FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 3 No. 4, December, 2019, pp 105 –114

ASSESSING AND MODELING THE DETERMINANTS OF HOUSEHOLD WATER CONSUMPTION IN LOKOJA TOWN, KOGI STATE

Olufayokemi Rasheedat Oyesanmi

Department of Geography, Federal University, Lokoja. PMB 1154, Lokoja, Kogi State.

Corresponding Author's email: fayokemmy87@gmail.com +2348036417113

ABSTRACT

Water is a scarce resource especially in Nigeria where water shortage is experienced in most of the cities. Determinants of domestic water consumption and their significance vary from place to place. This study analyzed sources and consumption of domestic water supply and investigating the determining factors of domestic water consumption in Lokoja. Data was collecting using the systematic random sampling method. 236 households were sampled and analysed using SPSS software. The results showed that 61.4% of the households got pipe borne water supply, 9% used well water, 9.3% used water from the River Niger and 20.3% got water supply through mechanized boreholes. Household water consumption vary from 121.50 litres/H/d to 2546.50 litres/h/d. The regression analysis has the model Y= 634.786 + 56.492 SE + 22.075AG + 7.428MA + 50.938EDU + 3.973OC+ 102.750MS + 135.585HS. The result of the multiple linear regression analysis indicated that such factors like size of household, level of education, age, sex and monthly income of households strongly determined household water consumption in Lokoja. The multiple correlation coefficient in R= 0.761 indicates that 76.1% of all tested variables correlated positively with domestic water consumption. This study concluded that even though more than half of the population have access to piped water, majority of people in the densely populated areas rely on other sources of water. This study recommends that Kogi State Water Board should take measures for expanding the network of government administered water supply to meet household water demand.

Keywords: water sources, domestic water consumption, regression model.

INTRODUCTION

Water, a precious resource has numerous uses which includes domestic, agriculture, recreation, industry, hydroelectric power as well as maintenance of the environment. The development of human society and the economic development of a country depend upon the availability of good quality water and in abundant quantities for various uses (Fan et. al. 2013 and Istifanus, 2017). Scarcity of freshwater resources has been one of the major challenges throughout the world. Water scarcity is attributed to many interrelated issues such as climate change, population explosion, urbanization and so on. These factors need to be considered during water resource management planning (Hussein, Memon and Savie, 2016, Sadr *et.al.* 2015, Shan *et. al.* 2015).

Urban population worldwide has risen rapidly from 751 million in 1950 to 4.2 billion in 2018 (UN, 2018). By the year 2050, 68% of the world's population will live in urban areas up from 55% at present (UN, 2018). Currently, Africa has a population of 1.3 billion with an urban of 40.6%. Subsequently, it has been projected that by 2050 the population of Africa would be about 2.5 million with an urban population of 53.0% (UN, 2018). The rapid increase of urban population therefore indicates an increase in demand of water especially for domestic purposes. Hence, pressure on the available water resources.

Water stressed urban areas suffer scarcity of water as a result of physical as well as human and social variables. Africa may be facing water crisis in the next decade if urgent and deliberate steps are not taken to address the current water problems already manifesting (Aho, Akpen and Ivue, 2016). Water scarcity is a menace in Africa today. By 2030, 75 to 250 million people in Africa will be living in water stressed areas (Oyesanmi, 2017). Scarcity of water in Nigeria has taken a new dimension as residents of many urban and semi urban areas do not have access to a readily available source of domestic water. Ajadi (2010) observed that pressure is being exerted on Nigeria's water resources due to an increase in demand of domestic water. This he attributed to high rate of population growth coupled with urbanization and increasing living standards.

Domestic water consumption is a significant component of the total water use. Domestic fresh water is a major and essential requirement for human survival. According to World Health Organisation (2003), domestic water is water used for all usual domestic purposes including bathing, food preparations.

