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Households' Water-Use Demand and Willingness to Pay for Improved Water Services in Ijebu Ode Local Government Area, Ogun State, Nigeria

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Abstract
This study examined the households' water choice decision and willingness to pay for improvement in water services. Data were collected from 216 randomly selected households from the ten sub-zones of Ijebu- Ode local government area, Ogun State. The data were analysed using descriptive statistics, generalized linear demand and logit regression models. Results show that majority of households' water supply was from private piped/borehole (64.8%) followed by public piped (18.5%), and well (16.7 %,). Also, majority (58.3%) of the households are dissatisfied with the current water supply situation and the households preferred water choices are public piped (64.4%), private piped/borehole (30.1%) and well water (5.6%).. These preferences of household's water choices were determined by quality, convenience, availability and cost with 35.6%, 33.3%, 18.5% and 12.5% respectively. It was revealed further that household per capita expenditure on water is ₦60 (US$0.38) per day an equivalent of ₦1,800 (US$11.5) per month which are significantly higher than current connection charge for public piped per month. The result of generalized linear demand model shows that connection charges, household size, distance to water source, availability and quality of water source, unit price paid per liter, and marital status were determinants of households' water choices. Logit regression analysis result shows that marital status, education, connection charges, household size and income are the correlates of willingness to pay for improved water services in the study area. It was recommended that the government and other donor agencies should facilitate the improvements of public water utilities in this area by increasing the number of public piped to cover all the sub- zones of Ijebu Ode and its environs.
Keywords: Households, water-use, Willingness to-pay, Generalized linear demand,

1. Introduction

Many developing countries are experiencing rapid urbanization in human settlements, at the same time, available fresh water supplies continue to decline. The interdependence between water availability and development is exemplified by the link between water and poverty. Due to poverty, access to adequate water and sanitation is low in Africa. As a result of inadequate access to safe water and sanitation, there is a high incidence of communicable diseases that reduce vitality and economic productivity on the continent. Inadequate access to water and sanitation is thus both a cause and a consequence of poverty. Similarly, inadequate water resources can become a constraint to improved agricultural development and food security.

Systematic development of water supply and management in Nigeria dates back to the colonial times showed that the colonial administration developed domestic water supply as part of overall programme to improve the level of personal hygiene and environmental sanitation throughout the country, and thereby the health of the people. Unfortunately, as noted by Oyebande (1977), the priority accorded domestic water supply by the colonial administration had not been sustained by post independence governments of the country.

Nigeria has 37 State Water Agency (SWAs) and 12 River Basin Development Authorities (RBDAs). Several of these water agencies and authorities depend on obsolete water equipments. This has been largely due to poor investments by Government and private sector organizations in the water sector in the last ten years in Nigeria compared to other sectors such as oil and gas, energy, housing among others (Adoga, 2006). These agencies lack capacity and financial resources and so are finding it difficult to meet the existing demand for safe water within their respective areas (Hall, 2006).

After almost sixty years of water supply development in Nigeria, it is regrettable that only 60% of the population has access to safe drinking water, and in rural areas less than 50% of the households have access to good portable water (National Millennium Development Goals Report, 2005). Access to piped water is regarded as a measure of access to safe water. It is pathetic to observe that access to piped water among Nigerians has decreased extensively from 14% in 1990 to 6% in 2008 (WHO/UNICEF JMP, 2010). Rural people in the country still depend very much on rivers, streams, ponds, and shallow wells for their water needs. During the dry

season, some of these sources dry up and households have to invest a substantial amount of their resources to get water of doubtful quality. This has very serious implications for the economic development and social welfare of the people specifically and the country as a whole. First, there is the tremendous economic waste involved in people spending so much time and effort in search of water. Secondly, lack of water often means relatively low levels of personal hygiene and environmental sanitation. Thirdly, because water is needed for most productive activities, inadequate access to water limits the livelihood options of the people, particularly in rural areas (IDRC, 2002).

