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Economic Factors Influencing Household Access to Clean Water in a Peri-Urban Area of Northern Tanzania

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Abstract

Economic factors and associated correlations play a crucial role in shaping household access to clean water in peri-urban areas, directly impacting the well-being and health of communities. Most communities globally still lack access to safe and clean water, resulting to illness and even death due to waterborne diseases. This study aims to investigate how economic factors influence household access to clean water in a Peri-Urban area of Northern Tanzania. To archive the objectives of this study, 353 questionnaires were administered, and for qualitative data collection semi-structured interviews were conducted with the key informants. Descriptive and inferential statistics were employed for quantitative data, and qualitative data were thematically analysed. Results show that 70.8% had no piped water, 65.4% were farmers, and 70.5% of individuals earning less than 110,000 TZS were 1.625 times more likely to lack access to clean water than higher-income households (95% CI: 1.221 - 2.163, $p = 0.001$) and 48.4% depended on water for production. Most communities in Peri-Urban area of Northern Tanzania rely on alternative sources of water, including rivers. To achieve sustainable development goal focusing on improvements in water access, policymakers must prioritise economic development initiatives that foster job creation and infrastructure enhancement.

Keywords

Clean Water, Economic Determinants, Socioeconomic Determinants, Waterborne Diseases, Water Sources, Income

1. Introduction

Access to clean water is fundamental to economic growth and human health, as it supports public health, agriculture, industry, and overall societal well-being. Safe water reduces the burden of waterborne diseases (Chan et al., 2021), enhances hygiene (Ripanda et al., 2022b; Vuai et al., 2022), and productivity by minimizing illness-related absences, and fosters economic development by sustaining industries, including agriculture. Clean water is essential to increase production and services so that entrepreneurs in the community get income and hence deliver services (Rwehumbiza & Hyun, 2024), to the community. The United Nations (UN) defines clean water as a fundamental human right (UN, 2015), clean is deemed safe for consumption as it has no impurities or microorganisms (WHO/UNICEF, 2023). Despite being acknowledged that clean water is essential to human life and development, some communities worldwide still lack safe and clean water (Inyang, 2022; UN, 2023), with report of contamination of surface and groundwater with heavy metal (Ripanda et al., 2025a), organics (Hossein & Ripanda, 2025; Ripanda et al., 2023a; Ripanda et al., 2024; Ripanda et al., 2025b; Ripanda et al., 2023b), microplastics (Ripanda et al., 2025b), nutrients and other emerging contaminants (Makaye et al., 2022; Miraji et al., 2021; Ripanda et al., 2022; Ripanda et al., 2021; Makokola et al., 2019). Similarly, the Sustainable Development Goal 6.1 aims to achieve universal and equitable access to safe and affordable drinking water by 2030 (UN, 2015). There is a report of over two billion people drink tainted water worldwide resulting into illness (Hossein et al., 2024; Isukuru et al., 2024; Miraji Hossein, 2019) and death (Koua et al., 2025) for a large number of people every year (UNICEF, 2021; WHO, 2024; WHO/UNICEF, 2023). Getting clean water has historically been a significant health concern in lower- and middle-income (Asmally et al., 2025; Kapaya et al., 2025; Koua et al., 2025; Miraji et al., 2023; Tshona et al., 2025) countries with limited access to improved water sources (Gomez et al., 2019; UN, 2024).

According to WHO/UNICEF study (2023), Sub-Saharan Africa is home to more than 50% of the 703 million people without safe and clean water. Individuals obtain water via springs, wells, streams, and rainfall, most in rural African regions (Inyang, 2022). In peri-urban and rural Northern Tanzania, many people suffer from lack of access to clean drinking water, which may harm their livelihoods and health (Gutierrez et al., 2021; Mbabaye et al., 2018; Nyanza et al., 2018; Tomasek et al., 2022). Access to clean water sources correlated with several factors, including income levels (du Plessis et al., 2024; Munissi & Mwalilino, 2024), employment opportunities, and investment in water infrastructure (Hughes et al., 2025). Studies indicate that higher-income households are more likely to invest in water purification technologies and reliable sources (Gomez et al., 2019; Inyang, 2022). At the same time, low-income households often resort to unsafe water, exposing them to health risks (Gomez et al., 2019). Furthermore, governmental and non-governmental organizations' (NGO) investment in water infrastructure is vital; the regions receiving adequate funding usually experience improved access to clean water (AfDB, 2015; AUWSA, 2017; URT-MoW, 2024).

