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EVALUATION OF WILLINGNESS TO PAY FOR RELIABLE AND SUSTAINABLE HOUSEHOLD WATER USE IN ILORIN, NIGERIA

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Abstract

This study focused on the evaluation of willingness-to-pay (WTP) for sustainable household water use in Ilorin, Nigeria. The study involved assessment of the existing water supply situation particularly considering water use indicators such as demography, adequacy of existing water supply system and WTP for reliable supply. Field work involved the use of structured questionnaire to obtain data on household water use and WTP for a reliable water supply of the sampled houses consisting three land use patterns. Stata/SE 8.0 and Microsoft EXCEL software were employed to evaluate the variables that affect WTP for improved household water use while ccontingency Valuation Method was adopted to evaluate the WTP for reliable and sustainable service delivery. The findings of the study revealed that: approximately 70 % of total sampled households were connected to municipal supply out of which 13 % indicated satisfaction in terms of sufficiency and 87 % used alternative sources to augment water supply; consumers are willing to pay an average sum of ₦737.22 per month for improved water supply services and; gender, water quality and household income level have significant impact on WTP at 5% level of significance. There is the need to put in place a framework to enhance improvement of system reliability and sustainability.

Keywords: *Evaluation, willingness, reliability, sustainability, household, water*

Introduction

Water supply is the active ingredient for achieving desired growth, enhance social economic-economic activities, and guarantee well-being of the people at both urban and regional levels. Water resource planners, usually the engineers, design local and regional scaled water pipeline systems to provide water of adequate quality and quantity. However, once pipelines are in place, land use planners rightly press for the lowest cost of expansion, which is along the pipeline route. As a result, even though these utilities initially respond to growth, the latter are impetus for urban and rural expansion (Ashton and Bayer, 1983). The overall goal and objectives are to provide safe, portable water for domestic use, adequate quantity of water at sufficient pressure for fire protection and industries. To meet the water supply requirement in a growing community, system reliability and sustainability level needs to be identified to satisfy the increasing demand. As a result of these needs in the phase of poor economy in the developing world, the methods for evaluation of water supply services needs to consider not only rehabilitation of existing urban water supply systems but also to consider the future development of new water supply systems to serve expanding population centers. Both the adaptation of existing technologies and the development of new innovative technologies will be required to improve the efficiency and cost-effectiveness of future and existing water supply systems and facilities necessary for industrial growth.

Household water use is the most important part of municipal water use in many countries because it accounts for over half of the total municipal water in many countries. In the UK, about half of abstracted water was found to be used for the domestic sector while in Spain, 70% of urban water consumption is for household (Lu and Smout, 2008). Hence, it is an expectation that with increase in population, urbanization and

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raised living standard, water demand for urban domestic use will be in a strong growing pattern in the coming decade. Hence, the need to study and appreciate this problem is the basis for undertaking this study with the hope that the outcome will assist decision makers on water supply improvement strategies.

Odigie and Fajemirokun (2005) observed that the provision of water supply and services in Nigeria has been traditionally regarded as a social responsibility of the Government. Consequently, the costs of water infrastructure have been met from budgetary allocations and donor contributions rather than from water tariffs and charges. This has created the public perception of water as a free good. The sector therefore find it very difficult to lay new pipeline and majority of the populace are without network coverage. Modern water resources managers according to Skaggs, *et.al.,* (2004), are constantly required to balance multiple, conflicting, incommensurate objectives in an environment characterized by high levels of uncertainty, varying data quality and availability, and competing models and approaches. The reliability of water resources management policies and decisions depends on the ability of measurements, response models, process models and policy models to interact with each other across the variety of temporal and spatial scales each represents. It also requires a cautious, probing, adaptive approach founded on fundamental economic principles, success of which depends upon improvement understanding, predictive accuracy and iterative performance assessment.

WTP is the maximum amount of money that the consumer would give up in order to enjoy an improvement in quality (Haq, *et.al.* 2007). The level of payment for water is directly proportional to financing of urban water supply infrastructure development (Whittington, *et al.,* 1987, 1991). WTP could be over-estimated by private sector and under-estimated by government agency (Rogerson, 1996). However, WTP at household level can be affected by access to other alternative water source which are reliable than the public water utility system (Littlefair, 1998).

