Assessment of Water Vending and Willingness to Pay for Improved Private Water Service within Kano Metropolis, Kano State-Nigeria

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Abstract: **The imbalance in the water infrastructural development, population explosion and rapid urbanization rate has created a serious deficiency in the quantity and quality of water being supplied by the public utility in Nigeria over the years. The scope, severity frequency and indeed complexity of this scenario have led to emergence of water vendors of varying degrees operating mostly in the urban and semi-urban areas of the country. Despite widespread recognition of the importance of water vending, the phenomenon has not received significant empirical researches in the academic literature. This work therefore assessed water vending and willingness to pay for improved private sector water supply within Kano Metropolis, Kano State-Nigeria. The study used primary data collected via questionnaires from 731 households using multi-stage sampling techniques and used both descriptive statistics and Tobit regression to analyze the data. The findings reveal that most of the respondents (80.16%) relied on informal water vendors as the major source of water for domestic consumption. Furthermore, significant percentage (90%) of the respondents expressed willingness to pay for the improved water supply system and reported the sum ₦1,119.51K equivalent to $3.11 of US dollar as mean willingness to pay. The Tobit regression result identified household income spent on water, average daily quantity of water consumed by household, average income of head of household and quality/absence of water supplied by public utility were found to be statistically significant in influencing households' willingness to pay for improved private sector water supply within the study area. The study recommends that there is need for effective regulation and inspection of small-scale water enterprises and informal water vendors by both NAFDAC and state ministries of water and Health; more intervention by both donors and non-governmental organizations NGOs in providing water to the urban population; and investment by organized private sector through Public Private Partnership PPP in the water industry as currently practiced by Lagos State Government, among others.**

Key Words: **Private Water Vending; Willingness-to-Pay; Tobit Model; Kano, Nigeria.**

I. INTRODUCTION

Access to portable water is not only a fundamental human right as advanced in Dubliner Convention 1952 but also facilitates the process of poverty reduction, economic growth and sustainable development. But as population, urbanization and indeed industrialization increases, the underlying challenges confronting municipal authorities especially in under-developed and developing countries have also increased in scope, severity, frequency and complexities. One of these challenges is their inability to provide this basic need of life (water) in both adequate quantity and appropriate quality. This has led to the emergence of private water vending of varying degrees (formal and informal) operating mostly in the urban and semi-urban areas of those countries that identified the huge public water deficit as investment opportunity.

Globally, about 785 million people lack access to basic drinking water service and at least 2 billion people use a drinking water source contaminated with faeces which a major source of water borne disease such as cholera, diarrhea, typhoid, hepatitis, among others (WHO, 2019).

The United Nations University Institute for Water, Environment and Health UNUIWEH (2017) reported that the global water crisis would increase where its projected that about 40% of the world's population will be living in seriously water-stressed areas by 2030; and the inability of the ecosystem to recreate fresh water supplies will become greatly compromised. This has made UN agencies, governments and civil societies to start thinking of alternative approaches to water so as to reverse these sobering water trends. They have realized that there is need to face the crisis in an intelligent and integrated way so that water will continue to support life, development and biodiversity for current and future eco-systems.

The current water demand and supply in Kano state is not at equilibrium because the state cannot adequately supply water to its population. The total water demand of the state (going by the WHO standard of at least100 litres as per capita water consumption for urban settler) is about 1.3 billion litres per day (bld) but the supply by the government utilities on the other hand is just 350 mld meeting just 26.76 per cent of its total daily requirements with over 73.24 per cent as deficit or excess demand. The total water demand within the metropolitan areas is about 757 mld but the available supply is only 250 mld, meeting only 33.03 per cent of the total water

demand (Kano State Ministry of Water Resources, 2017). It is evident that the demand for water far outweighs it supply. This justifies that the government alone cannot satisfy the demand of the general public. Table 1 gives the summary of both the available demand and supply of water within the State.

Table 1: Water Demand, Supply and Deficit in Kano State

Spatial unit	Demand (mld/bld)	Supply (mld)	Deficit (mld)
Kano metropolitan	757	250	507
Rest of Kano	550	100	450
Total	1,307	350	957

Source: Kano State Ministry of Water Resources, 2019 and calculated by the Researcher using the WHO standard.