Reducing waterborne illnesses and promoting a range of economic endeavours, such as small enterprises and agriculture in the Kikwe ward, depend on access to clean water. Therefore, there is a need for research on the economic factors that influence household clean water access in Kikwe peri-urban communities, promote economic growth, and enhance public health. This will aid well-informed investments in water infrastructure, solve problems with affordability, and advance equity across various socio-economic groups. This may contribute to the development of sustainable solutions that raise the standard of living in these areas, inform sensible policies, and promote community involvement. This study, therefore, aimed to investigate economic factors influencing household access to clean water in the Kikwe peri-urban ward of northern Tanzania to enhance the current understanding.

2. Methodology

2.1. Study Area

The study was conducted in the Kikwe peri-urban ward, found in the Meru district, covering an area of 77.04 square kilometers with a total population of 10,965 (5689 males with 5276 females) and 3030 households (URT, 2022). This area was chosen because many families were not connected to piped water, which often led to long queues at a small number of waters points available and the use of rivers, irrigation canals, and artificial ponds to have water access.

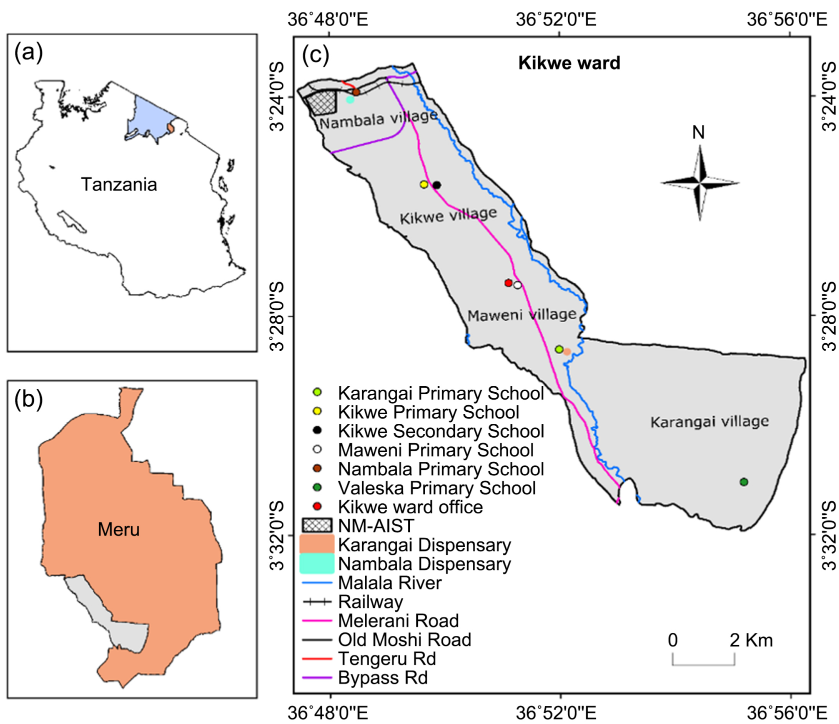

Figure 1. Map of Tanzania (a) showing Arusha region colored blue, map of Meru district (b), and map of Kikwe peri-urban ward (c) showing the study area (Source: Author 2024).

In Kikwe ward, access to clean water was limited, requiring intervention to ensure safety. The map was obtained using vector shapefiles from a street map platform using Quantum Geographic Information Systems (QGIS) software. The Tanzania National Bureau of Statistics (NBS) provided the boundary layers for the ward, district, region, and the whole nation. The map was produced using ArcMap 10.5 (**Figure 1**).

2.2. Sampling Procedure

The study employed simple random selection to gather data from household heads, ensuring that every individual in the population had an equal chance of being chosen (Creswell & Creswell, 2018). Additionally, purposive sampling was used to identify key informants for interviews, such as ward and village representatives and water and community leaders. This method involves selecting specific units from the population for targeted insights, as previously conducted by Burkholder et al. (Burkholder et al., 2020).

2.3. Sample Size

Based on the 3030 households of the Kikwe ward, a sample of 353 respondents was obtained and employed in this study. The Taro Yamane formula was utilised to ascertain the sample size of the population (Adam, 2020). The equation is

$$n = \frac{N}{\left(1 + N\left(e^2\right)\right)}$$

$$n = \frac{3030}{\left(1 + 3030\left(0.05^2\right)\right)} = \frac{3030}{8.575} = 353$$

Where N is the population size, and n is the sample size. The degree of precision (e) is the margin error expressed as a proportion (0.05 or ± 5%) as a degree of inaccuracy. The confidence level is 95%.

2.4. Data Collection

The current work employed a mixed-method approach, using structured questionnaires and interviews to collect detailed data from households in four villages found in the Kikwe ward, detailed by **Figure 1**, consisting of Nambala, Kikwe, Maweni, and Karangai. A total of 353 questionnaires were distributed to a diverse range of households with a diverse range of marital status, including single, widowed, divorced, separated, and married individuals. A survey consisted of a series of questions, both open and closed-ended. Respondents provided information on occupation, income, and water infrastructure. The investigator administered the questionnaire during field data collection, following the approach of previous researchers (Nade, 2022).