Domestic water consumption varies according to living standards of consumers in urban and rural areas (Fan .L.*et.al.* 2013, Al Amin *et. al.* 2011). Inadequate domestic water supply service is a common phenomenon in many developing countries such as Nigeria. Virtually all urban cities in Nigeria do not have adequate water supply in their homes (Enoh, Aniere and Ndukwe, 2014). More than 60% of urban centers in Nigeria face water related problems (Aho, Akpen and Ivue, 2016).

Lokoja town is a fast growing urban city in Nigeria. In recent times, lokoja has witnessed a huge population increase especially since it attained a double status of being a state capital as well as being a local government headquarter. This rapid rate of urbanization in recent times has resulted into more pressure on the available water infrastructure in the town (Abenu, Iwogu and Meduga, 2016, Oyesanmi, 2017). According to Yusuf and Agabe (2010), as the population of Lokoja continues to increase, meeting the need of water of the people by Lokoja water works becomes difficult. Similarly, Abenu *et. al*. (2010) asserted that residents of Lokoja have to depend on several others sources of water such as ground water sources, rain water harvesting, water vendors, streams and rivers for domestic water needs. This is due to the inability of the Kogi State Water Board (KSWB) through the Greater Lokoja Water Scheme to provide enough water to meet the demand of the increasing population.

Many factors influence household and per capita water consumption. Several studies done globally have shown factors like size of household, educational background and age of household head, income, source of water supply as the significant factors that determine quantity of household domestic water use. Fan, Liu, Wang, Geissen and Ritsema (2013) revealed that domestic water consumption in litres per capita positively correlated with water supply pattern and availability of garden area. Household size, monthly income, house quality and source of water supply were found to be the major determining factors of domestic water consumption in Bangladesh (Al Amin et. al., 2011). In Kandahar city of Afganistan, water consumption was found to be determined by factors like age of head of house and household income (Mohammed and Sanaullah, 2016). Keshavarzi *et. al.,* (2006) listed certain socio economic and cultural factors as well as house quality, water source and utility index as factors that correlated positively to household water consumption. Similarly, urban domestic water consumption in Nigeria is influenced by such factors like source of water supply, household size, gender, occupation, water price, level of education, quantity of water supplied, kitchen types, etc, (Ogunbode and Ifabiyi, 2014, Aho *et.al.,* 2016, Istifanus, 2017).

In essence, it is very crucial to have a clear understanding of water use patterns and the factors that determine water consumption in households. This is to ensure effective management of urban domestic water supply and effective design of related public policies. Although there are variations in domestic water consumption pattern of households in Lokoja town (Oyesanmi, 2017), the factors responsible for this variation has not been studies and scientifically established. It is on this premise that this paper seeks to determine the relevant factors that influence household water use in Lokoja. This paper also seeks to identify the various sources of domestic water supply and also estimate the quantity of water used by households daily.

METHODS OF DATA COLLECTION

Study Area

Lokoja town is located on latitude between latitude $7^{o}45^{1}$ and $7^{o}52^{1}$ north of the equator and longitude $6^{o}39^{1}$ and $6^{o}49^{1}$ east of the Greenwich meridian (Audu and Rizama, 2012). Lokoja town has a land mass of about $3200km^{2}$ (Dukiya and Vimal, 2013). Lokoja is underlain by basement complex rocks of Precambrian age that comprises mainly of granite, gneiss and schist (Ayuba *et. al.,* 2013). The town has distinct wet and dry seasons. The wet seasons record about 1215mm of rain annually mainly from April to October with its peak occurring in September (Abenu, *et. al.* 2016). The mean annual temperature scarcely falls below $27.7^{o}C$. Lokoja is drained by River Niger and R iver Benue. The rivers are the main sources of surface water in the area with other smaller streams like Mmeme, Akpomoba and Donka (Abenu, et. al. 2016). Groundwater sources drawn from unconfined aquifers also form a major component of the water resources (Abenu, et. al. 2016). Lokoja town witnessed tremendous influx of people and the population increased from45, 122 in 1991(NPC, 1991) to 181,369 in 2017 (NPC projection, 2017) with an annual growth rate of 3.2%.