It is very evident from table 1 above that Kano metropolitan demand for water is more than the rest of Kano state which mostly are rural based. The main reason could be attributed to the concentration of industrial and commercial activities which consume large quantity of water for their normal operation. Most of these industries such as tanneries, food and beverages and agro alliance industries use much water. Commercial activities such as markets, banks and hotels also need much water. Likewise the life style of city residents is linked to too much water consumption than those who live in semi-urban areas and villages.

Consequently, private individuals such as the commercial water vendors who mostly use carts and jerry-cans to supply water in high density residential areas. Majority of these water vendors collect water from boreholes and sell it to public at the average rate of 20-30 NGN per 25 litres depending on the distance from the source of water supply. Furthermore, there are several operators who deliver water to large consumers through the use of water tankers. It is against this back drop this study investigates private water vending and willingness of the sampled population to pay for improved water supply.

II. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

According to Olajuyibe *et al.* (2012) defines water vending as an informal out-of-pipe water distribution with the carriers, distributing vendors, usually employing some forms of transport, with manual or animal-driven vehicles typically catering to the better-off households in low-income areas, and motorized vehicles (tankers) typically serving higher-income low-density areas. The actors are all private and driven by motives of profit or income-generation. In line with their definition, this research conceptualizes water vendors as informal private individuals popularly known as *mai ruwa* who buy water using trucks, pushcarts and jerry-cans mostly from private bore holes at fixed charged price and re-sell it to the final consumers on a *door-to-door* service base. It also includes small-scale private films that produce package water in mostly 50-75 CL sachets and sell it to consumers as potable water.

A critical reviewed of relevant pieces of literature established that there are no significant researches of private water vending and willingness to pay for improved water supply within Kano Metropolis, Nigeria.

Ishaku, Peter and Dama (2010) who investigated the role of private water vending in Nigerian Peri-Urban informal settlements of Yola North in Adamawa state of Nigeria using a field survey method in the area with of which 100 households were sampled in each of the three informal settlements. Namely: Sabongari-University Village, Vinikilang and Wuro-Jabbe. The survey solicited for response concerning household water sources, water per capita use and household size. The findings revealed that about 92% of respondents in Sabongari-University, 66% in Vinikilang and 87% in Wuro Jabbe depend on vended water from bore holes, hand dug well, as well as surface water sources which are delivered by hand push trucks. This was attributed to the absence of piped water networks in the study area. It was recommended that the public agencies should evolve specific programmes for regulating informal settlements, improve service provision to meet the poor informal dwellers, among others.

In a related research, Olajuyigbe *et al.* (2012) did a research on the role of water vending in household water supply delivery a case study of FESTAC town Lagos, Nigeria. The study surveyed a total of 1,139 and 57 households and vendors respectively using simply random sampling technique. The result showed that there are two main categories of water vending namely; formal and informal vendors. All the formal vendors obtained their supplies from improved sources and while most informal vendors obtained their supplies from unimproved sources. Majority of the households consider vended water as a coping strategy since they are aware of safety implication. Therefore, most households are willing to pay for water services.

Asenso-Boadi and Vondolia (2013) also conducted a study on private sector participation in the provision of quality drinking water in Ghana's urban areas: *(are people willing to pay?)*. The research used primary data as source of data and employed the use of Contingent Valuation Method (CVM) to assess their willingness to pay. Certain characteristics of respondents such as income, sex, education at level, occupation, marital status, and how they ranked improvement in water provision by private sector were key variables for the researchers' model. The finding of the study reveals that the main source of water within the study area is the private sector and the water supply was of good quality (potable) in the sense they could drink it right without any further treatment. It was also established that income level of the households was a key determinant of the bid quoted in support of water privatization debate in Ghana. Private sector engagement in water provision has improved quality but

however has not increase access to water supply among the poor. It was recommended that government programme that increase access to water for low income households should be encouraged, among others.

While reviewing a case study specific literature by narrowing the empirical review to the study area, Bello and Tuna (2014) use secondary data from the several institutions that are related to water supply in Kano State to evaluate factors responsible for potable water demand and supply in the state. The data collected was analyzed using simple statistical techniques such as percentages. The result established that geographical characteristics such as climate, precipitation, soil type, vegetation cover, dams, population, agriculture and industry were the main factors responsible for potable water demand and supply in Kano State. The research concluded that the water supply in the state do not meet the demand due to the problems such insufficient number of water treatment plants, power failure and shortage of fund.