Additionally, interviews were conducted with informants, such as water authority representatives, community water committees, and local representatives, to gain qualitative insights. The study evaluated clean water accessibility, focusing on water sources, quality, service coverage, and infrastructure. The study area was selected because of its inadequate clean water supply, compelling residents to depend on irrigation canals and rivers for drinking water. The study survey collected demographic information, including gender and education level, water connectivity, reliability, and sufficient data. The information was gathered with the consent of the respondents through face-to-face interactions. We found interviewees at their homes, community taps, workplaces in their areas, and occasionally at local soup and drink spots. The research was conducted from February to May 2024, yielding important insights into household water access and related community challenges (Ngayaga et al., 2024).

The Joint Monitoring Programme (JPM) for Water Supply, Sanitation, and Hygiene categorizes water sources into five levels **Figure 2** starting from "surface" (indicating no service) and extending to "safely managed" (WHO/UNICEF, 2023) to benchmark service levels across countries. Household Water Insecurity Experiences (HWISE) was adopted (Young et al., 2019) to utilize and create surveys on household economic factors for clean water accessibility.

SERVICE LEVEL	DEFINITION
SAFELY MANAGED	Drinking water from an improved source that is accessible on premises, available, when needed and firee from faecal and priority chemical contamination
BASIC	Drinking water from an improved source, provided collection time is not more than 30 minutes for a round trip, including queuing
LIMITED	Drinking water from an improved source, for which collection time exceeds 30 minutes for a round trip including queuing
UNIMPROVED	Drinking water from an unprotected dug well or unprotected spring
SURFACE WATER	Drinking water directly from a river, dam, lake, pond, stream, canal or irrigation canal

Figure 2. JMP clean water service ladder for Sustainable Goal Number 6 [9].

2.5. Data Collection

Descriptive statistics, such as percentages and frequencies, were employed in analysing economic factors determining clean water access. Inferential logistics regression statistics were utilised to identify the association between household access to clean water and economic factors, as previously conducted by (Olutumise, 2024). The multinomial logistic regression model was used to analyse the economic factors influencing household access to clean water is detailed as follows.

$$\log\left(\frac{\left(P\left(Y=K\ |X\right)\right.}{P\left(Y=\text{refence}\right)}\right)=\beta 0+\beta 1X1+\beta 2X2+\beta 3X3+\beta 4X4+\beta 5X5+\beta 6X6+\beta 7X7+\varepsilon$$

where:

Y represents the categorical dependent variable indicating household access to clean water. P (Y = j) = is the probability of a household falling into category j of clean water access, β1 to β7 are the regression coefficients for each independent variable, X1= Occupation of the household head, X2 = Number of farming seasons, X3 = Household head income, X4 = Involvement in water activities dependents' activities, X5 = Monthly spending on clean water, X6 = Responsibilities for paying water bills, X7 = Water usage in economic activities, ε is the error term, the odds ratio (OR) values from the analysis indicate the effect size of each significant predictor (e.g. X3, X4, and X5) having a notable impact on household access to clean water, while X6 negatively influences access. Additionally, thematic analysis was applied to examine the qualitative data, respectively.

3. Results and Discussions

The findings of this study will provide crucial insights for policymakers and stakeholders aiming to enhance water accessibility and improve public health outcomes. Household clean water accessibility is essential for promoting sustainable water infrastructure and attracting investments. Additionally, this work highlights the importance of responsible water usage, including budgeting and timely payment of water bills, to ensure long-term access to safe and reliable water.

3.1. Sociodemographic Information of the Household Head

The results of the descriptive analysis showed that for most of the respondents interviewed, 53% were male and 47% were female, detailed in **Table 1**. Many of the respondents, 64%, had completed primary education, with only 2.3% holding advanced degrees (master's or PhD), 5.1% had a bachelor's degree, 8.5% had attended college, 17% had completed secondary education, and 3.1% had no formal education. The majority were aged between 45 and 54, comprising 25.8%, with a mean age of 48.78. Many of the respondents who participated in the survey were male, which is significant household heads. These are the primary decision-makers in the household, although they are not primarily responsible for collecting water from the source. The finding is similar to a study by (Kumar Ds et al., 2024) in India, where 82.5% of men are household heads. Some women whose spouses were absent did not participate until they had permission, or their husbands were at home. This suggests that these women may have felt obligated to seek approval from their spouses before engaging in certain matters, possibly due to cultural, social, or household dynamics that emphasize male authority or decision-making within the family.

Table 1. Socio-demographic information of the household head.

