ANALYSIS OF SOCIO-ECONOMIC CHARACTERISTICS AND DOMESTIC WATER DEMAND IN YELWA AREA OF BAUCHI METROPOLIS

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KEYWORDS
Analysis, Socio-Economic, Characteristics, Domestic, Water Demand

ABSTRACT
This paper examines the impact of socio-economic characteristics on domestic water demand among households in Yelwa Area of Bauchi Metropolis, Nigeria. Using systematic random and stratified sampling techniques, data were collected from 310 households across seven neighborhoods via structured questionnaires. Analysis of Variance (ANOVA) and multiple regression analysis were employed to analyze the data. The results reveal that socio-economic characteristics significantly influence domestic water demand. Specifically, income level and household size are significant predictors of domestic water demand, while occupation is not. The findings suggest that Policymakers and Water Resource Managers, Urban Planners, City Planners, Urban Managers and Urban and Regional Planners should consider the socio-economic characteristics of households when developing strategies to provide and manage water resources. Income and household size should be taken into account when predicting domestic water demand and further research is needed to explore the relationship between occupation and domestic water demand, as the findings of this study suggest that occupation is not a significant factor in contexts. This study contributes to existing knowledge by highlighting the relationships between socio-economic characteristics and domestic water demand in the study area, providing insights for improved domestic water supply strategies.

Introduction

The indispensable role of water in sustaining human life is well-documented, with domestic water demand emerging as a critical aspect of household well-being (Al-Amin *et al.,* 2011). However, the complex dynamics driving domestic water demand remain poorly understood, particularly in relation to socio-economic characteristics. While studies have established a link between household size, income level, occupation, and domestic water demand (Al-Amin *et al.,* 2011), a more nuanced examination of these relationships is needed.

A critical review of the literature reveals a paradox: despite the growing recognition of water's importance, domestic water demand continues to outstrip supply, driven by rising standards of living, lifestyle changes, and socio-economic activities (Al-Amin *et al.,* 2011). Furthermore, the impact of socio-economic characteristics on domestic water demand varies, with higher standards of living leading to increased demand for water-intensive activities (Istifanus, 2019). The interplay between income level, occupation, and household composition/size also requires closer scrutiny, as these factors influence access to water for domestic activities (Pittock *et al.,* 2016).

Notably, existing literature often focuses on quantitative aspects of domestic water demand, neglecting the qualitative experiences of households and communities. The World Health Organization's recommended 120 liters per capita per day (WHO, 2009) and the Nigeria National Water Policy (NWP, 2004) serve as benchmarks, but their applicability in diverse contexts, such as Yelwa, remains uncertain. This study addresses these knowledge gaps by investigating the complex dynamics of domestic water demand in Yelwa, with a particular emphasis on the intersections between socio-economic characteristics and domestic water demand.

Statement of Research Problem

Nigeria's rapidly growing population has led to a surge in water demand, exacerbating existing challenges in meeting the country's water needs. Despite efforts to improve access to basic water services, a significant proportion of Nigerians, particularly in semi-urban areas, rely on contaminated water sources (UNICEF, 2020). The disparity in access to domestic water between urban and semi-urban areas is stark, with urban areas having significantly better access (WHO, 2019). Climate change is expected to worsen the situation, with changing precipitation patterns and increased frequency of extreme weather events impacting water availability (IPCC, 2020).

In Yelwa area of Bauchi metropolis, the dry season (November to May) poses significant challenges, with households experiencing high water demand and resorting to alternative sources, such as wells, taps, and boreholes (Istifanus, 2019). This study observes that households in Yelwa, a semi-densely populated neighborhood, face considerable difficulties in accessing water for domestic activities during this period. The area's semi-dense population density, combined with inadequate water infrastructure, results in thousands of households lacking access to water, leading to suffering and inconvenience (Istifanus, 2019).

This paper analysis the effects of socio-economic characteristics, such as income levels, occupation, and household size, on domestic water demand among households in Yelwa area of Bauchi metropolis during the dry season. Using ANOVA and Multiple Regression Analysis, this paper aims to enhance understanding of household domestic water demand and its relationship with socio-economic characteristics, ultimately recommending strategies for improved domestic water supply.