The water supply varies dramatically from town to town in Ogun State and so does the cost. In the state capital, most people get free water from public supply, while in most other areas people have to pay for water from private vendors (OGS.W.C., 2010). Ijebu Ode city suffers from limited water supply, and present supply coverage is about 40%. Available water from existing water treatment plant is adequate to supply about 50% of the total estimated water demand of the inhabitants of the city(14,100m^3/day out of the needed 28,200m^3 /day).i.e. shortfall of 50% at full capacity of the existing plant after rehabilitation (OGSWC,2010). The most important river that supplies water to the inhabitants of the area is river Yemoji with average yield of 49.56. There is also evidence with the pipeline extension from Yemoji/Ijebu-Ode, 400mmØ pump line to Tai Solarin University of Education 8.4 kW, and doubling of Ijebu-Ode (OG.S.WC. 2010).

Overtime, this did not solve water shortages in the area, because most households still depend on water tankers and boreholes for water supply. The implications of the above scenario are that the citizens in the study area are groaning under the acute safe water supply and would be willing to pay for supply of potable, reliable and quality water.

Recognizing the harm to health, economic productivity, and quality of life that can result from inadequate services, international donors and governments of Nigeria have mounted numerous efforts to avert this problem. So far, the strategies of these organizations have been supply oriented, totally ignoring the importance of demand in the selection of appropriate policies. Hence, it is necessary to undertake a study on the demand side, which will depicts the needs of the consumers and whether they are willing to pay for such services.

2. CONCEPTUAL FRAMEWORK/LITERATURE REVIEW

Two main stems in residential/domestic demand economic oriented analysis are found in the empirical literature. The first deals with the estimation of price or income demand elasticities, exploiting either household data or municipal/provincial data as unit of analysis. The price demand elasticities can be used for water demand management purposes while the income price elasticities can be useful in the forecasting process of the water requirements. The second research direction deals with the estimate of consumer willingness to pay for increasing in water service quality in holistic sense or concerning single characteristics of the service

Adekalu and Ojo (2002) reported that owing to deficiencies in piped water availability, households invest in coping strategies in the form of alternative supplies and storage facilities to supplement piped water. Gbadegesin and Olorunfemi (2007) in their study reported that more than half of the total respondents indicated borehole/well as the source of water they used most frequently, while rainwater is the least frequently used (0.6%) while, in Ibadan rural communities, river/stream is the commonest and most available source of water they use. The reasons for the above distribution may have to do with the fact that most of the sources of water in the areas are seasonal and are incapable of all year round provision of water. Mu *et. al.*, (1990), presents a discrete choice model of households' water source choice decisions in developing countries. The results suggest that households' source choice decisions are influenced by the time it takes to collect water from different sources, the price of water, and the number of women in a household. Gbadegesin and Olorunfemi (2007) observed that there is variation in time spent fetching water among the communities sampled. Agbelemoge and Odubanjo (2001) reported that only 3% of the people have access to clean and safe pipe –borne water while the remaining 97% relied on streams, rain water, wells and springs for their domestic uses.

Previous studies have shown that low-income consumers are willing to pay for service they want including water supply (Cairncross, 1990; World Bank 1995). It has also been argued that if something is worth having, then it should be worth paying for. Chowdhury (1999) uses the contingent valuation method to estimate Dhaka Slum-dwellers willingness to pay for safe drinking water. The finding of the study shows that slum dwellers are willing to pay enough for water to cover the costs of providing it, suggesting that higher water charges would be a financially feasible to generate funds for water system investment.

A study from Nsukka district in Nigeria reveals that consumers are willing to pay for purchasing water from private vendors instead of paying flat rate user fees for potable water, reason being distrust in the quality and reliability of publicly supplied water (Whittington et.al., 1991) Stoveland and Bassey (2000) observed that the water supply situation is so poor that people say they are willing to pay a significant amount in cash on a regular basis is order to have access to reliable and safe water delivered through common types of facilities like wells and boreholes with hand pumps and motorised pumps.