Variable	Category	Name of the villages				Total %
		Nambala	Kikwe	Maweni	Karangai	
Gender (%)	Male	10.8	17.8	9.6	14.7	53
	Female	18.1	10.2	5.9	12.7	47
Age %	Below 24	0.6	0.0	0.3	0.6	1.4
	25 - 34	4.8	5.4	3.1	4.5	17.8
	35 - 44	5.7	6.8	2.5	6.2	21.2
	45 - 54	6.5	7.1	5.4	6.8	25.8
	55 - 64	5.9	5.1	2.3	4.5	17.8
	Above 64	5.4	3.7	2.0	4.8	15.9
Education (%)	Non-formal	1.4	0.8	0.8	0.0	3.1
	Primary	15.6	15.9	9.3	23.2	64
	Secondary ed.	5.4	5.7	3.4	2.5	17
	College ed.	3.7	2.3	1.1	1.4	8.5
	Bachelor's degree	2.0	2.0	0.8	0.3	5.1
	Masters & PhDs	0.8	1.4	0.0	0.0	2.3
Total		28.9	28.0	15.6	27.5	100

Most of the respondents, aged from 45 to 54, were actively involved in water-related projects and community activities. They made decisions for the household and were knowledgeable of the village's past water problems and regional management techniques. These results are consistent with the study by (du Plessis et al., 2024; Mapuka et al., 2024) in South Africa, it was found that most people were between 40 and 50 years old. Further, the small number of people under 24 may indicate that their main priorities are work, education, or family obligations (Ogunbode et al., 2024b).

In the households surveyed, gender was observed to significantly influence water access and decision-making. Although 53% of respondents were male and principally identified as household heads and the primary decision-makers, but were not typically responsible for collecting water. This highlights a clear gendered division of roles, as the task mainly fell to women and girls. Further, some women required their husbands' permission to participate in the survey, reflecting sociocultural norms that limit women's autonomy and the involvement in decision-making processes. As a result, while men make key household decisions, women bear the practical burden of water collection and management. This disparity suggests that water-related decisions may not fully reflect the needs and experiences of those most directly affected. Therefore, promoting greater inclusion of women in household and community-level water governance is essential for more equitable and effective water access solutions.

Most respondents had primary education, and 3.1% had no formal education, although some could read. Education is vital to raise awareness on clean water infrastructures and improved water utilities. This finding is similar to a study by (Adil et al., 2021; Inyang, 2022). In South Kordofan, Sudan, most respondents had primary education (Asmally et al., 2025). In Mexico 43% had incomplete primary education (Alvarado et al., 2022). The findings by (Ahmed et al., 2025) in Eastern Ethiopia, over half of the respondents had no formal education. The increase in the number of people with low education could lead to poor management of clean water sources and the use of unsafe water. During the investigation, the respondents stated that a lack of education led to insufficient knowledge about water resources, including infrastructural damage. The community and stakeholders should continue bringing education and raising awareness on protecting water sources.

3.2. Status of the Household Clean Water Accessibility at Kikwe

In the descriptive analysis of water sources in **Table 2**, most respondents, 37.4%, depended on rivers, and 2% harvested from rainwater. Similar sources were reported in previous studies by (Livhuwani et al., 2025). The rest used other sources, including public standpipes piped-on premises, as reported by (du Plessis et al., 2024), neighbors pipe, and springs/wells. During the survey, a considerable number of respondents showed that they relied on river water as their alternative source due to the absence of reliable, clean water taps, which primary schoolchildren have previously reported as harmful. Issues related to waterborne diseases (Koua et al., 2025), including diarrhoea and typhoid, were highlighted during survey interviews. **Table 2** presents the percentages of respondents' that use reported water sources.

Table 2. The percentages of respondents' water sources.

Variables	Category	Name of the village					Chi-Square
		Nambala	Kikwe	Maweni	Karangai	Total	
Primary source %	Piped on premises	12.2	2.8	1.4	0.8	17.3	X2 = 137.217; df = 15; p = 0.000
	Public standpipe	6.8	15	5.7	6.2	33.7	
	Piped to neighbour	3.4	1.4	0.3	0	5.1	
	Spring/well	2	0.8	0.6	1.1	4.5	
	River	4.2	6.8	7.4	19	37.4	
	Rainwater	0.3	1.1	0.3	0.3	2	
Total		28.9	28	15.6	27.5	100	

Most respondents used rivers and irrigation canals as their main water sources Figure 3. Many of these 19% are from Karangai village. These are aligned with the study by (Asmally et al., 2025) in Sudan, (Hughes et al., 2025) in the United States of America, using contaminated surface water leads to a high cost of treatment. Using contaminated surface water (Alvarado et al., 2022) led to the spread of cholera and death (Kapaya et al., 2025; Koua et al., 2025; Mwale et al., 2025). Most of the households' respondents, 6.8% from Nambala and 6.2%, depend on public piped water (Ahmed et al., 2025). Most of the respondents, 12.2 % from Nambala, had piped water on the premises compared to other villages. This is similar to the study by (Ahmed et al., 2025) in Dire Dawa town of Ethiopia. Piped water access on-premises facilitated easier availability and saved time.

