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Willingness to Pay for Improved Water Supply Among Rural Households in Benue State, Nigeria

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ABSTRACT: The study assessed the willingness to pay (WTP) for improved water supply among rural households in Benue State, Nigeria. Multistage sampling technique was used to select 120 rural households for the study. Contingent valuation method was used to elicit households' willingness to pay for improved water supply. Descriptive statistics and logit regression model were employed for data analysis. Results revealed that majority (78.3%) of the households were male headed with a mean age of 37 years and mean household size of 9 persons. The major source of water for the rural households was hand dug well. Majority (82.5%) of the respondents were willing to pay ₦21.68 for 25 litres of improved water, with age, household size, education, monthly income, distance to current water sources, existing water quality and the bid value having significant influence on households' WTP for improved water supply in the study area. Therefore, educational and enlightenment campaigns on the importance of improved water supply may enhance WTP in the study area.

Keywords: Contingent valuation; Improved water supply; Willingness to pay; Rural households

1. Introduction

Water is essential for human existence and economic development [16]. Water, a natural resource with no substitute, is feasibly the most important for human survival. Inadequate access to safe water supply may lead to outbreak of diseases [7]. Good quality water is crucial for advancement in human health and well-being. Water is necessary for economic activities such as agriculture, mining, food processing and for sustaining healthy ecosystems [2]. It is used in homes for drinking, cooking, bathing, washing and sanitation. Water is not only vital for subsistence but also an essential component of primary healthcare which is important for poverty alleviation. [8]. However, the availability and adequacy of water for the forenamed purposes has been a major content in developing countries, where accessible, the quality and quantity are far below the globally accepted standard [12]. About

844 million people do not have access to clean water supply worldwide, at least 2 billion people drink from a contaminated water source and about 319 million people have no access to good quality water supply in sub-Saharan Africa. Consequently, majority of the people have resorted to using water from unsafe sources which is the primary cause of water borne diseases such as cholera, diarrhea, typhoid, hepatitis, among others [19; 4].

In Nigeria, unsafe water sources are pronounced in all rural areas. The public water supply is insufficient, undependable, erratic, and in most cases unavailable leading to high reliance on unhealthy alternatives such as rivers, streams, hand dug wells and ponds which are vulnerable to water borne diseases. [7; 2]. Majority of rural households spend most of their times sourcing for water due to malfunctioning of public water schemes, where functional, the household spent time that could have been used for productive activities waiting for their turn on queues because of the inadequacy of public water supply in their locality.

In Benue State, demand for improved water far outweighs it supply because the government cannot adequately supply water to its teeming population. Previous studies only assessed water supply situation in the state. For instance, [6] investigated the "determinants of rural water supply pattern in Ugbokolo Community"; [7] examined "the contending issues of domestic water supply in Makurdi metropolis"; [2] assessed "residents coping strategies with water scarcity in Makurdi Town"; [3] investigated "the determinants of residential per capita water demand of Makurdi metropolis". These studies have mainly appraised water demand, supply and strategies adopted to cope with dearth of water supply situation in different parts of the state without recourse to the residents' willingness to pay for improved water supply. This study aims at bridging this gap by assessing the willingness to pay (WTP) for improved water supply among rural households in the state.

1.1 Specific Objectives of the Study

Specifically, the study

- describe the socio-economic characteristics of rural households in the study area;
- identify the sources of water used by rural households in the study area;
- estimate the parametric mean WTP for improved water supply in the study area; and
- determine the factors affecting WTP for improved water supply in the study area

Literature Review

2.1 Concept of Willingness to Pay

Of utmost importance to water project planners is the assurance of financial sustainability of the project. This involves forecasting and estimating what users will be willing and able to pay for the purposed water scheme in the future [16]. Willingness to pay refers to the economic value of a good to an individual under given conditions [20]. "It is the maximum amount of money an individual would be willing to sacrifice for an improvement in the quality and quantity of a good" [1; 5]. An individual Willingness to pay for a good or service is used as an estimation of the satisfaction that he or she obtains from the good or service in question. Willingness to pay surveys are very essential because they proffer answer to the question: "How much can be charged?" They help to determine the number of respondents who will pay a given price, the amount of returns that will be realized based on what is required to achieve the task, and the characteristics of respondents who will or will not pay that price.

