FACTORS INFLUENCING HOUSEHOLD WILLINGNESS TO PAY (WTP) FOR WATER: A CASE STUDY

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Abstract

One of the major issues confronted by the agencies formulating policies for water supply projects in developing countries is how to achieve efficiency, equity and sustainability. Achieving these objectives warrants an understanding of the determinants of household behaviour towards various components of the water supply projects, such as improved water supply services. Since these determinants are site-specific in nature, it is imperative that the water supply policies identify and accommodate these factors appropriately. This paper discusses the results of a case study that looked into identification of such determinants of household decisions regarding the improved water supply services in a suburban town of Tamil Nadu State, India.

Introduction

One of the concerns of policy makers, international donors and researchers, especially in developing countries, is to understand the factors influencing the households' willingness to pay for water and water supply services. A major objective of overall water planning and management at the project level is to find ways by which the 'low level equilibrium trap' (Singh *et al*, 1993) - characterised by supply of inadequate and poor quality service, which leads to low level of willingness to pay, which leads to low level of revenue, which in turn leads to inadequate and poor quality service - can be overcome in developing countries. Attainment of this objective will fulfill three major policy goals, namely, efficiency, equity and sustainability (Rogers *et al*, 2002). Overcoming the low-level equilibrium trap, as well as achieving the related objectives, warrants addressing certain important policy issues such as determining the appropriate service levels, identifying the right kind of institutional set-up for the provision of water supply, fixing of optimum level of tariff and dealing with the equity concerns.

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The literature on water supply, which includes a considerable number of contingent valuation (CV) studies pertaining to the drinking water sector in developing countries, suggests that an appropriate and efficient policy intervention to make water supply schemes economically viable and sustainable essentially requires understanding the factors determining the preferences of the households for water and water supply services. These studies have identified certain common factors such as income, level of education, reliability of supply and quality of water that are supposed to explain household behaviour regarding the improved water quality or water supply services. It should, however, be noted that not only does the significance of the influence of these factors differ among different regions but also the nature of influence is found to be different between regions depending on the kind of institutional set-up prevailing in those regions. An important conclusion stemming from the literature is that the regional factors, embedded in the socio-economic and institutional set-up, play an important role in household decision-making and, therefore, the economic efficiency and sustainability of a specific water supply scheme depend largely on these determinants at the local level. This paper makes an attempt to identify those regional factors using a case study conducted in a suburban area in India.

This paper is divided into four parts. The first reviews some of the developing country studies on water supply that looked into the factors affecting household behaviour regarding improved water supply services. The second part describes the study area, the proposed water supply scheme for which the present study has been undertaken and the methodology used in the study. The major results are discussed in the third part and concluding comments are made in the final part of this paper.

Experience from Other Developing Countries

The World Bank Water Demand Research Team (1993) has summarised the results of the CV studies conducted to elicit information on household demand for water in rural areas of Latin America (Brazil), Africa (Nigeria and Zimbabwe), and South Asia (Pakistan and India). One of the major objectives of these studies was to investigate the determinants of household demand for improved water supply in rural areas in these locations. Using both direct (contingent valuation) and indirect (revealed preference) economic valuation methods, these studies found that the following three factors 'jointly' influence the household demand for improved water supply: (i) the socio-economic and demographic characteristics of the households; (ii) the characteristics of the existing or traditional source of water versus those of the improved water supply; and (iii) households' attitude towards government policy on water supply and their sense of entitlement to government services.

In the case of socio-economic and demographic characteristics, the findings reveal that contrary to the conventional assumption income was *not* a major determinant of the household decision regarding improved water supply schemes. The implication of this finding is twofold: (i) it should be noted that not only the rich but also the poorer sections of the households are willing to participate in and pay for different components of the improved water supply schemes; and (ii) the households give importance to various other kinds of factors while making alternative decisions about improved water supply. Another finding suggests that education was directly correlated with the household decisions. One of the reasons attributed to this relationship is that highly educated households might be concerned more about the increased opportunity cost of time spent on collecting water from distant sources and cost of illness due to waterborne diseases and, therefore, tend to equate these costs with the benefit derived from the improved water supply scheme. Gender is another factor which was found to play an important role in influencing the household decision but the nature of the influence is different in different countries. For instance, in Tanzania and Haiti, women were willing to pay more than men, whereas that was not the case in Nigeria and India. An obvious explanation is that the economic and political empowerment of women at the household level differs among countries and this is reflected mainly in the decision of the women. The variable 'occupation' showed a mixed response, implying that in some countries households employed in the formal sector are willing to pay more than those in the informal sector whereas, in others the situation is contrary. Family size and household composition on willingness to pay for improved services show no significant effect. It was found that if the opportunity cost of time and the amount of money spent on obtaining water from existing sources were high, willingness to pay for improved services was also high. The willingness to pay for new service was obviously dependent on the perceived quality of water from the existing sources, and the reliability of supply from the improved sources.

Similar to the above study, an earlier CV study by Whittington *et al* (1990) in Haiti – designed to understand the validity of the CV results derived from a developing country context– also investigated factors influencing the households' willingness to pay for different levels of water supply services. This study used standard variables such as wealth of the households, remittance from the relatives received by the households, occupation of the members of the households, education levels, water quality aspects and the distance between the household and the existing source. It was found that wealth, education, distance and water quality were significantly influencing the households' willingness to pay for water services. One of the important findings was that the women respondents were willing to pay more for the public taps than men were whereas this is not the case with the private yard tap.

Apart from factors influencing household decision to go in for improved services, what are the major influencing factors that are exclusively responsible for the household decision *not* to connect to improved water supply system? McPhail (1994) tried to answer this question through a CV survey conducted among urban households in Tunis, Tunisia, who were not willing to connect to the improved water supply system even when it was readily available to them. The results of the study revealed that 62 per cent of the households reported that they could not afford to pay for a connection. Seventeen per cent of them said that they were renter households and the responsibility of paying for the improved system was with the landlord. While 12 per cent of the households cited some legal problem over the land title as the reason, the remaining 9 per cent of the sample households said that they either had the standpipe closer to their house or provided some other reasons for not connecting to the system.

