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Original Article

Factors Influencing Access to Safe Drinking Water between Low-Income and Non-Low-Income Households in Mainland Tanzania: A Statistical Analysis

Salehe Chivanga, [1*] Siamarie Lyaro[1]

[1]Eastern Africa Statistical Training Centre P. O. Box 35103, Dar es Salaam, Tanzania

*Corresponding Author: siamarie.lyaro@eastc.ac.tz

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Abstract

Mainland Tanzania had 10,642 out of 13,972 (77%) households which lacked access to safe drinking water, and 8,995 out of 13,972 (65%) households which belonged to low-income group. This study was undertaken to determine factors influencing access to safe drinking water between low-income and non-low-income households in Mainland Tanzania. The study applied GIS, binary logistic regression and Blinder-Oaxaca decomposition for analysis. GIS results revealed that low-income households lacked access to safe drinking water compared to non-low-income households. Binary logistic regression showed that access to safe drinking water was influenced significantly by income status being low ($p<0.01$), water collection point being bottled water or others ($p<0.01$), household size ($p<0.01$), secondary education ($p<0.01$), lacking access to electricity ($p<0.01$), residence being urban ($p<0.01$), water treatment method being chlorination ($p<0.01$), and age ($p<0.01$). Blinder-Oaxaca decomposition showed that accessibility gap for safe drinking water between low-income and non-low-income households was 0.089 units, whereby 0.047 units and 0.034 units were significantly due to predictors (endowments) and effects (coefficients) respectively. The study recommends the need for government to improve rural electrification, education services, and safe water infrastructure to ensure good quality water supply services, and equitable access to safe and affordable drinking water as per SDG 6.1.

Keywords: Access to safe drinking water, Household income categories, Blinder-Oaxaca decomposition

1. Introduction

The global water safety situation, as outlined by the UN, reveals a critical crisis affecting billions worldwide. Recent estimates indicate that approximately 4.4 billion people lack access to safe drinking water, particularly in low- and middle-income countries, highlighting a critical need for improved water management strategies (Hope, 2024). Over 2 billion people are without safely managed drinking water services, with projections suggesting this could rise to 5 billion by 2050 due to climate impacts (Hope, 2024) (Inwald *et al*., 2023).

Furthermore, approximately 2 billion people globally lack access to safe water in Central and South Asia (768 million), and in Sub-Saharan Africa (747 million) (Bain *et al*., 2020). For the case of Tanzania, 10,642 out of 13,972 (77%) lack access to safe drinking water (NBS, 2022). This implies that water remains a critical public health and socio-economic issue in Mainland Tanzania and in most cases affects low-

income households, and approximately 8,995 of 13,972 (35%) households in Tanzania belonged to low-income category, implying that they also have low access to safe water (NBS, 2022).Access to safe drinking water has been influenced by socio-economic, demographic, and geographic factors (Mkondiwa *et. al*., 2013; Yang *et. al*., 2013; Burt, 2015; Abdu *et. al*., 2016; Mengech *et. al*., 2017; Bae & Lynch, 2022; Onyechi *et al*., 2024; Khan & Fenner, 2024). Also, climate risks exacerbate water safety issues, particularly in low and middle-income countries (Hope, 2024). This suggest that access to safe water depends also on income of households. (Fierro *et al.,* 2019); Connor, 2015; Bain *et al.,*2020; Zhambikov, 2024; Mahamudu *et al*., 2024; Kazama & Takizawa, 2022) suggested measures for improving access to safe water by households but they did not apply decomposition models to explain these measures based on income categories of households.

Hence, the present study was designed to fulfill such gaps by applying the Blinder-Oaxaca decomposition model to analyse factors influencing access to safe drinking water between low-income and non-low-income households in Mainland Tanzania. The present study also determines the extent in which variation in water safety status between low-income and non-low-income households is caused by socio-economic

Table 1: Variables and their measurement scales

Variable	Description	Unit of Measurement	Scale
WSS	Accessibility to safe drinking water	1 = Accessed safe drinking water, 0 = Not accessed safe drinking water	Nominal
INC	Household income category	1= Low-income category if the average monthly income is less than the national poverty line TZS 49,320 per adult equivalent per month, 0= Non-low income category	Nominal
MDW	Point of drinking water collection	1 = Tape water, 2 = Bottled water, 3 = Others	Nominal
HOS	Household size	Number	Ratio
EDS	Education level of the head of household	1 = Without formal education 2 = with primary education only 3 = With secondary education and above	Ordinal
MAS	Marital status	1 = Single 2 = Married 3 =Others	Nominal
ELC	Access to electricity	1 = Accessed, 0 = Not accessed	Nominal
LOC	Location of a household	1 = Urban, 0 = Rural	Nominal
OCH	Employment status of household head	1 = Employed, 0 = Unemployed	Nominal
HWT	Method for treating drinking water by household	1 = Boiling, 2 = Chlorination, 3 = Others	Nominal
AGH	Age of household head	Years	Ratio