Socio-Economic Characteristics and Domestic Water Demand

Socio-economic characteristics, such as occupation, income level, and household size, significantly influence domestic water demand in Nigeria (Pittock et al., 2016; Ghiasi et al., 2021). Understanding the relationship between these factors and water demand is crucial for effective water management strategies and sustainable resource utilization.

Occupation plays a vital role in shaping domestic water demand, as it affects individuals' daily routines, work-related activities, and lifestyles (Pittock et al., 2016). Certain occupations, such as civil service and construction, may require more water-intensive

activities, potentially increasing domestic water demand. Additionally, occupation can influence individuals' environmental awareness and behavior, impacting water consumption patterns (Yazdanfar et al., 2022). Income level is a significant determinant of domestic water demand, as it influences an individual's purchasing power and lifestyle choices (Ngoc et al., 2019). Higher-income households tend to have higher water consumption due to greater access to water-intensive appliances and amenities. Conversely, lower-income households often exhibit lower per capita water use due to limited access to water resources and a higher propensity for water-saving practices (Adewumi et al., 2018). Household size is a key determinant of water demand patterns in Nigeria (Olajuyigbe, 2018). Larger households tend to consume more water due to the higher number of residents using water for various purposes. However, the relationship between household size and domestic water demand is complex and influenced by various socio-economic factors, including income level and occupation (Adewumi et al., 2018).

Conceptual Clarification

This paper is grounded in the concept of water stress index (WSI) and social and economic indicators within the context of social change in Yelwa area of Bauchi metropolis. The WSI, developed by Malin Falkenmark, assesses the availability of water in relation to population, using a minimum per capita water requirement of 100 liters for all uses (Gleick *et al.,* 2003). This framework is particularly relevant in Yelwa, where access to clean water is a significant challenge.

The concept of social change is critical in understanding the dynamics of water stress in Yelwa. As the community is not static, social change can influence water demand patterns, access to water resources, and the overall resilience of the community to water stress. By examining the interplay between WSI, social and economic indicators, and social change, this paper aims to provide a comprehensive understanding of the complex issues surrounding water stress in Yelwa area of Bauchi metropolis.

Theoretical Framework

This study adopts the neo-classical economic theory of supply and demand, as proposed by Alfred Marshall in 1890. The theory posits that the perception of the usefulness of products influences market forces, namely supply and demand. In the context of domestic water demand in Yelwa area of Bauchi metropolis, this theory suggests that the price of water affects its demand. When water prices increase, households reduce their water demand, and vice versa.

