Households' Willingness to Pay and Payments for Water Services by the Akwa Ibom Water Company Limited, Akwa Ibom State, Nigeria

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ABSTRACT

This study assessed households' willingness to pay and payments for water services supplied by the Akwa Ibom Water Company Limited using the Heckman two-step analysis. Using the survey research design, these households comprised households that have access to 5.06% of water supply services from the Akwa Ibom Water Company Limited *a la* Ubi-Abai (2024); and households that live close to the water company but do not have access to their water services. A sample of 200 households was selected using the two-stage cluster probability sampling and the purposive non-probability sampling techniques. Data were obtained using structured questionnaires. The weighted Kappa and Cronbach Alpha coefficients showed that questions in the questionnaires were valid and reliable. The cluster analysis revealed that 38 households used water efficiently. Furthermore, the Heckman two-step analysis revealed that factors such as water use efficiency, water quality, income and family size influenced households' willingness to pay and monthly water payment levels.

Keywords: Akwa Ibom, Heckman, Household, Water, WTP

1. INTRODUCTION

Access to adequate and safe water supply for consumption is a core of welfare in households necessary for sustainable development of an economy. The essence of access to adequate and safe water supply in development is proven in the Africa Water Vision (2000 – 2025) which seeks equitable and sustainable use of water for socioeconomic development (United Nations); and the first target of the sixth Sustainable Development Goal (2015 – 2030) which seeks to achieve universal and equitable access to safe and affordable drinking water for all.

Nigeria, a member of the United Nations, has played a key role to ensure that people have access to adequate and safe water supply. The Nigerian government, through the Federal Ministry of Water Resources (FMWR) developed the National Water Supply and Sanitation Policies of 2000 and 2004 aimed at ensuring Nigerians have access to sufficient potable water supply in an affordable and sustainable way (Wateraid, 2006). Specifically the National Urban Water Reform Projects (NUWRPs) were to ensure that selected urban areas in Nigeria have access to adequate piped water networks. The National Bureau of Statistics (2006) defined access to water supply as the availability of at least 20 litres per person per day of improved water supply from a source within 250 metres of user's dwelling. These sources could be provided by the government, some individuals, communities and national and international organisations.

The Nigerian government has established water supply utilities in different states of the Federation in a bid to ensure adequate and safe access to water. One of the state water utilities is the Akwa

Ibom Water Company Limited, supervised by the Ministry of Lands and Water Resources in Akwa Ibom state. The Akwa Ibom Water Company Limited is charged with the responsibility of providing adequate and safe water to urban and semi-urban areas of Akwa Ibom state in an efficient manner with a view to achieving continuous self-sustenance for the benefit of stakeholders.

The efficiency and total productivity of the Akwa Ibom Water Company Limited were assessed by Ubi-Abai (2024). According to the Monitoring and Evaluation Unit Monthly Analysis Report of the water company, from 2020 to 2023, of the average of over 2 million (2,964,373) population of their utility's area of responsibility, about 150,000 people were served with water supply depicting 5.06% access to water supply. This study focuses on households that have access to the company's water services. In addition, the study focuses on households that live close to the company's water pipeline connections but do not have access. Using the basic economic models of consumer choices, this study examines key specific objectives. First, the study seeks to assess households' water use efficiency. Second, the study examines the determinants of households' payment for water supply services. Third, the study examines the determinants of the willingness to pay for water supply services by households that live close to the water company but do not have access. This study is probably the first of its kind in Akwa Ibom State.

The study is significant as it will enlighten the Akwa Ibom Water Company Limited on the ways water supply are efficiently used. This will help to increase public awareness and develop strategies related to the efficient use of water supply. Examining the factors that influence the willingness to pay and payment for water services will provide the Akwa Ibom Water Company Limited the needed information on critical indicators that influence households' water demand decisions; and the measures to put in place to ensure optimum water supply.

2. LITERATURE REVIEW

The study is predicated on the basic economic model of the determinants of the willingness to pay. Economic models focus on two determinants of willingness to pay: income and the value of the good. Households are constrained by their disposable income when they make decisions on the payment for water supply services. Hence, there should be a correlation between income and the amount of money households are willing to pay for water supply services. Therefore, income is regularly included in stated preference surveys and is expected to have a positive effect on WTP (Liebe *et al*, 2011). The usage of the good is another important determinant of the willingness to pay and payment for the good, which is closely related to the economic concept of value. Households make use of water supply from the Akwa Ibom water company because it serves them

for domestic use and for drinking. Invariably, the link between the willingness to pay and the value of water to households tends to be positive.

Moffat *et al.,* (2011) investigated the willingness to pay for an improved water quality and reliability in Chobe ward in Maun. The study revealed that, on average, 54% of the households are willing to pay for improved water quality. Those with a higher income were willing to pay for an improved water quality and reliability of supply. The study discovered that the older the person the more they are willing to pay for improved water quality and reliability. The study also larger families are not willing to pay for improved provision of water services. Also, educated people are lesser willing to pay for improved water quality and reliability.