Figure 3. A community member was fetching water for domestic uses in irrigation canal. Source from the field.

The populations surveyed confront serious health concerns as a result of their heavy reliance on river water, especially when surface water sources may be contaminated. According to this study, river water is frequently used when there are no safe, piped alternatives. Past studies have connected these sources to waterborne illnesses like cholera, typhoid, and diarrhea. Many homes do not treat their water before consumption, which increases the danger of disease outbreaks and exacerbates these health problems. Because of contamination, relying on river water presents major health hazards, such as cholera, typhoid, and diarrhea. By expanding access to clean piped water, encouraging home water treatment practices, and funding long-term rural water infrastructure and quality monitoring, these dangers can be reduced.

3.3. Household Status on Clean Water Pipe Connection

Most of the household respondents, 70.8%, had no connection with a water pipe in their premises; however, 29.2% were connected (Figure 4). A total of 582 water pipes connected to the households in the Kikwe ward community were reported during the interview.

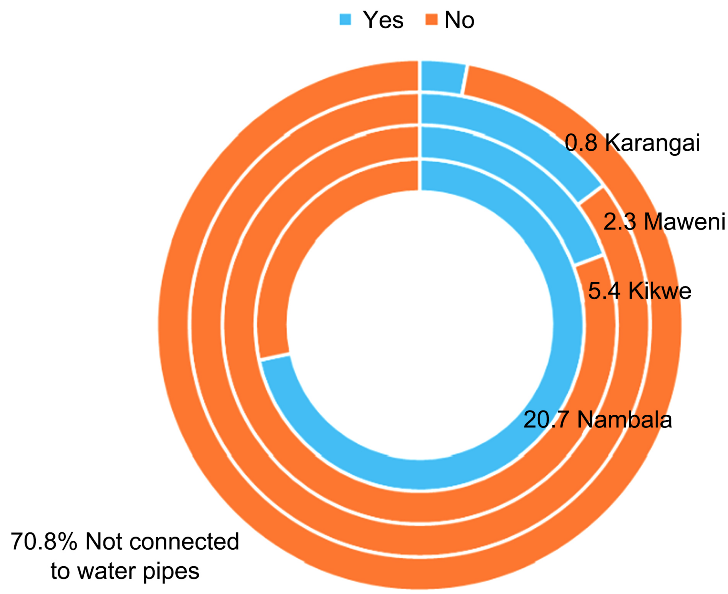

Figure 4. Household status on clean water pipe connection.

The majority had no clean water pipes connected to premises, which led to the majority depending on the water from the community water points and relying on the rivers and canals as their primary water sources, which may lead to diseases from contaminated water (Asmally et al., 2025; Girotto et al., 2024; Isukuru et al., 2024). The households with water pipes claimed the water was not flowing for days, there was allocation, and sometimes the water was insufficient with shallow pressure. During the interview, the respondents held that water was lacking, leading to ration. These indicate the poor and inadequate water infrastructure invested among households. This is similar to the findings by (Kumar Ds et al., 2024) in India, where people use unimproved sanitation facilities. For instance, a study by (Leahy et al., 2024) in Ghana, households have water pipes, but there's no water flow in that area; one can find about ten houses with non-functional pipes. Also, in South Africa (Tshona et al., 2025). Relying on unimproved rivers and canals could increase the spread of waterborne diseases and endanger community production.

3.4. Fetching and Storage of Clean Water

Most of the respondents, 96%, voted Yes to fetching and storing water using buckets, water containers, and barrels. About 4% of respondents voted No (**Figure 5**). It was reported that incorporated trials such as limited incentives for infrastructure developments, drought conditions reducing water supply, damaged existing infrastructure, insufficient water reserves, and population growth all contribute to unreliable and inadequate access to clean water. These topics create significant barriers to meeting the growing demand for clean water, eventually affecting public health and well-being. In **Figure 6**, examples of tools used to fetch and store water by most of the respondents are shown.