Omonona and Fajimi (2011) examines the factors that influence the willingness to pay for improved water supply services in Ibadan metropolis, Oyo State Nigeria. Result 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.

3.0 MATERIALS AND METHODS

This study was carried out in Ijebu-Ode Local Government area of Ogun State. The city is located in South Western Nigeria. With estimated population of 154,032 (NPC 2006) it is the second largest city in Ogun State after Abeokuta since the precolonial times it has been the capital of the Ijebu- Kingdom. The city is located 110km by road north east of Lagos; it is within 1000km of the Atlantic ocean in the eastern part of Ogun State and possess a warm tropical climate. Agriculture and trading are the major occupation of the inhabitants. It is the trade centre of a farming region where yam, cassava, grain, tobacco and cotton are grown.

Sampling technique and sample size: The sampling technique employed for this study is simple random sampling. A total of 216 respondents were randomly selected from the ten sub-zonal divisions of the Ijebu Ode local government areas as delineated by the Ogun State Agricultural Development Programme. A well structured questionnaire were used to elicit information from the sampled respondents

3.1 THEORETICAL MODEL

Following Casey *et. al.,* (2006) a simple model for household water demand was formulated.
Typical consumers maximize utility subject to constraints. The demand for water can be viewed as any other good or service and therefore modeled within the utility maximization framework or alternatively within the expenditure minimization model.

$E(H, Q)$……1
s.t. $U = U(H, Q)$……2
Faced with expenditures for both water services (H) and a composite good (Q) subject to the utility constraint, the consumer will attempt to minimize the following expenditure function:

$E^* = E(P_h, P_q, U)$……..3

However, since water service is being offered as a take-it or leave-it proposition it makes sense to think of this as a restricted demand problem where the consumer does not observe P_h and choose H, but rather is offered H and can choose to pay for it or not. Therefore, P_h is replaced with H and the expenditure function takes the following form

$E^* = E(H, P_q, U)$……4
In this restricted case, the WTP for water, or improved water services is simply the difference between two expenditure functions with $H_1 > H_0$ and the compensating surplus welfare estimate can be derived from this difference.

$CS(H_0, H_1) = E(P_q, H_o, U_o) – E(P_q, H_1, U_o)$…….5

This estimate of compensating surplus is a measure of the willingness to pay for water services in the home. It is the amount that each household is willing to give up and still remain at the previous utility level before the change. One can then infer that this WTP for improved water service is a function of not only the cost of service, but also a host of socioeconomic, demographic, and attitudinal characteristics of the household, which can be represented by g in the expenditure function.

$CS(Ho, H_1) = E(P_q, H_o, U_o; g) – E(P_q, H_1, U_o; g)$……6

3.2 Analytical technique

This study employed a number of analytical tools based on the objectives of the study. The tools are:

- Descriptive statistics such as frequency, mean, standard deviation and percentages for socioeconomic variables
- Household Demand Function for Water-Use using GLM (Generalized Linear Model) Regression Analysis
- Logit Regression Model for Determinants of Willingness To Pay for Improved Water services

$Y = a + b_1X_1+b_2X_2 +b_3X_3+b_4X_4 +$…… bnXn + u……8

Y = Household water use in liters per day
X1 = Connection charges (Naira/month)
X2 = Household size
X3 = Household income (naira/month)
X4 = Distance to water source (Km)
X5 = Availability and Quality of source
X6 = Unit price paid (Naira per litre)
X7 = Educational level
X8 = Age of Household head (year)
X9 = Gender (male=1, o= otherwise
X10 = Marital status (married =1, 0 = otherwise)
bi – bn= parameter coefficient
u = error term