Ayanshola *et al.,* (2013) evaluated the willingness-to-pay (WTP) for sustainable household water use in Ilorin, Nigeria using the contingent valuation method, descriptive statistics, the Tobit and Probit regression analysis. The study revealed that the supply reliability on weekly and hourly basis were 20% and 17% respectively. The Tobit and Probit regression output revealed that *sex* is negatively related to willingness to pay; poor water quality affected willing to pay positively and significantly. Household size was positively related to willingness to pay and was significant at 5% level; Income level significantly affected willingness to pay positively; Age was negatively related to willingness to pay at the 5% significance level; Household with sufficient water had a negative and significant impact on willingness to pay. The study concluded that the present water supply in the city of Ilorin was grossly inadequate and the people are not satisfied with the present supply.

Kanayo *et al.,* (2013) sought to identify the determinants of the peoples' willingness to pay for improved water supply in Nsukka using the Tobit regression. The study also ascertained what people would pay to support government and determine the amount of revenue that government could generate. The results showed that the willingness to pay for water was sensitive to the level of education and occupation of the household head, prices charged by water vendors, expenditure on water vending and the average monthly income of the households.

Mezgebo and Ewnetu (2015) estimated households' willingness to pay for improved water service in Nebelet. Cross-sectional data was collected from 181 households in 2011/2012. The Probit model was used to estimate the socio-economic factors that affect the willingness to pay of households. The study revealed that interruption, delay in maintenance, irregular/erratic availability of the public water supply, the price charged per unit, the unequal treatment households face while collecting water at the public supply were found to be the pressing water problem. The descriptive analysis showed that 96% of the sample households were willing to pay for the provision of

improved water service. The Probit model showed that income, distance, water expense, bid, education, level of existing water satisfaction, marital status and sex were associated with households' willingness to pay for the provision of improved water services.

Rananga and Gumbo (2015) evaluated the respondents' willingness to pay for water services in two communities in Mutale Local Municipality, South Africa. The study showed that respondents were dissatisfied with the unreliable water services (89.9%) but were willing to pay for water services to secure reliable water services (95.5%). The respondents with tertiary level education were willing to pay R 150 per month per 6 kilolitres. The maximum 6 kilolitres is the free basic water services that the municipality can provide without collecting water revenues. The following variables: literacy levels; household size of 3 to 6 members; the age of 40; and monthly incomes, had a significant effect ($p = 0.005$) on the monetary amount and the willingness to pay.

Dhungana (2016) analysed the factors associated with the willingness to pay for improved water supply system in rural Tanahu, Nepal using the Chi-square test. Using a structured questionnaire, the study proportionately selected one hundred and twenty seven households from different wards. The study showed that there is no significant association between willingness to pay for improved water supply system and some social, demographic and economic variables. The study also discovered that water source, dental pains, water quantity, desire for change and water-fetching time have significant association with willingness to pay for improved water supply system. It was concluded that the type of water source, quantity, fetching time, will for change, and prevalence of some diseases are the major factors influencing willingness to pay for improved water supply system.

Mohammad *et al.,* (2017) investigated the consumers' willingness to pay for an improved water supply system in a semi-urban area of Bangladesh using the contingent valuation method. The study revealed that 28% of the residents received water supply twice a day and only 2 hours of running tap water with complains of high iron and arsenic content. About 65% of the surveyed households expressed their willingness to pay for a safe and uninterrupted water supply. The average stated willingness to pay is BDT87.25 per month in addition to the present water utility charges.

Akeju *et al.,* (2018) examined the willingness to pay for improved water supply of 256 households in Owo local government area of Ondo state, Nigeria using descriptive statistics and logit regression. The study revealed that 43% of the residents accessed water from public utility while 20.3% and 18.8% of respondents accessed water from well and borehole respectively. The study

also revealed that 70.3% of the residents were dissatisfied with unreliable water services but were willing to pay for improved water supply, and 74.9% of the respondents were willing to pay an average sum of ₦1,617.64 per month for improved water supply services. Moreover, the results of the logit regression revealed that gender, frequency of water, education, household size, income, quality of water and connection charges were the factors influencing residents' willingness to pay for improved water supply services.

3. MATERIALS AND METHODS

The study adopted the combination of the survey research design, because information were gathered from the sample of the study through the use of a structured questionnaire; and the quasi-experimental research design was adopted because cause and effect relationships were examined using some statistical and econometrics techniques.

The focus of the study are the households that live close to the water company in Akwa Ibom State – the research area. Akwa Ibom state is one of the states in the niger delta region of Nigeria. The state lies between latitudes 4o32" and 5033" North and longitudes 70 35" and 80 25" East. Akwa Ibom state currently covers a total land area of 7,249 square kilometres. With annual growth rate of projected population at 3.4%, the 2016 projected population is estimated at 5,451,277 people (Female 2,680,687; Male 2,770,590).The state is an oil and gas producing state in the country. The state's capital is Uyo with over 500,000 inhabitants. The major cities in Akwa Ibom states are Uyo, Eket, Ikot Ekpene, Oron, Abak, Ikot Abasi, Ikono and Etinan (www.nigerdeltabudget.org). The indigenes of Akwa Ibom state are predominantly of the Christian faith. The main ethnic groups of the state are Ibibio, Annang, Oron, Eket and Obolo (http://Akwa Ibomstate.gov.ng).