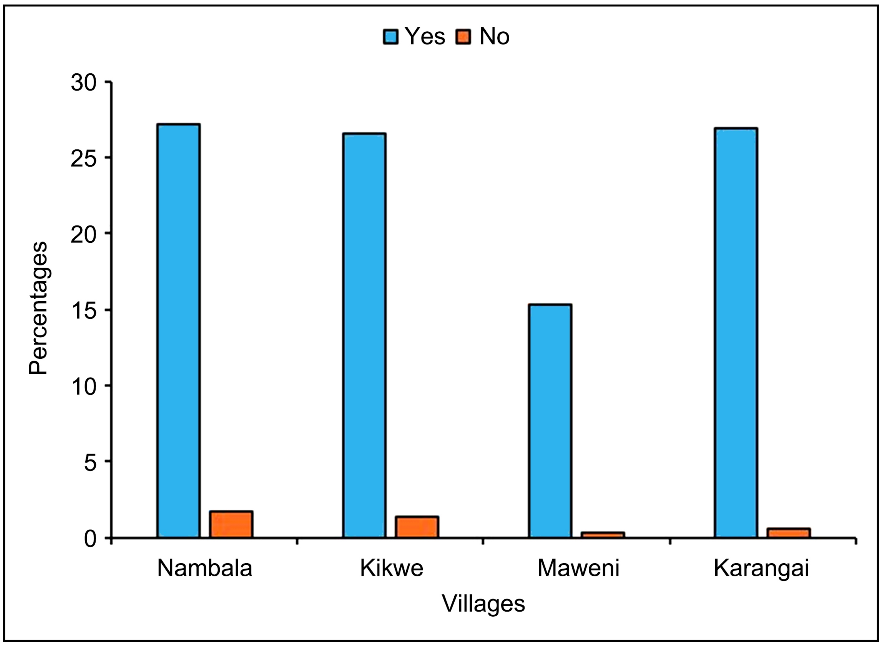

Figure 5. Fetching and storage of water in buckets, containers, or barrels.

More than 95% of the respondents said they used to fetch and store water in barrels, gallons, buckets, or other containers. Many responders used 10- and 20-litre buckets. That only briefly highlights the community's difficulties and lack of access to clean water. In rural South Africa (Vele et al., 2024), rainwater gathered from their compound was collected and kept in small buckets and water containers, and water was retrieved and stored using barrels (Asmally et al., 2025), gallons containers, buckets, and drums/jerricans (Bazaanah & Mothapo, 2023). Many households in rural Oyo State, Nigeria, have discovered that conserving water in drums of different sizes and types, such as jerricans, clay pots, and buckets of various sizes, is one way to avoid the crisis associated with water availability for domestic use (Ogunbode & Ifabiyi, 2017). The community struggles with water allocation for hours a day, twice or once a week, for extremely brief times at the public standpipe, which led to water purchases from vendors. These signify households' pressing water storage demands and the underlying issues of economic productivity, water infrastructures, and health. Gaining an understanding of these elements is crucial for creating water management strategies that work and attract the general economic situation in affected communities.

Recent work report practices for water storage such as using buckets, barrels, gallons, and other containers, while they are necessary due to limited and unreliable water supply, but can have significant implications for water safety and public health. These containers habitually used repeatedly and occasionally left uncovered or inadequately cleaned, increase the risk of microbial contamination, especially when water is stored for extended periods. The lack of proper sanitation and safe storage conditions can lead to the growth of bacteria and other infectious pathogens, making stored water unsafe for drinking and domestic use.

In **Figure 6**, examples of tools used to fetch and store water by most of the respondents are presented.

Figure 6. Figure examples of tools used to fetch and store water. Field sources.

Further, the practice of fetching and storing water in open or reused containers exposes the water to environmental contaminants, including dust, animal contact, or handling by multiple individuals, further compromising its quality and, hence health of users. These conditions can contribute to waterborne diseases, including diarrhea, cholera, and typhoid, which are particularly dangerous in communities with limited healthcare access. Therefore, while these storage methods are a practical response to water scarcity, they present serious public health concerns. Addressing these issues requires not only improving infrastructure and water supply reliability but also educating communities on safe storage practices, promoting the use of covered and clean containers, and encouraging point-of-use treatment methods like boiling or chlorination to ensure water safety.

3.4. Economic Factors Influencing Household Access to Clean Water

Table 3 presents descriptive statistics on economic factors influencing household access to clean water in Kikwe peri-urban ward. Over half (51.6%) of households use water for economic activities, primarily irrigation (37.3%) and animal feeding (10.5%), while 52.1% report no economic water use. Farming (22.4%) and livestock keeping (12.7%) are the main water-dependent activities. Despite these needs, most households (66.3%) are not responsible for paying water bills, and only 25.8% manage this expense. Monthly spending on clean water remains low, with 21.2% spending less than 5000 currency units and only 6.8% allocating 10,000 or more. Previous study reported that most household heads (65.4%) are farmers, with most engaging in one (32.0%) or two (34.8%) farming seasons per year (Olutumise, 2024). Household income is generally low, with 70.3% earning less than 110,000 currency units per month and only 8.7% exceeding 510,000 (Terefe et al., 2024). These findings suggest that low-income levels, reliance on farming, and limited monetary responsibility for water bills may influence access to clean water in households, highlighting potential economic constraints in ensuring sustainable water access, as similarly, observed in present study.