What we have learnt from the above studies is that, as we have already seen, there are certain standard variables which are found to influence the household decision to connect or not to connect to improved water supply services. However, one of the important questions that arises here is whether these variables are universal in nature or only site specific? The study by Griffin *et al.* (1995) provides an answer to this question. This study investigated two issues regarding household behaviour on water supply schemes, namely, (i) is the people's behaviour the same in both *ex-ante* and *ex-post* situations? (which is called 'benefit revelation') and (ii) is it possible to transfer valuation from one population to estimate how a second population would value the same resource? (which is called 'benefit transfer'). This study basically compared the results of an earlier study conducted by the World Bank Water Research Team during 1988 (*ex-ante*) and the results of the authors' 1991 study (*ex-post*) in northern areas of the Indian State of Kerala. The 1988 study was carried out among the households in three drinking water environments, namely, abundant water area, scarce water area, and an area with salt water intrusion. In each category, two types of households – Site A community households and site B community households – were chosen. In the case of site-A community households, piped water services were already available to these households. These households were further classified under two categories: (i) those who had already decided to connect to individual connections at the existing connection costs and tariffs, and (ii) those who decided not to connect. Connectors were asked whether they would continue to connect, for a range of hypothetical tariffs higher than the current tariff.

In the case of 'benefit revelation issue', the 1991 re-survey has found that ninety one per cent of the households out of the total number of households who said they would connect, were actually found to have connected to an improved service. In the case of households who said

they would connect but had not connected, more than 75 per cent reported inability to pay the connection cost as the major reason for their decision. Households who said they would not connect during the 1998 survey, but actually connected, cited 'changed economic circumstances' as the major reason for their decision. The reliability of water supply was found to be less influential on household decision to connect to an improved service. To test the validity of the 'benefit transfer method', these results were used to predict the people's behaviour in another site (site B). However, it was found that these factors could not explain the behaviour of the households in the B site and therefore, it has been concluded that the benefit transfer is *not* a superior method. The reason is that the respondents in the A site were very poor substitutes for the respondents in the B sites apparently because of unobservable, *site-specific factors*.

Two different kinds of conclusions can be arrived at from the review of the limited number of studies above. One is that the major objective of some of these studies is to understand the price elasticity (as well as income elasticity) of demand for water and water services in developing countries, which is implicitly revealed by the 'bidding game approach' adopted in these studies. The implication is that many of these studies focus on how to 'price' different levels of improved water supply services so that the 'revenue part' of the schemes could be substantially dealt with; second is that the conclusions of some of these studies suggest that the factors influencing the household decision are site specific and are affected by the socio-economic and institutional factors in the respective study areas. The implication is that the observations in one particular site may not be useful for deriving any policy conclusions in some other site and, therefore, site-specific factors need to be identified and incorporated in the overall objective of the water supply polices. Hence, in this paper we make a small attempt to highlight some of the factors influencing household decisions towards improved water supply services in an urban setting in a developing country context.

Description of the Study Area

Our study area, namely Othakkal Mandapam (hereafter Mandapam) is a suburban town of Coimbatore City, Tamil Nadu, India. Coimbatore is the second largest city in the state of Tamil Nadu in terms of population and is one of the major industrialised centres of Southern India. The suburban areas around Coimbatore were growing rapidly, which resulted in acute water scarcity in some of the suburban towns including the study area (TWAD, 1992). Mandapam has a total population of 9,353 as per the 1991 Census. According to the officials of the town, out of a total of 1,794 households, nearly 30 per cent of the households are engaged in agricultural activities, approximately 39 per cent in industrial activities and the rest in the service sector, government sector and other commercial activities. There are 11 administrative wards in the town. While ward

nos. 1, 2, and 7 possess the characteristics of rural areas (such as, more than 50 per cent of the households being engaged in agricultural and allied activities, existence of a large number of low-income households, etc), the remaining wards in the town can be treated as urban wards since they possess the characteristics of urban areas.

Even though both ground and surface water sources are available in the town, the existing water supply to the households depends mainly on groundwater sources. The surface sources include small ponds and a river, which are generally dry, except during the rainy season. At present, households in the study area get water from both private and public sources. Public sources consist of open wells, bore-wells and hand-pumps installed by the water supply authority of the town. Out of 18 open wells located all over the town, only one is used for pumping out water while the rest are completely dry. Public supply of water in the town is effected through individual house connections (568 numbers), public taps (80 numbers) and ground-level reservoirs (4 numbers). At present, two methods are being followed to effect water supply to the households. The water pumped out from the bore-wells is stored in two overhead tanks and distributed to households, industrial units and commercial establishments in all the wards except ward nos. 9, 10 and 11. In the case of these wards, water is supplied through direct pumping from the bore-well itself. Apart from individual connections and public taps, the water supply authority has installed thirty-one hand-pumps in different parts of the town, of which 27 hand-pumps are in working condition. Even among the 27 hand-pumps, only two are frequently used by the households on the ground that these are the only hand-pumps providing 'relatively good quality drinking water'. The local water supply authority has estimated the present average per capita availability of water at 40 litres and, therefore, decided to increase it to the prescribed norm of 80 litres per capita per day through the newly proposed water supply scheme called Pillur scheme.