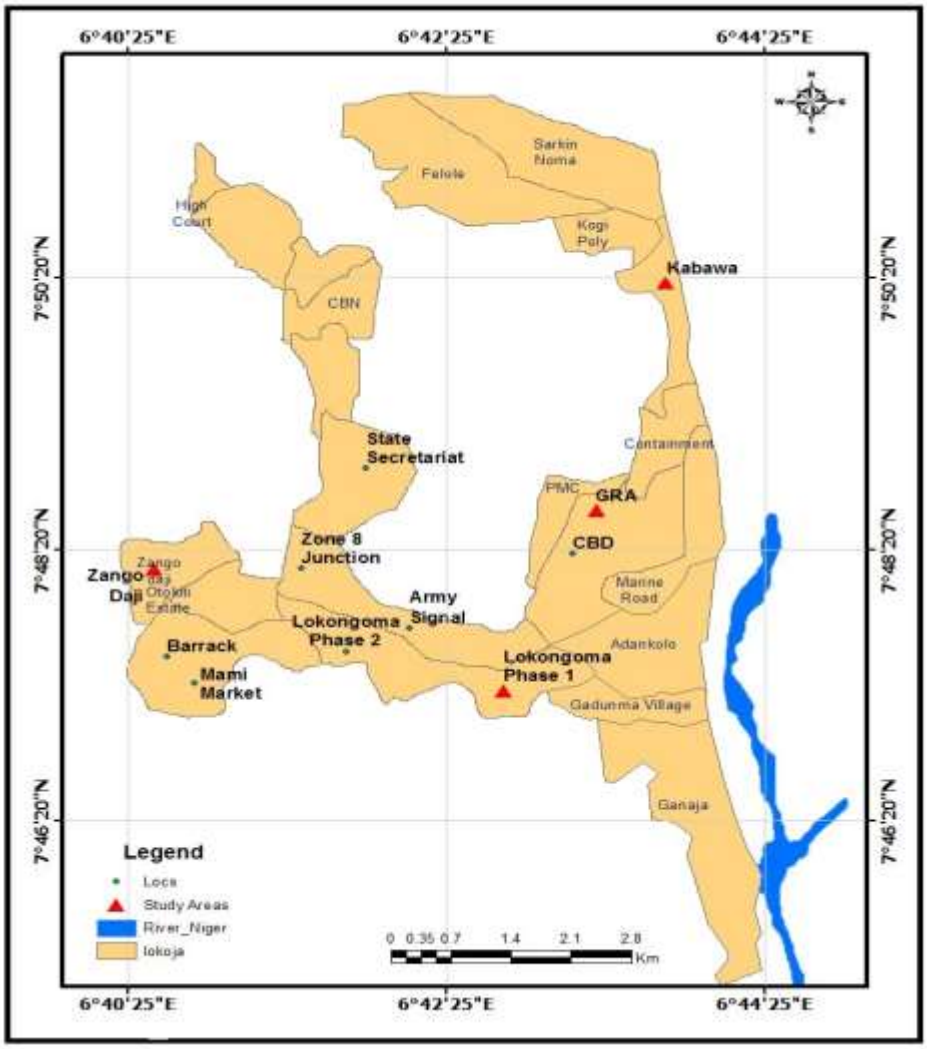

Fig. 1: Map of the Study Area
Source: Author's Analysis, 2018.

Water Resources Development in Lokoja

Lokoja is blessed with abundant water resources as it is located on the confluence of River Niger and River Benue. Despite the natural advantage of Lokoja as a confluence town, portable water supply is still abit of a problem. Prior to the creation of Kogi State in 1991, Lokoja water supply scheme was unoperational. When Kogi State was created in 1991, Lokoja became the state capita, there was increase in population, urbanization rate as well as water demand. The infrastructural facilities such as water facilities began to witness great pressure as they were originally planned to take care of the basic requirement of the population of a local government (Bagaji, et.al, 2011). Water demand increased from 1,460,000 gallons to 1,800,000 gallons per day, hence, the Kogi State Government established the Kogi State Water Board. The Board was established to see to the water supply problem in the town at that time but it could not achieve much as only 70,000 gallons of water per day was provided between 1991- 1996.