As reported by Littlefair (1998), people in Kerela and Akulam in India were willing to afford more prices to get ground water exploitation than paying for the public water utility not because of price but because of its reliability. There should be a close social distance between the planners and the beneficiaries because water has been identified as an economic good (Altaf and Hughes, 1994, Rogerson, 1996). Moreover, Littlefair (1998) further opined that improving the reliability of water supply to household will enhance WTP by the stakeholders. In doing this, the revenue base and cost recovery will as well be enhanced in as much as people are willing to pay for better services.

Other empirical methods have also been used to determine the WTP at different household level. A mathematical programming approach was developed for deriving estimates of the WTP of water customer for improvement in water supply reliability. Lund (1995) reported that much effort has been devoted in estimating the reliability of urban water supplies while little effort has been expended in developing method that value different reliability profiles. He thereby developed the approach to estimate the WTP for improved reliability of different classes of customers and for suggesting promising water conservation programs for different customer classes. He estimated customer WTP to avoid set of probabilistic water shortages without the expense of situation and proving a check on the result of direct contingent valuation estimates of WTP to avoid shortages. Alcubilla (2002) also derived the equation for the total expected value cost of households' water management. He used Monte-Carlo simulation techniques to represent household variability in the model parameter and derived estimates of aggregate WTP for water supply reliability, water demand curves and demand curves for conservation measures. He also reported that if a cost of a reliability enhancement project (water recycling and water transfer) is below the consumer's WTP, the project is economically visible and that WTP based on probabilistic supply valuation is the key tool in reliability planning. He concluded that WTP decreases as the price for water increases.

Branka and Kelly (2001) studied the WTP for improved conservation of environmental species in USA using the same approach and the mean willingness was established. Chowdbury (1999) used the CVM to estimate Dhaka slum-dwellers WTP for safe drinking water. The result showed that they were willing to pay for water to cover the cost of providing it, suggesting that higher water charges would be financially feasible to generate funds for water supply system investment.

Adepoju and Omonona (2009) showed that the demand for improved water services is significantly related to the income of the household members. The study revealed that household that earn less than ₦10,000 as a monthly expenditure will find it difficult to purchase or access alternative source of water supply bearing in mind the proportion of income that would be used for charges payment. Two factors were identified to be the determinant of household WTP for improved water services and these were household income and the connection charges to the alternative source. It was suggested that private investment in the provision of potable water should be encouraged in areas such as Ataoja estate, Agunbelewo, Odekale Halleluyah area and other affected areas.

People who live near the Pavana River in Pune city, India were willing to pay about RS 59 lakhs per year which is a little lower for what they were expected to pay (Immandoust and Gadan, 2007) because of water supply quality. Mean of WTP for rich people was Rs. 370 while for poor was Rs. 4.68 and for very poor it was Rs. 0. 71. For the whole sample, mean of WTP was Rs. 17.55 per family, per month. As expected by these researchers, WTP and education have strong relationship because WTP for illiterate people was Rs. 5.36 while for educated people (Diploma/ University Degree) was Rs. 22.31 which also proves the validity of this work.

Materials and Method

The research methodology comprises of both field work and data analysis. Preliminary work conducted involved the review of the literature and development of data collection techniques and instruments before the commencement of field work. Reconnaissance survey preceded field data collection which involves discussions with the respective stakeholders on the city water supply.

Data Collection and Sampling Technique

Ilorin city, the study area, was categorized into three land use patterns comprise of: planned area (e.g. Irewolede Housing Estate was selected); unplanned residential area (Oloje, Agboba and Ipata residential area) and; Government Reserved Area (G.R.A.) which represent the low density area as well as high income residential area (Ayanshola, 2013). This will allow for the sampling of the different patterns of water resource characteristics among the various segments of the city. Using simple random sampling from selected areas within the city, 250 face-to-face personal interviews were conducted, out of which 220 of samples were considered viable for the analysis. The study also used secondary data obtained from Kwara State Water Corporation and other relevant private and governmental organizations.

