Households Willingness to Pay for Improved Water Supply Services in Ibadan Metropolis of Oyo State, Nigeria

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Abstract: The study examines the factors that influence the willingness to pay for improved water supply services in Ibadan metropolis, Oyo State Nigeria. Data were collected using the multistage sampling technique from 102 households that are currently and not currently connect to the public water services. Data obtained from survey were analyzed using a logit model-based contingent valuation. Evidence from the logit model indicated that the mean willingness to pay of households for improved water supply is N1,080.80. The result also shows that price that households' is willing to pay for the service, age, educational level, time of water availability, household expenditure and perception of household on water provision are significant factors that influence the households' willingness to pay for improved water supply services and correlates in predictable ways with households willingness to pay for improved water supply services. The implication is that the households have certain socio-economic characteristics that influence their willingness-to-pay for improved water supply services and they can afford to pay the higher than the existing tariff if they are provided the improved water service.
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1. Introduction

Water is a source of life and a natural resource that sustains life and our environments. It is one of the precious gifts to mankind and most basic human needs, used for hydration, hygiene and sanitation. Water plays a great role in socio-economic development of human populations and also for human survival and economic development. Access to safe water supply has been one of the top priorities in developing countries over the past three to four decades, and billions of dollars have been invested in pursuit of the goal of "universal service" (Sumila *et.al*, 2005). The provision of adequate supply of potable water in urban areas in both developed and developing countries is essential for life.

The general consensus at the 2002 United Nations World Summit on Sustainable Development was that the current reality—as well as the situation expected in the near future is far from that goal (*The Economist* Sept. 7–13, 2002). Recent reports emphasize that the world "is facing a serious water crisis" and that water access and service delivery in the developing world need to be improved dramatically and urgently, especially if we are to make gains in the fight against poverty, hunger, and disease (United Nations 2003).

Shortcomings in the water supply service in large urban areas of developing countries are a critical problem affecting millions of people (WHO, *et al.*, (2000); New Delhi Declaration (1990); Dublin (1992). Almost half of the world's population live in urban areas, and most population growth are taking place in the developing world United Nations, (1995). It is currently estimated that 1.1 billion people in the world lack access to improved water supplies and 2.6 billion people lack adequate sanitation UNICEF *et al*., (2004).

The enormous volumes of water and extensive infrastructure required to fulfill urban water demand have frequently exceeded the ability of government to provide secure supplies, and have also created severe environmental problems (Munasinghe 1990, Hardoy, *et al.*, 1992, Serageldin 1994, Drakakis-Smith 2000). Governments in developing countries have often subsidized water supplies, typically in an attempt to achieve social and health benefits for the low-income households forming the large majority of the urban population (Lammerink, 1998; Whittington *et al*., 1998).

Access to improved water is a daily challenge for most Nigerian where only 60% of the population has access to improved water, and less than 50% of the rural households have access to good portable water (National Millennium Development Goals Report, 2005). FOS, (1999) shows that only half of the sources of water available for consumption in Nigeria can be categorized as safe. The present challenge of urban water supply are driven by rapid population growth, urbanization, budgetary constraints etc., while existing water supply projects suffer from poor funding or neglect in terms of Operations and Maintenance which has led

to epileptic services and resulting in new water supplies being sourced.

Ibadan city is the largest indigenous city in sub-saharan Africa and was among early beneficiaries cities in which Public water supply started in Nigeria in the twentieth century though at the lowest administrative level. Ibadan and its environs are presently supplied water by the state government through the Eleyele and Asejire water stations respectively and currently charge N1000 per Flat monthly for water supply service. The public sector monopoly in the provision of water has not been successful in meeting more than a small portion of the demand for water and sanitation of residential and commercial users. Services are in critically short supply. For example, out of the 85 million people living in urban and semi-urban areas, less than half have reasonable access to reliable water supply. Many households, often the poorest, end up purchasing water from private vendors much more expensively than from the public supply.

Water supply services (WSS), where they exist, are unreliable, and of low quality and are not sustainable because of difficulties in management, operation and pricing and failure to recover costs FGN,(2000). Many water supply systems show extensive deterioration and poor utilization of existing capacities, due to under-maintenance and lack of funds for operation. The shortcomings of the public sector to provide adequate and improved water supply to the populace and the desire of the citizenry for consistent and reliable water source, facilitated the need of this study to assess the willingness of consumers to pay for improved water supply services in the area of study. The working hypothesis is that household socio-economic characteristics will significantly affect the willingness to pay for improved water services.

2. Theoretical Concept

The concept of value measurement evolves from the neoclassical welfare economics. Though value does not have a universally accepted definition it is synonymous with the price of resources. This study adopted the definition of value by Mitchell and Carson, 1989 as the amount an agent/individual is willing to give up in exchange for the good out of the resources it controls. Willingness to pay generally refers to the economic value of a good to a person (or a household) under given conditions (ADB, 2007). The simple neoclassical microeconomic theory provides necessary elements to model the decision process of a household's choice of water supply source and this is based on the specification of the utility function (Fischer, (1996); Hanemann, (1991)).