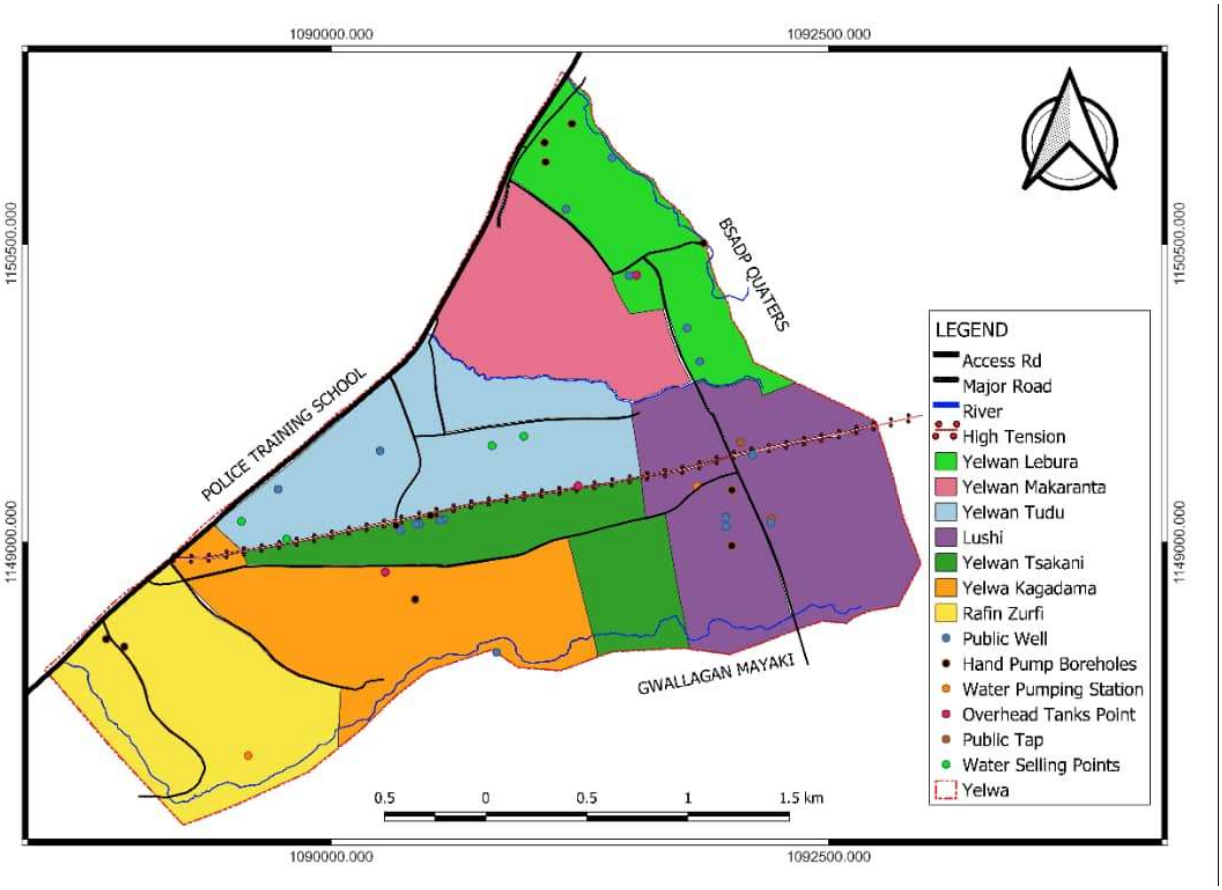
In Yelwa area of Bauchi metropolis, the demand for water for domestic activities such as drinking, bathing, and washing dishes is influenced by socio-economic characteristics, including occupation, income, and household size. Occupation affects households' daily routines, work-related activities, and lifestyles, which in turn influence their water consumption patterns (Pittock *et al.,* 2016). Income level also plays a significant role in determining households' water demand, as higher-income households tend to have greater access to water-intensive appliances and amenities (Ngoc *et al.,* 2019). Household size is another crucial factor influencing domestic water demand in Yelwa area of Bauchi metropolis. Larger households tend to consume more water due to the higher number of residents using water for various purposes (Olajuyigbe, 2018). However, the relationship between household size and domestic water demand is complex and influenced by various socio-economic factors, including occupation and income level (Adewumi *et al.,* 2018).

Recent studies have emphasized the importance of considering socio-economic characteristics in understanding domestic water demand (Abu-Bakar *et al.,* 2021; González-Gómez & García-Rubio, 2018). This study aims to contribute to this body of knowledge by analyzing the effects of occupation, income, and household size on domestic water demand in Yelwa area of Bauchi metropolis.

The Study Area

Yelwa area, situated in southern Bauchi metropolis, is a large settlement with a rich history dating back to the 1960s. Founded by Nde Waziri, the area has evolved into a

cosmopolitan community with diverse ethnic groups, including Hausa-Fulani, Sayawa, and Igbo. The area is home to several institutions, such as General Hassan Usman Katsina Unity College and Abubakar Tafawa Balewa University (Abubakar, 2020). Yelwa comprises several neighborhoods, including Yelwa Kagadama, Yelwa Tsakani, Yelwa Tudu, Yelwa Laborer, Yelwa Makaranta, Lushi and Rafin Zurfi and shares boundaries with other locations like BRC, Abubakar Tafawa Balewa University, Police Training School and Federal Low-cost. With a population of 73,145 people living in 9,174 households, the area is predominantly inhabited by residents and students from local universities and polytechnics (Muhammad, 2019). The inhabitants of Yelwa are mainly engaged in agriculture, producing both food and cash crops. The area experiences a hot climate for most of the year, with temperatures ranging from 40-50°C during the hottest months (March to May) and 6-7°C during the coldest months (December and January). The rainy season lasts from April to October, with an average annual rainfall of 1091.4 mm.