Ilorin, the capital city of Kwara State is located between latitudes 8^o 25′N and 8^o 32′N longitudes 4^o 30′E and 4^o 41′E (Figure 1). The town is located at southern part of Kwara State. Ilorin metropolis presently occupies an area of about 89 Km^2 (Adeleke, 2010). According to Ayanshola (2013), the population of Ilorin was estimated to be 606,533 in 1996 with a growth rate of 2.83% and in 777,667 in 2007 comprising three local governments (Ilorin East, Ilorin South and Ilorin West). This figure shows that the growth rate is about 2.82%, which follows the growth rate as proposed by NPC (2006). Three main rivers flow through the city: Oyun, Asa, and Moro rivers (Ayanshola, 2005) as shown in Figure 2.

Data Analysis and Evaluation of WTP factors

For this work, descriptive statistics such as frequency distribution tables, mean, confidence of interval and standard deviation were used to analyze the socioeconomic characteristics of the respondent. Two empirical methods of regression analysis were used in the analysis of the data obtained from the structured questionnaires in order to estimate the mean WTP of the people. The two methods are Tobit and Probit regression models. The factors considered and evaluated include; sex, poor water quality, household size, income level, age, education level, years of stay, sufficient water consumption. Because of problem of heteroscedasticity which is common with the use of the data obtained from the field, it was furthered tested for the existence of heteroscedasticity using Log-likelihood ratio (LR) which shows that simple Tobit could not be used but rather heteroscedasticity Tobit model (Ayanshola, 2013).

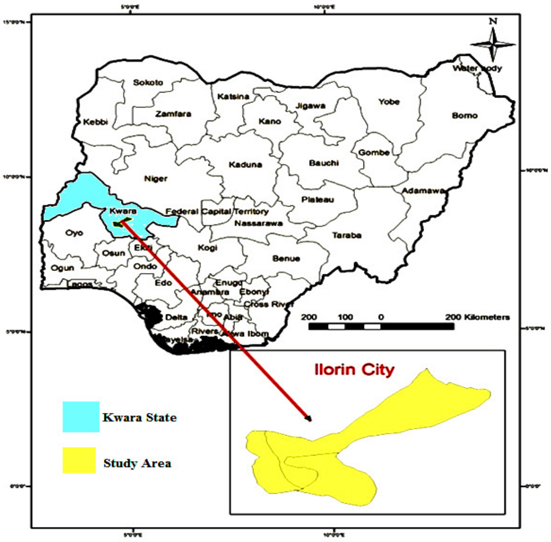

Figure 1 Map of Nigeria, showing the study area

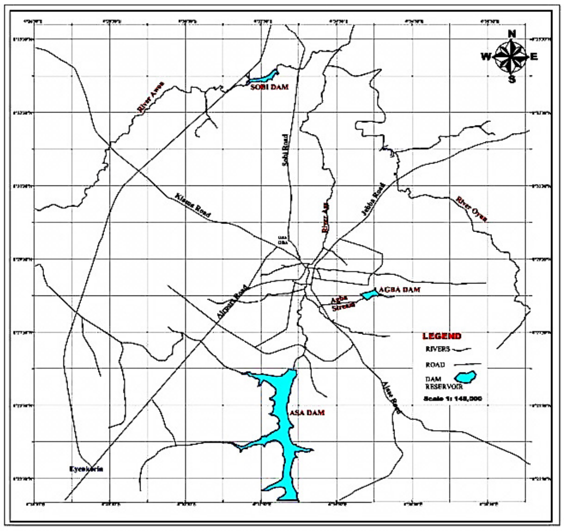

Figure 2 Map of Ilorin Showing the Dams and the Rivers

Result and Discussion

Demographic Profile of the Study Area

The family size of each household surveyed ranged between 1 and 10 people with a mean family size of 6 people per household as shown in Figure 3. The minimum age of the respondents was 22 while the maximum age was 65 with the mean age to be 46 years. People in the study area were of middle class with fairly high standard of living which is due partly to their literacy level. On the average, it was found that majority were learned people. Analysis showed that about 61 % of the total respondents were university graduates while 26 % had postgraduate degree qualifications and only 1.82 % was identified without any form of education (Figure 4).

