Social determinants for household clean water accessibility in northern Tanzania: A case of Kikwe peri-urban ward in Arusha

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ABSTRACT

Clean water accessibility is vital to human health and well-being, a fundamental human right. Over 1.7 billion people do not have consistent access to safe drinking water, negatively affecting their health and socioeconomic status. Despite global recognition of clean water as a fundamental human right, many households in peri-urban areas of developing countries, including northern Tanzania, continue to face significant challenges in accessing reliable water sources. In the Kikwe peri-urban ward, disparities in access to clean water are influenced by various social determinants such as education level, gender roles, marital status, and proximity to water sources. These social factors contribute to unequal water distribution and increased vulnerability to waterborne diseases and economic burdens, especially among women and marginalized groups. However, limited empirical data exists on how these social determinants specifically affect household water access in Kikwe, hindering the development of targeted, evidence-based interventions. This study, therefore, aimed to investigate the social determinants of household clean water accessibility in Kikwe peri-urban ward of northern Tanzania. The cross-sectional survey combined quantitative and qualitative research methods on 353 respondents sampled from the Kikwe ward. Inference and descriptive statistics were employed to analyze the social determinants and respective associations with clean water accessibility. Results show that 64% of respondents finished elementary school, 53% were male, the majority 25.8% aged between 45 to 54, 73.7% were married, 37.4% rely on water from the rivers, 33.7% use public standpipes as the primary source of water, 62.9% female primarily responsible for fetching water and 84.7% of users do not treat water for their daily use. A weak significant correlation existed between water sources and social variables tested, implying clean water is an essential commodity, which needs to be distributed equally regardless of individual status. The findings highlight that clean water accessibility in peri-urban Kikwe is significantly influenced by social inequalities, particularly gender, and proximity to water sources. While the statistical correlations were weak, the trends point to systemic disparities that require deliberate policy attention. It is concluded that equitable access to clean water cannot be achieved without addressing these underlying social determinants. Therefore, it is recommended that targeted educational programs using mobile platforms be introduced to enhance awareness on water treatment and conservation. Additionally, empowering communities through participatory water governance, investing in affordable and decentralized water treatment solutions, and improving local infrastructure is critical for long-term water security and public health resilience in peri-urban areas like Kikwe.

Keywords: Clean Water, Clean Water Accessibility, Peri-Urban, Socio-Determinants, Unimproved Water

I. INTRODUCTION

Clean water access is a vital component of human health and well-being and a fundamental human right (United Nations [UN], 2015). Ensuring clean water access to the communities aligns with the United Nations Sustainable Development Goals (SDG 6), which focus on providing safe, accessible, and affordable water for all (UN, 2015). Millions of people get sick, and some die each year globally due to the consumption of contaminated water. The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) estimates that over 1.7 billion people do not have consistent access to safe drinking water, negatively affecting their health and socioeconomic status (WHO/UNICEF, 2023). In Sub-Saharan Africa, the fight for clean water is a significant problem affecting millions of communities (UN, 2024; WHO/UNICEF, 2023). Discussions regarding water accessibility are frequently dominated by geographical and environmental factors (UNESCO, 2022), but social aspects are just as important (Hugho et al., 2024; UNESCO, 2022). In developing countries, including Tanzania, ensuring the safety and proximity of drinking water sources remain critical challenges that heavily impact public health and daily life. WHO/UNICEF categorises clean drinking water into improved facilities which involve piped supplies including tap water in the dwelling, yard, or plot, (Ripanda, et al., 2025; WHO/UNICEF, 2023) including piped to a neighbour and public taps or standpipes. Non-piped supplies include boreholes/tube wells, protected wells and springs, rainwater, packaged water, delivered water, and water kiosks. Unimproved facilities involve unprotected wells and springs, and no facility involves open water sources located above ground such as rivers, lakes, ponds, streams, canals, reservoirs, and irrigation channels.