The Tamil Nadu Water Supply and Drainage Board (TWAD), a public sector agency responsible for providing water supply to households, has undertaken the responsibility of implementing the Pillur Scheme with assistance from the World Bank to meet the growing demand for water in and around Coimbatore, which is one of the most industrialised cities in the state of Tamil Nadu, India. The Pillur scheme was designed to benefit the households, industries, and commercial establishments located in part of Coimbatore City, 21 suburban towns and 523 wayside villages, including our study area. Out of the proposed quantity of 553 kilolitres per day (KLD) to our study area, the households would get 457 KLD, leading to the average per capita availability of Pillur water to around 60 litres per day. Both individual house connections as well as public taps on the streets were proposed to be installed under the scheme. The officials of the Mandapam town framed a policy package under the proposed

scheme, which includes tariff policy consisting of one-time advance payment for the individual house connection (i.e. Rs.4,000)[1] and a flat monthly water tariff for the individual connection (i.e. Rs.60). Since the expected Pillur scheme, as well as the policy package formulated, provided us the *ex-ante* situation, we implemented a CV survey to understand the behaviour of the households regarding various components of the scheme.[2]

Methodology

For the present study, the sample households were selected through a systematic sampling procedure. The total number of households in the town were 1, 774, out of which 1,705 households were paying property tax to the town. Out of the total number of households, 206 (about 12 per cent) households have been randomly selected for the study. The sample households were selected from the list of property tax that is available with the town including approximately one per cent of the sample households representing 'non-tax paying households'. Two stages of sampling procedure were used for selecting the households namely, proportionate random sampling and simple random sampling. First, the property tax rates were classified into six different ranges from lowest level to highest level (see Table-1), representing six categories of the households in the town as a whole. The total number of sample households from all the 11 wards in the town were selected in proportion to the total number of households in each tax range. Second, the selected number of sample households were chosen from each ward by using simple random sampling. Since the list of tax-paying households does not include non-tax paying households ('no tax' category), the sample households in this category were selected with the help of officials of the town. It should be noted that our sample includes only one per cent of the non-tax paying households while these households constitute 5 per cent of the total households in the town. One can argue that a one per cent sample may not be a true representation of the non-tax paying households. We did not give more weightage to the non-tax paying households because the officials pointed out that these households are non-permanent households of the town.

Table -1: No. of Sample Households Selected on the Basis of Various Categories of Property Tax

Categories	(No Tax)	(Rs. 2.70 – Rs. 7.50)	Rs. 7.51- Rs. 14.00)	(Rs. 14.01– Rs. 25.00)	(Rs. 25.01– Rs. 37.50)	(Rs. 37.51– Rs. 54.00)	(Rs. 54.10 and above)	Total
Sample	2	28	39	40	39	25	33	206
Hslds.	(0.97)	(13.59)	(18.93)	(19.41)	(18.93)	(12.13)	(16.01)	(100.00)

Source: Household Survey, Mandapam.

As we have already seen, we have used CV survey among the households to understand household behaviour regarding the willingness to pay for water. Of course, the water and the service through which it is supplied are complementary to each other and, therefore, the willingness to pay value for water through a particular level of service is taken to combine the value for both water as well as the service under consideration. The CV survey was enhanced by the *ex-ante* situation, which is a prerequisite for the application of CV survey.

Having conducted the pre-testing among 15 non-sample households and modifying the interview schedule accordingly, we conducted the main survey among the sample households in a normal season (i.e., during September – November, 1997). The CV survey covered three major aspects of the households, namely, (i) the general socio-economic condition of the households; (ii) the situation with the present water supply system; and (iii) the CV part relating to household preferences regarding various components of the proposed water supply scheme[3]. The last part concentrated mainly on (a) eliciting household willingness to connect to individual house connection; and (b) household willingness to pay for two different service levels, namely, individual house connection and public taps.[4] Regarding individual house connections, household willingness to pay was elicited for both one-time advance payment as well as monthly water tariff. In the present study, open-ended elicitation technique has been used to elicit the WTP value from the households.[5] The following section discusses the results of the study.

Results

Household Willingness to Pay for Individual Connections -Advance Payment and Monthly Tariff:

It should be noted that out of 206 households, 182 households were willing to connect to individual connection and willing to pay some amount of money towards advance payment and monthly tariff. The remaining 24 households who did not want to connect to individual connection cited various other reasons such as income, uncertainty over the implementation of the programme, etc as the reasons for their decision.

Table-2: Willingness to Connect to Individual Connections by Households with and without Individual Connections under the Existing Scheme

WTP for the Individual Connections	No. of House-holds with Individual Connections	No. of House-holds without Individual Connection	Total
Yes	94	88	182 (88.34)
No	13	11	24 (11.65)
Total	**107**	**99**	**206 (100.00)**

Source: Primary data, Mandapam.

Out of the 182 sample households willing to connect to individual connections, 94 households (or nearly 52 per cent) have already connected to individual connections under the existing scheme and are willing to connect to individual connections under the Pillur scheme as well. It should be noted that approximately 88 per cent of the households with individual connection at present are willing to go in for individual connections under the Pillur scheme. As regards the households without individual connection at present, around 89 per cent of them are willing to go in for the same under the Pillur scheme (see Table-2).

Table-3: The Level of Willingness to Pay for Advance Payment and Monthly Water Tariff for the Individual Connections

	Advance	Monthly Tariff
No. of Cases	182	182
Mean	2368.13	32.19
Median	2000.00	25.00
Mode	3000.00	20.00
Std. Deviation	1346.00	18.40
Minimum	500.00	5.00
Maximum	6000.00	100.00
Range	5500.00	95.00

Source: Primary data, Mandapam.

The above table describes the descriptive statistics regarding the household WTP value for advance payment and monthly tariff. It should be noted that when the package consisting of both advance payment and monthly tariff was introduced to the households, they revealed their WTP for both the components separately. Also, the answers by individual households differed among different households, warranting separate assessment of WTP advance payment and monthly tariff for individual connections. In the following section, we model the household behaviour in which we will analyse the factors influencing the household WTP for different components of the individual connections.

Factors Influencing Household WTP Values

The factors influencing the household WTP for water can be classified as follows: (a) the socio-economic and demographic characteristics of the

households such as level of education of the household members, income of the households, possession of assets, etc; (b) the characteristics of the existing water supply sources as well as the expected water supply, etc; and (c) the households' attitude toward government's water supply policy (The World Bank Water Demand Research Team, 1993). In our analysis, we have selected the variables not only on the basis of the variables used in other developing country CV studies on water supply, but also on the basis of our observation in our study area. In the following section, we describe the model used to understand the influence of different factors on the willingness to pay value.