However, willingness to pay (WTP) is the sum of real expenditures at market prices plus the value of consumer surplus above market prices that the household would have been willing to pay or the maximum amount consumers are prepared to pay for a good or service (ABD, 2007b). Different methods are used in the literature to estimate the value consumers place on public goods. These include the contingent valuation method (CV), the referendum technique and the payment card. The CV method is a survey technique based on economic theory, originally and most widely used in the area of environmental economics to estimate the public's WTP for improvements in environmental quality or values of a good that is not traded in the conventional market [Cummings, Brookshire, and Shulze (1986); Mitchell and Carson (1989); Whittington et.al (1988); (1989) and (1990)]. The CV method is a survey-based elicitation technique to estimate WTP.

The survey uses questions to elicit people's preferences for public goods by finding out what they would be willing to pay for specified improvements in them and the essence of this method is aimed at eliciting peoples WTP for a public good in order to circumvent the absence of market. The dichotomous approach is the most widely use in eliciting information about the respondents' WTP.

3. Material and Methods

Data collection and sampling technique

This study was carried out in Ibadan metropolis. Ibadan is the capital of Oyo State, the city is located between longitude 70 20' and 70 40' East and latitude 30 55' and 40 10' North of the equator. Ibadan area has a typical tropical climate with high humidity of about 81% and average annual rainfall of 1,121mm with relatively constant temperatures between 16 -35^{0}C throughout the course of the year. Ibadan has 5 local governments within the metropolis. The study used multi-stage sampling technique for selecting the representative households.

The first stage involved the purposive selection of two local government areas within the metropolis – Ibadan North and Ibadan South West that sourced their public water supply from the Asejire and Eleyele State Water Scheme. The second stage involved the random selection of 4 wards within the selected LGAs. The third stage involved the use of systematic sampling to obtain the required households. In this context, every sixth household was interviewed. A total number of 120 households were sampled using a well structured questionnaire, however, 102 questionnaires were retrieved. The information obtained was on the socio-economic characteristics and the willingness to pay for improved water.

The logit model based on the cumulative probability function was adopted to determine the mean willingness to pay for improved water supply by households and factors influencing households' willingness to pay because of its ability to deal with a dichotomous dependent variable. The logistic regression analysis is a uni/multivariate technique which allows for estimating the probability that an event will occur or not, through prediction of a binary dependent outcome from a set of independent variables Roopa, (2000). The approach for this study follows the model adopted by Yusuf et.al, (2007).

Household Willingness to Pay for Improved Water Supply:

Logit regression model was used to obtain the willingness to pay of the households for an improved water supply and the factors influencing the household willingness to pay. The coefficients estimates obtained were used to calculate the mean willingness to pay of the households. The Logit regression model is as specified below:

$$P_i = E\left(Y = {}^{1}/_{X_i}\right) = \frac{1}{1 + e^{-(\beta_0 + \beta i x i)}} \quad \ldots 1$$

Where *Pi* is a probability that *Yi* = 1 (WTP for improved water supply services)

Xi is a set of independent variables

Y is dependent variable (Responses of household to willingness to pay question which is either 1 if Yes or 0 if No)

$ß_0$ is the intercept which is constant

$ß_1$ is the coefficient of the price that the households are willing to pay for improved water supply.

The Mean willingness to pay for improved water supply by households was calculated using the formula adopted by Yusuf et.al given as:

$$Mean\ WTP = \frac{1}{|\beta_1|} * ln(1 + \exp \beta_0) \quad \ldots 2$$

$ß_0$ and $ß_1$ are absolute coefficient estimates from the logistic regression and the Mean WTP is the mean for the improved water supply by households.

Assessing Factors Influencing Willingness to Pay by Household:

To assess the factors influencing willingness to pay for improved water supply by households, the household responses to the WTP question which is 1 if yes and 0 if no will be regressed against the prices the households are WTP and other socioeconomic characteristics of the household. The regression logit model is specified as:

$$Y = \frac{1}{1 + exp^{-z}} \quad \ldots 3$$

Where Y = Responses of household to willingness to pay question which is either 1 if Yes and 0 if No

$$Z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots \ldots\ldots\ldots\ldots X_{10} \ldots\ldots 4$$

$_1$……, $_{10}$ = coefficients of the explanatory variables X_1,…, X_{10} which are defined in table 1.

Table 1: Description of variables included in the model

Explanatory variables	Description of the variables	Hypothesised relationship with the WTP for improved water supply
Age (X_1)	Age of the respondents in years	Negative
Education (X_2)	Educational level of the respondents (no of years spent in school)	Positive
Marital status(X_3)	Marital status (D=1 if married, 0 otherwise)	Negative
Household size(X_4)	Number of people in the household	Negative
Occupation (X_5)	Occupation of the respondents (D= 1 if formal, 0 otherwise)	Negative
Source of water (X_6)	Source of water used by the respondents (D = 1 if SWC, 0 otherwise)	Positive
Perception of the respondent towards the administration of the water utility (X_7)	Perception of respondents on who to provide water (D= 1 if government, 0 otherwise)	Negative
Time of water availability (X_8)	Supply pattern (D = 1 if supplied once in a week, 0 otherwise)	Positive
Price (X_9)	Price household WTP for improved water supply (₦)	Negative
Monthly expenditure (X_{10})	Household monthly expenditure (₦) of food and non food items.	Positive

Monthly expenditure was used as a proxy for income as people cannot spend more than what they earned and because people do not disclose the real value of their monthly income.