Source: Compiled in 2026.

characteristics, and effects or coefficients. This will harness formation of strategies, which will improve water service delivery to households having different income categories as per the 2025 Tanzanian National Water Policy (NAWAPO). NAWAPO seeks to ensure good quality water supply services for household which is also in line with SDG 6.1 which aims at achieving universal and equitable access to safe and affordable drinking water for all.

2.0 Material and Methods

2.1 Research Design

This study was a cross-sectional one, which applied quantitative research design. The design was also applied by Khan & Fenner (2024) when studying socio-demographic factors driving the choice of alternative safe water sources and their implications for public health. Quantitative research design involves systematic collection and analysis of numerical data to understand patterns and causal relationships (Sage Publications, 2023). Application of this research design enabled to analyse factors influencing access to safe drinking water between low-income and non-low-income households in Mainland Tanzania. The study being a cross-sectional one, it could not establish a cause-and-effect relationship regarding factors influencing access to safe drinking water between low-income and non-low-income households in Mainland Tanzania over a period of time.

2.2 Population of the Study

Population of this study was all households in the Mainland Tanzania in the year 2022, thus 9,109,150 households. Out of 59,851,347 persons, 29,137,638 were male who accounted about 49% of all persons and 30,713,709 out of 59,851,347 persons were female who accounted about 51% of all persons (NBS, 2022). This population was chosen due to its ability to provide information on characteristics of the household's dwelling unit such as source of water, and information about socio-economic factors (NBS, 2022).

2.3 Sampling and Sample Size Determination

This study used the 2022 TDHS-MIS dataset, which was based on a stratified sampling approach conducted in two stages from the 2012 census framework. Stratification involved dividing each region into urban and rural sectors, with these sectors serving as the sampling strata (NBS, 2022). A total of 61 strata were created, noting that Dar-es-Salaam includes only urban areas. Samples within each stratum were chosen independently through a two-stage sampling process. To ensure implicit stratification and proportional allocation at each administrative level, the sampling frame within each explicit stratum was sorted based on administrative units at various levels before sampling, and probability proportional to size (PPS) sampling was used in the first stage of selection (NBS,2022). Stratified sampling begins with dividing the population into strata based on specific characteristics, ensuring that each subgroup is represented in the sample (Kalsbeek,2025).

In the initial sampling stage, 629 enumeration areas (EAs) were chosen using a probability proportional to their size, with independent selection within each sampling stratum based on the allocated sample (NBS, 2022). Out of these, 211 EAs were located in urban regions, while 418 were in rural regions. In the second stage, 26 households were selected from each enumeration area, and this yielded a sample size of 13,972 households at a 5% margin of error within 95% confidence level (NBS,2022). Interviewers were then administered to all pre-selected households. To ensure non-response and bias minimization, interviewers were also asked to make at least two to three follow-up visits to pre-selected households whenever necessary (NBS, 2022).

2.4 Data Source

The study used secondary data from the Tanzania Demographic and Health Survey-Malaria Indicator Survey. The survey used computer-assisted personal interviewing (CAPI) to gather data from 13,972 households in all regions of Mainland Tanzania from 24th February, 2022 to 21st July,2022 (NBS, 2022).

During data collection, field check tables were generated regularly from Syncloud to monitor data quality (NBS, 2022). The study accessed full data matrix and employed it for modeling so as to deduce conclusions and recommendations.

2.5 Variables and Measurement Scales

Table 1 presents variables, their descriptions, units of measurement, and scales.

2.6 Data Analysis

2.6.1 GIS-based Spatial Analysis

The study applied GIS-based spatial analysis. GIS has also been utilized to assess urban household living conditions, revealing spatial inequalities and influencing urban planning decisions (Roy *et al*., 2024). GIS integrates geospatial data with analytical techniques, to visualize, interpret, and make informed decisions based on spatial patterns and relationships. GIS enabled mapping and visualization of geographical disparities of accessing safe drinking water between low-income and non-low-income households in Mainland Tanzania to harness formation of strategies for improving water service delivery to households having different income categories as per the 2025 Tanzanian National Water Policy (NAWAPO).