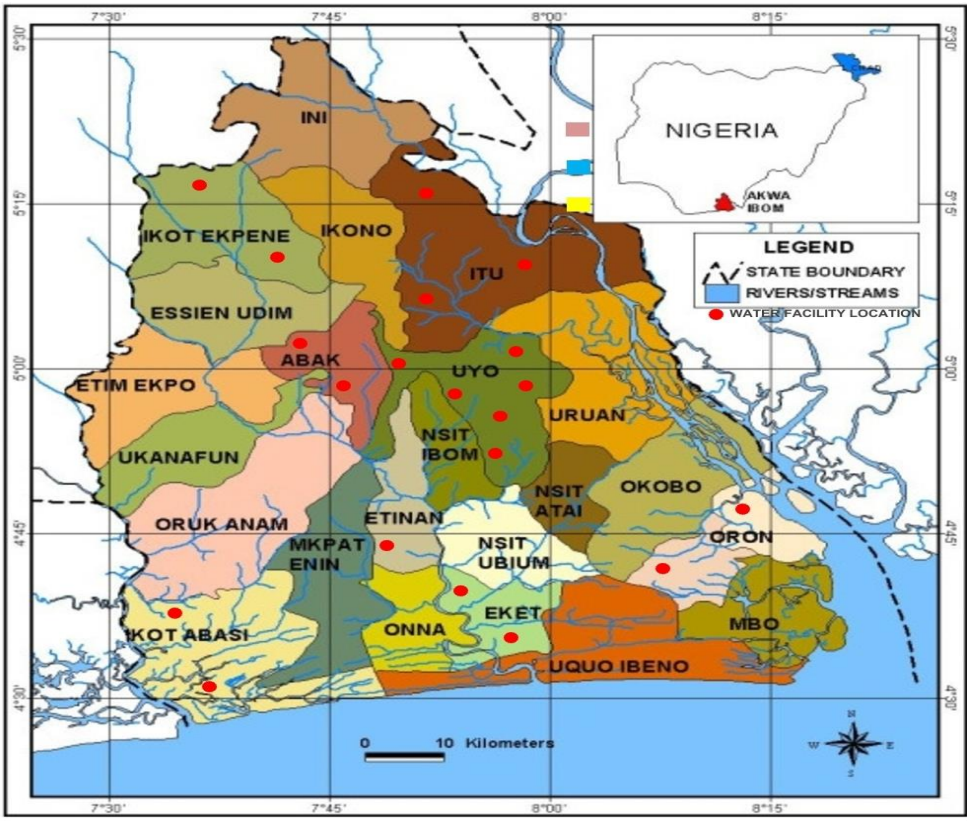

Figure 1: Map of Akwa Ibom State showing locations of the Akwa Ibom Water Company

The sample of the study comprised the households that resides close to the water connection pipelines of the Akwa Ibom Water Company Limited. The study obtained the sample using the rule-of-thumb method by selecting 10 households in each locations of the water company since the locations are in few areas with unequal spread. Using the purposive non-probability sampling technique, 200 households were visited. The households that were purposely visited comprised households that have access to water and pay the monthly water tariff and households that do not have access to water but live where the water connection pipelines are located.

The study obtained data using a structured questionnaire. The structured questionnaire was prepared and administered to households that live close to the water connection pipelines of the water company. The questionnaire provided information on the water connection status of each household, the frequent supply of water, the monthly payment for water bills, the rate of compliance for payment of water bills, the willingness to pay for improved water supply, the perception on the quality of water supply, the quantity of water consumed etc.

The study used the expert validity test to ascertain the validity of the questionnaire for what it was designed to measure and the Cronbach's Alpha' s (1951) reliability test to ascertain the reliability of the questions in the questionnaire. The results showed that the questions in the questionnaire were both valid and reliable. The data collated from the questionnaire were coded and subjected to

descriptive analysis. Descriptive analysis involves the pictorial representation of data using graphs and tables, and summary statistics such as frequency, frequency distribution, percentage, cumulative percentage etc.

The cluster analysis was applied to assess households' behaviours towards the level of efficiency in water usage which mirrors the use value of a good with respect to the basic economic model of consumer choices. This was possible using the peer comparison methodology *a la* Jorge *et al* (2015).

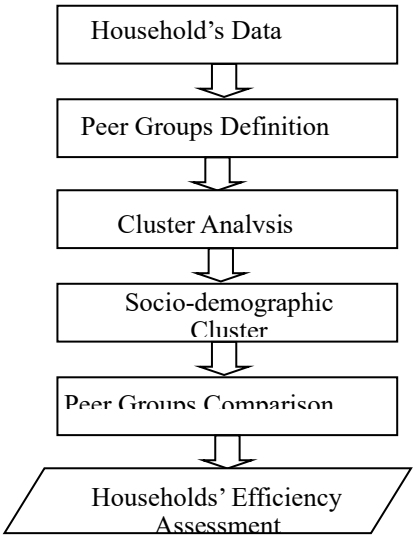

Figure 2: Peer comparison methodology

Peer groups were established through a cluster analysis based on their weekly and *per capita* consumption levels, and relevant socio-demographic characteristics. These socio-demographic characteristics were property type, family dimension and family composition by age. In cluster analysis, each household were selected as a target and compared to all other households. Based on this comparison, individuals with similar characteristics were chosen as a peer group. Then, the event (or behaviour) of the peer group was summarized by each subsequent point in time, and the event (or behaviour) of the target was compared to the summary of the peer group (Hong and Sohn, 2013).