It took the Kogi State Government two decades ─1991 to 2011─ after the state was created, to achieve some form of improvement in the provision of potable water in Lokoja through the Greater Lokoja Water Supply Scheme (Abenu, *et. al.* 2016). The Greater Lokoja Water Supply Scheme was initiated in 2009 and completed in 2011.

MATERIALS AND METHODS

The data was collected through field survey in Lokoja town. The population of Lokoja is 181, 369 with an average household size of 5 (NHDS). To determine the total sample size, Cochran (1963) equation was used (equation 1) with a limited error of 6%. This formula yielded a sample size of 265. 265 copies of

questionnaire were equally divided among four residential neighborhoods. However, a total of 236 copies of questionnaires were returned.

$$\text{Equation 1}\ldots\ldots\ldots\ldots\ldots\ldots n = \frac{z^2_{a/2}.p.q.N}{e^2(N-1)+z^2_{a/2}.p.q}$$

where n is the sample size, N is the total number of households, e is the limited error, z is the confidence level (95%), p is the estimated proportion of an attribute (0.5). The survey was conducted with the target to extract exclusive information on the household size and structure, daily water consumption for indoor and outdoor activities, socio-economic factors (age, sex, income, occupation, education) influencing water utilization, sources of water supply.

Household water consumption in selected houses situated in 4 different residential areas was surveyed (Figure 1). The areas were Government Reserved Area (GRA), Old/traditional areas (Kabawa), Modern Private Areas (Lokongoma Phase 1) and unplanned fringes (Zango Daji). These areas represent the residential divisions of developing cities in Nigeria (Oyegun, 1985). The target respondents were the women (mothers and wives) of each household as women are known to engage more in most of the domestic activities. Where she was unavailable, a reliable member of the family was interviewed. In the absence of efficient water meters, a standard size bucket of 15 litres was used by respondents as a standard measurement of household water use.

DATA ANALYSIS

Descriptive statistics (mean, percentage, frequency and standard deviation) were used to assess the household socioeconomic status, household water consumption pattern, sources of household water supply. Multiple Linear Regression analysis was employed to determine the factors that affect domestic water consumption. Factors considered were age, gender, education, income, religion, source of water supply, household size, availability of garden area and type of toilet. These factors were selected based on the review of relevant literature. To further establish the relationship between socio economic characteristics and household water consumption, the study hypothesized:

H_0 : there is no statistically significant relationship between socio economics characteristics and household water use.

H_1 : there is a statistically significant relationship between socio economic characteristics and household water use.

RESULTS AND DISCUSSION

Household characteristics

Details of the analysis of household characteristics of all sampled household respondents in the different residential neighborhoods are summarized in Table 1. Result on gender shows that most of the respondents were females (66.9%) and 33.1% were males. This is so because this study focused on heads on households especially the women as they are known to provide water for domestic uses and engage in most of the domestic activities. The proportion of male was only accommodated where a female is not available during the survey. Age distribution of respondents shows that majority of them are between the ages of 31- 40 years and 41 – 50 years. Each of these age groups constitute 29.2% of the sample population.

More than half of the respondents (57.6%) reported that they have completed tertiary education, 11.9% and 25.8% had completed primary and secondary education respectively while only 4.2% reported that they have other educational qualifications such as quranic education, etc. This implies that the respondents were literate enough to understand and give accurate answers to the questions in the questionnaire. Result on occupation revealed that 44.1% of respondents were civil servants working in various private and government establishments, 23.3% traders, 14.4% artisans and 18.2% had other kinds of jobs. The high number of civil servants in the study area is because Lokoja town has become a rapidly growing administrative centre since it became the state capital in 1991. 54.2% of the respondents practice Islam while 45.8% practice Christianity. This is attributed to the fact that state is located in the North central region of the country as well as the fact that the core or traditional area which is densely populated is made up of Hausa and the Bassa tribe who are predominantly muslims.