2.6.2 Binary Logistic Regression:

The logistic regression model is based on the log-odds of the probability of an event occurring, represented by the sigmoid function, which maps any real-valued number into the (0, 1) interval (Kravets *et al*., 2024; Evsyukov *et al.*, 2024). Binary logistic regression was applied in the study to determine factors influencing access of safe drinking water based on income categories (low-income or non-low-income) of households. Also, results of the binary logistic regression functioned as essential input for the Blinder-Oaxaca decomposition model.

Assumptions of the Binary Logistic Model

Each observation must be independent of others, meaning the outcome for one subject should not influence another (Harris, 2021.). Predictor variables should not be highly correlated with each other, as this can distort the model's estimates (Stoltzfus, 2011). There should be a linear relationship between the log odds of the outcome and continuous predictors, ensuring that the model accurately reflects the relationship (Kumar *et al*., 2016). A minimum number of events per independent variable is recommended to avoid over-fitting, typically ranging from 10 to 20 (Stoltzfus, 2011).

Limitations of the Binary Logistic Model

When the outcome is frequent (greater than 10%), logistic regression can produce biased estimates for relative risks and prevalence ratios, leading to misleading conclusions (Pinheiro-Guedes *et al.*, 2024). Multicollinearity among independent variables can distort the results, making it crucial to evaluate the relationships between predictors (Kilic, 2015). Statistically significant results do not guarantee that the model is the correct one, emphasizing the need for careful model selection and validation (Kilic, 2015). Binary logistic model for the study was specified as follows:

$$\log\left(\frac{p}{1-p}\right)=\beta_0+\beta_1 MDW_2+\beta_2 MDW_3+\beta_3 HOS+\beta_4 EDS_1+\beta_5 EDS_3+\beta_6 MAS_1+\beta_7 MAS_3+\beta_8 ELC_2+\beta_9 LOC_2+\beta_{10} OCH_2+\beta_{11} HWT_2+\beta_{12} HWT_3+\beta_{13} INC_1+\beta_{14} AGH+\beta_{15} HOS+u \quad (1)$$

Whereby:

p = probability of occurring coded as 1 = access to safe drinking water, and 0 = not accessed safe drinking water)

$\frac{p}{1-p}$ = odds ratio

β_0 = Intercept of the equation

$\beta_1 \ldots, \beta_{15}$ = Coefficients

u = Error term

INC_1 = (1=Household is classified as low-income, 0 = Otherwise);

INC_2 = (1=Household is classified as non-low-income, 0 = Otherwise); (Reference category)

MDW_1 = (1=Point of collection being tap water, 0= Otherwise); (Reference category)

MDW_2 = (1= Point of collection being bottled water, 0= Otherwise);

MDW_3 = (1= Point of being others, 0= Otherwise).

EDS_1 = (1=Education level of household head being non-formal education, 0= Otherwise);

EDS_2= (1=Education level of household head being primary education only, 0=Otherwise); (Reference category)

EDS_3= (1=Education level of household head being secondary education and above, 0= Otherwise).

MAS_1 = (1=Marital status being single, 0 = Otherwise);

MAS_2 = (1 =Marital status being married, 0 = Otherwise); (Reference category)

MAS_3 = (1= Marital status being others, 0 = Otherwise).

ELC_1 = (1= House which has access to electricity, 0 = Otherwise); (Reference category)

ELC_2 = (1=House which has not accessed electricity, 0 = Otherwise).

LOC_1 = (1=Location of household being rural, 0 = Otherwise); (Reference category).

LOC_2 = (1= Location of household being urban, 0 = Otherwise).

OCH_1 = (1=Employment status of household head being employed, 0 = Otherwise); (Reference category)

OCH_2 = (1=Employment status of household head being unemployed, 0 = Otherwise).

HWT_1 = (1=Household water treatment method being boiling, 0 = Otherwise); (Reference category)

HWT_2 =(1=Household water treatment method being chlorination, 0 = Otherwise);

HWT_3 =(1=Household water treatment method being other methods; 0 = Otherwise);

HOS = Household size

AGH = Age of household head.

Table 2: Summary of the descriptive statistics for quantitative variables

Variable	Obs	Mean	Std. dev.	Min	Max
HOS	13,972	5.676	4.011	1	34
AGH	13,972	45.063	11.879	17	90

Source: Compiled in 2026 from NBS (2022).