Table 3. Descriptive statistics of economic factors influencing household access to clean water.

Variable	Attribute	Frequencies	Percentages %
Occupation of the household head	Farmer	231	65.4
	Self-employed	48	13.6
	Government employee	29	8.2
	Housewife	22	6.2
	Others	23	6.5
How many seasons do you produce and harvest if you are a farmer?	Two seasons	123	34.8
	One season	113	32
	More than two seasons	10	2.8
	None	107	30.3
Income per month for the entire household	Less than 110,000	249	70.5
	110,00 - 500,000	73	20.7
	510,000+	31	8.7
What is the usage of water in your economic activity? Mention	None	184	52.1
	Irrigation	132	37.4
	Animal feeding and others	37	10.5
Are you involved in any water-dependent activities? Such as	None	182	51.6
	Farming	79	22.4
	Livestock keeping	45	12.7
	Others	47	13.3
Are you responsible for paying water bills?	Yes	91	25.8
How much money is used per month for clean water access?	None	234	66.3
	Less than 5000	75	21.2
	5000 to 10,000	20	5.7
	10,000+	24	6.8

3.5. Multinomial Logistic Regression on Economic Factors Influencing Household Access to Clean Water

The results of multinomial logistic regression on the economic factors influencing household access to clean water (Table 4) indicate that the occupation of the household head (OR = 1.222, $p = 0.132$) and the number of farming seasons (OR = 0.893, $p = 0.369$) do not show significant associations. However, household income (OR = 1.625, $p = 0.001$) is a strong predictor, indicating that higher income increases the likelihood of accessing clean water. The results indicate a strong correlation between lower income levels and reduced access to clean water, highlighting the necessity for targeted economic development to improve water infrastructure and accessibility. Involvement in water-dependent activities (OR = 1.171, $p = 0.030$) and monthly spending on clean water (OR = 1.465, $p = 0.002$) is also significant, suggesting that households engaged in these activities and those spending more on clean water have better access (Ogunbode et al., 2024b; Ogunbode et al., 2024a; Olutumise, 2024).

Conversely, responsibility for paying water bills (OR = 0.157, $p = 0.005$) negatively impacts access, implying that households bearing water costs may struggle more. Water usage in economic activities (OR = 1.168, $p = 0.052$) is borderline significant (Olutumise, 2024). Overall, income, water-dependent activities, and spending significantly influence access to clean water, while direct responsibility for water bills presents a challenge.

Table 4. Multinomial logistic regression analysis of economic factors influencing household access to clean water.

Variable	Odds Ratio	Beta Coeff	95% C. I for O.R		*p*-value
			L.B	U.B	
Occupation of the household head	1.222	0.2	0.941	1.586	0.132
How many seasons do you produce and harvest if you're a farmer?	0.893	−0.113	0.699	1.142	0.369
Income per month for the entire household	1.625	0.486	1.221	2.163	0.001*
What is the usage of water in your economic activity? Mention	1.168	0.156	0.998	1.367	0.052
Are you involved in any water-dependent activities? Such as	1.171	0.158	1.015	1.351	0.030*
Are you responsible for paying water bills?	0.157	−1.853	0.043	0.576	0.005 *
How much money is used per month for clean water access?	1.465	0.382	1.154	1.86	0.002*

3.5.1. Occupation of Household Head

Many respondents are farmers, which is essential, as they rely on rainfall for production and irrigation canals to utilise their farms. Those depending on water from the canals typically pay 10,000 TZS per year. These findings align with (Inyang, 2022; Olutumise, 2024). The finding is the opposite of the study by (Alvarado et al., 2022) in Mexico and (Ahmed et al., 2025) in Ethiopia, many of the respondents were housewives. Occupation in the community is vital in contributing to national development and ensuring clean water accessibility. For instance, a study (Ogunbode & Ifabiyi, 2017) in Oyo State, Nigeria, agencies insisted that infrastructure and agricultural development be prioritised to enhance water usage.

Since many relied primarily on irrigation canals and rainfall for agricultural purposes, the large percentage of farmers (65.4%) had an impact on patterns of water access. Although this made water somewhat accessible, it did not ensure that the water would be clean enough for domestic usage. Farmers frequently have more difficulty obtaining safe drinking water than non-farmers, underscoring the need for integrated water planning that supports both home and agricultural use.

