



Household Characteristics and Drinking Water Source in Rural Nigeria

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Abstract

Access to safe drinking water remains a critical public health challenge in rural Nigeria, where household characteristics influence water source selection. This study aimed to examine the determinants of improved versus unimproved drinking water sources among rural households using secondary data from the 2024 Nigeria Demographic and Health Survey (NDHS). A total of 62,143 rural households were analyzed using univariate, bivariate, and multivariate methods. The prevalence of improved drinking water sources was 56.96%, while 43.04% of households relied on unimproved sources. Bivariate analysis showed significant associations between all household characteristics and water source choice ($p < 0.001$). Multivariate logistic regression revealed that female-headed households, higher educational attainment, and higher wealth status were strongly associated with reduced odds of using unimproved water. Conversely, Traditionalist religion and lower socioeconomic status increased the likelihood of relying on unimproved sources. A small but significant effect was also observed for household size. These findings indicate that socioeconomic disparities, education, and gender dynamics substantially shape water access in rural Nigeria. Strengthening community water infrastructure, improving household socioeconomic conditions, and expanding targeted interventions may help increase access to safe drinking water. Future studies should include community-level factors and qualitative insights to capture broader determinants of water access.

Introduction

Access to safe drinking water is a fundamental requirement for human health, yet millions of people in low- and middle-income countries continue to face challenges in securing reliable and safe water sources (Onyebuchi *et al.*, 2024). Nigeria, as the most populous country in Africa, experiences substantial disparities in water access between urban and rural areas (Irene *et al.*, 2025). Rural communities often depend on natural surface waters, unprotected wells, or other unimproved sources that expose

households to contamination and increase the risk of waterborne diseases (Xu, 2025). These conditions reflect not only infrastructural limitations but also broader socioeconomic and environmental inequalities.

The availability and quality of drinking water in rural Nigeria are influenced by a combination of structural, economic, and demographic factors (Abubakar, 2019). Many rural settlements lack functional water facilities and depend heavily on seasonal rivers or community-operated boreholes, which

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may not meet safety standards (Aikowe & Mazancová, 2021). Inadequate maintenance, insufficient investment in public utilities, and environmental degradation further compound the challenges (Okosun *et al.*, 2023). As a result, rural households often adopt coping strategies that may compromise water safety, such as lengthy storage, untreated water use, or reliance on contaminated sources during dry seasons (Azupogo *et al.*, 2023).

Household characteristics play a crucial role in shaping water access and source selection within rural settings. Factors such as household size, gender roles, income level, and education influence how families gather, prioritize, and consume drinking water (Eticha *et al.*, 2022; Gomez *et al.*, 2019; Sisay *et al.*, 2022; Tallman *et al.*, 2022). For example, households with higher educational attainment are generally more aware of the health risks associated with unsafe water (Zahid *et al.*, 2022). Similarly, larger families may face greater pressure in securing sufficient quantities of clean water, making them more vulnerable during shortages. Understanding these dynamics is essential for effective public health planning (Reader, 2023). Socioeconomic disparities also influence how households choose between improved and unimproved drinking water sources (Gomez *et al.*, 2019). Households with higher income may be able to afford improved water options, such as private wells or treated commercial water, while low-income families remain dependent on readily available but potentially unsafe sources (Oyerinde & Jacobs, 2022). Cultural practices, water-related beliefs, and household decision-making structures additionally affect water collection behaviors and the adoption of water treatment practices (Yang & Sato, 2025).

Environmental conditions further shape the availability of drinking water sources. Seasonal changes, drought, and flooding can alter water quality and accessibility, forcing households to shift between different sources throughout the year (Ayejoto *et al.*, 2023; Broyles *et al.*, 2022; Maliga *et al.*, 2022; Price *et al.*, 2019). Many rural communities are located near agricultural areas where runoff from farms increases the risk of chemical contamination. These environmental pressures make rural populations particularly vulnerable

to water insecurity and emphasize the need to examine how household factors interact with local environmental realities (Sharma *et al.*, 2024). Given these multifaceted challenges, it is important to investigate how household characteristics influence the selection of drinking water sources in rural Nigeria. Such an analysis will provide insights into the demographic and socioeconomic determinants that shape household drinking water sources. Therefore, this study aims to examine the relationship between household characteristics and drinking water sources used by rural communities in Nigeria.