Describing the Economic Model for Willingness-To-Pay: The indirect utility function of the household's willingness to pay for water through different levels of service takes the following form:

$$V(Y_o - WTP, P_o, S_o, Q_1) = V(Y_o, P_o, S_o, Q_o) \qquad \text{Equation (i).}$$

Where, Y_o stands for the income of the household, P_o for the price of other marketed goods and services, S_o refers to other socio-economic variables of the households, Q_1 refers to the water from the new scheme (that is provided through a particular service) while Q_o refers to the situation prior to the new water supply.

The empirical model for the individual household's willingness to pay would take the following form:

$$WTP_{oi} = f(Q_{oi}, Q_{1i}, Y_{oi}, P_{oi}, S_{oi}) + zi \qquad \text{Equation (ii).}$$

Based on this model, the following statistical model has been used to analyse the impact of different factors on the WTP values.

Semi-Log Model: In our study, we have used the Semi-Log model which can be described as follows:

$$\text{Log } Y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_3 + \ldots\ldots + \beta_n x_n + z$$

where, Log Y stands for the logarithmic value of the dependent variable to be regressed against the set of independent variables; α stands for the constant that explains the unknown factors influencing the dependent variable; β is the coefficient; $x_1 \ldots x_n$ refers to the value of various socio-economic variables used in the model; and z stands for the error term. Substituting the parameters in the model with our variables, we get the following model.

Model 1: WTP for Advance Payment

Log $WTP_{ADV} = \alpha + \beta_1$ SEXR + β_2 EDMEM + β_3 CASTE + β_4 SZHHD + β_5 MILLWORK + β_6 ADULTEMP + β_7 INCOME + β_8 OWNWELL + β_9 ASSET + β_{10} RENTOUT + β_{11} OWNED + β_{12} WARDCODE + β_{13} RELIABLE + β_{14} QNTYSPECD.

Log WTP_{ADV} : Maximum WTP value for advance payment.

SEXR : Sex of the respondent (male – 1; female – 2).

EDMEM : Whether the household has a member with education more than secondary school level (yes –1; no–2).

CASTE : Caste of the respondent (lower caste –1; upper caste –2).

SZHHD : Size of the household (less than 4 – 1; more than 4 – 2).

MILLWORK : Whether the household has any of its household members working in the Cotton Mill (yes – 1; no – 2).

ADULTEMP : Number of adults employed (less than two – 1; more than two – 2).

INCOME : Monthly income of the household.

OWNWELL : Whether the household has installed its own bore-well (yes – 1; no – 2).

ASSET : Whether the household possesses liquid assets (yes –1; no – 2).

RENTOUT : Whether the respondent has rented out house to a tenant (yes – 1; no – 2).

OWNED : Whether the respondent is the owner of the house or renter (owner –1; renter – 2).

WARDCODE : Nature of the ward in which the household is located (rural ward –1; urban ward –2).

RELIABLE : Whether the respondent believes that Pillur water supply would be reliable (yes –1; no – 2).

QNTYSPECD : Level of quantity specified in the scenario (15 *kodams*[6] –1; 25 *kodams* –2).

Table-4: Regression Results for the WTP for Advance Payment

No. of Cases: 182	Dependent Variable: Log WTP_{ADV}	
Explanatory Variables	**Coefficient**	**t-Value**
CONSTANT	2.819*	6.539
SEXR	-4.36E-02	-1.210
EDMEM	3.996E-02	.546
CASTE	4.997E-02	1.241
SZHHD	5.615E-02	1.586
MILLWORK	-.229*	-5.880
ADULTEMP	-.154*	-2.980
INCOME	.381*	3.543
OWNWELL	-2.90E-02	-.087
ASSET	-.193*	-3.615
RENTOUT	2.786E-02	.539
OWNED	-.137*	-2.786
WARDCODE	9.698E-02*	2.582
RELIABLE	-.111*	-3.069
QNTYSPECD	5.039E-02	1.539
R^2 Value	.522	
Adjusted R^2 Value	.481	

* Significant at 1 per cent error level.

Regression results– model for advance payment: This section discusses about the nature and magnitude of the influence of the various explanatory variables included in the model on the WTP for advance payment. It is found that 7 out of 13 variables included in the model influence the WTP value significantly (Table- 4). The remaining variables, although not statistically significant, give us the expected sign.

Usually, women are supposed to experience a greater burden in collecting water than men, and therefore, the WTP value by women is expected to be greater than that of men (The World Bank Water Demand Research Team, 1993). However, the negative sign of the variable SEXR in the regression analysis suggests that the women are willing to pay less than the men but the influence of this variable on WTP value is statistically not significant. This implies that both men and women are willing to pay more or less the same amount towards advance. Another way of interpreting this low level of significance is that the men and women in

the household do share their responsibility over the allocation of available financial resources within the household and the decision to pay advance might have been arrived at on the basis of mutual negotiation and exchange of information between men and women.

One of the factors supposed to play a dominant role in influencing - usually positively - the WTP value is the level of education (EDMEM) of the household members. We have assumed that if the household has any of its members with more than secondary level education, the WTP by that household is expected to be greater than that of those households with members having less than secondary level education. This is because households with higher educated members are supposed to have relatively higher level of knowledge about the benefits of improved water supply services, quality of water to be supplied, etc, and therefore, their WTP value would be greater than other households. Even though the level of education of the household members does positively influence the WTP value, in our case, it does not significantly affect the WTP value. The implication is that since all the households are aware of the Pillur water supply scheme and its components, it is the knowledge about the scheme rather than the level of education that matters here.

In the study area, there are a considerable number of households belonging to lower caste group –mainly Scheduled Castes and Scheduled Tribes. Since the water supply authorities in this town were of the opinion that the lower caste households will not be willing to pay more, we wanted to know the role of the caste factor in influencing the WTP value. Even though the variable CASTE has a positive sign, suggesting that the upper caste households are willing to pay more than the lower caste households, the influence of this variable is insignificant, implying that there is not much difference between the WTP values provided by the lower caste households and those by the upper caste households.

Usually, the size of the household (SZHHD) is expected to have a positive relationship with the WTP value. This is because, more the household members the greater water requirement, and therefore, the WTP value of these households would be greater than the households with smaller size. However, the size of the household does not have any significant influence on the WTP value. Even though this may be attributed to reasons such as low level of household income, etc, the main reason may be that households with more members will be able to collect adequate water from different sources because of the availability of labour in the households. Since the additional requirement of water from the new scheme is less for these households, the WTP value is also less.

