Determinants of Demand for Portable Water and Sanitation in Benue State, Nigeria

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Abstract

This study examined the determinants of demand for portable water and sanitation in Benue state, Nigeria. The study utilizes primary data generated through the administration of questionnaires to the respondents in the study area that comprises of the six (6) Local Government Area of the state, vis-à-vis Okpokwu, Ado, Ogbadibo, Oturkpo, Agatu and Ohimini respectively. The population of the study is 1,113,060 and the sample size of 400 was used. The study used Taro Yamane sampling techniques and the model for the study is Logit through systematic random sampling with the application of SPSS statistical package for social sciences. The results of the major empirical findings demonstrate that income of household head, local and ownership of dwelling unit are major determinants of demand for portable water and sanitation in Benue State. The findings also reveal that household size and gender averagely determine the household demand for portable water in Benue state, while the level of education exerted the least (negative) impact on demand for portable water in Benue state. The study therefore, concludes and recommends that income of household head, location of a household head and ownership dwelling unit are major determinants of demand for portable water in Benue State and that government should as a matter of urgency, extends the provision of pipe borne water to rural areas to improve rural dweller's chance of having access to portable water.

Keywords: Portable Water, Sanitation, Determinants and Household

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1. Introduction

It is not new that access to good water and sanitation via the means of waste disposal are essential needs of human endeavors. As a matter of fact, they are important elements of human development goals (HDGs) and poverty reduction as these constitutes component of primary health care (Adeolu, Adeoye & Ibrahim, 2018). Therefore, provision of adequate water and sanitation are sacrosanct to hygiene that tends to reduces mortality in the society. Furthermore, availability of water has been

identified as the key to the survival of all civilization that is why the international drinking water supply and other international declaration has recognized that access to water is a fundamental human right, and has the most obvious and direct benefits in reducing mortality and morbidity (WHO, 2019). As a result, the sustenance management of rural and urban water has become imperative for the survival of every society.

This is why Water Demand Management (WDM) is utilized to assist in shifting consumer attitudes towards sustainable water consumption behavior. It is in the view of this that the provision of clean drinking water is fundamental requirement for human consumption to reduce waterborne disease and promote economic and social development (Obilom, 2013). Otti, (2012) observed that poor sustainability of rural water supplies has been recognized for some time, and a number of management approaches have come and gone with the aim of addressing these problems. Despite this policy, an estimated 141 million people who live in urban areas and 743 million who live in rural areas contributed to rely on unimproved sources for their daily drinking water (UN, 2015). This demonstrates worldwide, that 84% of the people who have limited access to drinking water live in rural areas. It is therefore, against this background that this study is out to investigate the determinants of demand for portable water and sanitation in Benue state.

Benue state was created on February 3rd, 1976. It was one of the seven new states created by military administration headed by late General Murtala Muhammed. Since its establishment, Benue state Water Board (BSWB) under the state ministry of health and environment and natural resources has been the responsibility providing pipe borne water across major cities, villages and communities in the state and the Local Government Areas. But then, it has not had the capacity to meet up with the demand for portable water in the entire Local Government Area of the state. Therefore, there is still gap, thereby leading to seeking alternative means by citizens of the Local Government Areas and the Benue state at large. Also, in terms of sanitation, many communities or villages are still largely littered with open waste disposal and open defecation which are characteristics features of many villages or communities in the state.

However, the state ministry of health has made several policies to reduce these aforementioned challenges of portable water and sanitation in the state vis-à-vis open defecation, improper waste disposal, violation of sanitation rules etc when caught but then all efforts made by the concerned authority were not manifesting. There are other measures made by the Local Government through

BSWB which include expansion and extension areas of coverage in terms of water supply, constant renovation and construction of new drainage system across the Local Government Area and the state in general. These and many more have not been able to ensure adequate portable water demand and sanitation in the Local Government and the state in general. All effort made by the State to attain portable water adequacy and sanitation have not yielded any positive result because all efforts made by the government were not working. In spite of these aforementioned challenges or shortcomings, many people within the Local Government Areas of the state who still demands for portable water and sanitation while others do not. It is therefore, against this challenges that this study is out to investigate the determinants of demand for portable and sanitation in Benue state by answering the following questions; What are the determinants of demand for portable water in Benue state, Nigeria? What are the determinants of demand for sanitation in Benue state, Nigeria? What is the current level of portable water supply and sanitation in Benue state, Nigeria? What is the current level of consumption of portable water in Benue state, Nigeria?