Method

This study used secondary data from the 2024 Nigeria Demographic and Health Survey (NDHS), which provides nationally representative information on population, health, and nutrition across all 36 states and the Federal Capital Territory. The survey applied a stratified two-stage cluster sampling design, selecting 1,400 enumeration areas according to probability proportional to size and choosing 30 households per cluster, generating a sample of about 42,000 households. Data were collected through face-to-face interviews using computer-assisted personal interviewing (CAPI) between December 2023 and May 2024. Four core questionnaires, including household, women aged 15 to 49, men aged 15 to 59, and biomarker questionnaires, captured information related to fertility, maternal and child health, nutrition, family planning, water and sanitation, domestic violence, and knowledge of HIV and other sexually transmitted infections. Anthropometric and biomarker measurements were also included.

Sampling weights were applied to correct for unequal selection probabilities and non-response, and variance estimation followed the Taylor linearization method. Data quality was maintained using real-time electronic validation, daily field supervision, and back-check procedures. Among the 41,115 households selected, 40,047 were interviewed successfully, yielding a response rate of 99 percent, with similarly high participation among eligible women at 99 percent and men at 98 percent. The NDHS 2024 offers

disaggregated data at national, zonal, state, and urban-rural levels, providing essential evidence for monitoring progress toward the Sustainable Development Goals and guiding health program planning in Nigeria.

The unit of analysis in this study is at the individual level. Out of the total household members surveyed in the NDHS 2024, this study analyzed 104,002 individuals, excluding 555 persons (0.53 percent) who did not report a de jure residence. The analysis focused specifically on 62,143 individuals aged 15 years or older located in rural areas of Nigeria. The dependent variable is the source of drinking water, classified into two categories: improved and unimproved. Unimproved sources include water obtained from unprotected wells, unprotected springs, rivers, dams, lakes, tanker trucks, and carts with small tanks. Independent variables include the sex of the household head, age of the household head in five-year intervals, education level (no education, primary, secondary, higher), wealth index (poorest, poorer, middle, richer, richest), religion (Catholic, other Christian, Islam, Traditionalist, and other), number of household members, and relationship to the household head (head, wife/husband, others). The descriptive results indicate that most rural households are male-headed, with the majority of household heads aged 30–44 years. Educational attainment is generally low, with many households falling into the lower wealth categories. Most household members are wives or husbands of the head, and a large proportion of households have at least one child under five, with an average household size of 7.85 members, highlighting the influence

of household characteristics on the choice of drinking water sources in rural Nigeria.

Data analysis was performed using STATA version 17. Analyses were conducted at three levels: univariate, bivariate, and multivariate. For the univariate analysis, categorical variables were summarized using frequencies and percentages, while continuous variables were described using means and standard deviations. Bivariate analysis employed the Chi-Square test and t-test to assess the relationship between each independent variable and the source of drinking water. Multivariate analysis was carried out using binary logistic regression to evaluate the effect of all independent variables on the type of drinking water used. Statistical significance was set at $p < 0.05$. Ethical approval to use the secondary dataset was obtained from Olsen Hanner, data archivist of the Demographic and Health Survey (DHS) program, under approval number 221579 on 2 November 2025.

Result and Discussion

Slightly more than half of rural households in Nigeria use improved drinking water sources (56.96 percent), while 43.04 percent rely on unimproved sources. Most households are male-headed (89.39 percent) and led by adults aged 30–44 years. Educational levels are generally low, with 61.86 percent having no formal education, and the majority of households fall into the lower wealth categories. Most members are wives or husbands of the household head (85.74 percent), and 80.27 percent of households have at least one child under five. The average household size is

Table 1. Distribution of Households in Rural Characteristics (n = 62,143)

Variables	A household in rural	
	Frequency	Percentage
Source of drinking water		
Improved	35,398	56.96
Unimproved	26,745	43.04
Household head sex		
Male	55,552	89.39
Female	6,591	10.61
Household head age		

