents were asked whether they have a reliable water source or not. Perception of water quality was obtained by asking them to choose whether it is safe, unsafe or uncertain. Type of water source was obtained by asking whether it is a private connection from the city water supply, a common tap, or a private well. Two

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1 Colombo is a good example of all problems faced by an urban area in the developing countries trying to manage their water supply services to their residents. According to National Water Supply and Drainage Board 30% of the existing pipe borne water scheme has a very poor supply and another 30% can supply only 12 hours or less per day.

2 Note the wording of the question. The question is hypothetical. Respondents do not get 100% reliable, safe water with good pressure at present, and therefore they will express their willingness to pay for 'quality' water.

dummy variables were used to describe type of water supply considering private well as the base. Highest education level of the respondent was obtained in terms of no schooling, primary school, secondary school, diploma, graduate or postgraduate. Gender of the respondent was noted.

RESULTS AND DISCUSSION

Mean and the standard deviation of the key variables are presented in Table 1. On average respondents are willing to pay 5.27 Rs./cubic metre to quality water. This amounts to 554,680 Rs./month for Colombo, where the population is 2800 and average water consumption per household per month is Rs. 37.59. The standard deviation of willingness to pay of the sample is 6.54 Rs./cubic feet, suggesting that the amount willing to pay has a high variation. This could be attributed to the heterogeneity of the sample in terms of income and the level of water consumption as shown in Table 1.

Table 1. Summary statistics of the key variables.

Variable	Units	Mean	Standard Deviation
Willingness to pay	Rs/m^3/mth	5.27	6.54
Income	Rs/mth	7616.41	8375.11
Water consumption	M^3/mth	37.59	25.80

The willingness to pay estimate was validated by regressing the log of willingness to pay as a function of income level, amount of water consumed, perception on water quality, gender of the respondent, education level and reliability of water supply. No significant correlations were found among the independent variables. The function was estimated using Ordinary Least Squares in Time Series Package.

Results of the estimation are presented in Table 2. Model explained 43% of the variation and considered as adequate since cross sectional data were used. Of the 8 independent variables 4 were statistically significant at

5% level (income, water consumption, perception on quality and reliability) and 2 were statistically significant at 10% level (type of water source is by private connection and gender). Two variables were insignificant, education and the dummy for common tap.

Table 2. Results of the estimation.

Variable name	Type of variable	Estimated coefficient	t statistic
Constant		0.6923	1.51
Income	Rs/mth	0.4508E-04	5.37**
Water consumption	m^3/mth	-0.0147	5.22**
Education	rank 1 to 7	-0.0587	0.45
Perception on safety	yes=1 no=0	0.3490	2.49**
Water source	Private connection yes=1 no=0	0.6203	1.93*
	Common tap yes=1 no=0	0.1458	0.80
Reliability of water source	Reliable=1 Not reliable=0	0.3510	2.39**
Gender	Male=1 Female=0	0.2184	1.68*

** indicates significance at 5% and * indicates significance at 10%

As would be expected the positive and significant coefficient on income suggests that respondents having a higher income are willing to pay more for quality water. This result is similar to that obtained by Shulz and Lindsay (1990) and Jorden and Elnagheeb (1993). The elasticity of willingness to pay with respect to income is 0.34.

The negative and significant coefficient on water consumption

suggests that respondents who are currently consuming more water are willing to pay less for quality water. The elasticity of willingness to pay with respect to water consumption is -0.55.

Those who perceive current water supply as safe and reliable are willing to pay more for quality water[1]. Coefficients of these variables show the amount that these individuals are willing to pay in log terms as opposed to those who perceive current water supply as unsafe/uncertain and unreliable respectively. Note that for both of these variables coefficients are equal to 0.35 indicating the difference between the two groups in log terms is 035. The amount is equal to 1.41 Rs. per cubic metre.

Those who get water from a private connection are willing to pay more for quality water than those who have private wells. The difference is 1.86 Rs./cubic metre. There is no significant difference in willingness to pay for quality water between those who are using common taps and those who obtain water from private wells.

Male respondents are willing to pay more than the female respondents. The difference is 1.23 Rs./cubic metre. Although there are no theoretical explanations for these results, opposite results were obtained by Shulz and Lindsay (1990) and Jorden and Elnagheeb (1993).

Willingness to pay for quality water does not change with the education level of the respondent. However, previous studies have shown that highly educated people are more concerned about the protection of the environment (Jorden and Elnagheeb, 1993).

CONCLUSIONS

Aggregate willingness to pay was estimated as 554,680 Rs./month for the population under investigation. Currently water is priced at 8.67 Rs./cubic metre by the government considering the marginal cost of provision. The willingness to pay estimate can be used in appraisal of investments in drinking water supplies and determining a water price. If a mechanism can be devised to improve the quality and reliability of the existing water supply at a cost less

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1 According to survey results 70% of households considers that the current water supply is reliable and 75% considered that current water supply is not clean. 63% of households purify water by boiling and 12% of households purify water by boiling and filtering.

than the total willingness to pay estimated in this study, efficiency of the system can be improved, by changing a levy.

Willingness to pay is positively related to income and it is negatively related to the current water consumption. Those who perceive current water supply as safe and reliable, those who get from a private connection and male respondents are willing to pay more for water.

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