Many communities rely on untreated water from rivers, lakes, or wells, which are often contaminated by industrial waste (Miraji et al., 2023; Ripanda et al., 2021), agricultural runoff (Makokola et al., 2019; Ripanda et al., 2023), and inadequate sanitation systems (Vuai et al., 2022), leading to widespread waterborne diseases such as cholera and dysentery. Additionally, the lack of nearby clean water forces women (UN, 2024) and children to travel long distances to collect water, which, as a result, leads to wasting time, reducing educational opportunities, and increasing exposure to risks like physical injury or violence. Addressing these issues is vital to improving health, reducing poverty, and achieving SDG 6. The coverage of safe drinking water according to WHO/UNICEF is presented in Figure 1.

Clean water is safe and free of contaminants, chemicals, bacteria, and viruses (WHO/UNICEF, 2023). Clean water has several vital functions, including drinking, cooking, and maintaining personal hygiene (Soeters et al., 2021). The availability and quality of clean water accessibility are greatly influenced by several factors, including cultural beliefs (Fleifel et al., 2019; United Nations Educational, Scientific and Cultural Organization [UNESCO], 2022), gender dynamics (Fleifel et al., 2019; Rwehumbiza & Hyun, 2024; UNESCO, 2022), education status (Baddianaah et al., 2024), age (Wrisdale et al., 2017), household size, and community involvement (Rwehumbiza & Hyun, 2024; UNESCO, 2022), these factors play a significant role in household clean water access.

The government of the United Republic of Tanzania has taken steps to ensure that urban, peri-urban, and rural areas have safe and clean water sufficient to survive (URT-MoW, 2019) as part of its efforts to improve public health and achieve SDG 6. The government is projected to increase access to clean water by over 80% by 2025 in rural areas (URT-MoW, 2024). Notwithstanding government initiatives through water institutions, most peri-urban people reported a lack of clean water for domestic use, requiring intervention to meet this target. Water authorities have made efforts to increase the effectiveness of service delivery.