On the same note, Tasi *et al*. (2016) while assessing water supply situation in Rural Areas of Kano State, Northern Nigeria sampled sixteen rural villages and interviewed 394 respondents. Their study employed simple percentages as tool for the analysis of the data collected. The result indicated that open well was the common source of water in the rural villages of Kano with 41.4% of the total responses. In terms of usage of the water, reservoir recorded the highest responses of 30.7%. It was also established that 60.7% of the respondents were of the opinion that drinking water was inadequate in the rural villages of the state. The research findings attributed that 39.9% of the respondents said the water sources were controlled by individuals and most of the users obtained their water in less than 500 meters' trek distance according to 67.8% of the respondents. In view of their findings, they strongly recommended that government, nongovernmental organizations, wealthy individuals and community should provide more boreholes and hand pumps in the study area to avoid drinking of untreated water supply.

In a similar vein, Ndaw (2016) look at private sector provision of water supply and sanitation services in rural areas and small towns in developing countries such as Bangladesh, Colombia, the Philipines, Uganda, Cambodia, Niger and Senegal. The methodology for the study was content analysis (documentary evidences) from the countries selected. It was revealed that low densities, low income, lack of institutional capacity, availability of alternative water sources were factors that discouraged private sector investment (provision) of water supply and sanitation services within the selected case study. He recommended that there was need for institutional support, assisting and improving access to finance adequate provision of public goods; design a sustainable subsidy scheme that will ensure affordability while allowing for financial sustainability of service provider and assisting the local champion and other relevant institutions to implement a PPP pilot project.

While investigating the sustainability of domestic water supply driven by informal water vendors in Dar es Salam, Tanzania, Dakyaga *et al*. (2018) drawing on suppliers-consumers' perspectives analyzed the capacities of the informal water supply and how the informal market operates. Four different data sets were comparatively analyzed from interviews with water engineers and World Health Organization (WHO). The available evidence from the finding was inclusive, yet sufficient to conclude that informal markets are not automatically predatory often satisfy crucial needs that may be beyond the ability and capacity of conventional water utilities.

Ayanshola *at el.* (2013) who conducted a research on the evaluation of willingness to pay for reliable and sustainable household water use in Ilorin, Nigeria and used cross sectional survey to obtain data on household water use and WTP for a reliable water supply. Stata/SE 8.0 and Microsoft EXCEL software were employed to evaluate the variables that affected WTP for improved household water use such as demography and adequacy of existing water system. Contingency Valuation Method was adopted to analyze the WTP for reliable and sustainable service delivery. The findings of the study revealed that approximately 70 per cent of total sampled households were connected to municipal supply out of which 13 per cent indicated satisfaction in terms of sufficiency and 87 per cent used alternative sources to argument water supply inadequacy, consumers were willing to pay an average sum of ₦737.22K per month for improved water supply services. The result of their *Tobit* model revealed that gender, water quality and household income level have significant impact on WTP at 5 per cent level of significant. The study therefore recommended among others, that there was need to put in place a framework to enhance improvement of system reliability and sustainability. They conclude that the water supply in the city of Ilorin was grossly inadequate and the people were not satisfied with the present supply.

In a related research, Abdul Wahid and Kah Hooi (2015) in their work investigated factors determining households' willingness to pay for water consumption in Malaysia. The study investigated whether taste, filtered water, colour, water contamination, drinkable tap water, customer services, uninterrupted water supply and income determine Malaysia consumer's willingness to pay (WTP) for their household water consumption. A survey was carried out on more than 262 representing households who are also paid domestic water consumers. Multiple regression analyses results showed that only four from the eight factors examined were significant and acted as determinants to WTP. These were taste, uninterrupted water supply, water contamination and income. They study also found that majority of households consumers are only willing to pay for increase of not more that RM5 from their water bill.