2.6.3 Blinder-Oaxaca Decomposition Model:

Blinder-Oaxaca decomposition model is a statistical technique used to analyze disparities in various social outcomes, such as income, employment, and healthcare access, by separating the effects of observed characteristics from those of unobserved factors. It is widely applicable across various fields, including health and economic disparities, allowing for a nuanced understanding of inequalities (Rahimi & Nazari, 2021). This model was used to decompose the differences in drinking water safety status between low-income and non-low-income households into explained and unexplained components. The explained component was the "Portion of the difference attributed to variations in predictors (endowments)

between the low-income and non-low-income households" while unexplained component was "portion attributed to differences in the effects (coefficients), which may indicate structural disparities or other unmeasured factors". This decomposition analysis helps to identify how much of the disparity in dependent variable such as accessibility to safe drinking water safety was due to measurable predictors (endowments) and other factors.

The Blinder-Oaxaca decomposition model for the study was specified as follows:

a. The low-income equation for water safety was specified as follows:

$$y_l=\beta_l X_{l's}+\varepsilon_l \quad (2)$$

b. The equation for non-low income was as follows:

$$y_n=\beta_n X_{ns}+\varepsilon_n \quad (3)$$

$$y_l-y_n=(\beta_l X_{l's})+\varepsilon_l-(\beta_n X_{n's}+\varepsilon_n) \quad (4)$$

$$y_l-y_n=X_{l's}(\beta_l-\beta_n)+(X_{l's}-X_{n's})\beta_n+\varepsilon_l-\varepsilon_n \quad (5)$$

Apply effects/characteristics to both sides

$$E(y_l)-E(y_n)=X_{l's}(\beta_l-\beta_n)+(X_{l's}-X_{n's})\beta_n+\varepsilon_l-\varepsilon_n. \quad (6)$$

$$E(y_l)-E(y_n)=X_{l's}\Delta\beta_s+\Delta X_s\beta_n \quad (7)$$

$$E(y_l)-E(y_n)=\beta_l-\beta_n+X_l-X_n \quad (8)$$

Whereby:

$E(y_l)-E(y_n)$ = Variation in accessibility for safe drinking water between low-income and non-low

income households

$\beta_l-\beta_n$ = Difference due to coefficients

X_l-X_n = Difference due to effects

The explained component from the Blinder-Oaxaca Decomposition attributes part of the disparity to differences in observable characteristics-such as education level or access to electricity highlighting which factors were responsible for the gap. The unexplained component reflects on the other unmeasured influences, such as cultural practices, policy differences, or unobserved household traits, which do not directly relate to the measured variables available in the study. By quantifying how much of the disparity was due to differences in these observed variables, the decomposition provided valuable insights into targeted areas for intervention.

3.0 Results and Discussion of Findings

3.1 Descriptive Statistics for the Studied Variables

Table 2 shows that on average, a household had approximately 5.7 members. This implies that many households in the study area had either 5 or 6 members. Furthermore, household size ranged between 1 to 34 members. This suggest that there is a need to ensure sustainability of water supply services in both rural and urban areas; and promote public awareness towards efficient use and management of water following the 2025 Tanzanian National Water Policy (NAWAPO) (URT,2025).

Results in Table 2 show that the average age of a household head was 45 years. Furthermore, this age ranged between 17 to 90 years. This suggests that demand of safe drinking water by household is also a function of time; and the demand changes across decades. Hence, there is a need to develop large-scale water projects, including a national water grid using reliable water sources to foster development over time as pointed out in the 2025 Tanzanian National Water Policy (NAWAPO) (URT,2025).

Table 3 presents a summary of categorical variables for the study. Results showed that among the interviewed households, about 50.83% of them collected drinking water from tap sources, implying that at least half of all households had access to improved water sources. Furthermore, about 20.01% of interviewed households used bottled water, implying that one-fifth of all households interviewed accessed drinking water through commercial sources. However, 29.16% of households accessed drinking water sources from other sources such as wells, surface water, or rainwater, sources, which are less safe and unreliable, something that increases their chances of consuming contaminated water.

Table 3 also shows that 19.89% of interviewed households had household heads who had no formal education. This implies that there is a need to expand access to adult education services to combat illiteracy. Furthermore, 39.87% of household heads completed primary education, and 40.24% of household heads attained secondary education and above. This indicates that about 80.11% of household heads had formal education. This suggest that majority of household heads in the study were literate.