2. Literature Review

2.1 Conceptual Literature

2.1.1 Concept of Portable Water

Portable water is water substance that is free from impurities, pathogenic organisms, and other harmful elements which is without taste or odor and therefore, aesthetically appealing and socially acceptable for human consumption Ogunniyi, Sanusi & Ezekiel, 2016). Alaba (2011) defined portable water as that water that is well treated, safe for drinking, considering its physical, chemical and microbiological properties. Aalaa (2010) defined portable water as water that is considered safe to drink. It has been either treated cleaned or filtered and meets your local established or drinking water standards. UNICEF (2015) defined safe drinking water as “water with microbial, chemical and physical characteristics that meets WHO guidelines or national standards on drinking water quality. The guidelines include an assessment of the health risks presented by the various microbial, chemical, radiological and physical constituents that may be present in drinking-water

2.1.2 Concept of Sanitation

World Bank, (2009) refers to sanitation as public conditions related to clean drinking water and adequate treatment and disposal of human excreta and sewage. (WHO, 2014), sanitation generally

refers to the provision of facilities and services for the safe disposal of human urine and feces. It also refers to the maintenance of hygiene conditions, through services such as garbage collection and wastewater.

Otti (2012) observed that people give attention to water supply more than sanitation during planning, whereas both elements are essential to life. The layman understanding of sanitation refers to the provision of toilets. But in the actual sense, the word sanitation is wider in scope. Sanitation involves a process of disposing human and animal excreta, domestic and industrial wastes to final disposal sites. Sanitation in essence involves a process of hygiene behaviour in the home, community, school and work environment.

2.1.3 Determinants of Demand f or Portable Water

The demand for portable water in the study area is fast outpacing than its availability for consumption and the supply of domestic water is seriously constrained by the rising population (Ezekiel & Dominic). On account of this, the price of water, of whatever grade, increases daily and, this is not helped by commercial water vendors who adopt arbitrary pricing of the product. In line with the ongoing, different household demands for a particular source of water and this calls for the need to know what enforces their decision. Judging from these challenges and the dynamics of demand for portable, we need to examine those factors that determine the demand for portable water by households.

According to Aho, Akpen & Ivue (2016), many factors determine the demand for water by every household. The presence of household facilities such as low flush toilets, dishwashers and washing machines has been identified as influencing water consumption. According to the study conducted by Ogunniyi, Sanusi & Ezekiel (2016), the level of income, employment status of the head of the family, owning of the house in which the family reside, monthly expenditures and educational status of the household head are major determinant for the demand for portable water. It is necessary to point out that the proxy for portable water used in the study is pipe borne water.

According to Otti (2012), poor accessibility of potable water is an issue of poverty. Unwholesome water and lack of sanitation are the destiny of poor people across the world. One in five people in the developing world lack access to sufficient clean water. In addition, the poor pay more. From the study

by Adeolu, Adeoye & Ibrahim (2018) which seeks to examine the determinant of household choice of drinking water source, it is also gathered that several factors are responsible for the choice water source by household. These factors include; Location of household, i.e. either in urban area or rural area, level of education of household head, Income level of household head, Household size and Distance between household and portable water source. In their study, the water sources categorized as portable water include hand pump water source, motor pumped water source, tap water and bottled water. From the various studies reviewed, there are several factors that have been revealed to be responsible for the determining household ‘s demand for portable water, they are summarized below: Location of household, i.e. either in urban area or rural area Level of education of household head, Income level of household head, Household size, Distance between household and portable water source, National Government ‘s commitment to infrastructural development, Employment status of the head of the family, Owning of the house in which the family reside, Monthly expenditures, Gender, Kitchen type, Number of cars, Source of water.