While reviewing related literature from other African countries, Mezgebo and Ewnetu (2015) in their work at

Nebelet town in Ethopia assessed the households' willingness to pay for improved water services in urban areas. The research used cross-sectional data that was collected from 181 households in 2011/2012 and used Contingent Valuation Method for the analysis of the data collected. The *probit* model identified socio-economic factors such as regular interruption, delay in maintenances, irregular/erratic availability of public water supply, the price charged per unit, the unequal treatment of households while collecting water at the public were found to be pressing water problem existing in the study area. The descriptive analysis result showed that about 96% of the sampled households were willing to pay for the provision of improved water service. The *probit* model confirmed that income, distance, water expense, bid, education, level of existing water satisfaction, marital status and sex were associated with willingness to pay for the provision of improved water services. In designing water project/policy, socio-economic factors such as age, monthly income, and educational level should be considered for successful water project/policy at household level, the study recommended.

Tussupora *et al* (2015) also investigating consumers' WTP for piped water supply in Pavlodar Region, Kazakhstan also used Contingent Valuation Method(CVM) but with different starting point bids. The results showed that households with access to groundwater (well or borehole water uses) perceived this as of good quality. Consumers without access to ground water used open-source, standpipe or delivered water for which they had to travel and spend time or pay. Open source water and stand pipe water quality was perceived as bad or satisfactory. More than 90% of the consumers were willing to pay for better water quality and regular water supply. The mean WTP was estimated to be about 1120 in bids and about 1590KZT per household per month in open-ended question format (150KZT~$1 as of January, 2012).

In a related study, Salahudeen (2015) investigated the role of water vendors in domestic water supply in Nassarawa Local Government Area (LGA) of Kano State, Nigeria. Both systematic and purposive sampling techniques were used to select the sampled areas in the study area as well as the respondents. A total of three hundred and eighty-four (384) respondents were sampled, out of which two hundred and eighty-four (284) residents and a hundred (100) water vendors were sampled respectively. The study showed that majority of the vended water was sourced from outside Nassarawa LGA and mostly from shallow well/stand pumps located at the extreme north western part of the study area bordering Fagge, Ungongo and Kumbotso LGAs which is a 3-4 KM away from Nassarawa LGA. It was further established that majority (64.1%) of the residents within the study area patronized the services of water vendor. It was also found out that most of households (51%) are not connected to pipe borne water network connection. Among those connected, majority (45.3%) received duration of water flow from the tap between 1.5-6 hours daily. Challenges identified are lack of water quality guarantee, high charges from vendors and lack of guaranteed services of vendor.

Wutich *et al* (2016) also examined the role of informal water vendors in the urban poor's effort to secure safe and affordable water in the squatter settlements of Cochsbamba, Bolivia. Their study used an economic of justice framework to evaluate how informal water markets operate, differences in client and vendors' perception of distributive, procedural, and interactional (in) justice, and how cooperation among vendors impedes or assists in achieving justice in water delivery. The research included a comparative institutional analysis of three key data sets: long-term participant-observation in water-scarce squatter settlements; interviews with 12 water vendors; and interviews with 41 clients from 23 squatter settlements. The study established that informal water vendors organized themselves to safeguard distributive justice (e.g., fair pricing, good water quality), but clients are distressed by procedural and interactional injustice (e.g., unreliable and inequitable service). Their research showed that unionized vendors are more effective than non-unionized vendors in creating and enforcing rules that advance distributive, procedural, and interactional justice.

On a similar note, Ahmad (2016) assessed the role of water vendors in water service delivery in developing countries: a case study of Dala Local Government, Kano, Nigeria. The research included cross-sectional mixed method in which questionnaire survey was administered to 218 households; and interviews and Focus Group Discussions FGDs were conducted with water vendors. Findings revealed that water vendors supplied most households irrespective of season. Retail vendors buy 25litres at ₦4.00k ($0.013) from wholesale vendors and resale at ₦20.08 ($0.07) during dry season and at ₦14.02 ($0.05) in wet season. The price is 28 and 40 times the cost of in house connection from Kano State Water Board (KNSWB) during rainy and dry seasons respectively. Vendors who buy from hand-dug wells pay ₦100.00 ($0.33) per day and draw as much water within the day. Furthermore, WTP for in-house connection was elicited at ₦367.00k ($1.20), lower than monthly flat fixed tariff set by KNSWB. The study recommends recognizing vendors formally in form of Public Private Partnership so that technical and financial support be given, thus their activities and charges be regulated. The study also recommended further research to focus on estimating total volume of water supplied by water vendors.