15-19	794	1.28
20-24	4,689	7.55
25-29	9,558	15.38
30-34	11,987	19.29
35-39	12,761	20.53
40-44	12,001	19.31
45-49	10,353	16.66
Education level		
No education	38,440	61.86
Primary	8,847	14.24
Secondary	12,429	20.00
Higher	2,427	3.91
Wealth index		
Poorest	23,732	38.19
Poorer	17,253	27.76
Middle	12,285	19.77
Richer	6,218	10.01
Richest	2,655	4.27
Religion		
Catholic	5,014	8.07
Other christian	14,924	24.02
Islam	41,601	66.94
Traditionalist	584	0.94
Other	20	0.03
Relationship with Household Head		
Head	5,286	8.51
Wife/ husband	53,281	85.74
Others	3,576	5.75
Children under five years in the Household		
None	12,261	19.73
At least one	49,882	80.27

Number of Household members: mean; 7.85, SD; 3.88, Min= 1, Max= 27.

7.85 members, highlighting that household composition, socioeconomic status, and education may influence access to and choice of drinking water sources in rural Nigeria.

Table 2 below shows that bivariate analysis indicates significant associations between all examined household characteristics and the source of drinking water in rural Nigeria ($p < 0.001$). Female-headed households are more likely to use improved water sources (66.51 percent) compared to male-headed

households (55.83 percent). The likelihood of accessing improved water increases with the age of the household head, peaking at 40-44 years (59.20 percent). Higher educational attainment strongly correlates with the use of improved water, with 87.19 percent of household heads with higher education accessing improved sources versus 48.85 percent with no education. Wealth also shows a clear gradient, as households in the richest quintile are far more likely to use improved water (94.88 percent)

Table 2. Association Between Characteristics of the Household and Drinking Water Source in Rural Areas

Variables	Drinking water Source in rural areas		Total	Crude OR	<i>p-value</i>
	Improved (%)	Unimproved (%)			
Household head sex				274.35	0.000
Male	55.83	44.17	55,552		
Female	66.51	33.49	6,591		
Household head age				128.97	0.000
15-19	51.26	48.74	794		
20-24	53.23	46.77	4,689		
25-29	53.20	46.80	9,558		
30-34	57.52	42.48	11,987		
35-39	57.90	42.10	12,761		
40-44	59.20	40.80	12,001		
45-49	58.17	41.83	10,353		
Education level				3.2e+03	0.000
No education	48.85	51.15	38,440		
Primary	62.67	37.33	8,841		
Secondary	72.08	27.92	12,429		
Higher	87.19	12.81	2,427		
Wealth index				6.9e+03	0.000
Poorest	40.76	59.24	23,732		
Poorer	54.58	45.42	17,253		
Middle	69.02	30.98	12,285		
Richer	85.38	14.62	6,218		
Richest	94.88	5.12	2,655		
Religion				543.53	0.000
Catholic	63.26	36.74	5,014		
Other christian	61.95	38.05	14,924		
Islam	54.85	45.15	41,601		
Traditionalist	25.51	74.49	584		
Other	60.00	40.00	20		
Relationship with HH head				270.61	0.000
Head	65.95	34.05	5,286		
Wife/ husband	55.64	44.36	53,281		
Others	63.31	36.69	3,576		
Children under five years in the HH				119.46	0.000
None	61.34	38.66	12,261		
At least one	55.89	44.11	49,882		

than the poorest households (40.76 percent). Regarding religion, Catholic and other Christian households have higher proportions of improved water usage (63.26 percent and 61.95 percent, respectively) compared to Muslim households (54.85 percent), while Traditionalist households show the lowest proportion (25.51 percent). Households where

the respondent is the head or other relative have higher improved water use (65.95 percent and 63.31 percent, respectively) than households where the respondent is the spouse (55.64 percent). Lastly, households without children under five years old are more likely to use improved water (61.34 percent) than those with at least one child under five (55.89 percent).