Source: QGIS v22, 2025.

Figure 1: Map of the Study area showing the different neighbourhoods

Method of Data Collection

Required data were from primary sources and were obtained through structured questions. The structured questionnaire was used in collecting information from the household heads in Yelwa. The quantitative and qualitative data obtained was subjected to both descriptive and inferential statistics. In this paper, quantitative data were collected by means of the structured questionnaire technique, which was adopted in

eliciting information of 310 household heads from the total number of 9, 174 households. The researcher using the household listing numbering from the General Household Survey 2018-2019 numbered the entire households by the already existing numbering. The researcher then selected all households which are odd numbers until the total number of samples are gotten. To get the required sample size from the existing neighbourhoods the researcher employed the proportion formula to calculate the proportion of households to be selected by the neighbourhood. Proportionate formula = nh = (Nh / N) x n. Where; n= is the population of households in a particular neighbourhood. The questionnaire was designed to analysed the effects of socio-economic characteristics on domestic water demand in the study.

The effects of socio-economic characteristics of households on domestic water demand were analysed using inferential statistics specifically Regression Analysis and the Analysis of Variances (ANOVA) which tested relationship between socio-economic characteristics and domestic water demand among households in Yelwa area of Bauchi Metropolis, the study employed multiple regression analysis to analyze and proof that the collected data truly represents the sample, the assumption of regression analysis is necessary (Hair, *et al,* 2019). Similarly, the assumption for multiple regression analysis includes among others is the test of multi-co linearity Assumption. Kothari, (2019) asserted that multicollinearity is a situation when there is a high degree of correlation between the independent variable. Accordingly, the tolerance value closed to 1 and VIF (Variance Inflated Factor) around 1 and not more than 10 can be confirmed that there is absence of multicollinearity between independent variable in the regression model.

Result and Discussions

i. Multiple Regression Analysis

The result of the multiple regression indicated absence of multicollinearity index among the independent variable with respect to the fact that the VIF value are less than 10 while the tolerance values are more than 0.10. The result showed absence of multi-collinearity in the model. Hence, the study concluded that there were no dilemmas of multi-collinearity among the examined variables. The research finding presented above suggests that the study has successfully established the absence of multicollinearity among the independent variables. This is a crucial step in regression analysis, as multicollinearity can lead to unstable estimates of the regression coefficients and inflated variance (Kutner et al., 2005). The study's conclusion is based on the Variance Inflation Factor (VIF) values being less than 10 and the tolerance values being more than 0.10. This is consistent with the guidelines provided by various researchers (e.g., Hair et al., 2010; Field, 2013), who suggest that VIF values greater than 10 and tolerance values less than 0.10 indicate multicollinearity.

Recent studies have also emphasized the importance of checking for multicollinearity in regression analysis. For example, a study by Dahlan and Mohamed (2020) found that multicollinearity can lead to biased estimates of the regression coefficients and recommended using VIF and tolerance values to detect multicollinearity. Similarly, a study by Alinaitwe et al. (2020) used VIF and tolerance values to check for multicollinearity in their regression analysis and found that the independent variables were not highly correlated. The research finding presented above is consistent with the existing literature on multicollinearity in regression analysis. The study's use of VIF and tolerance values to check for multicollinearity is also consistent with recommended best practices therefore, there are no dilemmas of multicollinearity among the examined variables is supported by the data and the literature.