In another related study, Abubakar (2016) analyzed the determinants of willingness to pay for improved portable water supply in Kano metropolis. The study used primary data as the major source of data of which a multistage random sampling technique was adopted to collect information from 3,735 households that were connected or not connected to the public water services. The technique for the data analysis was a logit model-based contingent valuation. Evidence from the

logit model indicated that the mean monthly willingness to pay for portable water supply was ₦1,358.60k. the result further showed that households monthly expenditure, age, vendor price, educational qualification, household size and percentage of household income willing to pay for improved portable water supply are significant factors that influenced the household's willing to pay for improved portable water supply services. Lastly, the study recommended that government and policy makers in the water supply agencies should ensure the provision of up to date water infrastructures. This according to Abubakar would help to transform the old rudiment any system of transporting, filtering and distributing the resource to a more efficient form among others.

Furthermore, Tolulope *et al.*(2018) examines WTP for improved water supply in Owu Local Government Area of Ondo Sate, Nigeria in which data were collected from 256 households via multi-stage sampling approach from eleven political wards in Owo. The data were analyzed using both descriptive statistics and logistics regression analysis. Results show that 43% of the residents obtained water from the public utility, while 20.3% and 18.8% obtained water from well and boreholes respectively. Majority of the residents representing about 70.3% were dissatisfied with unreliable water services but were willing to pay for improved water supply (74.90%). Residents were willing to pay an average sum of ₦1,617.64K (US$4.5) per month for improved water services. The result of logit regression analysis revealed that gender, frequency of water, education, households' 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.

The study adopts Hedonic price model in Cost Benefit Analysis CBA as the theoretical framework of the research. This was adopted because of its usage in evaluating economic value of environmental goods such as noise, air or water quality, and landscape. The use of this approach is of particular interest in the field of environmental valuation as it can be assumed that the values attributed to natural resources are attributes of commodities which are sold on the market and since water poses the extreme features of both public and private goods.

III. METHODOLOGY

Cross section household's survey was used to collect data across seven-hundred and thirty-one (731) households using multi-stage sampling techniques but with specific interest on purposeful;, stratified proportionate and systematic sampling techniques to collect qualitative data using electronic Owner's Data Kids (ODK).

In the first stage, purposeful sampling technique was used where four local government areas-Dala, Kano Metropolis, Nassarawa and Ungogo- were carefully selected as the first four most densely populated Local government areas within the metropolitan. The second stage of the sampling technique considers certain socio-economic features of the residents such as income and population density for the selection of wards using cluster and stratified sampling techniques. That is, the questionnaires were distributed in the proportion of 5:3:1 in low income/high density, medium income/medium density and high income/low density residential areas respectively. Systematic random sampling technique was finally used in the selection of number of households at 20^{th} interval in low income/high density, 10^{th} interval in medium income/medium density and 5^{th} interval in high income/low density residential areas.

Both descriptive and Tobit regression analysis were adopted in analyzing the data that was collected. Water lies between the two extreme of purely public and private goods; acknowledging the nature of the good, one does not know how much monetary value people attached to water service for the private supply. The study while assessing the extent of households' willingness to pay for improved Private Sector Water Service (SSPSWS), adopted the empirical model of Wendimu and Bekele (2011) who used contingent valuation method to assess the determinants of household of individual willingness to pay for quality water supply (a case study of Wonji Shoa Sugar Estate, Ethopia). Consequently, the empirical model for this study is presented in table 2 below:

Table 2: Definition of Research Variables for Objective (ii)

S/No	Variable label	Variable Code	Expected Sign	Definition of Variables
1.	MWTPSSIWS	Y	Dependent variable	Willingness to Pay for Private Sector Water Supply by household (Yes=1 if water supplied by private sector, 0 if otherwise). This was followed by the proposed amount of money individual are willing to spend on private water per month.
2.	AILHPM	X_{1i}	+	Average Income Level of Household Per Month
3.	PQPWS	X_{2i}	_	Present Quality/availability of Public Water Service (Rank from 1-5) based on the responses.
4.	ELHH	X_{3i}	+	Educational level of Head of Household
5.	OHH	X_{4i}	+	Occupation of Head of Household (1 if Head of Household is a fixed income earner or any formal occupation, 0 if otherwise).
6.	PIYCH	X_{5i}	+	Presence of Infants or Young Children below 12 years of age in the House (1 if present, otherwise 0).
7.	SH	X_{6i}	+	Size of Household (Proxy by numbers of people living in the household)

8.	QWCPDH	X_{8i}	+	Quantity of Water Consumed Per Day in a Household (Measured in Litres or drums)
9.	AVMISW	X_{9i}	+	Average Monthly Income Spent on Water
10.	PHMIWPPSW	X_{11i}	+	Percentage of Household Monthly Income Spent on Private Sector Water Consumption

Source: Author's Empirical Model.