2.2 Contingent Valuation Method (CVM)

This study applies CVM to evaluate consumer WTP for improved water supply in the study area. The CVM, a stated preference evaluation method, is a survey-based technique of monetary valuation used to elicit respondents' preferences expressed in terms of WTP. The CVM utilizes a well-designed questionnaire to elicit the bids of households about a change in the value of an environmental good, and how much they are willing to pay in order to maintain or improve the value [10; 21]. CVM employs bidding methods to estimate the respondents or households' willingness to pay for an environmental good.

2.3 Empirical Review of Previous Studies on WTP and CVM

Results of previous empirical studies on the WTP for improved water supply revealed that sex, age education, household size, income distance to existing water source, quality of existing water supply employment status and bid value influenced willingness to pay for improved water supply. For instance, [4] examined willingness to pay (WTP) for improved water supply in Owo Local Government Area of Ondo State, Nigeria using CVM and logit regression model. Their results revealed that 70.3% of the residents were not satisfied with erratic water services and were willing to pay an average sum of N1,617.64 (US$4.5) per month for improved water supply services. The results of logit regression analysis revealed that gender, frequency of water, education, household size, income, quality of water and connection charges were the factors influencing residents' willingness to pay (WTP) for improved water supply services in the study area. [16] analysed household's willingness to pay for improved water supply services in Mettu Town, Ethiopia. The study revealed that 69% of Mettu households were willing to pay for improved water quality, with household income, water supply satisfaction, and supply price having a strong impact on households' willingness to pay for improved water services while increase in educational level reduces their willingness to incur additional financial costs on water supply. Also, [21] investigated Consumer ability and willingness to pay more for continuous municipal water supply in Chitungwiza using CVM and binary logistic regression model. Results indicated that only 28.9% of the 289 sampled households were willing to pay the hypothesised prices for improved 24/7 water supply. Residents were willing to pay $40/month for improved services against the $75/month proposed for improved services. Results of the binary logistic regression model established that the presence of alternative water source to municipal water and education level of the household head significantly determined consumer WTP for improved water services in Chitungwiza.

METHODOLOGY

3.1 Study area

This study was conducted in Benue state, Nigeria. Benue State is one of the Middle Belt States, located in the North Central region of Nigeria, named after the Benue River and formed from the former Benue-Plateau State in 1976. Its capital is Makurdi. It is located on latitude 6º25' and 8º8'N and longitude 7º47' and 10º0'E and shares boundary with Nasarawa State to the north, Taraba State to the east, Cross River State to the south, Enugu State to the south-west and Kogi State to the west. Benue occupies a landmass of 34,059 square kilometers and has a total population of 4,253,641 in 2006 census. Benue State comprises of twenty-three Local Government Areas. Agriculture is the main stay of the economy, engaging over 75% of the state population.

3.2 Sample size and sampling technique

Multi-stage sampling technique was used in selecting the respondents for this study. The first stage involved the purposive selection of three Local Government areas because they are densely populated rural LGAs in the state. The second stage involved the random selection of four villages in each of the local government areas making a total of 12 villages. In the third stage, simple random sampling technique was used to select 10 households from the selected villages making a total of 120 respondents for the study.

The study was based on the primary data obtained from household heads in the study area using an interview schedule with the aid of structured questionnaire. Data collected included the socio-economic characteristics of households, types of water supply used as well as willingness to pay for improved water supply in the study area.

3.3 Analytical techniques

The following analytical tools were employed in the analysis;

3.3.1 Descriptive statistics: Descriptive statistics such as frequencies, percentages, means, standard deviation and charts was adopted to describe information on the socio-economic characteristics of the rural households as well as types of water supply used in the study area.