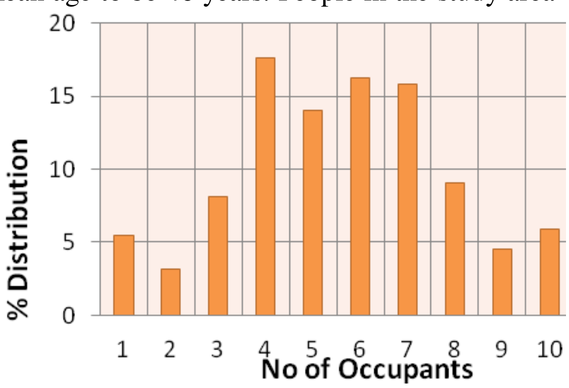

Figure 3 Household Population Distribution

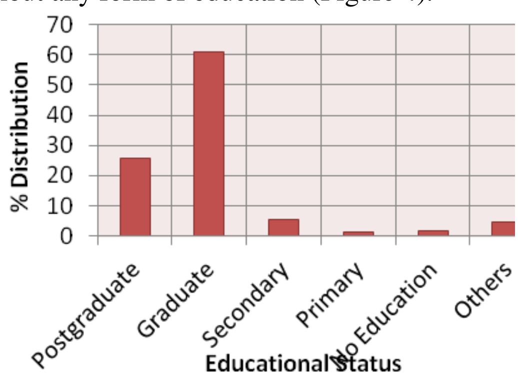

Figure 4 Educational Status of Household Head

Bungalows were the most dominant type of house with highest percentage of about 39 and closely followed by Block of Flats with 32 % of the total sample (Figure 5). For those that are paying rent, it was found that the rentage cost ranges between ₦3,000 and ₦6,000 has the highest frequency (Figure 6). All these factors are the socio-economic factors of the household. As the level of income increases, the probability that a household would adopt and pay for improved services also increases.

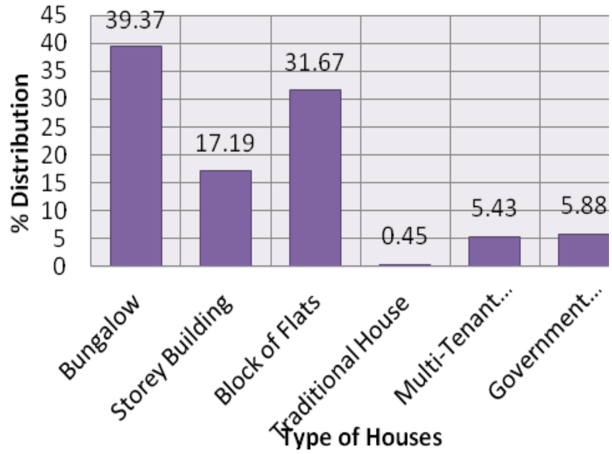

Figure 5 Types of Houses

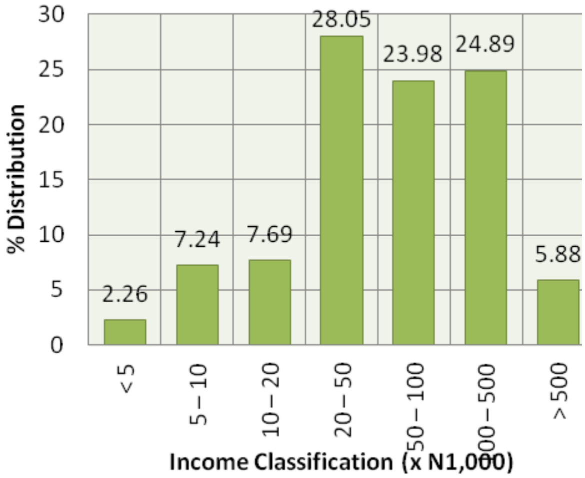

Figure 6 Income Classification

Also, the water use patterns were evaluated. Approximately 70 % of total sampled households were connected to municipal supply out of which 13 % indicated satisfaction in terms of sufficiency and 87 % used alternative sources to augment water supply. Those that were connected to the municipal water supply and usually get water supply in the morning period were 8.8%, daytime period, 21.3% and evening period, 70%. All respondents reported that their primary source of water supply was municipal connection. Only 23.8% of the respondents have wells and boreholes as their secondary sources. The survey conducted has clearly indicated that the supply reliability on weekly and hourly basis were 20% and 17% respectively (Table 4).