Table 1: Socio economic characteristics of respondents

VARIABLE	CATEGORY	FREQUENCY (f)	PERCENTAGE (%)
SEX	Male	78	33.1
	Female	158	66.9
	TOTAL	236	100
Age of Respondents	20-30 years	47	19.9
	31-40 years	69	29.2
	41-50 years	69	29.2
	51-60 years	41	17.4
	above 60 years	10	4.2
	TOTAL	236	100
Level of Education	Primary	28	11.9
	Secondary	61	25.8
	Tertiary	136	57.6
	Others	11	4.7
	Total	236	100
Occupation	Civil servant	104	44.1
	Trader	55	23.3
	Artisan	34	14.4
	Others	43	18.2
	Total	236	100
Monthly income	less than 10,000	42	17.8
	10,001-30,000	53	22.5
	30,001-50,000	31	13.1
	50,001-100,000	52	22.0
	above 100,000	58	28.6
	total	236	100
Religion	Islam	129	54.2
	Christianity	108	45.8
	Total	236	100

Source: Author's field survey, 2018

Sources of Domestic Water Supply

As discussed in the earlier section, KSWB through the Greater Lokoja Water Scheme is saddled with the responsibility of providing portable water to households in Lokoja. However, this study revealed that 61.4% of the households use piped water, majorities (45.8%) of which are households in planned neighborhoods (GRA and Lokongoma Phase 1 housing estate). This implies that more than half of the residents of Lokoja have access to piped water supply. Similarly, Abenu, *et.al* (2016) also revealed that most households in all the planned neighborhood in Lokoja were connected to the water supply scheme with more than 80% of the respondents in these areas having access to tap water. 20.3% rely mainly on motorized borehole dug within compounds with majority of these households located in the unplanned fringe of Zango Daji. This is because the entire area is not integrated into the portable water supply scheme. The River Niger and other small streams that serve as its tributaries serve 9.3% of the respondents most especially the residents of Kabawa area that is located along the river channel.

Table 2: Household Source of Water Supply

Source of water supply	Frequency (f)	Percentage (%)
Pipe borne water	145	61.4
Well	21	9.0
River/Stream	22	9.3
Borehole	48	20.3
Total	236	100

Source: Author's fieldwork, 2018

Household Water Consumption

Domestic water consumption was classified into indoor and outdoor uses. Indoor water uses include water for drinking, laundry, cooking, dish washing, brushing, washing vegetables, performing ablution (for muslims), personal hygiene (shaving, brushing, bathing, toilet). Outdoor activities are washing of cars, cleaning of yards, garden, swimming and other uses such as operation of grinding machine, poultry and livestock feeding, etc. as presented on Table 3, bathing and laundry make up the largest quantity of household water consumption with 141.56 l/h/d and 308.83 l/h/d respectively. This may be attributed to the fact that the weather of Lokoja is usually very hot which necessitates the need to take frequent baths. High humidity and the dusty nature of the town make one sweat profusely and clothes get dirty easily which necessitates washing of clothes frequently.

Table 3: Household Water Consumption Pattern

Activities	No	minimum	maximum	Sum	mean	SD
Drinking	236	2	30	2629	11.14	5.666
Bathing	236	28	480	33408	141.56	81.238
Laundry	236	40	1920	72883	308.83	243.502
Ablution	129	1.5	50	2292.70	17.77	13.09427
Shaving	187	.2	6	178.4	.95	.80892
Toilet	236	1	200	12423.20	52.64	40.28601
Washing dishes	236	4.00	54	4460	18.89	9.11710
Washing vegetables	236	.75	9	748.20	3.17	1.67563
Cooking	236	4	60	5274.10	22.35	9.80578
Brushing of teeth	236	1	82	1438.65	6.1	7.39374
Washing of car	168	12	120	8950	53.27	19.48981
Yard cleaning	51	4	90	1294	25.37	19.1746683
Gardens	51	2	80	1355	26.57	17.46683
Others	229	1	2	379	1.6	.476
Household water consumption	236	121.50	2546.50	147334.35	624.2977	369.16535

Source: Author's fieldwork, 2018

The mean quantity of water used for cooking is 22.35l/h/d, 18.89 l/h/d is used for washing dishes and 52.64 l/h/d is consumed for sanitary purposes in the toilet. 54.2% of sampled households are muslims and they account for the use of an average water use of 17.77 l/h/d.