The number of adult members in a household (ADULTEMP) having employment is significantly but negatively affects the WTP value. It means that households with more than two adults having employment are willing to pay *less* than those having 2 or less than 2 adults employed. One can expect that households with more adults employed will have higher

household income and therefore, higher will be its WTP value. However, the sign of the variable ADULTEMP suggests differently. One of the reasons why there exists a negative relationship between the number of adults employed and the WTP value is that even though there may be more adults employed in a household, the income of the household may not be sufficient because of the nature of the employment. It was noticed that many of the households in this particular town, except the mill workers, are engaged in those activities whose wages are relatively less or which do not provide constant employment. More precisely, the employment to many of the households comes mainly from the informal sectors such as agriculture, where relatively low wage and uncertainty over availability of employment especially during off-seasons are observed. To compensate the low level of income at the household level, the household has to employ more adults but the total income of the household is still less due to low wage and uncertain employment. This vicious circle explains why, even if more adults are employed, the income at the household level is less.

Another factor which significantly influences the WTP value is whether the household has got any of its members employed in the cotton mill located in the town (MILLWORK). This is because many of the workers in the cotton mill have reached an agreement with the mill management that the management would pay the advance amount of those workers willing to connect to individual connections and would deduct a particular amount from the salary of the workers every month.[7] Though the level of advance payment and the amount to be deducted had not yet been decided by the workers of the mill, the arrangement with the mill management considerably reduces their initial burden of paying the advance. This simply suggests that if the instalment system of paying the advance is available to the households, then the households would be willing to pay more.

We expected that the households with more income would be willing to pay more than those with relatively less income. It is found that, as expected, the income of the households (INCOME) positively and significantly influences the WTP value. More precisely, the households with low levels of monthly income are willing to pay less than those with relatively higher levels of monthly income.

In the case of households with and without own bore-wells, it was expected that the households with own bore-wells would be willing to pay less than the households without own bore-wells. This is because those households with own bore-wells had already made considerable investment (on an average Rs. 6,000 per household) on installing the bore-wells. The additional advance payment to the individual connections under the Pillur scheme would be an extra financial burden to these households, and therefore, their WTP will be less compared to other households. However, the sign of the variable OWNWELL suggests that the households with own bore-wells are willing to pay more than those

households with the individual connections – even though the influence is not significant. This may be because even if these households have installed their own bore-wells, the water from these bore-wells is considered to be of low quality and, therefore, the desire to have Pillur water influences their WTP. Moreover, almost all the households with own bore-wells belong to higher income category which has the ability to pay.

Another interesting aspect to be noted here is that the variable OWNED significantly but negatively influences the WTP value. This implies that the rented households would be willing to pay less than those households which are staying in their own houses. The rented households stipulated that they are willing to pay an advance to the house owner but the latter should deduct a portion of it every month from the rent. It is to be noted here that the rented households are willing to share the advance payment with the owners rather than paying the entire amount. Some of the rented households pointed out that in the town the house owners do not demand any deposit while renting the house, whereas the deposit is a prerequisite in other parts of Coimbatore town. This being the case, these rented households stated that they are ready to pay some amount of deposit in case the house owner is willing to install an individual connection in the house. However, some of the rented households said that they would not stay in the rented houses for very long and they have to recover the advance money from the owner while leaving the house. They also pointed out that recovering the money from the owners is sometimes difficult and, therefore, paying a considerable amount of advance is not possible. This kind of uncertainty influences the rented households against paying the entire advance. Another way of interpreting the result is that some of the rented households might have tried to 'free-ride'. Because, as long as the owner of the house is supposed to pay the advance the rented households may have the tendency to understate their WTP value. Another possible reason why the households staying in their own houses are willing to pay more is that these households have to bear the entire advance since they cannot share it with anybody else.

Another factor that influences the WTP value for advance payment is possession of liquid assets (ASSET) such as gold, silver, bronze, and cattle by the households. Those households which own the liquid assets are willing to pay more than the households without these assets. Since these liquid assets can either be mortgaged or be sold to meet the bulk financial requirements, this variable has the power to influence the household decision.

It should be noted that the attitude of the households towards the expected supply of the Pillur water (RELIABLE) also significantly influences the WTP value. Households who believe that the water supply under the Pillur scheme would be reliable, i.e., continuous and adequate, are willing to pay more than those who believe that it would be unreliable.

The nature of ward (WARDCODE) also influences the WTP value significantly. Households living in those wards with rural characteristics are willing to pay less than households living in those wards with urban characteristics. This phenomenon may be attributed to the fact that households in urban areas are much more concerned about whether the neighbouring households are willing to connect to individual connections or not. Since the individual connections in these wards are considered to be 'status commodity', the WTP for advance payment is higher than that of households in the rural wards where, the majority are willing to collect water from the public taps.

The quantity levels specified (QNTYSPECD) to the households in the scenario influence the WTP value but with low level of significance. This may be because the marginal willingness to pay for additional water is small.

Model-2: WTP for Monthly Tariff

$$\text{Log WTP}_{\text{Tariff}} = \alpha + \beta_1 \text{SEXR} + \beta_2 \text{EDMEM} + \beta_3 \text{CASTE} + \beta_4 \text{MILLWORK} + \beta_6 \text{ADULTEMP} + \beta_7 \text{INCOME} + \beta_8 \text{INDCON} + \beta_9 \text{OWNWELL} + \beta_{10} \text{PCAVAIL} + \beta_{11} \text{FREQINC} + \beta_{12} \text{QLTYEXSTS} + \beta_{13} \text{OWNED} + \beta_{14} \text{WARDCODE} + \beta_{15} \text{WATDEF} + \beta_{16} \text{QNTYSPECD}.$$

$\text{LogWTP}_{\text{Tariff}}$: Maximum WTP value for monthly water tariff.

SEXR : Sex of the respondent (male – 1; female — 2).

EDMEM : Whether the household has a member with education more than secondary school level (yes —1; no—2).

