A willingness to pay survey for improved water supply conditions in Taxiarchis municipal district of Halkidiki prefecture, Greece

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Abstract

Water supply in rural and urban areas is an issue of prime concern, especially in developing countries. The present study aims at determining consumers' willingness to pay (WTP) more for improvements of water supply conditions, identifying the factors affecting WTP and describing their impact on WTP more for improved supply conditions through logistic regression analysis. It was hypothesized that consumer satisfaction about water supply service, their beliefs in the water management system and affordability might influence WTP more for water. Accordingly, a contingent valuation study was planned in the Taxiarchis municipal district of Halkidiki prefecture in North Greece. Also, the analysis of percentage increase in WTP is presented in the last part of the paper.

Résumé

La fourniture de l'eau dans les zones rurales et urbaines est une question très inquiétante, surtout dans les pays en voie de développement. Cette étude a pour objectif de déterminer le consentement du consommateur à payer plus pour l'amélioration des conditions d'approvisionnement de l'eau, en identifiant les facteurs qui influent sur ce comportement, à travers une analyse de régression logistique. On a assumé l'hypothèse que la satisfaction des consommateurs concernant le service de fourniture de l'eau, leur confiance dans le système d'aménagement de l'eau et l'abordabilité du prix pourraient influencer le consentement à payer davantage pour l'eau. Par conséquent, une étude d'évaluation contingente a été planifiée dans le district municipal de Taxiarchis de la province de Halkidiki, dans le nord de la Grèce. En même temps, l'analyse du pourcentage d'accroissement du CAP est présentée dans la dernière partie de ce travail.

1. Introduction

Many of the world natural resources lie in developing countries. It is ironic that relatively few economic valuations of such resources have been done in these parts of the world (Hadker et al., 1997). The ability to put a value on natural resources like recreation, national parks, water, etc. is a difficult task; especially valuing water, which is the most crucial component of human life often leads to controversies. In developing countries, large financial inputs and human resources are devoted to improve water supply in rural and urban settlements. Many of these projects have been successful, but many have failed to meet the needs of the intended beneficiaries (Singh et al., 1993). Moreover, the existing systems are poorly maintained because of financial constraints. To overcome this obstacle, it is imperative to devise innovative financial arrangements, not only to meet the future demand, but also to maintain the quality of service. Since the major source of revenue generation is water users, it is essential to know whether people at different settings are ready to financially support the system for improving and maintaining the quality of the service (Winpenny, 1994). In other words, whether the cost of such systems and their sustainability can be gauged in view of the consumer willingness to pay (WTP) more for the service.

Mirroring the literature on environmental economics and in particular WTP, two fundamental approaches are used to analyze such issues. The indirect approach involves observing consumers' behavior and modelling of behavior based on the approximate expenditure in terms of time and money to obtain the goods or services and infer about WTP. The direct approach, also referred to as "Contingent Valuation Method" (CVM), involves surveying through a structured questionnaire of consumers' WTP specified prices for hypothetical services. This method has been extensively reviewed (Mitchell and Carson, 1989; Bateman and Turner, 1995) and despite criticism is still used in several resource valuation studies (Lockwood et al., 1994; Smith, 1977; Sutherland and Walsh, 1985). The CVM-derived values such as WTP are contingent upon the levels of information the respondent brings to the survey and the extent of information provided by the survey (Pate and Loomis, 1997). The method has major advantages over the indirect method in that it can value services that are normally difficult to assess with the indirect method. It can conveniently assess WTP for hypothetical improvements in the quality of service. There are studies reported on WTP for water in some developing countries (Altaf et al., 1993; Brown, 1997; Griffin et al., 1995). The studies successfully implemented CVM to assess WTP for the improved supply conditions and appropriateness of government policies on water supply. But despite advantages, its application results in some biases in the study. For instance, respondents may express a positive WTP because they feel good about the act of giving for social service, although they protest some aspect(s) of the service and believe that paying for it is a waste. Alternatively, some respondents value the service but state their non-WTP for the

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same reason. The bias could be also due to respondents taking questions lightly and quoting unrealistically high in anticipation that they will not have to pay for the service. Conversely, responses may be unrealistically low if they believe that they have to pay. Further, in many studies, respondents are prompted by suggesting a starting bid and then increasing or decreasing the bid based upon whether the respondent agreed or refused to pay the sum. It has been shown that the choice of starting bid affects respondents' final WTP response. Another kind of bias may be the information bias that arises whenever respondents are forced to value the service about which they have little knowledge. In such a case, the amount and type of information presented to respondents may affect their answers. Since the present study also makes use of CVM, efforts were made to handle these biases carefully.