2.3 Theoretical Framework

For the purpose of this study, the study adopts the Slutsky demand theory. This was developed by Slutsky in 1942. Thus, the Slutsky demand theory was considered appropriate as the theoretical framework of the study since it decomposes the impact on the demand for a good into two different effects, namely substitution effect and income effect. According to Slustky (1942), changes in demand arising from a price change are always the sum of a pure substitution effect and an income effect. He asserted that, if, at the new prices, less income is needed to buy the original bundle then ―real income‖ has increased, while if, at the new prices, more income is needed to buy the original bundle then ―real income‖ has decreased.

The Slutsky demand theory decomposes the impact on the demand for a good into two different effects, namely substitution effect and income effect. The substitution effect considers the impact on demand for a good (say, good Y) of an increase in the price of such good holding utility constant. If the price of a good goes up holding utility constant, income must increase in order to prevent real income deterioration. In other words, the consumer is compensated for the increase in price. The effect of the price change on product demand, then, is only through the change in relative prices and not through the effective loss in real income. On the other hand, income effect considers the impact on demand for good Y of an increase in price through the effective drop in real income. The Slutsky

demand theory can be expressed algebraically using the Slutsky demand equation which is specified as follows:

$\partial Y/\partial Pj = \partial Y^*H/\partial Pj - \partial Y^*/\partial I\ Y^*$……..(1)

Where ∂ is first-order derivative (change) symbol; Y* is the optimal value of good Y; Y*H is the optimal value of the Hickshian (compensated) demand for good Y; Pj is the price of good Y; and I is income. There are two terms on the right-hand side of equation (1): $\partial Y^*H/\partial Pj$ and $- \partial Y^*/\partial I\ Y^*$. The first of these is called the substitution effect. The second is called the income effect. The first term of the income effect is the effect of a naira loss in income on demand for good Y: $- \partial Y^*/\partial I$. The second term is then equal to the amount of lost naira from the price change (which is equal to the amount of the good being purchased). The significance of this theory to this study is based on the fact that the theory is anchored on the two major determinants of consumer behavior towards demand for goods and service which are prices and income.

2.3 Empirical Review

Several studies related to demand for portable water and sanitation were reviewed for the purpose of establishing clearer understanding of the subject matter.

Ezekiel & Dominic (2015) specifically assessed the Nigerian policy trend and practices in relation to water supply and sanitation coverage over the past ten decades. Using descriptive statistic and trend analysis, the study observed that the Nigerian water and sanitation policy environment has been ineffective and as such recommended that that government should practice policy continuity so as to achieve stated results. Abaje, Ati, & Ishaya (2009) examined the nature of potable water supply and demand in Jema‘a Local Government Area of Kaduna State, Nigeria. Using qualitative technique to analyze the data collected, the findings revealed that at some times and locations, the value of water can be very high due to scarcity, but at other times and locations it can be very low or even free due to relatively plentiful supplies.

Ogunniyi, Sanusi, & Ezekiel (2016) examined the use of the contingent valuation method to study the determinants of rural households ‘willingness to pay (WTP) for safe water in Kwara State. Applying Tobit model to explain household preferences for quality and quantity of domestic water supply and derive estimates of WTP for such a service, the results confirm that household age had a negative and

statistically significant impact on WTP for both quantity and quality. Income, water consumption and water source are positively associated with WTP for better quantity but with a negative sign. This implies that the more the income, water consumes, water source, the less that household would be WTP for better water quantity. Willingness to pay for improved water quality is positively related to waiting time and education. Rural households showed a much higher WTP for better water quantity than for improved water quality. There is therefore scope to improve water service levels in the study area.