IV. RESULT PRESENTATIONS AND KEY FINDINGS

This section presents the result of both descriptive statistics, Tobit regression model which was presented on table 2 above and explains their respective economic implication.

Table 3: Major Sources of Domestic Water for Household

Source of Water	Frequency	Percent	Cumulative
Public Utilities	55	7.52	7.52
Household Effort	90	12.31	19.84
Water Vendors	586	80.16	100.00
Total	731	100.00	

Source: Outcome of Author's Reconnaissance Survey, September, 2019.

The descriptive statistics estimated using STATA 14 from table 3 above established that about five hundred and eighty-six (586) respondents representing 80.16 per cent of sampled population relied on water from vendors as their major source of water for domestic consumption. While as 7.52 per cent depends on public utilities and 12.31 per cent have either personal boreholes or wells and fetching water from neighborhoods as their major sources of water for domestic uses. This by implication suggests that for every ten (10) households within the study area, eight (8) depend on water supplied by small-scale vendors; while as the remaining two (2) households relied on personal sources and/or public water utilities. This result has no significant differences with the findings of Tasin *et.al* (2016) who assessed the water supply situation in the rural area of Kano State where he reported that about 60.7 per cent of the households surveyed reported buying water from the vendors, Coster and Otufale (2014) also reported 64.7 per cent of private pipe/borehole supply in Ijebu-ode Local Government Area, Ogun State. Furthermore, Venkatachalam (2015) established that informal water markets do play an important role in fulfilling poor households' drinking water requirements in major cities in India. It was also reported by the World Bank (2017) that Nigerian Government provided clean water to fewer than 10 per cent of its city dwellers in 2015. The report further reveals that most of them drink water from sachet, bottle water, taps, wells and boreholes, depending on the location.

Table 4 below presents summary of socio-economic characteristics of the respondents that were used to estimate the Tobit regression model.

Table 4: Summary Statistics for Model II

Variable	Observation	Mean	Std. Dev.	Min	Max
Willingness to Pay	731	.9083447	.2887363	0	1
Family size of Household	731	7.760602	4.381328	1	30
Present of Infant in an Household	731	.8686731	.3379888	0	1
Occupation of Head of Household	731	3.095759	1.404151	0	5
Educational Level of Household	731	2.351573	1.260923	0	4
Percentage of Household's Income Spent on Water	731	4.895759	2.522304	0	25
Average Amount Spent on Water	731	1119.508	743.0884	0	5000
Average Quantity of Water Consumed by HH	731	210.3694	139.2067	0	1875
Average Income of Household	731	72426.81	47558.63	15000	350000
Quality of Water Supplied by Public Utility	731	.6402189	1.282323	0	5

Source: Outcome of Field Survey Computed by the Researcher, September, 2019.

Table 5: Tobit Regression Result

	Tobit Model	Tobit ModelB
model		
famsize	-0.007**	-0.011***
	(0.002)	(0.002)
prfant	-0.009	-0.000
	(0.027)	(0.028)
occup	-0.009	-0.015*
	(0.007)	(0.007)

edul	-0.007	-0.014
	(0.008)	(0.008)
pmipw	0.014***	0.015***
	(0.004)	(0.004)
awtp	0.020***	0.000***
	(0.000)	(0.000)
avqwcd	-0.03***	
	0	
qwspu	-0.024***	
	(-0.007)	
aveincome	-0.47*	
	0	
Constant	0.832***	0.800***
	(0.040)	(0.040)
Sigma Constant	0.243***	0.248***
	(0.006)	(0.006)
Pseudo		
R-squared	76.04639	86.72967
N	731	731
* p<0.05, ** p<0.01, *** p<0.001		

Source: Computed by the Researcher Using Stata 14, September, 2019.