Thereafter, correlation matrices were built to support the decision about the variables that are most correlated with each other. If the correlation coefficient was high, the variables are not independent and one of them was discarded from the cluster analysis. The high value showed that variables have large multicollinearity and the variables were not simultaneously considered as independent variables. In this situation, cluster analysis was not carried out with these variables, because conclusions will not be reliable, since a variable directly influences the other. Finally, the identification of the most efficient households was made through the comparison of their own

consumption with the minimum and the average values within their cluster and by calculating an efficiency level for individual households. The efficiency level of households is specified thus:

$$H_E = 100 + \frac{(Cl - C_{CD})}{C_{CD}} \times 100$$

where, H_E = household's efficiency level (%), Cl = cluster average or minimum (litres) and C_{CD} = consumption based on household's data (litres).

The Heckman two-stage model analysis was adopted to analyse the factors influencing households' willingness to pay and payment for water supply by the Akwa Ibom Water Company Limited. The Heckman two-stage model analysis was adopted because the issue of sample selection bias occurred as a result of the limited information obtained on a non-random sub-sample of the population of interest.

A non-random sub-sample of access to water supply included households that are actively connected to the water supply pipelines and pay their water bills. This group of household were willing to continue to pay for water supply services if water supply services improve. The fact that the piped water supply distribution network spreads among different locations in the state implies that the non-random sample included households that are inactively connected to water supply for some reasons. For this category of household, there were two situations. On the one hand, some households were willing to be actively connected and willing to pay should water supply services improve. On the other hand, some households were not willing to be actively connected even if water supply services improve. This can cause a potential biasing factor or create a selection bias that induces endogeneity.

Furthermore, there are bound to be deviations in the selection process that may lead to biased inferences regarding a variety of outcomes. In particular, sample selection bias may occur when values of the dependent variable are missing as a result of another process (Greene, 2011; Sartori, 2003). To resolve this potential bias, Heckman (1976) introduced the Heckman model, a two-step process for data analysis. Heckman's two-stage model could effectively correct the selectivity deviation, which is a unique problem of econometrics (Morrissey *et al.*, 2016). The Heckman's two-stage model for data analysis involved two stages – the first stage and the second stage. The first stage used a probit model to estimate the probability of an observation's presence in a sample, and the second stage used the Ordinary Least Square (OLS) to predict the dependent variable. To account for the potential sample selection biases that resulted from non-randomness in the sub-sample, the Heckman's two-stage model estimated the probit model for selection, followed by the

insertion of a correction factor – the Inverse Mills Ratio (IMR), calculated from the probit – into the second Ordinary Least Square (OLS) model of interest (Bushway *et al.*, 2007).

It is important to know that Heckman's two-stage model included at least one variable in the first stage that did not appear in the second stage (Sartori, 2003). These variables which are known as exclusion restrictions, influence the probability of an observation's appearing in the sample, but do not influence the ultimate dependent variable of interest in the second-stage ordinary least square model (Certo *et al.*, 2016). Without the exclusion restrictions, Heckman's two-stage model can often do more harm than good (Kennedy, 2006). Moreover, Wooldridge (2010) suggested that the effectiveness of this technique relies on meeting three assumptions.

First, the independent variable of interest is available for the broader population, while the dependent variable is only available in the selected sample. Examining the role of the independent variable in both stages, not just the second stage, of the analysis helps to check this assumption (Lennox *et al.*, 2011). Second, an omitted variable creates a correlation between the two error terms in the selection and structural Equations. Third, the independent variable is not correlated with either of the error terms, and is thus exogenous in both stages (Lennox *et al*., 2011). With the requirements and assumptions in mind, the study will adopt the models specification in Kim and Jang (2010) and Xiong *et al.,* (2018) in specifying the Equations for the Heckman's two-stage model estimation, with some appropriate modifications.

Equation 1 is a probit model which examines the effect of factors that have influences on households' willingness to pay for water supply services from the Akwa Ibom Water Company Limited.

$$WTP^* = \alpha_o + \beta_1 AGE_i + \beta_2 GENDER_i + \beta_3 EDUC_i + \beta_4 WRKTYP_i + \beta_5 HHINC_i + \beta_6 NFAM_i + \beta_9 WATQUA_i + \beta_{10} WATQUANT_i + \beta_{11} WATRIF_i + \beta_{12} WATUSE_i + \mu_i \quad \text{Equation 1}$$

where, WTP* = households' willingness to pay and non-willingness to pay, AGEi = age of each respondents, $GENDER_i$ = gender of each respondents, $EDUC_i$ = education attainment of head of each household, $WRKTYP_i$ = work type of the head of each household, $HHINC_i$ = annual Income of each household, $NFAM_i$ = number of family members, $WATQUA_i$ = households' perception of water quality, $WATQUANT_i$ = households' perception of water quantity, $WATRIF_i$ = water tariff, WATUSE = water use efficiency, and μ_i = error term.

For the household that are willing to pay compared to households that are not willing to pay, age, gender, level of education, work type, household annual income, number of family members, residential location, water quality, water quantity, water tariff and water use efficiency were vital factors considered.