The study by Chia, Ijir, Iwar & Ndulue (2014) investigated the various sources of water available in Makurdi metropolis, the state capital of Benue State, its distribution across the various wards, its availability and frequency using both primary and secondary sources of data. The study employed descriptive statistical technique to analyze the data and revealed that 53.7% of all the respondents had running public taps in their homes while 46.3% do not have such facilities at home and of those that had running taps at home indicates that only 23.8% of them had water running more than three times in a week. Also, about 45.4% of the respondents only had water occasionally and 18.8% had water once a week. The remaining 15% had water running in their taps two to three times in a week.

More so, this study shows how sufficient and adequate is water supply from Water Board. The study therefore suggests some solutions in which if properly implemented will help to a greater extent in solving the problem of water supply in area. The studies reviewed above have been able to expose the various relationships that have been established between sanitation and portable water as well as the various factors responsible for the choices made by each household. It will be pertinent to point out that these studies not only differ in nature, scope and methodology, they also differ in findings and the recommendations with very few studies sharing similar views.

3. Methodology

The study employed both qualitative methodology in sourcing, collecting and analysing the data collected for this study. The study employed the use of questionnaire as the instrument of data collection and Taro Yamane sampling technique to determine the sample size from the population. The estimation of the Logit model was carried out by utilizing the maximum likelihood (ML) estimation technique through Statistical Package for Social Sciences (SPSS) software. The

justification for using ML method is that it gives parameter estimates that are asymptotically efficient, consistent and normal and the analogue of the regression Z-test can be applied. Moreover, the Logit model is a nonlinear model which is suitable for estimates using ML estimation technique.

3.1 Model Specification

The model for this study is adapted from work of Francis, Ozovehe & Jibrin (2020) which utilizes the Logit regression model which belongs to the families of qualitative (binary choice) response model where the dependent variable takes on dummy values of 0 and 1 with 0 indicating absence of an attribute or a factor while 1 implies presence of such attribute/factor. The explanatory variables in the Logit model could be exclusively qualitative or quantitative, or admixture of both (Gujarati, 2009). The Logit model for the study is specified as follows:

$$(Pi)/(1-Pi) = \beta_0 + \beta_1 INCi + \beta_2 HSi + \beta_3 LOCi + \beta_4 OWNi + \beta_5 EDUi + \beta_6 GENDRi + Ui \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where: (Pi)/ (1-Pi) is the dependent variable which is the probability of a household using portable water or not (simply denoted as Li); i represents number of households; the independent variables (INC, HS, LOC, EDU, OWN and GENDR) are quantitative variables: β_0, β_1, β_2, β_3, β_4, β_5 and β_6 are the parameters of the model to be estimated; and Ui is the error term.

Where:

L; P=1: If households consume portable water; P=0: If otherwise

INC: Monthly Income of Household head

HS: Household size

LOC: Location of Household (Rural or Urban)

EDU: Educational level of Household Head

OWN: Ownership of dwelling unit

GNDR: Gender of Household Head.

3.1.1 Apriori Expectation

Our apriori expectation are given below; β_1, β_3, β_4 and $\beta_5 > 0$; β_2 and $\beta_6 < 0$

3.2 Measurement of Variables

This section deals with the way the variables have been classified and measured given to the fact that the study has make use of primary data. The variables have been measured as shown in table 3.1 below.

Table 3.1; Measurement of Variables

S/NO	VARIABLES	MEASUREMENT	EXPECTED SIGN
1	L	P=1; If household consume portable water; P=0 if otherwise	
2	INC	Income of Household (measured in Naira)	+
3	HS	Household size (measured in numbers)	_
4	LOC	Location (1; if urban, 0; if otherwise)	+
5	OWN	Ownership of dwelling unit (1; if household head own a dwelling unit, 0; if otherwise)	+
6	EDU	Education (1; if post-secondary, 0; if otherwise)	+
7	GENDR	Gender of Household head (1; if female, 0; if male)	_

Source: Researcher's Compilation, 2024.