Note: farsize=family size of household sampled, prfant=presence of infant, Occup=occupation of head of household, pmipw=percentage of income spent on water consumption per month, avqwcd=average quantity of water consumed per day, qwspu=availability and quality of water supplied by public utility, and aveincome=average income earn by head of household per month.

Table 6: Marginal Effect for the Tobit Model

variable |	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
Household size	-.007406	.00235	-3.16	0.002	-.012002	-.00281	7.7606
Present of Infant	-.0092925	.02729	-0.34	0.733	-.062784	.044199	.868673
Occupation HH	-.0089115	.00699	-1.27	0.202	-.022611	.004788	3.09576
Educational Level	-.0073594	.00796	-0.92	0.355	-.022967	.008248	2.35157
% Income On Water.	013784	. 00402	3.43	0.001	.005905	.021663	4.89576
Ave. amount on water	.0204872	.00151	13.54	0.000	.017522	.023453	11.1951
Ave. quantity of water	-.0285986	.0075	-3.81	0.000	-.043292	-.013905	2.10369
Ave. HH Income	-.4695726	.214	-2.19	0.028	-.889012	-.050133	.072427
Quality of Public	-.0244162	.00737	-3.31	0.001	-.038858	-.009974	.640219

Source: Computed by the Researcher, (September, 2019).

The descriptive statistics results are presented in Table 4 accounts for the data collected across the sampled households on factors such as family or household size, occupation of head of households, present of infant, educational qualification of head of household, percentage of household income spent on domestic water consumption, average daily expenditure on water, average daily quantity of water consume per day, quality of public water supply and average monthly income of household per month. The consideration of these factors was informed by both the available empirical literatures and perceived water situation within the study area.

About 90 percent of sampled population has expressed willingness to pay for improved private sector water service. In other words, they are willing to connect to a private water network that could supply them with more quantity of water within the study area. The Mean Willingness to Pay (MWTP) per month per the household was reported to be one thousand, one hundred and nineteen naira, fifty-one kobo (₦1,119.51k) only. This amount by implication is a reference point for any potential investors to consider while assessing the market situation in the water sector within the area under consideration.

A total of nine (9) explanatory or independent variables were selected in the Tobit regression analysis, out of which six variables- household size or family size, percentage of households' income spent on water, average daily quantity of water consumed by household expressed in litres, average monthly expenditure of household on water consumption, average monthly income of head of household and quality of public water supplied- were found to have significantly influenced the households' Willingness to pay for the hypothetical improved private sector water supply within the area under investigation. While as three (3) of the variables- presence of infants below the age of twelve (12), educational level of head of household and type of occupation of head of household- were found to be statistically insignificant as contained on tables 5 and 6 above.

Household or Family size as conceptualized for this study refers to the total number of people in a particular house and members depend on income of the head of household for consumption expenditure. This variable was found to be significant ($p<0.01$) but is negatively related to the dependent variable. This is not in line with the *a priori* expectation stated in the empirical model in chapter three. This suggests that

willingness to pay for an improved private sector water supply decreases as household's size increases. This might be due to the availability of labour force such as children and other dependents that collect water from other alternative sources such as fetching from neighborhoods and public/private taps as norms and culture of the society. Furthermore, there could be high opportunity cost of using income for improve water due to high demand for food and other necessities in such families.

The marginal effect result shows that when the family size of a household increases by one person, it will decrease the probabilities of willingness to pay for improved private water by 0.007. This finding is in line with the finding of Bekele and Wendimu (2011).

Furthermore, the percentage of household's income spent on water consumption was also found to be statistically significant ($p<0.001$) and with a positive effect which confirms the *a priori* expectation of the model. This means that household's willingness to pay for improved private sector water supply increase as percentage of household's income spent on water consumption increases. This is attributed to the fact that when more proportion of income is allocated to water consumption, household will begin to think of alternative means of water supply that could be both cost effective and efficient.

The marginal effect result indicates that when the percentage of household's income spent on water consumption increase by one, it will also increase the probability of willingness to pay for improved private water supply system by 0.014 all things being equal.