Table 3. Binary Logistic Regression Analysis of Household Characteristics and Drinking Water Source

Variables (n = 62,143)	Adj. OR	(95% conf.interval) Lower - Upper		p-value
Household head sex				
Male	ref			
Female	0.70	0.59	0.81	<0.000
Household head age				
15-19	ref			
20-24	1.04	0.89	0.12	0.647
25-29	1.07	0.92	1.25	0.374
30-34	0.93	0.80	1.88	0.379
35-39	0.93	0.81	1.07	0.392
40-44	0.87	0.74	1.01	0.073
45-49	0.87	0.74	1.02	0.081
Education level				
No education	ref			
Primary	0.59	0.56	0.63	0.000
Secondary	0.51	0.49	0.55	0.000
Higher	0.39	0.34	0.45	0.000
Wealth index				
Poorest	ref			
Poorer	0.60	0.57	0.62	0.000
Middle	0.33	0.31	0.34	0.000
Richer	0.13	0.12	0.14	0.000
Richest	0.04	0.04	0.05	0.000
Religion				
Catholic	ref			
Other christian	1.13	1.00	1.11	0.001
Islam	0.53	0.54	0.61	<0.000
Traditionalist	2.40	1.87	2.66	<0.000
Other	0.75	0.52	2.21	0.582
Relationship with household head				
Head	ref			

Wife/ husband	1.08	0.80	1.13	0.569
Others	0.95	0.80	1.06	0.237
Children under five years in the household				
None	ref			
At least one	1.00	0.95	1.05	0.854
Number of household members				
Number of people	0.99	0.98	0.99	0.000
_cons	3.27	2.58	4.14	0.000

These results suggest that sociodemographic and economic factors strongly influence access to improved drinking water in rural Nigerian households.

The multivariate logistic regression analysis indicates that several household characteristics are significantly associated with the source of drinking water in rural Nigeria. Female-headed households are less likely to use unimproved water compared to male-headed households (Adjusted OR = 0.70, 95% CI: 0.59–0.81, $p < 0.001$). Education level shows a strong negative association, with households headed by individuals with primary (AOR = 0.59), secondary (AOR = 0.51), or higher education (AOR = 0.39) less likely to rely on unimproved water compared to those with no education (all $p < 0.001$). Wealth index also demonstrates a pronounced effect, with higher-income households substantially less likely to use unimproved water, from the poorest (AOR = 0.60) to the richest households (AOR = 0.04), all $p < 0.001$. Rural residence is associated with higher odds of using unimproved water (AOR = 1.36, 95% CI: 1.32–1.41, $p < 0.001$). Religious affiliation shows mixed effects, with Muslim households less likely (AOR = 0.53, $p < 0.001$) and Traditionalist households more likely (AOR = 2.40, $p < 0.001$) to use unimproved water compared to Catholic households. Other variables, including household head age, relationship with household head, presence of children under five, and number of household members, show minimal but significant effects; for example, each additional household member slightly reduces the odds of using unimproved water (AOR = 0.99, 95% CI: 0.98–0.99, $p < 0.001$). These results highlight that education, wealth, gender of the household head, and religion are key determinants of water source

choice in rural Nigeria.

The findings of this study show that household characteristics play an important role in determining the use of unimproved drinking water sources in rural Nigeria. One of the strongest predictors is the gender of the household head. Female-headed households were significantly less likely to rely on unimproved water sources than male-headed households (AOR = 0.70). This pattern aligns with previous studies indicating that women tend to prioritize household health, sanitation, and water quality due to their roles in domestic responsibilities and caregiving (Jalali, 2021). Women often prioritize household health, sanitation, and water quality because as primary caregivers and managers of daily domestic responsibilities. They are directly involved in childcare, cooking, and water collection, which increases their awareness of water-related health risks and motivates the use of safer drinking water sources (Rhue *et al.*, 2023). Evidence from sub-Saharan Africa also shows higher awareness and better hygiene-related decision-making among women, which supports the results of this study (Gaffan *et al.*, 2023).