3.3.2 Mean willingness to pay: The Contingent Valuation Method (CVM) was used in assessing the rural households' willingness to pay for improved water supply in the study area. This method was considered to be appropriate when dealing with estimation of goods that is not traded in the conventional market. To obtain the mean willingness to pay of the households for improved water supply, the responses of the households to the willingness to pay question was regressed on the prices they were asked to pay for the improved service (bid) and analysed using the logit regression model as used by [13], [4] below:

$$Y = \frac{1}{1 + \exp^{-(\beta_0 + \beta_1 X)}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:

Y = Response of households to the willingness to pay question which is either 1 if yes, 0 otherwise.

X = the price (₦) that the household was asked to pay for the improved service (bid)

The coefficient estimates obtained were then used to calculate the mean willingness to pay of the households using the formula derived by [9] as used by [11] and [4]) where mean WTP was taken to be negative and the ratio of regressed constant to bid price coefficient.

3.3.3 Determinants of willingness to pay: The logit model was used to determine the factors that influence the households' probability of acceptance of the bid offered for improved water supply in the study area. The logit regression model is specified as:

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

Where

Y is dependent variable (Responses of the household to willingness to pay question which is either 1 if Yes or 0 otherwise)

$Z = \beta_0 + \beta_1 V_1 + \beta_2 V_2 + \ldots\ldots\ldots + \beta_{13} V_{13} \ldots\ldots\ldots\ldots\ldots (4)$

β_0 = constant; $\beta_1 \ldots. \beta_{13}$ = coefficients of the explanatory variable $V_1 \ldots\ldots\ldots V_{13}$(socio- economic variables that are hypothesized to influence WTP including the bid amount i.e. prices offered) which are: V_1 = Age of the respondents (years); V_2 = Sex of the respondents (1 if male, 0 otherwise); V_3 = Marital Status (I if married, 0 otherwise); V_4 = Household size (number of people); V_5 = Education (no of years); V_6= Occupation of the respondents (1 if farming, 0 otherwise); V_7 = Household income (₦/month); V_8 =

Distance to primary water source (km); V_9 = Pay for current water supply (₦/month); V_{10} = Reliability of water (1 if reliable, 0 otherwise); V_{11} = Quality of existing water (1 if of good quality, 0 otherwise); V_{12} = Bid value (₦)

RESULTS AND DISCUSSION

4.1 Socio-economic characteristics of the respondents

The result of the socio-economic characteristics of the respondents is presented in Table 1. The age distribution of the respondents reveals that, a larger proportion (44.2%) of the respondents were below 30 years of age. The mean age of about 37 years implies that the respondents were within their economically productive years. Majority (78.3%) of the rural households were male headed while 21.7% were female headed. The educational level of the respondents shows that 21.7% can neither read nor write (illiterate), 24.2% had primary education, and 25.8% had junior secondary education while 17.5% had senior secondary and 10.8% had adult education. Majority (62.5%) of the respondents were married with a mean household size of 9 persons. The major occupation of the respondents was farming (63.3%), earned a mean monthly income of ₦21,712 and travelled an average distance of 401.25 meters to the existing water source in the study area.

Results in Table 2 reveal that the respondents obtained water from multiple sources in the study area. Majority (73.3%) of the respondents sourced water from hand dug well, 30% sourced from surface water such as lakes, streams, rivers, etc., and 17.5% from borehole. The percentage of respondents that obtained water from pipe was 14.2% while 12.5% of the respondents obtained water from other sources such as rain, packaged water and vendors. This implies that majority of the respondents sourced water from unimproved sources in the study area. The respondents also reported about their perception regarding the quality of existing water source in the study area. From the total of 120 households, 10% reported water to be "very. good", 12.5% to be "good" and 25% to be "just ok" while 43.3% and 9.2% considered the water quality to be "poor" and "very poor" respectively. This result is consistent with the findings of [10] who reported that about 95% of the respondents in Chobe Ward, Maun did not find water to be of good quality. Since the quality of the current water in the study area was perceived to be poor, majority (90%) of the households adopted some coping strategies as a means of improving the water quality before use. These strategies include among others, boiling (9.2%), filtering (34.2%), Add alum (30.8%), use water guard (5%) and leave to settle