Findings presented in Table 3 indicate that about

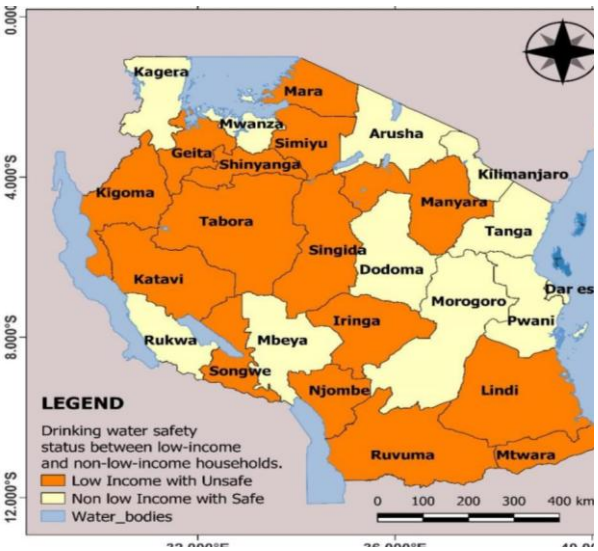


Figure 1: Spatial distribution of access to safe drinking water between low-income and non-low-income households

Source: Compiled in 2026 from NBS (2022).

59.62% of household heads were married. This suggests that there is a growing demand of safe drinking water among households (AUDA-NEPAD, 2022). Furthermore, about 30.27% of household heads were single, while about 10.11% of household heads were divorced, widowed, or separated. This implies that there is a need to formulate strategies for ensuring good quality water supply services to meet demand of safe drinking water by households in the long run.

Again, Table 3 showed that about 70.33% of all households interviewed had access to electricity. Furthermore, about 29.67% of all households interviewed had no access to electricity. This indicates that majority of households were connected to the national power grid system, while few were not. This also points out the need to improve access to renewable electricity sources, which directly help to ensure availability of water as per SDG 6, especially in areas with water scarcity (UNESCO, 2024).

Regarding residence, results presented in Table 3 show that 53.74% of 13,972 interviewed households were located in urban areas. This implies that there is a need to formulate strategies for ensuring sustainable water supply services in urban areas. Moreover, 46.26% of 13,972 interviewed households were located in rural areas. This implies that urban and rural households need to access safe water since safe water is among the prerequisites to healthy living, and contributes towards meaningful livelihoods and dignity (AUDA-NEPAD, 2022).

Also, results presented in Table 3 show that 50.34% of 13,972 interviewed household heads were employed, while 49.66% of 13,972 interviewed household heads were unemployed. These findings suggest that there was a nearly an equal split, as almost half of all household heads were not employed. This situation points out the need for formulating strategies for generating employment opportunities to decrease the likelihood of poverty. Poverty is one of the great barriers to accessing clean water supply (AUDA-NEPAD, 2022).

Results presented in Table 3 show that interviewed households used variety of water treatment methods to improve safety of drinking water. Table 3 shows that about 39.65% of all households interviewed used boiling as a method of water treatment. Furthermore, about 30.05% of households interviewed used chlorination as a means of water treatment. Also, about 30.29% of all households surveyed used other methods which included filtration or solar disinfection for water treatment. This implies that households in the study area preferred quality water services due to its associated benefits on health. These findings concur to Burt (2015) who found that household water treatment affect safety of drinking water.

3.2 Spatial Variability of Access to Safe Drinking Water between Low-income and Non-low-Income Households.

Results presented in Figure 1 show that households with low-income were situated in Geita, Iringa, Katavi, Kigoma, Lindi, Manyara, Mara, Mtwara, Njombe, Rukwa, Ruvuma, Shinyanga, Simiyu, Singida, Songwe, and Tabora regions, regions shaded in orange colour. Mkondiwa *et al.* (2013) found that poverty correlated positively with the use of unsafe drinking

Table 3: Summary of the descriptive statistics for categorical variables

Variable	Frequency	Percentage
Access to safe drinking water		
Accessed safe drinking water	3,150	23
Not accessed safe drinking water	10,642	77
Total	**13,972**	**100**
Household income category		
Low-income category	8,995	65
Non-low income category	4,797	35
Total	**13,972**	**100**
Point of drinking water collection		
Tape water	7,102	51
Bottled water	2,795	20
Others	4,074	29
Total	**13,972**	**100**
Education level of the head of household		
Without formal education	2,779	20
With primary education only	5,570	40
With secondary education and above	5,622	40
Total	**13,972**	**100**
Marital status		
Single	4,229	30
Married	8,331	60
Others	1,412	10
Total	**13,972**	**100**
Access to electricity		
Accessed	9,827	70
Not accessed	4,145	30
Total	**13,972**	**100**
Location of a household		
Rural	6,464	46
Urban	7,508	54
Total	**13,972**	**100**
Employment status of household head		
Employed	7,034	50
Unemployed	6,938	50
Total	**13,972**	**100**
Method for treating drinking water by household		
Boiling	5,540	40
Chlorination	4,199	30
Others	4,232	30
Total	**13,972**	**100**