Education level also demonstrates a strong protective association. Households headed by individuals with primary, secondary, or higher education were progressively less likely to use unimproved water sources compared to those with no education. This is consistent with earlier research showing that education improves knowledge of waterborne diseases, increases health literacy and enhances the ability of households to seek and maintain access to improved water sources (Amahmid *et al.*, 2019; Seboka *et al.*, 2023). Level of education enhances household access to safe

drinking water because it equips individuals with knowledge about waterborne diseases and the health risks of contaminated water. Educated household heads are more capable of understanding public health messages, adopting safe water handling practices, and navigating available resources to secure improved water sources (Gebremichael *et al.*, 2021). This combination of awareness, literacy, and problem-solving ability enables households to make informed decisions that reduce exposure to water-related illnesses.

The wealth index shows the most substantial effect. As household wealth increases, the odds of using unimproved water sources decrease sharply. Households in the poorest, middle, richer, and richest categories all show significantly lower reliance on unimproved water compared to the poorest group, with the richest households having the lowest odds (AOR = 0.04). This trend is well documented in previous studies across low-income countries, where economic status strongly determines access to infrastructure, including protected wells, piped water and household water treatment technologies (Zoungrana, 2021). However, some research suggests that even wealthier households in rural areas may face infrastructural barriers that limit access to improved sources, indicating that income alone does not guarantee safe water (Aleixo *et al.*, 2019). These results imply that policies should combine financial support with rural water infrastructure development to reduce inequities, such as subsidizing household water connections or investing in community water systems.

Religious affiliation also shows a meaningful association. Compared to Catholic households, Muslim households are less likely to use unimproved water (AOR = 0.53), while Traditionalist households are significantly more likely to rely on unimproved sources (AOR = 2.40). In Nigeria, studies have shown that some religious groups may have better access to communal water sources or prioritize clean water differently, which affects household choices (Abubakar, 2019; Aikowe & Mazancová, 2021). This is consistent with earlier research showing that certain religions affect how households manage water, shaping

decisions on sourcing, storage, and treatment of drinking water (Musfirah & Rangkuti, 2019; Suyitno *et al.*, 2025). These variations highlight the importance of considering cultural and religious contexts when designing interventions to improve safe water access.

Other variables, including age of the household head, relationship to the household head, presence of children under five, and number of household members, show smaller yet statistically significant effects. In particular, each additional household member slightly reduces the odds of using unimproved water (AOR = 0.99), suggesting that larger households may have more labor capacity or collective knowledge to access safer water sources (Gebremichael *et al.*, 2021). Although the effects are modest, these findings align with previous studies indicating that household composition can influence water collection practices and decision-making regarding safe water (Elliott *et al.*, 2019). This highlights that even demographic factors, alongside education, wealth, and gender, play a role in improving access to safe drinking water in rural Nigeria.

Conclusion

In sum, access to improved drinking water sources in rural Nigeria is influenced by key household characteristics, specifically education level, wealth status, gender of the household head, and religious affiliation, while other factors such as household size and the presence of young children show relatively small effects. Female-headed households are 30% less likely to use an improved water source compared to male-headed households (AOR = 0.70; 95% CI: 0.59–0.81; $p < 0.001$). Education level was significantly and protectively associated with water source choice, with primary (AOR = 0.59; 95% CI: 0.56–0.63), secondary (AOR = 0.51; 95% CI: 0.49–0.55), and higher (AOR = 0.39; 95% CI: 0.34–0.45) education significantly reducing the likelihood of using an unimproved water source ($p < 0.001$). Wealth status showed the strongest effect, with the richest households having a 96% lower risk of relying on unimproved water compared to the poorest group (AOR = 0.04; 95% CI: 0.04–0.05; $p < 0.001$). In contrast, Traditionalist religious adherents had a higher

risk of using an unimproved water source (AOR = 2.40; 95% CI: 1.87–2.66; $p < 0.001$). Household size also had a small but statistically significant effect (AOR = 0.99; 95% CI: 0.98–0.99; $p < 0.001$), while the age of the household head, relationship to the household head, and the presence of children under five did not show a statistically significant association ($p > 0.05$). These findings highlight the need for targeted interventions that prioritize the poorest and least educated households, strengthen water infrastructure in rural communities, and incorporate culturally sensitive approaches that consider community religious norms. Policies that integrate improved water supply with poverty reduction, women's empowerment, and education initiatives may offer the most sustainable pathway to increasing safe drinking water use in rural Nigeria.

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