Table 1: Showing Multi- Collinearity Statistics of the Respondent

Model		Collinearity Statistics	
		Tolerance	VIF
1	Occupation	.339	2.951
	Income level	.212	4.321
	House size	.248	4.026

Source: Author, 2024
Dependent Variable: Quantity of Domestic Water Demanded (QDWD)

ii. Regression analysis between the predictors (socio-economic characteristics) and the outcome variable (quantity of domestic water demanded)

Multiple regression analysis was carried out to ascertain the direct effect of the independent variables (occupation, income level and house hold size) on the dependent variable (quantity of domestic water demanded). The regression model indicated how much of the variance in dependent variable is explained by predictor variables. Additionally, to ascertain the relationship between the predictors and the outcome variable. The research finding presented above suggests that multiple regression analysis is used to examine the relationship between three independent variables (occupation, income level, and household size) and one dependent variable (quantity of domestic water demanded). The study aimed to determine the direct effect of the independent variables on the dependent variable and to identify the proportion of variance in the dependent variable explained by the predictor variables.

This approach is consistent with previous research that has used multiple regression analysis to investigate the factors influencing water demand (e.g., Arbues *et al*., 2010). For instance, a study by Wang *et al*. (2019) used multiple regression analysis to examine the factors affecting household water demand in China, and found that income level, household size, and education level were significant predictors of water households domestic water demand.

The use of multiple regression analysis in this study allows for the control of confounding variables and the examination of the relationships between the independent variables and the dependent variable while holding all other variables constant (Cohen *et al*.,2013). This is particularly important in studies examining water demand, as there are often multiple factors influencing demand. The finding regression model indicated how much of the variance in the dependent variable is explained by the predictor variables is also consistent with previous research. For example, a study by Aladenola *et al*. (2019) used multiple regression analysis to examine the factors influencing water demand in Nigeria, and found that the predictor variables explained 65% of the variance in water demand.

Table 2: Showing Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.937[a]	.878	.876	.34613

Source: Author, 2024

Predictors: (Constant), occupation, Income level, household size

The model summary of the relationship between economic characteristics and quantity of domestic water demanded is presented in Table 2 above and the finding of the analysis revealed the value of R^2 =0.878 which demonstrated a positive and strong relationship between economic characteristic and quantity of domestic water demanded. This implies that socio-economic characteristic account for about 89% of the variation in quantity of domestic water demanded. However, the overall significance of the relationship is presented in Table 4. The research finding indicates a strong positive relationship between economic characteristics and the quantity of domestic water demanded, with an R-squared value of 0.878. This suggests that socio-economic characteristics account for approximately 89% of the variation in domestic water demand. The high R-squared value in this study implies that the model is a good fit for the data, and the relationships between the variables are well-explained.

Table 3: Showing Analysis of Variance (ANOVA)

ANOVA[a]

Model		Sum of Squares	df.	Mean Square	F	Sig.
1	Regression	164.259	4	54.753	457.004	.000[b]
	Residual	22.884	191	.120		
	Total	187.143	195			

Source: Author, 2024

Dependent Variable: Quantity of water demanded

Predictors: (Constant), occupation, Income level, household size

The ANOVA result of the relationship between socio-economic characteristics and quantity of domestic water demanded indicated the regression model predicts the outcome variable is statistically significance. This was confirmed with an F statistic of =457 which showed that the overall model was significance at 95% confidence level and the relationship between the variables was not just by chance. This was confirmed and supported by a probability value of 0.000 which was less than the alpha =0.005. This implies that with P=0.000<0.005, the goodness fit of the model is established. The results of ANOVA analysis the relationship between socio-economic characteristics and the quantity of domestic water demanded. The results indicate that the regression model is statistically significant, with an F-statistic of 457, confirming that the overall model is significant at a 95% confidence level. The probability value (p-value) of 0.000, which is less than the alpha level of 0.005, further supports the significance of the model. This implies that the relationship between socio-economic characteristics and domestic water demand is not due to chance.

This finding is consistent with previous research that has explored the relationship between socio-economic characteristics and

water demand. For example, a study by Hernandez et al. (2017) found that socio-economic factors, such as income, education, and household size, were significant predictors of water demand in urban areas, Hernandez *et al.* (2017).Another study by Mabeta *et al.* (2020) examined the impact of socio-economic characteristics on household water demand in South Africa and found that factors such as household income, education level, and access to water were significant determinants of water demand, Mabeta *et al.* (2020).