Evaluation of factors that affect WTP

The estimates of the heteroscedasticity Tobit model are presented in Table 1. The variable 'Sex' is significant at 5% level. Sex is negatively related to willingness to pay, i.e. men are willing to pay more for improved water supply. This is contrary to believe that it is women who should be willing to pay more because of their longer stay in the house and higher need for water for domestic purpose. Poor water quality which can cause diseases in some parts of the study area is positively significant at 5% level. This implies that those that think that their family members are affected medically due to poor water quality supplied were more willing to pay for improved water. Household size is positively significant at 5% level which complies with the economic theory that higher population is positively related to demand in the case of normal goods. Income level is also positively significant at 5% level; hence those with higher income are more willing to pay for improved water service.

The variable 'Age' has negative impact at 5% level of significance. This is because elderly members of the household with children will prefer their children to fetch water at the secondary sources as this will be cheaper for them than to pay a higher rate for any improvement. Also, such people are used to free use of water or little payment for water. Sufficiency of water has an unexpected sign and it is significant at 5% level. This implies that household with sufficient water have a negative and significant impact on WTP in the Tobit model. This is because as the water is adequate they are willing to continue to pay for the water without any additional price. All other variables are not significant at 5% level because they do not have a direct effect on the level of WTP.

For the Probit model analysis, most of the variables could not be regressed because they were dropped which indicated that they were predicted perfectly. Therefore, the variables in this model are; age, educational level, year of stay and water consumption. Also, probit log likelihood was used to predict the significance and the result are shown in Table 2. The R^2 for the regression equation is 0.8855 (88.55%), which means that the model is very adequate as it explains over 88% of the variation in the dependent variable (WTP) (Table 3)

Table 1 Tobit Log-likelihood Regression Analysis for WTP

Variables	Coefficient	Standard Error	t-value	P>/t/	(95% Confident Interval)	
Sex	-.4097138	.1094299	-3.74	0.000	-.6278582	-.191569
Water quality	.3166437	.0989369	3.20	0.002	.1194165	.5138708
Household size	.1958868	.0435519	4.50	0.000	.1090677	.2827058
Income level	.1258337	.0503648	2.55	0.013	.0281333	.2289341
Age	-.0095013	.0038706	-2.45	0.017	-.0172172	-.001785
Education level	-.1236673	.08806183	-1.40	0.167	-.3003247	.0529901
Years of stay in the area	.0068531	.0170443	0.40	0.689	-.0271241	.0408303
Sufficiency of water	-.3098561	.1363155	-2.27	0.026	-.5815961	-.038116
Regularity of supply	.1324679	.2794458	0.47	0.637	-.424597	.6895329
Standard error	.1744754	.0283047				

Log likelihood = 3.1114614; Number of observations = 80; LR Chi^2 (8) =132.97; Prob > chi^2 =0.0000; Pseudo R^2 = 1.0491

Table 2 Probit Log likelihood Regression Analysis for WTP

Willingness to pay	Coefficient	Standard Error	T	P>/t/	95%Conf. interval	
Sex	-.0502649	.0633119	-7.9	0.000	-.062889	-.376409
Poor water quality	.1421458	.0438728	3.24	0.002	.054666	.229626
Household size	.0335517	.0120198	2.79	0.007	.009549	.057519
Income level	.1074533	.0231745	4.64	0.000	0.61245	.153662
Age	-.002931	.0017884	-1.1	0.260	.005597	.001535
Education level	-.108784	.0397448	-0.5	0.638	-.09813	.060565
Years of stay	.0102764	.0089419	1.15	0.254	-0.07550	.028106
Sufficient water	-.232130	.0824590	-2.8	0.006	-.39655	-.067712
Regularity of supply	.2274582	.1472977	1.54	0.127	-0.66450	.521162

Number of observation = 80; LR chi^2 = 5.14; Prob >chi^2 = 0.1621; Pseudo R^2 = 0.2107