3.5.2. Seasons for Farmers' Productions

Most farmers grow crops like maize, bananas, beans, and vegetables and keep animals such as cattle, sheep, and goats (Doh & Mclean, 2024). Half of the farmers produce and harvest twice annually. The data presented in **Table 4** shows that farmers rely on two main seasons each year for production and harvesting. This includes the long rainy season (Masika) for planting and the short rainy season (Vuli) for harvesting. Many farmers produce twice yearly, depending on the rainy season and short rain supported by rivers and canals for irrigation. The finding is similar to a study (Inyang, 2022); intelligent investments in irrigation infrastructure and sustainable farming practices are essential for boosting productivity, improving soil health, and ensuring economic stability amid changing climate conditions. Further research should focus on innovative solutions to address these challenges and enhance resilience in agricultural systems. Increasing production could lead to improved clean water by installing alternative sources and filters.

3.5.3. Income Per Month of the Household Head

The general income of the respondent household head is less than 110,000 TZS. Most respondents' income was meagre, with Tanzanian shilling per month, and the findings are statistically significant. Limited financial resources hinder the creation of alternative water sources and the establishment of solid infrastructure, which are crucial for improving household quality of life. In a study (Olutumise, 2024), farmers income was below 600,000 Nigerian Naira per annum, the survey aligned with (Inyang, 2022; Terefe et al., 2024) in which low-income households and those living in poverty are less likely to have access to clean, piped water because the costs of developing water infrastructure and paying utility bills are often beyond their financial means (Revollo-Fernández, 2023). Marginalised, low-income communities face more significant challenges (Kumar Ds et al., 2024), as higher-income families are more likely to have access to protected wells, piped water (du Plessis et al., 2024), and improved water sources (Patterson et al., 2023; Nyanza et al., 2018). Our findings showed that financial presence enhances water quality and accessibility (Leahy et al., 2024; Immurana et al., 2022).

3.5.4. Water Usage in Economic Activities

The majority of the respondents, approximately 48%, benefit from water usage to raise economic activities used in irrigation and domestic activities aligned with (Ogunbode et al., 2024b; Ogunbode et al., 2024a), animal feeding, and other economic activities related to water, including saloons (Inyang, 2022). Most respondents use water in agricultural activities, including farming and livestock production, small industries, and most used for domestic activities. However, about 48% of respondents have been involved directly in water-dependent activities, including water for farming, livestock keeping, poultry, and very minor in fisheries. This was similar to the study of (Ogunbode et al., 2024b). In Mexico, clean water was effective in tourist activities, rainfed and irrigated agriculture activities (Alvarado et al., 2022). This indicates that clean water infrastructure investments are significant for the community to produce and provide services. That could lead to quality production and services that bring good health and increase individual and national income. During the survey, we observed ponds for fish, livestock, poultry, and chickens and farming activities, such as vegetable production, which requires clean water.

3.5.5. Payment of Water Bills

Approximately 26% of respondents are significantly paying water bills and contributions related to the responsible authority, compared to the majority who do not. We observed that most depended on free community water pipes, rivers, irrigation canals, and insufficient water infrastructure, leading to water allocation and frequent cut-offs. The finding is similar to (Immurana et al., 2022) as people cannot afford the cost of services, leading to poor quality services. Many respondents cost less than 5000 TZS in monthly water bills, and the price is statistically meaningful. These include those who depend on water from canals as their primary source of domestic activities, buying water from vendors, and neighbours piped water. Individuals who have water pipes used to charge 50 TZS per 20-litre bucket. During the survey, respondents added that the cost of water service is 5000 TZS per month in households without water meters, but most do not pay water bills. The finding aligns with the study by (Tshililo et al., 2022) in Diepsloot township, South Africa households utilising free water sources or granted municipal exemptions are beneficiaries of the national free basic water policy. Those relying on communal taps are legally exempt from paying for water services. Paying water bills is essential (Immurana et al., 2022; Kumar Ds et al., 2024), for improving clean water access within communities.

4. Conclusion

Improving access to clean water in rural Northern Tanzania is essential for enhancing health and economic well-being. This study highlights the significant role that financial factors play in determining household access to clean and safe drinking water. Key findings indicate that higher income levels, robust employment opportunities, and targeted investment in water infrastructure are critical to overcoming clean water accessibility challenges.

To achieve sustainable development goals and improvements in water access, policymakers must prioritize economic development initiatives that foster job creation and infrastructure enhancement. Additionally, empowering local communities to manage their water resources can lead to more sustainable and practical solutions. By addressing these economic factors, we can significantly improve the quality of life for rural households in Northern Tanzania, contributing to broader public health and development goals.

In order to enhance the significance of this study, it is advised that further research includes a longitudinal element by returning to the same households over time. This method would allow for a more thorough comprehension of how interventions, infrastructure upgrades, or economic shifts affect water access, storage habits, and associated health outcomes. Monitoring these relationships would provide important information on the resilience of communities and the success of initiatives that have been put into place. Furthermore, regular follow-up would act as an essential feedback system for stakeholders and policymakers, assisting in the improvement of public health and water management programs based on empirical data and evolving community requirements.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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