For outdoor activities, washing of cars accounted for the highest quantity of water consumed. A total of 168 (70%) households confirmed to own at least a car, thus, consuming an average of 53.27 l/h/d although only 74% of these households attested to washing their cars in their homes. Most of the households sampled were without gardens, only 21.7% (51) has gardens with an average water use of 26.5 l/h/d for gardening. In the same vein, most of the houses sweep their yards and compounds with broom instead of cleaning with water, with only 51 households confirming to the use of water to clean their yard, 25.37 l/h/d of water is used.

Factors Affecting Domestic Water Consumption

Pearson moment correlation was conducted to examine the factors that determine household water consumption pattern. Seven variables (sex, age, and marital status, level of education, occupation, monthly income and household size) were examined (table 4). It can be seen from the correlation matrix that six out of all seven variables were positively correlated and significant in determining household water consumption pattern. The variable that was most strongly significant was size of household ($r = 0.594$, $p < 0.05$), followed by monthly income ($r = 0.510$, $p < 0.05$), age ($r = 0.312$, $p < 0.05$), level of education ($r = 0.197$, $p < 0.05$), marital status ($r = 0.152$, $p < 0.05$) and sex ($r = 0.055$, $p<0.05$).

Table 4: Correlation matrix of relationship between household water consumption and 7 independent variables.

	1	2	3	4	5	6	7	
water consumption /h/day	1							
Sex	0.055	1						
Age	0.312	-0.038	1					
Marital status	0.152	0.083	0.499	1				
Level of education	0.197	- 0.119	-0.009	-0.137	1			
Occupation	-0.210	0.010	-0.143	-0.176	-0.140	1		
Monthly Salary	0.510	-0.011	0.259	0.047	0.378	-0.260	1	
Size of Household	0.594	0.004	0.250	0.173	0.179	-0.164	-0.074	1

($p < 0.05$)

This association demonstrates that there is increase in household water consumption as such factors as age of head of household, level of education of head of household, household monthly income and others increase while there is no relationship between household water consumption and occupation of household head ($r = - 0.210$, $p< 0.05$). This implies that the higher the number of people living in a household, the higher the quantity of water consumed per day. Furthermore, the higher the age of head of household, the more water that is consumed. This is simply due to the fact that rich, elderly people love to live luxurious and comfortable life. This is similar to the findings of Mohammed and Sanaullah (2017), Istianus (2017) where they revealed that domestic water consumption in Kandahar city of Afganistan and Bauchi in Nigeria is highly influenced by age of head of household, size of household and household monthly income. This may also be the result of different attitudes toward environmental issues, where older individuals possess less information about and give less attention to water conservation (Keshavarzi et.al, 2006).

Multiple Regression Analysis of variables influencing household daily water consumption

In multiple regression models, the unstandardised coefficients indicate how much the dependent variable varies with an independent variable when all other independent variables are held constant. As shown on table 5, the results of the analysis of the coefficient of variable revealed that all variables tested influenced household water consumption positively at 5% significant level.

Size of household was positively significant. This indicates that households with more members consume water more than households with few members. Therefore, a unit increase in household size by one person will increase Household Water Consumption (HWC) by 135.585 litres. This is however in constrast with the findings of Keshavarzi et.al, (2006). Monthly income has an unstandardized coefficient of 102.750 which also shows a positive significance. This implies that a unit increase in monthly income leads to an increase in HWC. In otherwords, wealthier households consume more water because they are able

to afford a lot of water consuming household appliances (Istifanus, 2016, Lee and Wang, 2017).