Table 1: Socio-economic Characteristics of Respondents in the Study Area ***(n = 120)***

Variables	Frequency	Percentage (%)	Mean
Age			
≤30	53	44.2	
31-40	28	23.3	36.91±12.246
41-50	24	20.0	
Above 50	15	12.5	
Sex			
Male	94	78.3	
Female	26	21.7	
Educational Qualification			
None formally	26	21.7	
Primary Education	29	24.2	

Junior Secondary	31	25.8	
Senior Secondary	21	17.5	
Adult Education	13	10.8	
Marital Status			
Single	45	37.5	
Married	75	62.5	
Household Size			
≤5	38	31.7	
6-10	42	35.0	9±2.337
Above 10	40	33.3	
Occupation			
Farming	76	63.3	
Artisan	19	15.8	
Trading	15	12.5	
Paid employment	10	8.3	
Monthly Income (₦)			
≤10,000	63	52.5	
11,100-30,000	37	30.8	21,712±12925.241
>30,000	20	16.7	
Distance to Water Source			
Within residence	3	2.5	401.25m
100-500m	88	73.3	
501-1000m	29	24.2	

Source: Field survey, 2020

(10.8%). This result is in tandem with the report of [21] that most of the sample households in Chitungwiza embarked on various coping strategies because the quality of municipal water was widely perceived as poor.

4.2 WTP for improved water supply

Result in figure 1 shows that majority (82.5%) of the respondents were willing to pay for improved water supply while 17.5% were not willing to pay in the study area.

Table 2: Distribution of Respondents by some Water Related Factors

Water Factors	Frequency	Percentage
***Existing Water Source**		
Well	88	73.3
Surface water	36	30.0
Borehole	21	17.5
Pipe	17	14.2
Others	15	12.5
Water Quality		
Very good	12	10.0
Good	15	12.5
Just ok	30	25.0

Poor	52	43.3
Very poor	11	9.2
Purification/Coping Method		
Boil	11	9.2
Filter	41	34.2
Add alum	37	30.8
Use water guard	6	5.0
Leave to settle	13	10.8

Source: Field Survey, 2020

This result signifies that majority of the respondents viewed water as an economic good rather than public good as they are willing to pay for it. This result corroborates the findings of [16]. When asked for the reasons influencing their answers to the WTP question, the respondents gave multiple responses, the "yes" reasons vary from "I can afford it", "really need improved water supply" "the price is reasonable" while the "no" reasons were: "do not trust the program" "its government's responsibility especially the senators and house of assembly members representing our constituencies" and "do not have the financial ability". This result confirms the findings of [14; 5] that respondents in Manikganj Municipality and Lahore, Pakistan considered it not necessary to pay for improved water supply due to reasons such as government should do it is free of cost, do not have the financial ability and have uncertainties regarding the program