Table 4: Showing Regression Coefficient

Coefficients						
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	.186	.101		1.843	.067
	Occupation	.047	.064	.039	.732	.465
	Income	.505	.059	.497	8.601	.000
	Household size	.409	.050	.438	8.173	.000

Source: Author, 2024

a. Dependent Variable: quantity of Domestic Water Demanded

Also, Table 4 revealed that occupation was not significant in explaining the variation in quantity of domestic water demanded in the study area. This is because the t- values 0.732 is less than the required 1.96 required for a two-tail test. Also, insignificant relationship was confirmed by the p-value of 0.465 which is greater than the required 0.05 significance level (β = 0.47, t = 0.732, p = 0.465). Based on the findings of standardized regression weights from Table 4, the study concludes that their occupation does not have effect on the quantity of water demanded in the study area. A significant and positive relationship was observed between income and quantity of domestic water demanded (β = 0.50, t = 8.601, p = 0.000). That is to say, with a p-value of 0.000, the regression weight for income in the prediction of quantity of domestic water demanded differs significantly from zero. Therefore, income affects the quantity of domestic water demanded in the study area.

Furthermore, result from the regression analysis revealed a positive and a significant relationship between household size and quantity of domestic water demanded in the study area. The t -value of 8.173 which is greater than the required 1.96 for a two-tail test is a clear indication of the significant relationship. The significant relationship was also confirmed from the p-value of 0.000 which is below 0.05 significant level. The household size, has effect on the quantity of domestic water demanded in the study area. The regression analysis examining the relationship between socio-economic characteristics (occupation, income, and household size) and the quantity of domestic water demanded in the study area.

The results indicate that:

1. Occupation is not a significant predictor of domestic water demand (β = 0.47, t = 0.732, p = 0.465).
2. Income has a significant and positive relationship with domestic water demand (β = 0.50, t = 8.601, p = 0.000).
3. Household size also has a significant and positive relationship with domestic water demand (t-value = 8.173, p-value = 0.000).

These findings are consistent with previous research that has explored the relationship between socio-economic characteristics and

water demand. Study by Hernandez *et al.* (2017) found that income and household size were significant predictors of water demand in urban areas. Another study by Mabeta *et al.* (2020) found that household size and income were significant determinants of household water demand in South Africa. In this study, occupation is not a significant predictor of domestic water demand is somewhat surprising, as previous research has suggested that occupation can influence water demand (e.g., (Grafton, 2020).

Conclusion and Recommendations

This paper findings presents valuable insights into the socio-economic factors that influence domestic water demand. The study's use of VIF and tolerance values to check for multicollinearity is also consistent with recommended best practices. Therefore, the study's conclusion that there are no dilemmas of multicollinearity among the examined variables is supported by the data and the literature. The research finding presented above is consistent with previous research on domestic water demand and the use of multiple regression analysis to examine the relationships between independent variables and a dependent variable. The study's findings contribute to our understanding of the factors influencing water demand and can inform policy decisions aimed at managing water resources effectively. These findings highlight the importance of considering economic characteristics in understanding domestic water demand.

The results suggest that socio-economic characteristics, such as income and household size, have a significant impact on domestic water demand. Specifically, Income has a significant and positive relationship with domestic water demand, Household size also has a significant and positive relationship with domestic water demand but Occupation is not a significant predictor of domestic water demand. The study's findings are consistent with previous research that has explored the relationship between socio-economic characteristics and households domestic water demand. The research findings contribute to our understanding of the factors that influence water demand and can inform policy decisions aimed at managing water resources sustainably.

Based on the research conclusions, the following recommendations were proffered: Policymakers and Water Resource Managers, Urban Planners, City Planners, Urban Managers and Urban and Regional Planners should consider the socio-economic characteristics of households when developing strategies to provide and manage water resources. Income and household size should be taken into account when predicting domestic water demand and further research is needed to explore the relationship between occupation and domestic water demand, as the findings of this study suggest that occupation is not a significant factor in contexts.

However, the research conclusion and recommendation are with the following limitations: The study's findings may not be generalizable to other contexts, as the research was conducted in a suburb neighborhood of Bauchi and further research is needed to explore the relationship between other socio-economic characteristics and domestic water demand.

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