Equation 2 is the multiple regression equation that examined the influencing factors of the households' payments for water supply. Equation 2 is specified thus:

$$WPL = \alpha_o + \beta_1 EDUC_i + \beta_2 WATUSE_i + \beta_3 WATQUA_i + \beta_4 WATQUANT_i + \beta_5 HHINC_i + \beta_6 NFAM_i + \beta_7 WATRIF_i + e_i \quad \text{Equation 2}$$

where, WPL = households water pay-out level, $EDUC_i$ = education attainment of head of each household, $HHINC_i$ = annual income of each household, $NFAM_i$ = number of family members, $WATQUA_i$ = households' perception of water quality, $WATQUANT_i$ = households' perception of water quantity, $WATRIF_i$ = water tariff, WATUSE = water use efficiency, and e_i = error term

4. RESULTS AND DISCUSSIONS

Table 1 presents the socio-economic characteristics of households which comprise the age of the head, gender status of the head, marital status of the head, highest level of educational attainment of the head, the nature of work of the head, family size, income level of the household, and the dimension of the apartment.

Table 1: Socio-economic characteristics of selected households.

Social-Economic Characteristics	Frequency	Percentage	Cumulative Percentage
Age of Head of Household			
30 and below	16	8	8
31 – 40	59	29.5	37.5
41 – 50	79	39.5	77
51 – 60	30	15	92
61 – 70	15	7.5	99.5
71 and above	1	0.5	100
Gender of the Head of Household			
Male	163	81.5	81.5
Female	37	18.5	100
Marital Status			
Single	51	25.5	25.5
Married	141	70.5	96
Divorced	1	0.5	96.5
Widow/Widower	7	3.5	100
Educational Attainment of Head			
FSLC	2	1	1
SSCE	1	0.5	1.5
OND	48	24	25.5
Bsc/HND	108	54	79.5
PGD	21	10.5	90
Msc	18	9	99
Mphil	2	1	100
PHD	0	0	100
Work Type of Head of Household			
Self Empoyed	39	19.5	19.5
Civil Service	89	44.5	64
Private Organisation	50	25	89
Service	6	3	92
Pensioner	16	8	100
Family Size			
1 – 3	63	31.5	31.5
4 – 6	104	52	83.5
7 – 9	31	15.5	99
10 – 12	2	1	100
Income Level of Household			
20,000 and below	13	6.5	6.5
20,001 - 50,000	45	22.5	29
50,001 - 100,000	61	30.5	59.5
100,001 - 200,000	64	32	91.5
200,001 - 300,000	16	8	99.5
300,000 and above	1	0.5	100
Apartment Dimension			
Single Room	17	8.5	8.5
Self-contain	27	13.5	22
One-bedroom Flat	43	21.5	43.5
Two-bedroom Flat	70	35	78.5
Three-bedroom Flat	26	13	91.5
Four-bedroom Flat	17	8.5	100

Source: Researcher's Field work, (2024).

Table 1 shows that 8% of the households are between ages 30 and below. 29.5% of the households are between ages 31 to 40. 39.5% of the households are between ages 41 to 50. 15% of the households are between ages 51 to 60. 7.5% of the households are between ages 61 to 70. 0.5% of the household are from ages 71 and above.

The gender status of the heads of each household shows that 163 or 81.5% of the heads of each household are males while 37 or 18.5% are females. Accordingly, 51 or 25.5% are married, 141 or 70.5% are single, 1 or 0.5% is divorced and 7 or 3.5% are widows/widowers. With respect to the highest educational attainment, 1% of heads of each household obtained FSLC, 0.5% obtained SSCE, 24% obtained OND, 54% obtained BSC/HND, 10.5% obtained PGD, 9% obtained MSC, and 1% obtained MPhil. The work types of the heads of each household show that 39 of them were self-employed, 89 of them were civil servants, 50 of them worked in the private sector. 6 of them works in the service sectors and 16 of them are pensioners.

With respect to family sizes, 63 households ranged from 1 to 3, 104 households had from 4 to 6 members, 31 households had from 7 to 9 members, and 2 households had from 10 to 12 members. Accordingly, the total income earned differs across households. 13 or 6.5% of households had a total income from 20,000 naira and below, 45 or 22.5% of households had a total income ranging 20,001 naira to 50,000 naira, 61 or 30.5% of households had total income ranging 50,001 naira to 100,000 naira, 64 or 32% of households had total income ranging 100,001 naira to 200,000 naira, 16 or 8% of households had total income ranging 200,001 naira to 300,000 naira, and 1 or 0.5% of households had total income ranging 300,000 and above. Accordingly, households in single room apartment constitute 17 or 8.5% of total households. Households in a self-contain apartment constitute 27 or 13.5% of total households. Households in a one-bedroom flat constitute 43 or 21.5% of total households. Households in two-bedroom apartment constitute 70 or 35% of total households. Households in three-bedroom apartment constituted 26 or 13% of total households. Households in four-bedroom apartment constituted 17 or 8.5% of total households.

The study answered the first key objective by utilizing the four-step procedure outlined by Jorge *et al.,* (2015) in Figure 2 to assess the water use efficiency of households. The first step was to obtain the consumers' data. Hence, data on water consumption was obtained from 155 households that have access to water supply from the Akwa Ibom Water Company Limited. The data obtained include socio-demographic data as well as the volume of water consumed either through existing water devices such as water closet, shower, taps, dishwater, and washing machine or through

private water vendors. Table 5.11 gives a summary of the data recorded for water use by the 155 households.