Source: Compiled in 2026 from NBS (2022).

water. This implies that these regions also contain households with poor access to safe drinking water. households ought to rely on unimproved sources of water.

Table 4: Binary logistic regression predicting access to safe drinking water

WSS	Odds Ratio	St.Err.	t-value	p-value	[95% CI]	
Household income category						
Low income	0.772	0.037	-5.44	0.001***	0.704	0.848
Point of drinking water collection						
Bottled water	0.714	0.035	-6.82	0.001***	0.648	0.787
Others	0.792	0.035	-5.28	0.001***	0.726	0.863
Households Size	0.983	0.005	-3.71	0.001***	0.974	0.992
Education level of the household head						
Primary education	0.926	0.046	-1.55	0.122	0.84	1.021
Secondary education and above	1.703	0.09	10.08	0.001***	1.535	1.888
Marital status						
Married	1.028	0.044	0.65	0.518	0.946	1.117
Others	1.117	0.079	1.57	0.115	0.973	1.282
Access to electricity						
No	0.629	0.026	11.11	0.001***	0.58	0.683
Location of a household						
Urban	1.446	0.059	8.99	0.001***	1.334	1.567
Employment status of household head						
Unemployed	1.022	0.039	0.57	0.57	0.948	1.101
Method for treating drinking water						
Chlorination	1.356	0.064	6.42	0.001***	1.236	1.488
Others	0.975	0.044	-0.57	0.57	0.893	1.065
Age	1.012	0.002	7.18	0.001***	1.008	1.015
Constant	2.237	0.239	7.52	0.001***	1.814	2.76
Pseudo R^2	0.044		Number of obs		16354	
Chi-square	765.092		Prob > chi2		0	
Akaike crit. (AIC)	16839.470		Bayesian crit. (BIC)	16955		
Hosmer-Lemeshow goodness-of-fit test:	Pearson Chi-Square value of 15,807.		Degrees of freedom=74, 15,788	p-value of 0.4543		

$LR\ \chi^2\ (1) = 765.092$ and Pseudo-$R^2 = 0.044$

=Significant at 10%, **=Significant at 5%, and *=Significant at 1% levels respectively*

Source: Compiled in 2026 from NBS (2022).

This reflects also low standards of living, as many

On the other hand, Figure 1 shows that non-low-income regions, regions shaded in yellow colour, included Arusha, Dar es Salaam, Dodoma, Kagera, Kilimanjaro, Mbeya, Morogoro, Mwanza, Pwani, and Tanga. Households in these regions do access safe drinking water, reliable water infrastructure and improved water sources that in most cases are locate in their dwelling premises. Furthermore, households in these regions tend to have good standards of living with broader access to clean energy for cooking or lighting, improved sanitation, durable housing, and household assets.

3.3 Factors Predicting Access to Safe Drinking Water: Binary Logistic Regression Results

Binary model fit information

Results presented in Table 4 showed that the model was statistically significant ($\chi 2 = 765.092$, $p < 0.001$), with the pseudo-R^2 value of 0.044 which suggested the modest explanatory power. Also, the Hosmer-Lemeshow goodness-of-fit test was used to assess the overall fit of the binary logistic regression model. With a Pearson Chi-Square value of 15,807. With 74, 15,788 degrees of freedom, and a p-value of 0.4543, the test indicates that the model fits the data well.

Results presented in Table 4 show that households classified as low-income were less likely to access safe drinking water compared to non-low-income households (OR = 0.772, $p < 0.01$). These findings were similar to Mkondiwa *et al.* (2013) and Terefe *et al.* (2024) who found that poverty correlated positively with the use of unsafe drinking water. Also, Mengech *et al.* (2017) found that safety of drinking water was associated with household income. This suggest that a need to formulate strategies for improving household income through decent jobs to ultimately improve access to safe drinking water.