CASTE : Caste of the respondent (lower caste –1; upper caste – 2).

MILLWORK : Whether the household has got any of the household members working in the cotton mill (yes – 1; no – 2).

ADULTEMP : Number of adults employed (less than two –1; more than two — 2).

INCOME : Monthly income of the household.

INDCON : Whether the household already has individual connection under the existing scheme or not (yes –1; no —2).

OWNWELL : Whether the household has installed its own bore-well or not (yes –1; no – 2).

PCAVAIL : Per capita availability of water at present.

FREQINC : Frequency of water supplied from the existing sources of public supply (if less than two days –1; if more than 2 two days — 2).

QLTYEXSTS : Quality of drinking water from the existing source (satisfactory–1; not satisfactory —2).

OWNED : Whether the respondent is owner of the household or tenant (owner —1; tenant —2).

WARDCODE : Nature of the ward in which the household is located (rural ward –1; urban ward – 2).

WATDEF : Whether the respondent believes that the Pillur water supply would be effected within six months (yes –1; no – 2).

QNTYSPECD : Level of quantity of water specified in the scenario – (15 *kodams*–1; 25 *kodams*—2).

Table -5: Regression Results for the WTP for Monthly Tariff

No. of Cases: 182	**Dependent Variable: Log WTP_{Tariff}**	
Explanatory Variables	**Coefficient**	**t-Value**
CONSTANT	-.224	-.471
SEXR	-2.12E-02	-.538
EDMEM	.228*	2.885
CASTE	7.878-02***	1.847
MILLWORK	-8.27E-02**	-2.060
ADULTEMP	-9.83E-02***	-1.840
INCOME	.482*	4.218
INDCON	.113	1.484
OWNWELL	-6.39E-02	-.842
PCAVAIL	-2.16E-02	-1.016
FREQEXST	.111*	2.456
QLTYEXSTS	8.190E-02**	2.288
OWNED	-8.45E-02	-1.637
WARDCODE	3.105E-02	.795
WATDEF	-.106*	-2.689
QNTYSPECD	1.67E-02	.048
R^2 Value	.333	
Adjusted R^2 Value	.273	

* Significant at 1 per cent error level.
** Significant at 5 per cent error level.
*** Significant at 10 per cent error level.

Regression Results - Model for Monthly Tariff: As can be seen from the model, some of the variables are different from those used in the advance payment model. After several runs of the model with different combinations of the set of explanatory variables, we found that some of them were more relevant. It is to be noted that the effect of some of the variables included in the monthly tariff model is somewhat different from that of the advance payment model. For instance, the variable EDMEM which had no influence on advance payment is significantly influencing the WTP for monthly tariff (Table-5). This suggests that the households with higher educated members are willing to pay more than those without higher educated members. This may be because households with higher educated members must be more concerned with the improved benefits of Pillur water supply and thus relating these benefits to the monthly tariff rather than the advance payment.

Similarly, the caste factor (CASTE), which did not have any significant impact on the WTP value for advance payment, is affecting the WTP value for the monthly tariff significantly. One of the reasons may be that lower-caste households are concerned more with the monthly payment which occurs as a flow than with the one-time advance payment. Also, lower-caste households which are engaged primarily in non-formal sectors, may not get constant flow of income, and this has a bearing on the WTP value of monthly tariff. It is interesting to note that in the case of monthly tariff also the sex of the respondent has no influence on the WTP value. As in the case of advance payment, households with a member employed in the cotton mill are willing to pay more than the other households. This suggests that permanent employment which generates constant flow of income, does influence the WTP value for the monthly tariff.

The number of adults employed (ADULTEMP) has a negative influence on the WTP value. Households with more adults employed, as we have already seen, may not get permanent income, and the uncertainty over income does affect the WTP value negatively. This is evident from the sign and significance of another variable INCOME which suggests that households with higher monthly income are willing to pay more than those with lower income. Hence, income plays a major role in influencing the WTP for both advance payment as well as monthly tariff.

In the case of monthly tariff, the positive sign of the INDCON suggests that households with individual connections at present are willing to pay less than the others. This is because many of the households with an individual connection at present are not only willing to connect to new individual connections under the Pillur scheme but also want to retain the existing connections because of their skepticism over the sustainability of the new scheme. In this case, the households have to pay monthly tariff for both the connections. Since the monthly tariff for the existing

connection is constant (i.e. Rs. 20 per month), the households might have stated a lower WTP for new connection so that the total tariff for both connections paid can be brought within the affordable limit.

Another aspect to be noted is that the households who have installed their own bore-wells are expected to pay less monthly tariff than the others. This is because the monthly electricity bill for lifting water from the bore-wells (through electric motors) comes to around Rs.125 per month, in addition to which the households will have to pay monthly tariff for individual connections under the Pillur scheme. However, the sign of the variable OWNWELL suggests that households with their own bore-wells are willing to pay more than the others. This may be because these households may be belonging to a higher income group, which can afford to pay both the electricity bill and the monthly tariff for the individual connections. The alternative interpretation is that households with their own bore-wells might find the monthly tariff for the individual connections relatively cheap compared with the monthly electricity bill paid at present. Once the individual connection is installed there will be no need for running the electric motor and, therefore, the household need not have to pay the present level of electricity bill. In this sense, the household would gain by way of paying only the monthly tariff for water from individual connections.

The per capita availability of water at present is expected to influence WTP value negatively. This is because households with low per capita availability would be willing to pay more than those with relatively high per capita availability at present. As expected, the sign of the variable PCAVAIL is negative, suggesting that the present level of availability of water plays a role in influencing the WTP value. The frequency of water supply from the existing public source is supposed to influence the WTP value positively. More precisely, households that are getting water supply (either from the public taps or from the individual connections) at a frequency of less than two days (or more frequently) would be willing to pay less than households which get water at a frequency of more than two days (or less frequently). Our result suggests that the frequency of water supply (FREQINC) at present does positively and significantly influence the WTP value, implying that households getting water supply at a frequency of more than two days are willing to pay more than those who get water at a frequency of less than two days. The quality of water, especially that which is used for drinking and cooking purposes, from the existing sources also influences the WTP value. Those households who are not satisfied with the quality of water from the existing sources are willing to pay more than those who stated that they are satisfied with the quality of water from existing sources.