From table 3.1 above, L represents the probability that a household consume portable water or not. In the coding of the primary data collected from the field, "1" is used to represent the outcome that a household consume portable water and "0" if otherwise.

4. Results and Discussion

4.1 Regression Results

This section deals with the analysis of the logistic regression model results obtained using Statistical Package for Social Sciences (SPSS 20) to run the results. Below is the summary of the results.

Table 4.1; Results of the Logistic Regression Model

Determinants of Portable Water	Coefficients	P-value	Odd Ratio
INC	0.771	0.000	2.120

HS	0.007	0.550	1.008
LOC	0.462	0.001	2.038
OWN	1.123	0.000	2.244
EDU	-0.055	0.321	0.200
GENDR	0.016	0.023	1.004
Constant	-1.522	0.000	0.068
Cox & Snell R Square		0.118	
Nagelkerke R Square		0.149	

Source; Researcher's computation using SPSS 20

From table 4.1 above, the odd ratio of 2.1 for income shows that the income of a household heads is more than 2 times more likely to determine the choice of portable drinking water in Benue state. In other words, as household income increases by 1, the probability of the household choosing portable drinking water increases by 2.120 times. For this, the probability of a household with high income choosing portable water is 72.90%.

Similarly, with an odd ratio of 1.008 for household size, it implies that the size of a household is less likely to determine a household's choice of portable drinking water in Benue state. In other words, a one-unit increase in the number of people per household makes slightly more than a proportionate increase in the likelihood of household choosing portable drinking water. From this finding, the probability of a household with high household size choosing portable water is 52.00%. This means that there is a significant demand for portable water in Benue state.

Location has odd ratio of 2.038 demonstrating that the location of the household (rural or urban) is more than 2 times more likely to determine the choice of portable drinking water in the study area during the period under investigation. When the probability is taken, the chance of a household located in urban areas choosing portable water is given as 65.72%. This implies that there is a significant supply of portable water and sanitation in Benue state.

Ownership of dwelling unit has an odd ratio of 2.244. This means that household heads who own their residence units more than 2 times more likely to choose portable drinking water over other sources of water. In other words, as ownership of dwelling unit increases by 1, the probability of the

household choosing portable drinking water increases by 2.244 times. For this result, the probability of a household head who owns their dwelling unit choosing portable drinking water is 72.47%. This implies that there is significant demand for portable water and sanitation in Benue state.

The odd ratio for education is given as 0.200 which implies that as the educational status of a household head increases by 1, the probability of the household head choosing portable drinking water increases by 0.200 times. In other words, educational qualification is 0.200 times more likely to determine a household's choice of drinking water in Benue state. From the result above, the probability of a household head with post-secondary education choosing portable water is obtained as 45.78%. This demonstrates that no significant demand for portable water in Benue state.

The odd ratio for gender is 1.008 indicating that the gender of a household head is slightly more than 1 times more likely to determine the choice of drinking portable water. In other words, if this variable "gender" increases by one, the probability of a household choosing a portable drinking water over other sources of water increases by 1.008. The probability of a female household choosing portable water is 50.55%. This implies that there is significant consumption of portable drinking water in Benue state.

5. Conclusion and Recommendations

The finding of this study revealed that income of a household head, location of a household (rural or urban) and ownership of dwelling unit and gender of household head are major determinants of demand for portable water while the level of education of household head and household size are less likely to determine demand for portable water with level of education of household head being the least significant. In other words, household head with high income tends to demand for portable water over than household head with lesser income. Similarly, households located in urban areas demand more portable water than households located in rural areas. In the same vein, household heads that live in their own house have a higher chance of demanding for portable water than those who live in rented houses. The study concluded that income of a household head; location and ownership of dwelling unit and gender have significant impact on the demand for portable water. The study further concluded that people who reside in the urban area have more access to good sanitation and that the income of the household head is also a major determinant of the demand for sanitation. To this end,

the study revealed that there are no sufficient waste disposal facilities and public toilet in public places which adversely affected the sanitation. Therefore, the determinant of demand for sanitation is basically location and income level of the household heads.