Furthermore, results presented in Table 4 show that households which used bottled water and other sources were less likely to access safe drinking water compared to those which used tap water as a point of drinking water collection (OR = 0.714, $p < 0.01$; OR = 0.792, $p < 0.01$). This suggests that access to safe water increases when a household accesses water services which are located on their premises, and are available when needed (WHO, 2023). Similarly, Yang *et al.* (2013) found that the use of non-piped water supply sources affected safety status of drinking water.

Moreover, results presented in Table 4 show that the likelihood of accessing safe drinking water by households decreased significantly with household size (OR = 0.983, $p < 0.01$). These findings are similar to Abdu *et al.* (2016) who found that household size was a factor which influenced access to safe drinking water. This implies that larger households experience challenges towards attainment of sufficient, continuous, safe, acceptable, and affordable water for personal and domestic use (NBS, 2025; WHO, 2023).

Again, results presented in Table 4 show that household heads with secondary education were more likely to access safe water compared to those without formal education (OR = 1.703, $p < 0.01$). These results are similar to Mengech *et al.* (2017) and Terefe *et al.* (2024) who found that access to safe drinking water was associated to education level of parents or guardians. This could have been so due to the fact that educated household heads do understand importance of safe water and can plan for efficient consumption of safe water drinking water (Florez-Garcia *et al.,*2025).

Again, results presented in Table 4 show that the likelihood of accessing safe drinking water decreased significantly with lack of access to electricity (OR = 0.629, $p < 0.01$). Results are similar to the findings reported by Abdu *et al.* (2016), and Nguea (2024) who found that access to electricity increased the likelihood of accessing safe drinking water by households. This means that electricity increases demand and consumption of safe drinking water within households.

Also, results presented in Table 4 show that urban households were more likely to access safe drinking water compared to rural households (OR = 1.446, $p < 0.01$). Results are similar to Bae & Lynch (2022) who found that the likelihood of utilizing safe drinking water increased if a household was located in urban areas. This could have been so due to the fact that attributes of urban households differ from those of rural

in aspects such as education level, household size, and the use of technology (Yu *et al*.,2018; NBS, 2025).

Also, results presented in Table 4 show that households which used chlorination method were more likely to have safe drinking water (OR = 1.356, $p < 0.01$) compared to those which used boiling methods. These findings are in line with Burt (2015) who found that safety of drinking water depended on household water treatment and safe storage systems. This implies that households need to pursue water treatment methods to reduce pathogens which could cause diseases, and to improve quality of drinking water (Admasie *et al*., 2022; WHO, 2026).

Lastly, results presented in Table 4 show that the likelihood of accessing safe drinking water increased significantly with the age of the household head (OR = 1.012, $p < 0.01$). These findings are similar to the submission of Terefe *et al*. (2024) regarding factors which affected access to safe drinking water among households in the Eastern Africa. These findings suggest that adults have accumulation of experience regarding benefits of safe water probably due to health campaigns, or mass media (Terefe *et al.,* 2024).

3.4 Variation in Access to Safe Drinking Water Based on Household Income Category

Table A.1 present results for Blinder-Oaxaca decomposition model, a model which reinforces binary logistic findings, by highlighting differences in access to safe drinking water between low and non-low-income households. Results presented by Table A.1 show that the accessibility gap for safe drinking water between low-income and non-low-income households was 0.089, and this was statistically significant ($p < 0.01$). Furthermore, about 52.81% of the disparity was due to the different distribution of the predictors (endowments) (0.047, $p < 0.01$), and location being urban (LOC = 0.025/0.089=28.04%) contributed the most in the disparity of accessing safe drinking water. This implies that formation of strategies for reducing rural-urban differences, for example by improving access to electric services between low and non-low-income households. This will lead to a reduction of about 28% in the disparity of accessing safe drinking water.

Also, Table A.1 showed that about 38.20% of the disparity was due to the effects (coefficients) (0.034, $p < 0.01$), and household size (HOS= 0.024/0.089=26.97%) contributed the most in the disparity of accessing safe drinking water. This implies that there is a need to formulate strategies for managing household size for example by improving literacy levels between low-income and non-low-income households. This will lead to a reduction of about 27% in the disparity of accessing safe drinking water.

4.0 Conclusion and Policy Implications

The study sought to determine factors which influenced access to safe drinking water between low-income and non-low-income households in Mainland Tanzania. The study applied the GIS spatial analysis, binary logistic regression, and Blinder-Oaxaca decomposition for analysis. Results from GIS spatial analysis revealed that households in the low-income group lacked access to safe drinking water compared to those in the non-low-income group. This implies that there is a need for the government to address poverty and improve living standards in low-income regions by implementing integrated poverty reduction programs that simultaneously tackle water safety, sanitation, housing, and education to effectively break the cycle of deprivation in achieving SDG 6.1.