Table 2: Data recorded for each water use

Water Use	Recordings	Characteristics of Water Device Measured
Water Closet Flushing	Number of Flushes	Cistern Capacity
Showers and Taps	Number of Uses	Average Flows
Dishwashers and Washing Machine	Number of Uses	Volume used per wash

Source: Jorge (2014).

Data on the number of times of water device usage were obtained from consumers' responses and estimated using the GWMWater measurement (According to GWMWater.org.au (2018), the single flush cistern uses 9 to 11 litres per flush. The study used the minimum (9 litres). The shower uses approximately (for old style shower) 10 litres per minutes and almost 100 litres for 5 minutes. Dishwashing by hand uses around 15 to 18 litres of water to fill the kitchen sink. Washing machine uses 50 litres, and tap usage is 5 litres per minute) for water usage. These measurements were used to estimate the water consumption per person per day and weekly consumption per household.

Accordingly, the second step was the peer group definition. The peer groups were defined through a cluster analysis based on the 155 household consumption and relevant socio-demographic characteristics such as apartment dimension, family size, and family composition by age. Table 3 presents the socio-demographic and consumption characteristics of the 155 households.

Table 3: Socio-demographic and water consumption data of households

Socio-Economic Characteristics	Minimum	Average	Maximum
Apartment Dimension	1	-	6
Family Size	1	4.4	11
Family Composition by Age	0.4	44.3	100
Water Consumption Data			
Weekly Consumption (Litre/household per week)	420	1993.6	6419
Per Capita Consumption (Litre/person per day)	13.6	75.8	360

Source: Researcher's computation, (2024).

Apartment dimension varies from 1 (single room apartment) and 6 (4-bedroom apartment). The sizes of families vary from a minimum of 1 person to a maximum of 11 persons, with an average of between 4 and 5 persons. The age ranges from less than 1 year and 100 years, with an average of 44 years. The per capita consumption, that is, litres consumed by each person per day, varies from a minimum of 13.6 litres and a maximum of 360 litres, with an average of 75.8 litres. The weekly consumption, that is, litres consumed by each household per week, varies between a minimum of 420 litres and a maximum of 6419 litres, with an average of 1993.6 litres.

After defining the peer group through the cluster analysis, the next step was to present the socio-demographic clusters, and thereafter create a peer group for consumer comparison. A parametric correlation was carried out to determine which variables were more correlated. Table 4 present the correlation analysis of the apartment dimension, family size and family composition by age.

Table 4: Correlation analysis

	Apartment Dimension	Family Size	Age
Apartment Dimension	1.0000	-	-
Family Size	0.5638	1.0000	-
Age	0.4900	0.4462	1.0000

Source: Researcher's computation (2024).

The variables showed strong positive correlation with each other. This implies that the variables were not independent of each other. More so, the correlation values show that there is multicollinearity among the variables and hence, they should not be simultaneously considered as independent variables. In this case, a cluster analysis cannot be carried out on each of the socio-demographic variable since one directly influences the other. Therefore, the researcher carried out a socio-demographic cluster analysis based on family size since people are responsible for water usage irrespective of their apartment dimensions and ages. Table 5 presents the family size clusters and their per capita and weekly consumptions.

Table 5: Characteristics of the family size clusters

Cluster	Number of Households	Family Size	Per Capita Consumption [Litres/(Person.day)]			Weekly Consumption [Litres/(Household.week)]		
			Minimum	Average	Maximum	Minimum	Average	Maximum
Cluster 1	49	1 – 3	33.33	130.84	360	700	1671.71	3654
Cluster 2	82	4 – 6	20.83	55.85	203.75	700	1827.68	5705
Cluster 3	22	7 – 9	13.89	38.15	105.71	879	1906.23	5180
Cluster 4	2	10 – 12	13.64	15.91	18.18	1050	1225	1400

Source: Researcher's computation, (2024).

Cluster 1 corresponds to small families. The cluster comprised 49 households with members ranging 1 to 3. Cluster 2 corresponds to large families. The second cluster contains 82 households with members ranging 4 to 6. *Cluster 3 corresponds to larger families which comprise 22 households with members ranging 7 to 9. Cluster 4 is formed by two households with the largest family size (10 to 12 members).*

Cluster 2 consumed the highest minimum and maximum litres of water per capita, and Cluster 1 has the highest per capita consumption on average. However, Cluster 2 shared the same minimum weekly consumption with Cluster 1, but a higher maximum per capita and weekly consumption of 203.75 and 5705 litres of water respectively. On weekly consumption, Cluster 4 consumed the

highest minimum litres of water, and Cluster 3 had highest weekly consumption on average. The last step assessed the efficiency level for water consumption of the 155 households included in the family size clusters. The household efficiency level was calculated based on Equation 11. Figure 3 presents the per capita consumption of the 155 households with access to water supply from the Akwa Ibom Water Company Limited.