Level of education is also found to influence HWC positively. An increase in the level of education of members of a household brings an increase in HWC by 50.938 litres per day. This influence could be as a result of the act that educated people tend to live a modern life which could involve engaging in water consuming activities more (Istifanus, 2016). It could also be because high literacy level of members of a household is an indication of high level of hygiene. Therefore, more water is meant to be used for sanitary purposes. Sex of members of households has an unstandardized coefficient of 56.492. this is an indication that households with more female members tend to consume more water than males. This could be because females are usually known to do almost all household chores, most of which require the use of water.

With an unstandardized coefficient value of 22.075. it is established that the older the head of household, the more water that is consumed. In essence, an increase in the age of head of household increases HWC by 22.075 litres per day. Other variables that were significantly positive are marital status as well as occupation.

Table 5 : Coefficients of Determinants

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-634.786	122.865		-5.167	.000
Sex	56.492	34.167	.072	1.653	.100
Age	22.075	17.389	.067	1.270	.206
Marital_status	7.428	27.515	.014	.270	.787
Level_of_education	50.938	23.202	.105	2.195	.029
Occupation	3.973	14.727	.012	.270	.788
Monthly_salary	102.750	12.540	.406	8.194	.000
size_of_household	135.585	11.001	.556	12.324	.000

a. Dependent Variable: total_household_water_consumption

Model Summary of Regression Analysis

The summary table shows the result of the regression analysis as presented on table 6. The table provides the R, R^2 and adjusted R^2 values as well as the standard error of the estimate. The R value (multiple correlation coefficient) is considered to be one measure of the quality of the prediction of the dependent variable. In this case, R value was calculated to be 0.761 which indicates a good level of prediction. The R^2 (coefficient of determination) is the proportion of variance in the dependent variable that can be explained by the independent variables. R^2 for this study analysis stands at 0.579; this indicates that all of the seven independent variables explains 57.9% of the variability in daily household water consumption. However, this is an acceptable result for household level cross-sectional data (pallant, 2010).

Table 6: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.761[a]	.579	.566	243.30199

a. Predictors: (Constant), size_of_household, Sex, Monthly_salary, Marital_status, Occupation, Level_of_education, Age

b. Dependent Variable: total_household_water_consumption

Statistical significant of the Regression Model

The F-ratio in the Analysis of Variance (ANOVA) table (table 7) tests whether the overall regression model is a good fit for the data. The ANOVA result also tested the hypothesis postulated. The F- value was calculated to be 44.718 which was significant at 1%. Therefore the F – test (F = 44.718, p = 0.01) shows that the independent variables used in the model statistically predicts the dependent variable. In otherwords, the socio economic characteristics that were analysed significantly influence household domestic water consumption pattern in Lokoja, Kogi State. Therefore, the null hypothesis that states that there is no significant relationship between socio economic characteristics

and household water use is hereby rejected while the alternative hypothesis is accepted.

Table 7: **ANOVA[a]**

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	18529862.886	7	2647123.269	44.718	.000[b]
	Residual	13496655.625	228	59195.858		
	Total	32026518.511	235			

a. Dependent Variable: total_household_water_consumption

b. Predictors: (Constant), size_of_household, Sex, Monthly_salary, Marital_status, Occupation, Level_of_education, Age

Regression model

A regression model was developed for estimating and predicting daily household water use. The equation is as follows: Y= 634.786 + 56.492 SE + 22.075AG + 7.428MA + 50.938EDU + 3.973OC+ 102.750MS + 135.585HS

Where Y is daily household water consumption, SE stands for sex, AG means age, MA stands for marital status, EDU means level of education, OC is Occupation, MS stands for Monthly Salary and HS stands for Household Size.

CONCLUSION AND RECOMMENDATION

This study investigated household water sources, water consumption and the factors that influence household water consumption in Lokoja town. The results showed that 61.4% of the households got pipe borne water supply, 9% used well water, 9.3% used water from the River Niger and 20.3% got water supply through mechanized boreholes. Household water consumption varies from 121.50 litres/h/d to 2546.50 litres/h/d. The findings of the multiple regression analysis revealed that 57.9% of the variation in household water consumption was explained by the regression model. Household water consumption in Lokoja is highly influenced by such socio economic factors like age, sex, marital status, level of education, occupation, monthly salary and household size. This study concluded that even though more than half of the population have access to piped water, majority of people in the densely populated areas rely on other sources of water. This study recommends that Kogi State Water board should take measures for expanding the network of government administered water supply to meet household water demand.