Also, results from binary logistic regression showed that access to safe drinking water was influenced significantly by income status being low-income, point of water collection being bottled water or other sources, household size, education level being secondary, lack of access to electricity, residence of household being urban, household water treatment method being chlorination, and age of household head. This suggests that there is a need for government to prioritize policies aimed at enhancing educational attainment, expanding infrastructure, and improve access to electricity in order to effectively increase access to safe drinking water among households.

Additionally, results from the Blinder-Oaxaca decomposition showed that the accessibility gap for safe drinking water between low-income and non-low-income households was 0.089 units, with 0.047 units were due to predictors (endowments) and 0.034 units

were due to effects (coefficients). This means that there is a need for the government and stakeholders to prioritize on rural electrification, education services, and rural-urban water infrastructure to improve equality in accessing safe drinking between low-income and non-low-income households in Mainland Tanzania.

Hence, the study recommends to the government the need for improving infrastructure necessary for improving rural electrification and access of safe water. Furthermore, the study recommends the need to investigate the effect of macroeconomic variables on utilization of safe drinking water by households to broaden understanding of factors affecting utilization of safe drinking water by households for at least three consecutive decades. This will ensure good quality water supply services and equitable access to safe and affordable drinking water as per SDG 6.1.

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Author Contribution

S.C drafted the manuscript; S.L reviewed it; S.C together with S.L prepared it for grammar and spelling checks.

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Table A.1: Blinder-Oaxaca decomposition of differences in access to safe drinking water bet

WSS	Coefficient	Std.err	Z	P>z	[95% CI]	
Overall						
Low-income	0.83	0.005	166.48	0.001***	0.82	0.84
Non-low income	0.741	0.004	174.9	0.001***	0.732	0.749
Difference	0.089	0.007	13.64	0.001***	0.076	0.102
Endowments	0.047	0.004	11.52	0.001***	0.039	0.055
Coefficients	0.034	0.011	3.04	0.002***	0.012	0.055
Interaction	0.008	0.009	0.92	0.358	-0.01	0.026
Endowments						
MDW	0.001	0.001	-0.97	0.333	-0.001	0.001
HOS	0.001	0.001	0.17	0.867	-0.001	0.001
EDS	-0.001	0.001	-0.86	0.392	-0.002	0.001
MAS	0.001	0.001	-0.47	0.637	0.001	0.001
ELC	0.023	0.002	9.54	0.001***	0.019	0.028
LOC	0.025	0.003	7.62	0.001***	0.019	0.031
OCH	0.001	0.001	-0.74	0.462	0.001	-0.001
HWT	0.001	0.001	-0.3	0.768	0.001	-0.001
AGH	0.001	0.001	-0.3	0.764	-0.001	0.001
Coefficients						
MDW	0.001	0.014	-0.02	0.987	-0.028	0.027
HOS	0.024	0.01	2.37	0.018**	0.004	0.043
EDS	0.01	0.02	0.53	0.016**	-0.028	-0.049
MAS	0.006	0.021	0.3	0.762	-0.034	0.047
ELC	-0.033	0.024	-1.35	0.017**	-0.081	-0.015
LOC	0.024	0.021	1.14	0.254	-0.017	0.065
OCH	-0.019	0.021	-0.94	0.349	-0.06	0.021
HWT	0.008	0.016	0.51	0.011**	-0.023	-0.039
AGH	0.024	0.026	0.94	0.345	-0.026	0.075
_cons	-0.011	0.06	-0.18	0.856	-0.128	0.106

Appendix B

Interaction						
MDW	0.001	0.001	-0.02	0.987	0.001	0.001
HOS	0.001	0.001	-0.17	0.868	0.001	-0.001
EDS	0.001	0.001	-0.44	0.661	0.001	-0.001
MAS	0.001	0.001	-0.26	0.002***	0.001	0.001
ELC	0.004	0.005	0.84	0.042**	-0.006	-0.014
LOC	0.004	0.005	0.78	0.438	-0.006	0.015
OCH	0.001	0.001	0.69	0.492	0.001	-0.001
HWT	0.001	0.001	0.48	0.632	-0.001	0.001
AGH	0.001	0.001	-0.28	0.017**	0.001	0.001

Source: Compiled in 2026 from NBS (2022).