The primary objective of this study was to determine the factors (variables) and their influence on consumer WTP more for improved water supply conditions. The factors identified were consumers' satisfaction about water supply service, their beliefs in the system and affordability towards increased water rates. Then, the logistic regression analysis has been carried out using the above three factors as independent variables and WTP as dependent variable. The analysis leads to the probability of consumers' WTP more for water and also reveals the influence of each factor on WTP. The percentage increase in WTP amounts in addition to the existing bill amounts have also been estimated at the end.

2. Methods

The goal of any CVM is to value the change in the level of service by minimizing biases. In this study, consumers were provided with sufficient details about the existing and proposed water supply scheme as well as the future production cost of water. Their responses about WTP more for the improved water supply service were sought using an interviewer-assisted survey instrument.

2.1 The survey instrument

The survey instrument/interview schedule comprises three different sections. The first section contained the "personal profile" of the respondent and included questions relating to education, occupation, and income level. The second section included questions about the type of water supply and supply conditions in the respondent's property area. The type of supply refers to whether users in the property are getting water directly from the distribution system or whether they are storing water in a suction tank and then using it for their daily needs. For the supply condition a five-point scale ranging was used from not at all satisfied, not satisfied, partially satisfied, satisfied and highly satisfied was used to get the opinion of respondents on each of these factors. The last section included questions relating to per-month bill amount and the respondent's WTP more for improvements. The respondent was offered an initial bid amount, equal to the future production cost of water per cubic meter, and was asked whether he/she would be WTP water bills as per this rate in future. The response was obtained on dichotomous (yes or no) scale (Johnson, 1986). For a negative response, an open-ended question was asked, whether the respondent would be WTP partially more in addition to the existing bill amount. If yes, how much? The respondent who agreed to pay even partially more than the existing bill amount was considered as WTP for improvements, while the one who refused to pay more than the existing amount was considered as not WTP. Also, the opinion of the respondent about "belief" in the water supply management and "affordability" towards increased water charges was sought on a dichotomous scale. Also, it must be pointed out that these factors were finalised after interacting with users during the pilot study. The factors were also of interest to municipal authorities to make decisions relating to water supply management.

2.2 The model

The model uses variables LOS, belief and affordability to describe consumers' WTP more for water. Because of the dichotomous structure of the dependent variable, i.e. WTP more, a non-linear probabilistic model has been used for estimation. The most widely used model in contingent valuation studies is based on logistic regression analysis. The model helps in estimating the probability of occurrence of an event and is given by (Siardos, 2000):

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$$\text{Probability (event)} = 1/1+e^{-Z} \quad (1)$$

Where Z is the linear combination of variables $X_1, X_2, \ldots, X_p$

$$Z = a + b1X1 + b2X2 + \cdots + bpXp \quad (2)$$

The above probability expression can be transformed to determine the log odds in favor of the event as

$$\log\left(\frac{\text{Prob(event)}}{1-\text{Prob(event)}}\right) = a + b_1X_1 + b_2X_2 + \cdots + b_pX_p \quad (3)$$

In the present context $Z = a + b_1(LOS) + b_2(\text{belief}) + b_3(\text{affordability})$.

The variable *LOS* was considered with a view that the satisfaction level might have a negative influence on WTP of the people. In other words, people with low satisfaction levels might indicate their WTP in anticipation that in future their demands would be fulfilled, while those who are already satisfied might not be WTP.