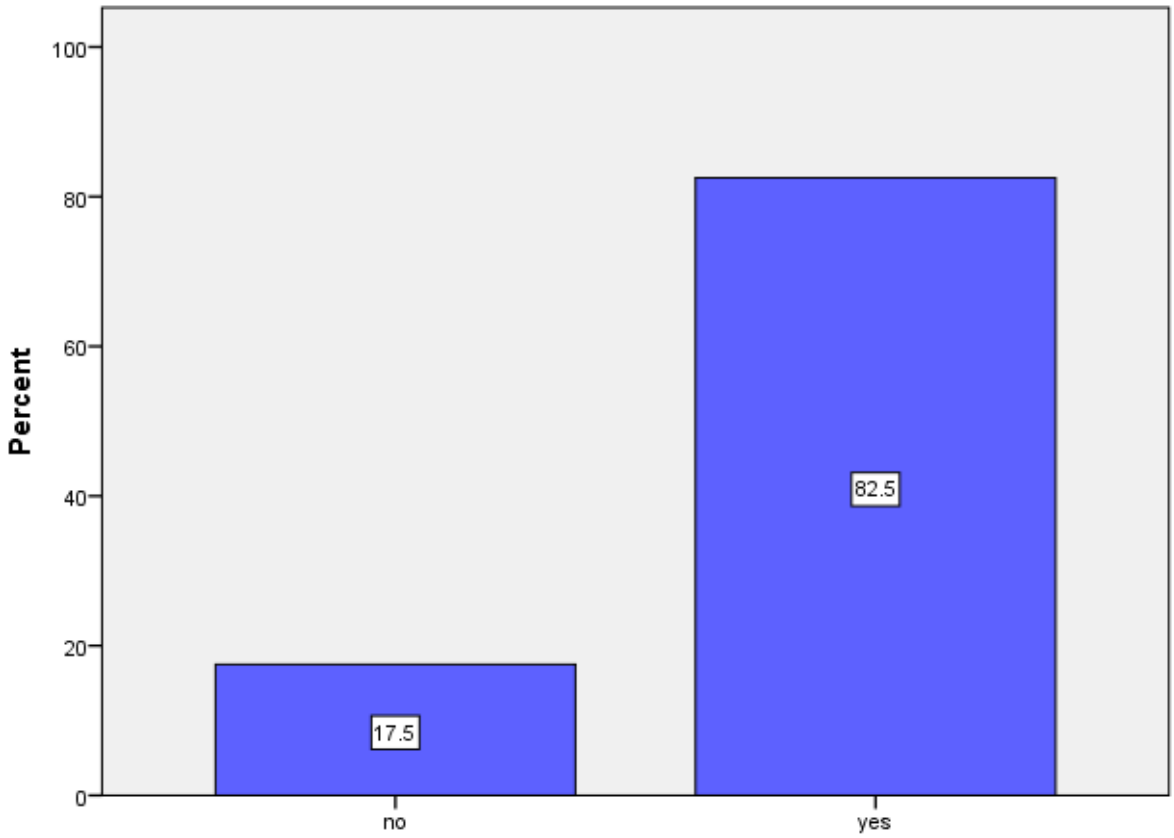

Figure 1: willingness to pay for improved water supply

4.3 Mean WTP for improved water supply

Results of the bivariate logit regression model used to estimate the mean willingness to pay for improved water supply is presented in Table 3. The mean WTP for improved water supply was estimated to be - (-1.366/0.063) = ₦21.68 per 25 litres of water. This amount is fair enough considering the fact that majority of the sampled households were low income earners whose major source of livelihood was farming.

Table 3: Estimates of the Bivariate Logit Model

Bid	Coefficient	Standard Error	Z	p>|z|
Constant	-1.366	0.398	14.333	0.0021
Price	0.063	0.017	11.762	0.000***

**** Sig @ 1%; chi-square =26.019; -2 Log likelihood = 138.699*

Source: Computed from Field Survey Data, 2020

4.4 Determinants of willingness to pay for improved water supply in the study area

Table 4 presents the results of the logit regression analysis on the determinants of WTP for improved water supply in the study area. The chi square value of 45. 307 was significant at 1% level indicating that the model fits the data well. The result reveals that age of the household head ($p<0.05$), household size ($p<0.05$), education ($p<0.01$), monthly income ($p<0.01$), distance to current water sources ($p<0.01$), existing water quality ($p<0.05$) and the bid ($p<0.01$) were the factors determining the WTP for improved water supply in the study area.

The result shows that coefficients of education, income, distance and water quality had direct significant relationship with WTP, implying that household's probability of WTP for improved water supply increases with these variables. On the other hand, age, household size and bid were found to decrease the likelihood of WTP for improved water supply as they had inverse relationship with WTP in the study area.

The coefficient of education was positive and significant at 1% alpha levels. This implies that educated households were more likely to be willing to pay for improved water supply than the uneducated ones. The more the number of years spent in school, the higher the tendency of WTP for improved water supply in the study area. This is probably because an educated household are knowledgeable and tend to be more aware about the negative consequences of poor water supply in the study area This result corroborates the findings of [15; 14 & 4] that educated households have higher probability of willingness to pay for improved water supply. Monthly income of the household was also found to be positive and significant at 1% level of significance. This implies that the probability of WTP for improved water supply increases with income in the study area. The result agrees with economic theory that demand for a commodity is a function of income. Therefore, an increase in respondent's income will increase the probability of paying for improved water supply in the study area. [17] reported similar results for respondents in Accra-Tema Metropolitan Area of Ghana.