Of the 155 households, the water usage of 101 households were efficient since each household efficiency level lies between the efficiency level at the minimum and the efficiency level at the average. In other words, these 101 households are 100% efficient in water usage. Of the 101 households, household 8 and household 35 are the most efficient households. Also, each cluster has households that are better off in the efficient use of water. For example, household 35 is the most efficient household of cluster 1 with efficiency level at 36%. Household 16 is the most efficient household of cluster 2 with efficiency level at 27%, household 8 is the most efficient household for cluster 3 with full efficiency at 36%, and no household was 100% efficient in cluster 4

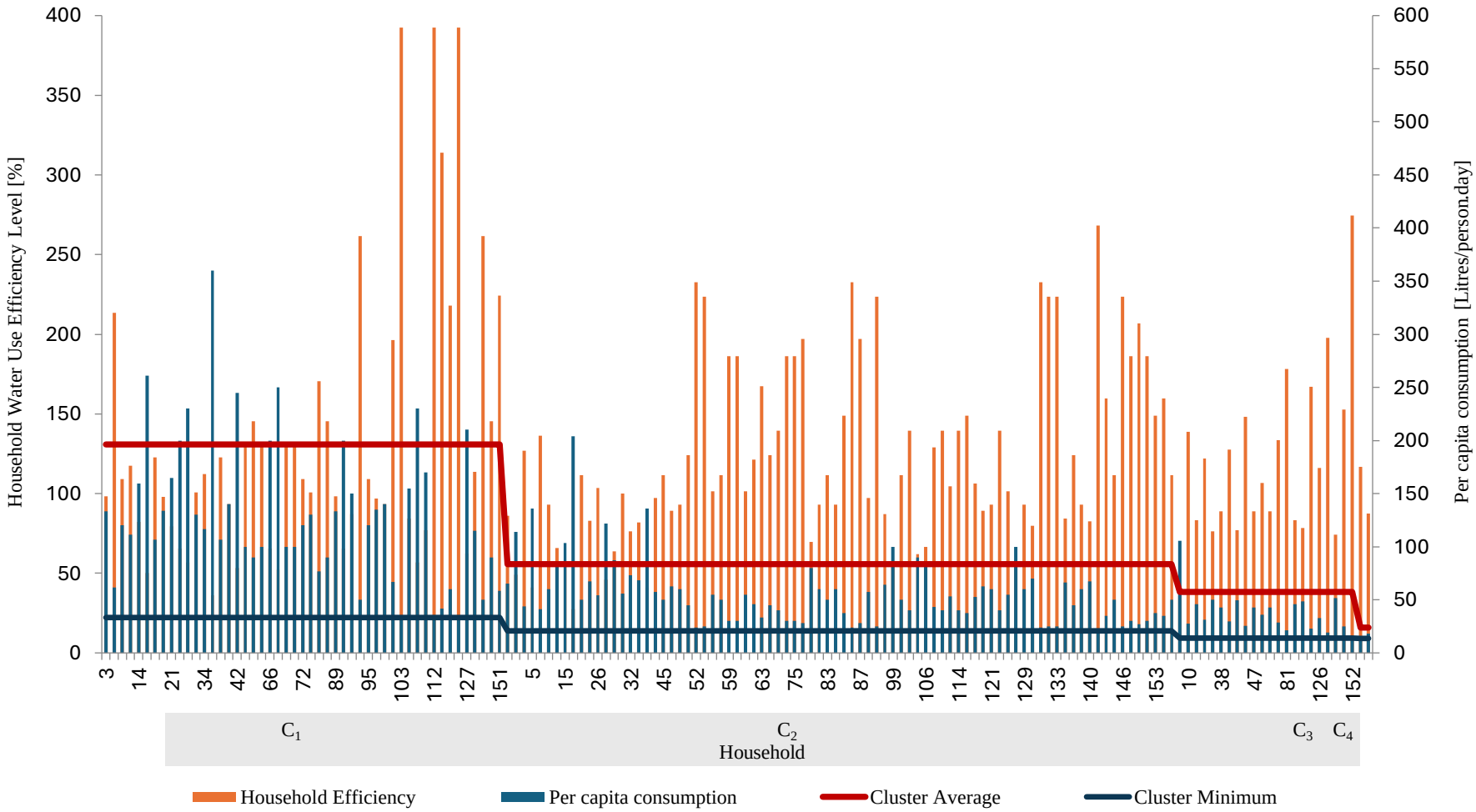

Figure 3: Municipal water use efficiency levels of 155 households.
Source: Researcher's computation, (2024).

Having analyzed the water use efficiency of households, the study utilized the Heckman two-step analysis to provide answers to the second and third objectives. Table 6 gives the output of the determinants of households' willingness to pay and payment for water supply services from the Akwa Ibom Water Company Limited.