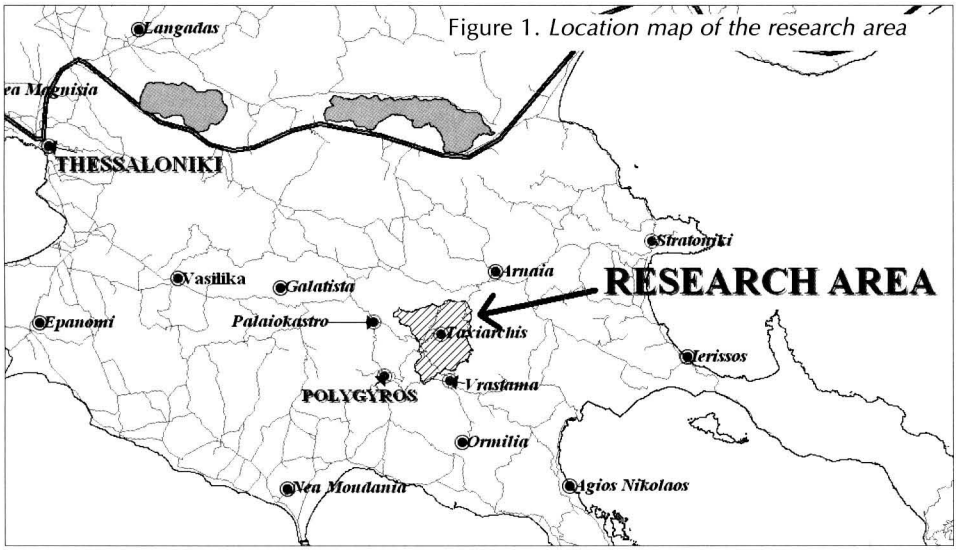
The variable *LOS* took a value between 1 and 5, which re-

flects the individual's aggregated impression or satisfaction about the water supply service. Besides this, the variable "belief in the system" was considered because lack of faith in the water supply management would restrain the user from paying more for improvements. The individual "affordability" was also considered as a relevant variable in the model because the increase in the water rates would increase the billing amount, which might be of concern to the people especially from the lower income group. Both these variables, i.e. "belief" and "affordability", were treated as dichotomous, each taking values either 1 or 0 for the corresponding yes or no reply of the respondent.

2.3 Case study

Taxiarchis, a mountainous village on mount Holomondas of Halkidiki prefecture in North Greece was selected as the research area (Figure 1). For this village, as well as for the wider area, water is of great importance because its shortage is of such an extent that it can not cover basic needs, despite the fact that the area is mountainous, forested, with a great average annual rain height. Moreover, the particular area, besides being mountainous with an intense relief as well as a dense vegetation cover, it is located in a forest of special property status. The forest belongs to the Aristotle University of Thessaloniki, a fact which made the research even more attractive as there were facilities for its accomplishment. The authorities in this area are putting forth efforts to improve the supply standards, but the way people perceive these efforts and whether they are financially ready to support the system was the matter of interest of this study.

Figure 1. *Location map of the research area*



Accordingly, a sample survey was planned in which only domestic users were targeted. The water supply charges for the residents range between 0,35 and 0,70 €/m^3.

An interviewer-assisted questionnaire, as discussed before, was pre-tested on a sample of approximately 50 individuals to determine whether they can respond to questions. People could conveniently respond to questions related to the existing water supply. As regards WTP, few respondents refused to pay more because of lack of faith in the management system. The impact of this factor was quantified by including the variable "belief" in the expression of WTP. Also, people were told that after the implementation of a new scheme, there would be a rise in water charge; hence, they should take the issue seriously and state their true WTP. As a result, some respondents indicated their WTP partially more than the existing amounts, while very few agreed to pay as per the future production cost of water, i.e. 1,4 €/m3. This reduced the chances of respondents stating unrealistically high WTP values. The starting bid bias due to varying initial bids was overcome in this study, as the same initial bid amount, i.e. 1,4 €/m3, was offered to each respondent. Further, attempts were made to reduce the bias in response due to lack of information or knowledge about future services to respondents. A brochure was prepared giving brief information about the existing and upcoming water supply scheme, its location and capacity, capital expenditure and the future production cost of water.

Interviewers were trained to convey this information to users in easy and comprehensible manner and make them aware of the forthcoming improvements in the system.