REFERENCES

Abenu, A., Iwugo, K.O. and Medugu, N.I. (2016). An Assessment of Domestic Water Supply Patterns in Lojoka, Kogi State: *International journal of trend in Research and Development, (3)3: 647-653.*

Aho, M.I., Akpen, G.D.,and Ivue, P. (2016). Determinants of residential per capital water demand of markudi metropolis: *Nigerian Journal of Technology,* (35): 426-431.

Ajadi, B.S. (2010).Portable Water Availability and Consumption Pattern in Ilorin Metropolis, Nigeria: *Global Journal of Human Social* Science,10 (6/1): 44 – 50.

Al-Amin, M., Mahmud, K., Hosen, S. and Akhsanul Islam, M. (2011). Domestic water consumption in a village in Bangladesh: In the proceedings of the 1st Engineering Congress, Bangladesh, pp: 83-83.

Bagaji, A.S.Y., Yakub, N. and Maji, A. (2011). Lokoja urban water supply as a basic service programme: A critical appraisal of achievements and failures, 1991-2011: *Canadian Social Science, 7(4): 82-88.*

Enoh, A.E., Aniere, Q.U, and Ndukwe, A.A. (2014). Residential Water Use in Onitsha North Local Government Area, Anambra State, Nigeria: *International Journal of Innovation and Applied Studies, 9(3):1409-1415.*

Fan, L., Liu, G., Wang, F., Geissen, V., Ritsema, C. J and Tong, Y., (2013). Water Use Patterns and Conservation in Households of Wei River Basin, China: *Resources, Conservation and Recycling Journal,* (74):45 – 53.

Hussein, W.A., Memon, F.A. and Savic, D.A. (2016). Assessing and Modelling the Influence of Household Characteristics on per Capita Water consumption: *Water Resource Management, (30) 2931-2955*

Istifanus, V. (2017). Determinants of Domestic Water Use in Bauchi Metropolis:A Model Perspective: *Journal of environment and Earth Science,*7(6): 1-4.

Keshavarzi, A.R., Sharifzadeh, M., Kamgar-Haghighi, .A.A., Amin, S., Keshtkar S.and Bamdad, A. (2006). Rural Domestic

Water Consumption Behavior: A study in Ramjerd area, Fars province, I.R. Iran. *Water research 2006*, 40:1173-1178.

Mohammed, A.H. and Sannuallah, P. (2017). An Empirical Analysis of Domestic Water Sources, Consumption and Associated Factors in Kandahar City, Afganistan. *Resources and Environment Journal 17(2): 49 – 61*.

Ogunbode, T.O. and Ifabiyi, P.I. (2014). Detreminants of Domestic Water Consumption in a Growing Urban Center in Osun State, Nigeria. *African Journal of Environmental Science and Technology 8(4): 247-255.*

Oyesanmi, O.R. (2017). An Assessment of Domestic Water Consumption Pattern In Lokoja Metropolis, Kogi State. *International Journal of Social Sciences, 11(3): 46-56*

Sadr, S.K., Memon, F.A., Jain, A., Gulati, S., Duncan, A.P., Hussein, W., Savić, D.A., and Butler, D. (2016). An Analysis of Domestic Water Consumption in Jaipur, India*: British Journal of Environment and Climate Change, 6(2): 97-115.*

Shan, Y.,Yang, L., Perren, K. and Zhang, y. (2015). Household Water Consumption: Insight from a Survey in Greece and Poland*: Procedia Engineering, (119) 1409-1418.*

Yusuf, Y.O. and Agabe, V. (2010). Assessment of water supply and distribution in Lokoja township, Kogi state. A Paper Presented at the 51st Annual Conference of the Association of Nigerian Geographers, 7-11 March, 2010. www.abu.edu.ng/publications/2013-03-14-095653_5380.doc