Based on the analysis and the findings of this study, the following recommendations are made;

The government should as a matter of urgency, extends the provision of pipe borne water to rural areas so as to improve rural dweller's chance of having access to portable drinking water.

The government should also provide quality and sufficient sanitary facilities like public waste disposal facilities, public toilets and good drainage system in both rural and urban centers so as to improve the sanitation of residences in the areas.

Policies like subsidizing connection costs and supplying credit facilities for connection payment could enable household heads to get piped connection, this system need to be adequate so that this would not increase the number of days in which household heads experience a service scramble.

REFERENCES

Abaje, I.B., Ati, O.F., & Ishaya, S. (2019): Nature of Portable Water Supply and Demand in Jema'a Local Government Area of Kaduna State, Nigeria, *Research Journal of Environmental and Earth Sciences 1(1); 16-21*

Adeolu, A.R, Adeoye, P.A, & Ibrahim, H.M (2018): Appraisal of rural water supply; case of kwara state, north central Nigeria. *International Journal for Basic and Applied Science 1(4), 816-826*

Ahmed, A., Ali, U. Mirza, O. & Lotia, O. (2016): Household demand for portable water in major industrial cities, Pakistan, *International Journal of Water Resource Management & Environment, 2(5) 12-14*

Aho, M.I., Akpen, G. & Ivue, P. (2016): Determinants of residential per capita water demand of Makurdi metropolis, *Nigerian Journal of Technology (NIJOT), 35(2), 424-431*

Alla, E.A (2010): Individual and societal benefits of saving water. Proceedings of the Fifth Gulf Water Conference, Doha, Water Science and Technology Association, Bahrain.

Chia, V. D., Ijir, S. T., Iwar, R., & Ndulue, O. (2014): The Contending Issues of Domestic Water Supply in Makurdi Metropolis, Benue State, Nigeria, *Civil and Environmental Research, 6 (9); 2-5*

Davis, J. (2003): Corruption in Public Services; *Experience from South Asia's Water and Sanitation Sector, World Development, 32(1);53-71*

Ezekiel, A., & Dominic, A.A. (2015); Sources, demand and problems of domestic water in Nassarawa Eggon Town, Nigeria, Pollution, 1(1); 55-65

Francis, A.A., Ozovehe, A. & Jibrin, I.M (2020): Analysis of the Determinants of Demand for Portable Water and Sanitation in Nasarawa State, Nigeria; *International Journal of Innovative Research and Advanced Studies, (IJIRAS) 7(12), 1-35*

Gujarati, D.N. & Porter, D.C. (2009); Basic Econometrics, 5th Edition. New York; McGraw Hill.

Kassa, M. (2017); Evaluation of water supply and demand; The case of Shambu town, Western Oromia, Ethiopia, *International Journal of Water Resources and Environmental Engineering, 9(5) 96-101*

Nasarawa State Ministry of Health (2016): Public Lecture on Negative health impact on contaminated water in Karu Local Government Area, Nasarawa State.

Obilom, S.O (2013): Evaluation of the Role of Anambra Environmental Sanitation Authority (ASESA) in the Disposal of Refuse in Enugu and Onitsha Urban of country experience Unpulished M.ed project, University of Nigeria, Nsukka.

Ogunniyi, L.T., Sanusi, W.A & Ezekiel, A. A. (2011): Determinants of rural household willingness to pay for safe water in Kwara State, Nigeria. *International Journal of the Bioflux Society, 4(5); 111-120*

Otti, V.I., (2012): Developing a Sustainable Water Sustainability Programmme Management in the Rural Areas of Nigeria, *International Journal of Engineering and Technology, 2(6) 20-49*

UN (2015); United Nations Annual Report

UNICEF (2015); United Nations International and Children Emergency Fund Annual Report

WHO (2014); World Health Organization Annual Report.