Willingness To Pay for Improved Water Services

The logistic model will be use to estimate the effects of independent variables (household socio economic characteristics and income) on the dependent variable (WTP)
The basic logit model is specified below:

$$L_1 = \left(\frac{P1}{1-P1}\right) = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + \cdots \ldots\ldots\ldots\ldots b_nX_n + u \ldots\ldots\ldots 9$$

Where

$$L_1 = \ln\left(\frac{1}{0}\right) = If\ \ houshold\ is\ willing\ to\ pay\ for\ improved\ water\ services \quad \ldots\ldots\ldots\ldots 10$$

$$L_1 = In\left(\frac{0}{1}\right) = if\ household\ is\ not\ willing\ to\ pay\ for\ improved\ water\ services \ldots\ldots 11$$

$X_1 – X_n$ = Explanatory variables
$b_1 - b_n$ = parameter coefficients

4. RESULTS AND DISCUSSION

Table 1 reveals the socioeconomic characteristics of the respondents in the study area. The results show that majority (70.4%) of the respondents falls within age group 41 to 60 years. This is the active and working population implying economic age group, This indicates that the respondents will welcome improvements and will be willing to pay for improved water services. However, 96.7% of the respondent are married and majority are female., The results show that majority of the respondents (87%) are educated and 17% have no formal education. This indicates that the respondents will be receptive to innovations and will be more willing to pay for improvement of water services because they would appreciate the importance of safe water for improved health condition. This result is in line with the findings of Adepoju and Omonona (2009) that education influences household willingness to pay for improved water supply service. The result shows that majority (60%) of the respondents are traders while23.6% and 10.2% are artisanal, and civil servant respectively.

As shown in Table 2, 64.8% of the respondents derived their water-use from private piped/borehole and 18.5% from public piped while 16.7% from well. On the other hand, majority (64.4%) of the respondents preferred public piped and 30.1% preferred borehole water. 5.6% of the respondents, however, preferred well water over other water sources. This is an indication that the respondents in this study area are enlightening populace who knows the quality and essential of good water source. Over thirty-five per cent (35%) of respondents adduced quality as reason for their preferences for sourcing water from improved sources while 33.3%, 18.5% and 12.5% gave convenience, availability and cost respectively as reasons for their preferences. .The source of water being use presently by the respondents shows that private piped (borehole) constituted the highest percentage (46.8%), followed by community based water project (37.3%), family owner (13%), public piped own by government

(3.3%). This analysis shows that government presence in the study area is little being felt which should not be in reality because water is an essential services that any government should put as a top priority of its cardinal programme for her citizens. The study also revealed that 93.1% of the respondents trek more than 30 minutes to fetch water on daily basis and 5.6% of the respondents trek more than an hour to water source. This shows that water fetching in this area are tasking and can result in frequent illness of the young ones who are responsible for fetching water. This result corroborated with the findings of Gbadegesin and Olorunfemi (2007) that a great deal of time and energy is spent fetching water in the rural areas in Nigeria and that more than half of the total number of respondents spend less than one hour fetching water daily.

As regards who's responsibility is to fetch water in an household, results show that female children bears the burden as it constituted 53.2%, women folks 26.4% and male children 18.5%. This analysis represents a typical southwestern Nigerian culture where female are saddled with house-upkeeps task while male are to work and provide income for the family. The results further show that on average, 150 liters of water are being used per household per day at a cost of N10/25lt jerrican. This provides an estimate that a household in our sample is spending an average of N60 (US$0.38) per day on water-use which is equivalent of N1,800 (US$11.5) per month. However, the connection charges on public piped in this study area is between N1,000 (US$6.4) for bungalow building and N1,500 (US$9.62) for a storey building. This gives credence to the reasons why majority of the respondents preferred public piped. The result revealed further that majority (58.3%) of the households were dissatisfied with the current water supply situation, 88.9% of the respondents gives their support for an improvement in water services in the study area. While 87.4 % express their readiness to pay for an improvement in water services, the remaining 12.6% were indifferent doubting the sincerity of government to undertake any improvement on the current water supply situation.