Average monthly of households' expenditure on domestic water consumption was found to be significant ($p<0.001$) and have a positive effect on willingness to pay for improved private sector water supply within Kano Metropolis. This suggests that for every household that pays more on water consumption is more likely to indicate interest or willing to pay for water supply. This may be in line with the reality that households who incur higher cost would be willing to pay more if provided with improved water service. This is similar to the research result found by Bayru (2014), Herath and Masayuki (2014) and Mezgebo and Ewnetu (2015) from their researches conducted on the households' willingness to pay for improved water service.

The result of the marginal effect suggests that if the amount of household's expenditure increases by one naira (₦1), the likelihood of willingness to pay for the improved private water service will also increase by 0.014 per cent while considering other factors to be constant.

However average daily quantity of water consumption per household is negatively correlated and statistically significant at 1 percent ($p<0.001$); this implies that has the amount of water consumption increases by households in the study area, their willingness to pay for the improvement of water services decreases with about 0.03 percent. The result is not in conformity with the *a priori* expected sign of the model.

Marginal impact of a litre increase in average per capita water consumption of the household will decrease the probability of their willingness to pay with 0.03 while considering other factors to be constant.

In tune with the above finding, average monthly income of household is negatively correlated but statistically significant ($p <0.05$) which does not conform to the theoretical expectation of the model. By implication, the marginal effect of 1 per cent increase in Household income could decrease the probability of willingness to pay with about 0.47. The result has a considerable inverse impact on the variable of interest (Willingness to pay for improved private water supply). This implies that as household's income increases, he/she may prefer better alternative sources of water like drilling personal borehole or connecting to public utility water system to paying more for improved private sector water supply. It was also established from the field survey that most households whom reported higher monthly income relied on personal boreholes as major source for domestic water.

Lastly, the quality of public water supply was established to be statistically significant at 1 per cent ($p<0.001$) and has a negative coefficient has predicted. By implication, if the quality of public water supply decreases, household's willingness to pay for improved private sector water system will increase.

The marginal effect of quality of public water system as contained on table 5 implies that if the quality of the water improves with 1 % the probability of willingness to pay will decrease with 0.024 all things being equal. Since government often subsidizes public water supply service, the price charged for water bill would be less than that of the private sector. Consequently, there will more demand for public water than privately supplied water system if there is an improvement in quality. But as the quality of water provided by public utility decreases, people will be willing to pay more for improved private sector supply.

Given the fragility of the Tobit model it is a good practice to test for distributional mis-specification and for consistency of the Maximum likelihood Estimates (MLE). Wald test was used to test for normal errors and correct specification of the functional form of the heteroskedasticity since most Micro econometricians use the same tests now because wherever possible fully parametric models are used (Cameron and Trivedi, 2005).

The Wald test results shows that there was no evidence of heteroskedasticity and the error terms are normally distributed for all the explanatory variables at p-value<0.001. This is an indication that the MLE is robust; in

other words, it is consistent, efficient and asymptotically normal estimator of the Tobit Model.

V. CONCLUSION AND RECOMMENDATIONS

The research concluded that significant population of the urban dwellers especially the poor population within Kano metropolis rely on small-scale private water vendors as the major source of water for their domestic consumption and expressed willingness to pay for improved private sector water provision services. Hence, the study recommends that Since large population of the urban poor of Kano metropolis relies on water vendors as the most dominant source of their domestic water providers, there is need for healthy promotion and adequate monitoring of small-scale water enterprises and informal water vendors to ensuring that adequate regulations of their operations by both NAFDAC and State Ministries of Water and Health so that the safety of both consumers and the eco-system are not compromised. Furthermore, there is need for the affected communities and government to build synergy with international donor agencies such as the World Bank, African Development Bank and Non Governmental Organizations (NGOs) in order to reprioritize their focus so that the urban poor could be integrated into their ongoing water provision projects that are mostly implemented in the rural communities in Nigeria. Lastly, the is need for organized private sector investment-through Public Private Partnership (PPP) such as concessional and/or *affermage* agreement(s)- in the areas of upgrading and expanding network of the existing public water system that could serve more population of the state. The amount for the mean willingness to pay and the factors identified will serve as a reference point for Cost Benefit Analysis by any potential investor(s) who is(are) interested in the water industry. This approach is more ecosystem friendly since the continues use of ground water in residential areas has the potential of exposing future generation to earthquake.

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