2.4 Sampling

The sampling method used was Simple Random Sampling. It is the simplest, most basically and commonly used and therefore the most important one. It has two features: the former refers to the fact that it presupposes less possible knowledge on population than any other method, while the latter refers to the fact that many other sampling methods use simple random sampling at a given stage or they are simple modifications of it (Matis, 1992).

In this particular sampling and in order to estimate the size of the sample we apply the formula (Matis, 1992):

$$n = \frac{Nt^2 s^2}{Ne^2 + t^2 s^2} \qquad (4)$$

Where:

n = the sample size,

t = the value of STUDENT-distribution for possibility (1-α) and n-1 degrees of freedom,

s^2 = evaluation of population variation from the sample data,

e = the maximum acceptable difference between the sample average and the unknown average of population in absolute values, and

N = the total size of population.

In our case, the above formula (4) for s^2=105,17, e=1, t=1,96 and *N*=496 (total number of households) gave the size of the sample in *n* = 217 households.

The sample households were selected randomly from the respective lists. The interviews were conducted by contacting the concerned person in these households. The data generated in this way was analyzed with results obtained as below.

3. Results

The analysis presented in this paper is based on 217 interviews and responses therefrom. Then, logistic regression model was used with *LOS*, belief and affordability as predictor variables. The analysis was carried out category-wise with regression coefficients obtained as shown in Table 1.

As it appears in Table 1, χ^2 value is quite significant, indicating the goodness-of-fit of model. Another measure of goodness-of-fit is the percentage correct classification (prediction accuracy) given by model, which is about 96%. This is also shown graphically through histogram in Figure 2.

Table 1. *Results of the logistic regression model*

Variable	B	SE (B)	Wald	df	Sig	exp(B)
LOS	-0,8101	0,4093	3,9174	1	0,0478	0,4387
Affordability	6,8043	0,7032	93,6213	1	0,0000	901,6947
Belief	2,9177	0,7566	14,8733	1	0,0001	18,5128

Model χ^2: 352,829 (P<0,001); percentage correct classification: 95,62%.

The figure shows frequency plot for the estimated probability of the event. If this probability is less than 0,5, then the event, i.e. WTP does not occur as indicated by 0's on the probability scale ranging from 0 to 0,5. For probability values higher than 0,5, the event is supposed to occur as indicated by 1 on the probability scale ranging from 0,5 to 1. The goodness-of-fit of the model lies in its classification ability. The more the cases for whom the event has occurred are to the right of 0,5, and those for whom the event has not occurred are to the left of 0,5, the better is the model. From Figure 2 it is evident that, the two groups cluster at their respective ends of the plots, giving a clear distinction between the groups.

Table 1 also gives regression coefficients along with the associated Wald's statistic. This statistic is the square of ratio of coefficient value to its standard error and follows a χ^2-distribution. The significance level of the Wald's statistic is shown by the column labeled Sig and shows the significance of difference of each regression coefficient from zero. The significance values are less than 0,05 (assumed significance level), implying that the variable sufficiently deviates from zero. The column labeled exp(B) gives the increase in the odds in favor of WTP more when the dichotomous variable changes from 0 to 1. As regards WTP more, there were very few respondents who agreed to pay as per the initial bid amount, i.e. 1,4 €/m³ of water. However, many of them were willing to pay partially more than what they are currently paying as evident from Table 2.

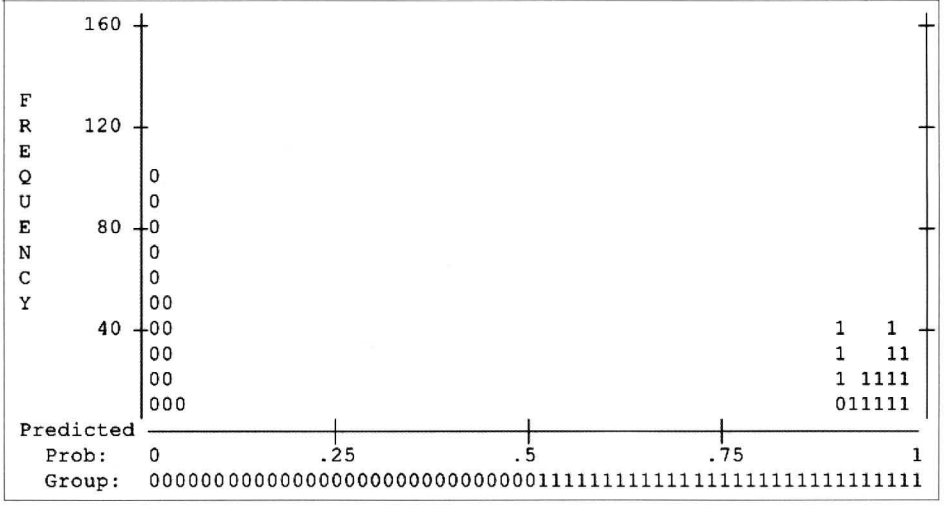
Table 2. *Percentage increase in WTP amounts*