Table 3 revealed the result of the house water use demand model. The R^2 value of 0.58 implied that the explanatory variable included in the model were able to explain 58% of the variability in the house water use demand. The F-test shows that the overall model is significant at 1% level, and the Dubin Watson value of 2.280 shows the absence of autocorrelation.

The result shows that household water-use demand is being influenced by connection charges household size, distance to water source ,availability and quality of water source ,unit price paid per litter and marital status This implies that a unit increase in connection charges, quantity demand of water use will increased by 12%. The implication might be because of improvement in ease of getting the water to their home, better quality of water and government policy that increases the purchasing power of consumers, The coefficients of household size and availability and quality of good water source are positively signed and statistically significant. This implies that a unit increase in household number will result in 37.2% increases in water usage, whereas, availability and quality of good water source will increase water demand by 20.4%. The result revealed further that a unit increase in price paid per litre of water will lead to a decrease of about 0.1% in the quantity of water demanded for daily use. The price elasticity of demand for water is normally negative because the demand curve is downward sloping, which means that an increase (decrease) in price is expected to lead to a reduction (increase) in demand. It is important to note that our demand function analysis here is based on demand for water from all sources. It is thus expected to yield inherently lower price elasticity than in a source specific. The relatively low price elasticity of demand in this analysis is a reflective of the prevailing water supply situation in the study area

On the otherhand, the coefficient of the distance to water source has negative sign and significant. This implies that a unit increase in the number of hour spent to reach the source of water supply reduced demand by 28.1% . The result indicates that households place a very high value on the opportunity cost of their time. This result support the findings of Agbemolege and Odubanjo (2001) that the rural dwellers had to reduce their rate of water consumption as a result of having to trek long distance before getting safe water supply.

Table 4 presents the result of the household willingness to pay for improved water services. The results show that marital status, education, connection charges, household size and income significantly influenced household's willingness to pay for improved water services.

However, being married enhances willing to pay for improved water services because the daily water consumption of household will increase as more people are added to an household. Also, educational level of the households increases their awareness and exposure level, thus they will be more receptive to policy that lead to improved livelihood and welfare. This result corroborated the findings of Haq et. al., (2008); Adepoju and Omonona (2009) that education level has direct relationship with willingness to pay for safe drinking water. The connection charge is also positively correlated and significant with household willingness to pay. This implies

that the household will be willing to pay improved service if they were sure their lot or situation will be better off with new water regime. This would not only reduce the drudgery associated with water fetching but also reduce per capita expenditure on water on daily basis. The Household size coefficient has positive sign and significantly influenced the willingness to pay for improved water services. The implication of this is that as household increases in number their water need will increase hence; per capita expenditure on water also increases.

However, income is negatively correlated and statistically significant at 1%. The marginal impact of income is negligible implying that regardless of the amount of wage earned by these societies they were willing to pay for the improvement of water services in their area. This shows the degree of need for public piped in the study area. This result corroborated the findings of the Mu et. al., (1990); Cairncross, (1990); World Bank, (1995) that even low-income consumers are willing to pay for the service they want. This confirms that willingness to pay for any service is the foundation of the economic theory of value.

5. CONCLUSION AND RECOMMENDATION

The study finds that households' water supply situation is majorly constituted by private piped/borehole, public piped , and well . However, the households were dissatisfied with the current water supply and their preferred sources are public piped followed by, private piped/borehole and well water . These preferences of choices was determined by quality , convenience , availability and cost . Also majority of the household trek more than 30 minutes to fetch water daily and women folks were responsible for fetching water. The results revealed further that on average, 150 liters of water are being consumed per day by an household and the per capita expenditure per day is N60 (US$0.38).