Table 6: Heckman two-step regression results

The First Stage: Probit Model **Dependent Variable: Willingness to Pay**						
	Coefficient	**Std. Err.**	**Z Stat.**	**P>|z|**	**[95% Conf. Interval]**	
Age	0.002	0.009	0.24	0.809	-0.016	0.020
Educ	-0.050	0.080	-0.62	0.532	-0.208	0.107
hhinc	0.003	0.002	1.82	0.068***	0.000	0.006
Nfam	-0.127	0.088	-1.44	0.150	-0.299	0.046
WatQua	0.173	0.096	1.8	0.072***	-0.016	0.362
Watquant	0.001	0.001	0.49	0.621	-0.002	0.003
Watuse	0.002	0.001	1.34	0.180	-0.001	0.004
Constant	-0.108	0.654	-0.165	0.869	-1.389	1.174
The Second Stage: Ordinary Least Squares Model **Dependent Variable: Water Payment**						
	Coefficient	**Std. Err.**	**Z Stat.**	**P>|z|**	**[95% Conf. Interval]**	
Watuse	3.955	0.981	4.03	0.000*	2.031	5.878
WatQua	247.489	70.941	3.49	0.000*	108.448	386.530
Watquant	0.688	0.928	0.74	0.458	-1.130	2.507
Hhinc	3.796	1.375	2.76	0.006*	1.101	6.491
Nfam	217.802	81.109	2.69	0.007*	-376.773	-58.832
Constant	198.500	294.364	0.67	0.500	-378.43	750.427
Mills Lambda	1178.517	501.483	2.35	0.019	195.628	2161.405
Rho	1.11509					
Sigma	1056.883					

Source: Researcher's computation (2024).

Note: *, **, *** denote coefficients significant at 1%, 5% and 10% respectively.

The first stage, the probit model, presents the factors that affect the willingness to pay for water supply from the Akwa Ibom Water Company Limited. These factors are age, educational attainment, household income, family size, water quality, water quantity and water use efficiency. The results in table 5.15 show that a positive and significant ($\beta = 0.003$; $P>|z| = 0.068$) relationship exists between household income and the willingness to pay for water supply services by the Akwa Ibom Water Company Limited. The results in table 5.15 also show that a positive and significant ($\beta = 0.173$; $P>|z| = 0.072$) relationship exists between the quality of water supply and the willingness to pay for water supply services by the Akwa Ibom Water Company Limited the quality of water supply.

The factors that influence the willingness to pay for water supply from the Akwa Ibom Water Company Limited are age, educational attainment, household income, family size, water quality, water quantity and water use efficiency. Of these factors, two affected the willingness

to pay for water supply from the Akwa Ibom Water Company Limited positively and significantly. These factors are household income and the quality of water supply services. Specifically, the positive and significant relationship between household income and willingness to pay implies that the respective households are willing to pay for water supply services because their total earned income can afford it. The findings agree with studies conducted by Ayanshola, Sule and Salami (2013); Kanayo, Ezebuilo and Maurice (2013); Mezgebo and Ewnetu (2015); Rananga and Gumbo (2015); Akeju *et al.,* (2018); Islam *et al.,* (2018), and Tolulope *et al.,* (2018) that household income level significantly affected willingness to pay positively. The positive and significant relationship between quality of water supply and willingness to pay implies that the respective households are willing to pay for water supply because they feel the quality of water supply is very reliable. The findings agree with the studies conducted by Moffat, Motlaleng, and Thukuza (2011) that 54% of households are willing to pay for improved water quality. Akeju *et al.,* (2018) and Tolulope *et al.,* (2018)

The second stage, the OLS model, presents the factors that affect the payment for water supply from the water company. These factors are water use efficiency, water quality, water quantity, household income and family size. Though the relationship between the water quantity and water payment level was positive and insignificant ($\beta = 0.688$; $P>|z| = 0.458$), the water use efficiency of households influenced their water payment positively and significantly ($\beta = 3.955$; $P>|z| = 0.000$). Likewise, a positive and significant relationship ($\beta = 247.489$; $P>|z| = 0.000$) exists between the quality of water supply and payment for water supply services. A positive and significant relationship ($\beta = 3.796$; $P>|z| = 0.006$) exists between household income and payment for water supply services.. Lastly, a positive and significant relationship ($\beta = 217.802$; $P>|z| = 0.007$) exists between family size and payment for water supply services.

The second stage shows the factors that influence payment for water supply services from the Akwa Ibom Water Company Limited. These factors are water use efficiency, water quality, water quantity, household income and family size. Of these factors, four affected the payment for water supply services positively and significantly. Specifically, the positive and significant relationship between water use efficiency and water payment implies that households with access to water supply services have continued to pay for water supply services as long as they make use of water efficiently to satisfy their needs. The positive and significant

relationship between water quality and water payment implies that households with access to water supply see the need to continue to pay for water supply services because the quality of water is very reliable. The positive and significant relationship between household income and water payment implies that the increase in income of each household increases their aggregate demand for water which in turn affects households as they maintain or sustain their payment for water supply services. The relationship between family size and water payment implies that as members of households increase, the level of water consumption increases. The findings agree with the studies conducted by Rananga and Gumbo (2015) that household size and monthly income have significant effects on households' water payments.

CONCLUSION

This study assessed households' willingness to pay and payments for water services supplied by the Akwa Ibom Water Company Limited using the Heckman two-step analysis. Based on the findings, the study recommends that households should know that there is a price to pay for a commodity of good quality. The water supply from the Akwa Ibom Water Company Limited is seen to be of good quality. Hence, households should continue to pay for water supply services as a lot of resources are employed to ensure the quality of water from the Akwa Ibom Water Company Limited is reliable. This will assist the water company recover the costs of operations. More so, households that are willing to pay should pass through the necessary procedures to get connected to the water distribution pipeline of the Akwa Ibom Water Company Limited.

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