Existing water charges (€/month)	No. of consumers	Percentage increase in WTP amounts
0 - 11,74	75	60,13
11,74 - 26,41	59	50,88
26,41 - 55,76	44	41,64
55,76 - 76,30	26	52,47
76,30 and more	13	47,03

4. Discussion

The first hypothesis to be tested was whether the satisfaction level of consumers affects their WTP more for water. The exp(B) value corresponding to each variable, as shown in Table 1, indicates the variable's contribution (Christensen, 1997) to the odds in favor of WTP. The values corresponding to LOS are so low that any change in the satisfaction level hardly makes an impact on the probability estimates of WTP. The negative sign of the regression coefficient implies that with the increase in LOS, the probability of WTP decreases. However, the change in the probability value due to change in LOS is insignificant, making it a weak indicator of individual's WTP more for water. As regards the variable "affordability", its effect on WTP is quite pronounced as reflected by a very high exp(B) value because most of the respondents stated their inability to pay more for water due to financial constraints. A change in the value of "affordability" from 0 to 1 increases the odds in favor of WTP nearly 900 times. However, "belief" or "faith"

Figure 2. *Histogram showing the estimated probability of WTP of consumers*



of these people in the management system as regards planning and execution of projects has relatively less influence on WTP as compared to the previous variable. The self-interests of the politicians, delays in project implementation, mis-utilization of funds are some of the primary causes for creating disbelief in the minds of these people. They realize the need for new water supply schemes to meet the growing demands but are not sure about the returns from the same and hence, despite being satisfied with the present services, are reluctant to pay more for water in future.

The data for individuals who showed their WTP more was analyzed and a frequency distribution table is created for the existing bill amounts, as shown in Table 2. Also, the table gives the average percentage increase in amounts corresponding to each class interval, which consumers are WTP over the existing bill amounts. As expected, with the increase in the existing bill amounts, the percentage increase above the existing amounts decreases. This decrease is indicated by a correlation coefficient of -0,5663. On average, people are ready to pay 51% more than what they are currently paying.

5. Conclusion

The objective of the study was to determine WTP more of consumers for water and the factors influencing WTP. The authorities were interested to know whether consumers are ready to accept the hikes in water charge in near future. Accordingly, a study was planned in a mountainous village on mount Holomondas of Halkidiki prefecture in North Greece. Nearly 50% of respondents were ready to pay partially more than their current bill amounts. Three important factors were identified and their impacts on WTP were studied with recourse to logistic regression analysis. The analysis revealed that the satisfaction level about the water supply does not influence the odds in favor of WTP, on the contrary with the variable "affordability" which significantly affects the odds. These people expressed their inability to pay more due to continuous increase in the price of other basic amenities like food, shelter and clothing; hence, they are not ready to accept the increase in water charge any more. However, this factor has a greater impact, comparatively with the variable "belief" which has less influence on WTP.

Thus, there are two important issues to be considered before increasing the water rates. Firstly, the affordability of the intended beneficiaries from projects concerning improved water supply conditions. A marginal increase in the water rates, that too step- wise, would perhaps be a right strategy for the management so as to get minimum resistance from these people. Secondly, the municipal body would have to exert more to restore faith amongst people, and the management must ensure transparency in project operations, utilization of funds so that people willingly pay more for improved service and its sustainability in the future. Finally, we must point out that the attitudes of consumers relating to WTP more for improvements require due consideration before revising the tariff structure.

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