As in the case of WTP for advance payment, households staying in their own houses are willing to pay higher monthly tariff than the

rented households. In many cases, as we have seen in the case of advance payment, the rented households are actually willing to 'share' the monthly tariff with the owners of the households rather than paying the full amount. This is one of the reasons why rented households are willing to pay less than owner households. As in the case of advance payment, the rented households may be trying to free ride by way of stating a lower level of WTP value.

The nature of the ward does not have any influence on the WTP value though it affects it positively. This implies that households living in the urban wards are willing to pay more than those living in the rural wards. One of the reasons may be that the households living in the rural wards have access to nearby agricultural bore-wells that are providing relatively good quality water. So, the availability of substitutes may be influencing the WTP value. The uncertainty factor over the implementation of the Pillur scheme also affects the WTP value significantly. Households who believe that the Pillur water would be supplied in a six-month time period are willing to pay more than the others who are uncertain about the Pillur water supply. Again, the quantity levels specified do not have any significant influence on the WTP value though the sign of the variable QNTYSPECD suggests that the households are willing to pay more for higher quantity.

WTP for Public Taps

Apart from individual connections, we also wanted to know whether the households are willing to pay for the water supplied through public taps, though the water supply authorities had no intention of charging for public taps. Every household in the sample group was asked also to state its WTP for water through public taps. It should be noted that out of all the 206 households, 141 households are willing to pay for public taps while the remaining 65 households either refused to pay or refused to collect water from public taps. To our surprise, we found that, on an average, households are willing to pay a monthly tariff of approximately Rs 13 for the public taps. The following table describes various descriptive statistics of the household WTP value for public taps.

Table-6: Level of WTP Values for Water from the Public Taps

No. of Cases	Mean	Median	Mode	Std. Dev.	Range	Mini-mum	Maxi-mum
141	12.86	10.00	10.00	8.18	48	2	50

Source: Primary data, Mandapam.

Model-3: WTP for Public Taps[8]

Log $WTP_{Pubt} = \alpha + \beta_1$ SEXR + β_2 EDMEM + β_3 CASTE + β_4 INCOME + β_5 OWNED + β_6 PCAVAIL + β_7 FREQPPT + β_8 PREFPT+ β_9 GOVT + β_{10} WARDCODE + β_{11} QNTYREQD + β_{12} QNTYSPECD[45].

SEXR : Sex of the respondent (male –1; female —2).

EDMEM : Whether the household has a member with education more than secondary school level (yes—1; no—2).

COLW : Whether the respondent has the habit of collecting water from the public taps (yes –1; no —2).

CASTE : Caste of the respondent (lower caste – 1; upper caste — 2).

INCOME : Monthly income of the household.

OWNED : Whether the house is owned or rented (owned—1; rented–-2).

PCAVAIL : Per capita availability of water at present.

FREQPPT : Frequency of water supply from the public taps at present (less than two days –1; more than two days –2).

PREFPT : Whether the household would continue to collect water from the public tap in future (yes—1; no —2).

GOVT : Whether the respondent feels that the government should be responsible for providing water through public taps (yes–1; no —2).

WARDCODE : Nature of the ward in which the household is located (rural ward –1; urban ward – 2).

QNTYREQD : Level of quantity required by the household.

QNTYSPECD : Level of quantity of water specified in the scenario (15 *kodams* –1; 25 *kodams* –-2).

Table -7: Regression Results for the WTP for Public Taps

No. of Cases: 141 Dependent Variable: Log WTP_{Pubt}		
Independent Variables	**Coefficient**	**t-Value**
CONSTANT	.542	1.223
SEXR	-.277*	-5.365
EDMEM	.151	1.451
CASTE	.102**	2.184
INCOME	9.635E-02	.812
OWNED	-9.54E-02	-1.572
PCAVAIL	2.953E-02	1.353
FREQPPT	-3.89E-02	-1.398
PREFPT	.165**	2.165
GOVT	-7.27E-02	-.154
WARDCODE	-5.72E-02	-1.210
QNTYREQD	.138*	2.221
QNTYSPECD	.171*	4.085
R^2 Value	.370	
Adjusted R^2 Value	.311	

* Significance at 1 per cent error level.
** Significance at 5 per cent error level.
*** Significance at 10 per cent error level.

Regression Results –- Model for Public Taps: It is evident from the above table that in the case of WTP for public taps, only a few variables are playing a significant role in influencing the WTP value. Nevertheless, the sex of the respondent is found to be influential on the WTP value unlike the other two previous models. More precisely, men are willing to pay more for public taps than women. This may be because it is mainly women who collect water from the public tap during which they experience problems such as waiting in the queue, fighting with other households, etc. The women might have taken into account all these problems and based these aspects on the WTP value. Therefore, they are willing to pay less than men. The other variable that is significantly influencing the WTP value is households' preference to collect water from

public taps continuously in future. Households that are willing to collect water from the public taps for a longer time in future are willing to pay more than those that prefer public taps only temporarily. The quantity required by the households influences the WTP value positively and significantly. Households that need more water are willing to pay more than those requiring less water. Households belonging to the upper caste are willing to pay more than those belonging to the lower caste. Another variable that has a significant positive impact on the WTP value is the quantity of water specified to the households.[9]

As can be seen from Table -7, many variables in the model do not influence the WTP value significantly, but possess the expected sign. Such variables are existence of higher educated members in the households, income of the households and the per capita availability of water at present. In the case of public taps as well, households staying in their own houses are willing to pay more than rented households. A possible reason is that rented households may expect the owner to provide them with water supply within the premises of their houses and, therefore, show less interest in paying for public taps. The variable FREQPPT, referring to the frequency of supply from the existing public taps has negative sign, suggesting that the greater the distance between two supplies, the less the WTP value and vice versa. Another interesting aspect is that households who believe that the government is responsible for providing water through public taps are willing to pay more than those who think otherwise. These households may think that even though the government is responsible for providing public taps, the households have an equal responsibility of sharing the cost of such provision.