Table 4: Determinants of WTP for improved water supply in the Study Area

Variables	Coefficient	Std. error	Z	p>|z|
Age	-0.251	0.027	-2.01**	0.036
Sex	-0.629	0.588	1.14	0.499
Marital status	0.635	0.699	0.82	0.420
Household size	-1.024	0.053	-2.19**	0.035
Education	0.297	0.188	2.58***	0.002

Main occupation	-0.248	0.202	1.51	0.375
Monthly income	0.000	0.000	2.21***	0.001
Distance of water source	1.242	0.528	5.54***	0.003
Pay for current water supply	1.332	0.938	1.61	0.406
Water reliability	-0.186	0.367	0.26	0.620
Water quality	1.125	0.421	2.08**	0.041
Bid	-0.069	0.022	-10.09***	0.000
Constant	-3.805	1.750	4.72	0.003

Pseudo R^2 = 0.6199; LR Chi square (12) = 45.307; Prob>Chi2 = 0.000; -2 Log likelihood = 119.411

*** and ** indicate significance at 1% and 5% levels.

Source: Field Survey Data, 2020

Distance was positive and statistically significant at 1% alpha level. This implies that distance to current water source increases the probability of willingness to pay for improved water supply. Respondents whose current source of water supply was far from the residence were likely to be more willing to pay for improved water supply in the study area. Furthermore, quality of existing water supply was positive and significant at 5%. This is perhaps because majority of the households perceived the current water quality to be poor, thereby increasing their tendencies to pay for improved water supply in the study area. This result affirms the submission of [18] that household who perceive the poor quality and health hazards of the current water service are likely to pay for improved water services than those households who don't perceive the problem with quality and related health hazards.

Age of household head, on the other hand, had a negative significant relationship with WTP for improved water supply at 5% level of significance. This implies that the probability that a household will be willing to pay for improved water supply decreases with age. A year increase in the age of the household head will decrease the probability of WTP by 0.251% in the study area. This is in consonance with the findings of [21] that active group (20–54 years) had a relatively higher WTP odds ratio compared to the elderly group in Chitungwiza, Zimbabwe. This result is however contrary to the findings of [16] who reported that, the older locals in Ethiopia metropolitan areas were willing to pay for improved water quality and security of water supply. Household size of the respondents was also negative and significant at 5% alpha levels. This implies that the larger the household size, the less the likelihood of WTP for improved water supply in the study area. The result agrees with the submission of [18] that the decrease in WTP could be due to availability of more hands that assist in collecting water for the households. [10] opined that, the larger the household size, the more difficulties encountered in terms of budgetary constraints, hence the decreased WTP. Finally, the coefficient of the bid price was negative and statistically significant at 1% alpha level. This implies that the probability of households WTP for improved water supply decreases with the bid price. That is, the higher the bid price or connection charges, the less the likelihood of willingness to pay for improved water supply in the study area. This is in line with the findings of [4] that higher connection charges may reduce the probability of willingness to pay for improved water supply.

CONCLUSION

This study used the CVM and logit regression model to analyse the willingness to pay for improved water supply in the study area. Results revealed that, the mean WTP for improved water supply in the study area was ₦21.68 per 25 litres of water. This shows that there is opportunity for improvement in

water supply services through a cost recovery mechanism. Furthermore, WTP is significantly influenced by age of the household head, household size, education, monthly income, distance to current water sources, existing water quality and the bid value. The study concludes that, the probability of WTP for improved water supply could be higher if income levels and water quality are high, and if the rural households have access to educational programs that will strengthen their knowledge on the importance of improved water supply in the study area.

CONFLICTS OF INTEREST

No conflict of interest

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