Table 3 Ordinary Least Square Regression Analysis Result

Variable	Coefficient	Standard Error	Z	P>/z/	(95% Conf. Interval)	
Age	-0.0497	0.0376	-1.32	0.187	-0.1233	0.0241
Education level	1.0136	0.6850	1.48	0.139	-0.3289	2.3561
Years of stay	0.1645	0.1645	1.00	0.317	-0.1577	0.0487
Water Supply Regularity	1.2422	2.0908	0.59	0.552	-2.8558	5.3402

[F (8, 71) = 68.62; Prob > F = 0.0000; R-squared = 0.8855; Adjusted R^2 = 0.8726; Root MSE = -0.15806]

Cost of water use and WTP

The results furthered shown that people are willing to pay for both installation cost and volume of water used. From the result, the amount of money the respondents are ready to pay for cost of installation ranges between ₦50 and ₦70,000 while the average is about ₦4,417. Presently, the cost of a typical household connection is about ₦7,500 which is higher than the cost of installation that people are willing to pay. For water use, the average amount people are willing to pay stands at ₦737.22 while the minimum and maximum respectively are ₦50 and ₦5,500 on monthly basis. This is an indication that people really need improvement on the system and they are ready to pay the price. Monthly flat rate of ₦200 charged by KWWC is much lower than the average monthly of ₦737.22 people are willing to pay for an improved and a reliable water supply to the city. In a similar study conducted, people of Oyun in Kwara State are also willing to pay N1,100 per month on average, which also indicated that people are always ready to pay for a reliable system (Okeola, 2009; Sule and Okeola, 2010); while at Ibadan, Oyo State, the mean willingness to pay of households for improved water supply was N1,080.80 per month (Omonona and Fajimi, 2011). Paying more on monthly basis compare to the current charges will bring more improvement to the system and at long run; it will enhance the sustainability of the system. The mean, standard deviation, minimum and maximum amount that consumers are willing to pay are in Table 4.

Conclusion

The result of the study shows that water quality is positively significant at 5% level which implies that family members were more willing to pay for improved water because they are not satisfied with present supply. Household size is positively significant at 5% level of significant which complies with the economic theory that says that higher number of population is positively related to their demand in the case of normal goods. Income level is also positively significant at 5% level and it can be explained that those with higher income are more willing to pay for improved water. Age has a negative 5% of significance since the older people who have children will prefer their children to fetch water at their secondary source at cheaper cost.

Sufficient water has an unexpected sign and it's significant at 5% level of significance and indicates that household with sufficient water have a negative significant impact on WTP in the Tobit model. It can be recommended that both the private and public water agencies should bridge the gap that usually exist between the customer and the agencies by using contingent valuation survey to get the required information and also stress the importance of their payment for the maintenance and improvement of the water facilities.

In conclusion, the present water supply in the city of Ilorin is grossly inadequate and the people are not satisfied with the present supply. Government should create enabling policy for Public-Private Partnership in water supply to secure the much needed fund for improvement for sustainable service delivery since citizenry are willing to pay for reliable and an improved water service delivery.

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Table 4 Descriptive Statistics of the Existing Water Supply

Variables/Index Considered	No	Range	Minimum	Maximum	Sum	Mean	STD	Remarks
No of Supply per week	221	7	1	8	318	1.44	0.95	20% reliable
No of supply hour per day	221	23	1	24	917	4.15	3.95	17% reliable
Additional No of hours of supply required	221	23	1	24	3101	14.03	8.04	
Amount that can be Afford Installation (₦)	134	9700	300	10000	287986	2149.15	1924.02	> Amount willing to pay
Amount that can be Afford Consumption per month (₦)	134	1300	200	1500	93119	694.92	281.88	< Amount willing to pay
Storage facility capacity (litres)	144	19950	50	20000	233512	1621.61	3572.16	
Cost of installation of storage facility (₦)	144	48000	2000	50000	2292000	15916.67	14667.08	> Amount willing to pay
Water use per day (litres)	222	962	38	1000	70099	315.76	218.00	52.63 l/c/d usage rate
Last Payment made (₦)	183	8200	200	8400	377209	2061.25	2220.19	> Amount willing to pay
Amount willing to pay per month for water use (₦)	151	5450	50	5500	111320	737.22	868.27	
Amount willing to pay for installation (₦)	125	69950	50	70000	552100	4416.8	7589.36	

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