Discussion and Conclusion

It should be noted that the above analysis of household survey provides useful inputs for decision making in the case of proposed water supply projects. One of the major conclusions of our study may be that the efficiency, equity and sustainability of the water supply projects depend largely on the extent to which household preferences are taken into account in the water supply policy-making process, especially by the water supply authority at the local level. The present water supply policy is embedded mainly in the notion that if the revenue part of the project is taken care of properly by way of fixing an appropriate price for water, then the sustainability objective of the water supply schemes would be automatically ensured. However, even in those cases where 'financial scarcity' is not a major issue thanks to international donors, water supply programmes tend to fail because the preferences of the actual users do not get reflected in policy-making. The underlying cause for this phenomenon emanates from the 'mismatch' between what users actually expect from the water supply authority and what the water supply authority

want to achieve. Our study results provide some useful input which, if incorporated into policy-making, would make the proposed water supply scheme more sustainable. For example, we found that only 32 (or 17.8 per cent) households were willing to apply for individual connections for the proposed advance payment of Rs.4,000. We also found that the average willingness to pay advance stands approximately at Rs.2,400, which means that if the advance payment is reduced to this level, an additional 150 (or 82 per cent) households (out of 182 'willing' households) would go in for individual connections. Similarly, what level of service to be provided to which section of the households; what is the level of monthly tariff that would result in maximum benefit to the households, which section should be charged and which section needs to be subsidised, what is the quantity of water that should be provided to the households; what is meant by reliable supply from the users' point of view and how this can be met by the water supply authorities; etc are some of the useful policy questions that the water supply authority can consider. It should be noted that the provision of drinking water to households should not be seen merely as a revenue generating activity. Rather, it is a social welfare measure and as such should aim at maximizing the welfare of the individuals. Though the insights provided by our results may not be completely transferred to another project in an other region we have found that some of the variables found to play a role in household decision in our study area are similar to the ones that play a role in other parts of the world. This means that the benefit transfer method may not be completely irrelevant but offers scope for using conclusions of studies in one region to formulate water supply policies in some other region. However, further research would need to be carried out on this particular aspect before any definite conclusion can be drawn.

Notes

1 $1 = Rs.36 at the time of 1997.

2 The major objective of the CV study conducted was to test the 'validity' of the CV results obtained in a developing country context. More precisely, the CV study looked into the 'content validity' and 'theoretical validity' of the WTP results elicited from the households in the study area. A detailed description about the CV methodology used in our study is available in Venkatachalam (2000).

3 The items (i) and (ii) are not our major concern here and therefore, we do not give priority to these two items in this paper.

4 It should be noted that various components of the Pillur scheme are not independent of each other but are already in the package. The households were familiar with the package and therefore, were asked to take it entirely into account while answering the CV questions. But the analysis of the WTP data was conducted independently for each component in the package.

5 Though the open-ended method is criticized for various reasons, we have used the open-ended method for specific reasons: Since almost all the households were aware of the proposed advance payment and the monthly tariff for individual connection under the Pillur scheme, we expected the households not to experience any difficulty in answering our open-ended WTP questions. This is because their WTP answers might have been made easy by already existing advance and monthly tariff rates. This is also based on the consensus in the literature that the open-ended method performs well in the case of use values with which the respondents are familiar (see, Mitchell and Carson, 1989). However, the disadvantage of using the open-ended method is that the households might behave strategically by 'understating their true willingness to pay'. To understand whether the strategic bias has occurred or not, the final results were involved for testing for strategic biases and we concluded that either the strategic bias did not occur in our results or the bias was negligible (see Venkatachalam, 2000).

6 *Kodam* is a plastic vessel, used by the households to both fetch and store water. The average capacity of a *kodam* is 12 litres.

7 But this does not mean that these households have agreed to pay the entire amount of Rs.4,000.

8 It should be noted that the number of variables used as well as the nature of variables used in the public taps model are different from that of the individual connection model. This is because, after several runs of regression, we found that many of the variables included in the individual connection model did not perform well in the public taps model and some of the variables not performing well in the individual connection model did perform well in the public taps model. Hence, omissions and commissions of variables in the public taps model.

9 Since this variable has been included to test the scope effect, we would discuss this aspect in detail in the following section.

References

Griffin, Charles C., John Briscoe, Bhanwar Singh, Radhika Ramasubban, and Ramesh Bhatia (1995). Contingent Valuation and Actual Behavior: Predicting Connections to New Water Systems in the State of Kerala, India. *The World Bank Economic Review,* 9 (3): 373-395.

McPhail, Alexander A. (1994). Why Don't Households Connect to the Piped Water System? Observations from Tunis, Tunisia. *Land Economics,* 70 (2): 189-196.

Mitchell, Robert Cameron and Richard T. Carson (1989). Using Surveys to Value Public Goods: The Contingent Valuation Method. Washington, D. C: Resource for the Future.

Rogers, Peter, Radhika de Silva and Ramesh Bhatia (2002). Water Is an Economic Good: How to Use Prices to Promote Equity, Efficiency, and Sustainability. *Water Policy,* 4 (1): 1-17.

Singh, Bhanwar, Radhika Ramasubban, Ramesh Bhatia, John Briscoe and Charless Griffin (1993). Emerging from a Low-Level Equilibrium Trap: Willingness to Pay for Water in Kerala, India. *Water Resources Research,* 29 (7): 1031-43.

The World Bank Water Demand Research Team (1993). The Demand for Water in Rural Areas: Determinants and Policy Implications. *The World Bank Research Observer,* 8 (1): 49-70.

Venkatachalam, L. (2000). Economic Valuation of Water Used in the Household Sector: A Contingent Valuation Approach in a Developing Country Context. Unpublished Ph.D Thesis submitted to University of Madras, Chennai.

Whittington, Dale., John Briscoe, Xinming Mu and W. Barron (1990). Estimating the Willingness to Pay for Water Services in Developing Countries: A Case Study of the Contingent Valuation in Southern Haiti. *Economic Development and Cultural Change,* 38 (2): 293-312.