When presented with improvement options, majority (88.9%) of the respondents gave their support for an improvement in water services in the study area. While 87.4 % express their readiness to pay for an improvement in water services, 11.1% of the respondents said they were not ready to pay . The households' water demand situation was analysed using generalized linear demand model; it was found that household water-use demand is being influenced by connection charges, household size, distance to water source, availability and quality of water source, unit price paid per litter, and marital status.

Regarding the household willingness to pay for an improvement in water services using logit regression model, results show that marital status, education, connection charges, household size and income were the determinants of the household willingness to pay for improved water services in the study area.

Based on the findings above, we recommend that the government and other donor agencies should facilitate the improvements of public water utilities in this area by increasing the availability of public piped to cover all the sub- zones of Ijebu Ode and its environs. This will guarantee the good health and safety of life of the populace.

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APPENDIX

Table 1. Socioeconomic Characteristics of the Respondents

Variable	**Frequency**	**Percentage**
Age (yrs)		
< 40	12	5.6
41-50	68	49.1
51-60	84	38.9
>60	14	6.4
Marital		
Married	196	96.7
Single	20	9.3
Gender		
Male	100	46.2
Female	116	53.8
Education		
Informal	28	13.0
Primary	24	11.1
Secondary	103	47.7
Tertiary	61	28.2
Occupation		
Trading	131	60.6
Civil servant	34	15.8
Artisanal	51	23.6

Table 2. Choice and Sources of Water Supply

Available sources	Frequency	Percentage
Public piped	40	18.5
Borehole	130	60.2
Well	36	16.7
Stream/River	10	4.6
Preferred Source		
Public piped	139	64.4
Borehole	65	30.1
Well	12	5.5
Stream/River	-	-
Reason for preference		
Availability	40	18.5
Quality	77	35.6
Cost	27	12.5
Convenience	72	33.3
Source of water use presently		
Public piped	24	11.1
Borehole	109	50.5
Community	80	37.0
Fed. Govt	03	1.4
Distance to source		
30mins - 1hr	201	93.1
1hr – 2hr	12	5.6
>2hrs	3	1.4
Who fetch water on daily basis?		
Male children	40	18.5
Female children	115	53.2
Mother	57	26.4
Husband	4	1.9
Quantity fetch per day		
50lt – 100lt	164	75.9
101lt – 200lt	43	19.9
>200lt	9	4.2
Satisfies with current water supply		
Yes	90	41.7
No	126	58.3
Support an improvement in water services		
Yes	192	88.9
No	24	11.1
Ready to pay for an improvement		
Yes	188	87.0
No	24	11.1
Indifferent	4	1.9

Table 3. Result of the Household Water Use Demand : Generalized Linear Model Regression

Variables	Coefficients estimate
Connection charges for public piped	0.012**(0.006)
Household size	0.312*(0.099)
Household income	1.35E-0.006(0.000)
Distance to water source	-0.281**(0.174)
Availability and Quality of source	0.204*(0.067)
Unit price paid for private piped	-0.001*(0.000)
Educational level	0.089(0.076)
Age of Household head	0.036(0.011)
Gender	0.749(0.169)
Marital	0.877*(0.079)
Constant	3.133*(0.694)
R^2	0.55
F – ratio	6.104*
Durbin Watson	2.280

Table 4. Result of Logistic Regression Analysis

Dependent variable: Probability of "willing to pay" for improved water services relative to "not willing to pay"

Independent variables	Co-efficient estimate
Age	0.190805
Gender	0.87437
Marital	0.1924**
Occupation	-0.32163
Education	0.1655**
Connection charges	0.3157*
Household size	0.0136*
Income	-0.00095*
Distance to water source	-0.0820**
Satisfaction with current water source	0.1622
Constant	0.3620**
Log likelihood	-117.65245
Number of observation	216
LR Chi2(20)	144.39
Prob > chi2	0.0000
Pseudo R^2	0.3803

Note: * significant at 1%, ** significant at 5%

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