4. Results and Discussion

Mean Willingness to Pay: The mean WTP for improved water supply services was estimated to be ₦1,108.80. The logit regression was used to obtain the parameter estimates as specified in the methodology. The result of the logit regression is shown in table 2. The results obtained showed that

the mean WTP is positive and respondents' households are willing to pay more than existing water rate of ₦1000 per flat on a monthly basis charged by the state water corporation. The mean WTP results can be attributed to the fact the majority of the household surveyed are middle and low income earners. This result goes in line with the theory that higher household's income the more they are willing to pay for improved water service. Also majority interviewed were lining in a rented apartment and jointly pay for public utilities such as electricity and thereby makes the amount payable for such service relatively low and affordable.

Factors influencing households' willingness to pay: Logit regression analysis was use to determine the factors that influence the probability of respondents' willingness to pay for improved water supply services. The chi-square (LR-statistics) shows that the overall goodness of fit of the model was statistically significant at 1% level. The Pseudo R squared indicates that 60.9% of the variance was explained by the independent variables.

Table 2: Results of logit regression

Variables	Coefficients	T-value	P(Z/Z)
Constant	0.4494116	1.44	0.149
Price	-0.0004254	3.37	0.001***

*** Statistically significant at 1%, degree of freedom 1, log likelihood -37.723144, Chi-squared (LR statistics) 44.9

Table 3 shows the logit model result. From the table, respondent's age, education, frequency of supply, price, attitude of respondents on water provision and total monthly expenditure are the significant factors that influence respondents' willingness to pay for improved water supply services and are consistent with the a priori expectation. Other variables such as marital status, household size, primary occupation and source of water do not significantly influence the willingness to pay for improved water supply services. The coefficient of age is negatively related to the willingness to pay for improved water supply services and is statistically significant at 10% significance level, this implies that the likelihood of paying for improvement in water supply services decreases as respondents' age increases.

The coefficient of perception of respondents on who should provide public utility such as water is also significant at 5% and is negatively related to WTP for improved water supply services this shows that if government should provide adequate water supply services the likelihood of respondents to pay decreases. This further implies that the respondents consider water supply as a social good which is to be provided by the government. The frequency of supply of current water supply service is positively related to the WTP for improved water supply services and this reveals that the respondents will be more willing to pay if the frequency of current water supply service is improved.

Likelihood of respondents to pay for improved water supply service increases as the number of years of formal education increases. The respondents' expenditure which was used as a proxy for income relates positively with WTP for improvement in water supply services and this result confirms with economic theory, which states that an individual/household demand for a particular commodity depends on his/her income, and that income and quantity demanded are positively related, except in the case of inferior goods Bayrou, (2002), therefore an increase in respondents income will increase the likelihood of paying for improved water supply services.

Table 3: Determinants of Factors influencing Willingness to Pay for Improved Water Supply.

Variables	Coefficients	T-value	P(Z/Z)
Price	0.0150	3.91	0.000***
Age	-0.0121	-1.92	0.055*
Marital status	0.8992	0.74	0.458
Educational level	0.3254	1.80	0.073*
Household size	0.4851	1.58	0.114
Primary occupation	-0.8343	-1.48	0.139
Time of water availability	4.6937	1.86	0.063*
Household expenditure	0.0001	1.88	0.061*
Perception of respondents	-2.5306	-2.57	0.010**
Source of water	0.19407	0.96	0.932

*** Statistically significant at 1%, Chi-squared (LR statistics) 75.85 ** statistically significant at 5%, degree of freedom 10, * statistically significant at 10%, significance level 0.000, Log-likelihood -23.8646, Pseudo R-squared 0.6183

Conclusion

The study shows that majority of the respondents are willing to pay up to 5% of their total household expenditure for improved water supply. The estimated mean willingness to pay for improved water supply services showed that the demand for improved water supply services is associated with benefits derived from improved water supply services. Education, price that the respondents are willing to pay, frequency of supply, household expenditure and respondents perception on provision of water supply services are important factors that influences WTP

for improved water supply services. Based on the findings of this study the following recommendations are made:

1. The strong positive relation between the household expenditure and the willingness to pay for improved water service imply that there is a need to consider household's with low income status in designing policies related to supply of improved water services.
2. The estimated mean willingness to pay shows respondents are able to pay for improved water supply services if they are provided the services at the a price equal to the estimated mean willingness to pay.
3. The study also serves as a signal for the water utility to set objective which can abandon the low-level equilibrium trap, which is the cycle of poor service and low reliability, which can lead to attain high level equilibrium, which is high private connections and high reliability of the service given the improved water supply service is provided.

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