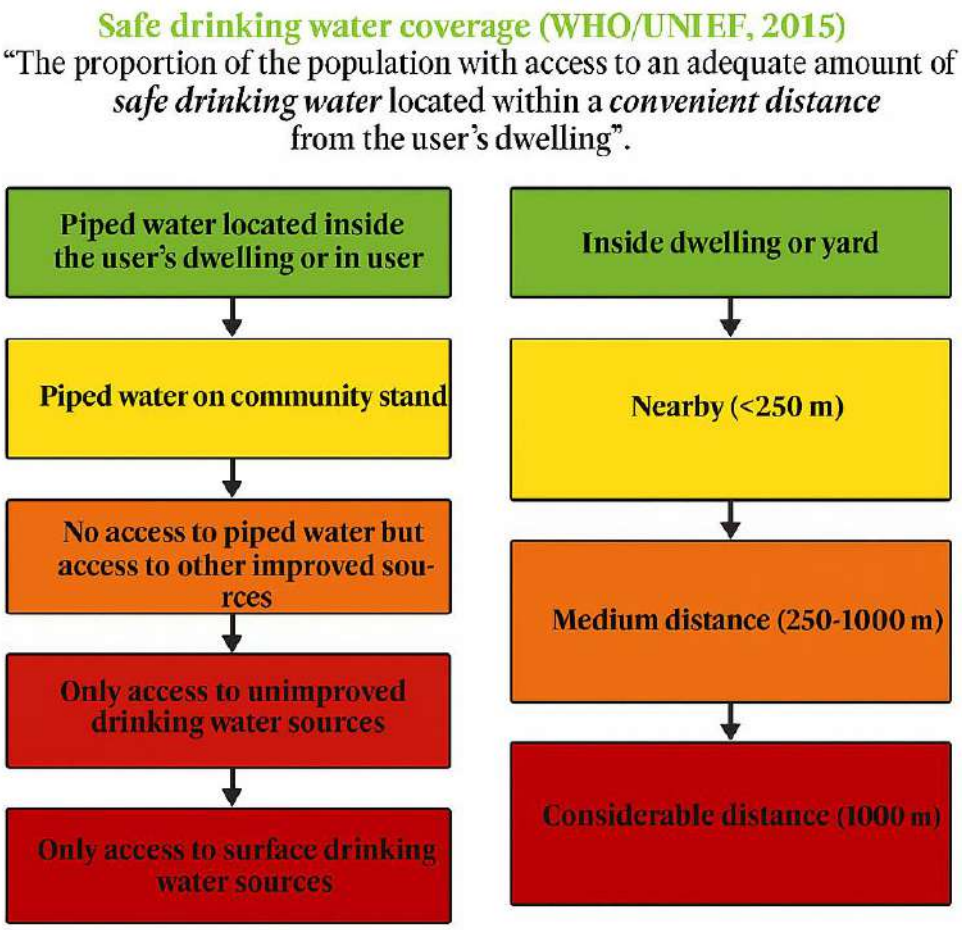

Figure 1
Safety and Accessibility of Drinking Water Sources
Source: Oskam et al. (2021).

Yet, several issues remain unsolved, such as water loss, complaints over water bills, water rationing, delays in customer service delivery, and reliance on subsidies (URT-MoW, 2024), as previously reported (Gutierrez et al., 2021). The inadequate access to infrastructure (URT-MoW, 2024) often affects marginalized communities (United Republic of Tanzania, Ministry of Education, Science and Technology [URT-MoEST], 2022), as socioeconomic disparities impede its development and upkeep. Gender dynamics further complicate the landscape, as women and girls are disproportionately responsible for collecting water, impacting their educational and economic opportunities (Gomez et al., 2019). Community involvement in water management can also improve equity of access and sustainability (Rwehumbiza & Hyun, 2024), but many communities lack the platforms that make this possible (Rwehumbiza & Hyun, 2024). Therefore, the current study investigated the social determinants of households for clean water access in the peri-urban wards of northern Tanzania.

1.1 Statement of the Problem

In the Kikwe peri-urban wards of Arusha, Northern Tanzania, access to clean water is not just a matter of pipes and pumps it is shaped by who you are, where you live, and what you earn. Rapid urban expansion has blurred the lines between rural and urban governance, creating a policy vacuum where informal settlements grow but services do not follow, as presented by previous work (Ngayaga et al., 2025a; Ngayaga et al., 2025b). Within this space, social factors such as gender roles, informal land tenure, education, and household income determine who gets water, how often, and at what cost. Women and children are disproportionately affected, often sacrificing time, health, and education in the struggle for daily water needs. Yet, current approaches continue to overlook these lived realities, focusing instead on infrastructure alone. To create sustainable solutions for Kikwe ward, we must rethink clean water access as a socially-driven issue and uncover the hidden forces that determine why, in the same city, water flows freely for some and barely at all for others.

1.2 Research Questions

The study addressed two main questions

(i) What is the status of household clean water accessibility in Kikwe peri-urban ward in Arusha?

(ii) How do social determinants influence clean water accessibility in Kikwe peri-urban ward in Arusha?

II. LITERATURE REVIEW

2.1 Theoretical Review

This study is guided by Mary Douglas's Cultural Theory, which explores the dynamic interplay between water-related risks, societal values, and institutional frameworks. The cultural theory of risk is a sociological paradigm that investigates how people view and react to community dangers. It implies that people's worldviews, cultural beliefs, and values affect how they perceive danger (Douglas & Wildavsky, 1983; Slovic, 2000). Mary Douglas' cultural theory of risk says that four cultures exist: egalitarianism, individualism, bureaucracy, and fatalism. Koehler et al. (2018) explained cultures in water points services as follows: first, egalitarianism (community) is the society's participation and involvement (Kryvda & Storozhuk, 2022; Roca et al., 2022). Such as meetings, contributions to access and usage, and maintenance of water sources. Second, the individualist culture includes water stations, which may be privately owned and used by businesses, and they are also self-supply options. Third, the bureaucratic culture comprises water stations run by educational, medical, and religious institutions. The state frequently provides funding to these institutions for maintenance projects like building water supply infrastructure. Finally, Fatalist culture includes Water point user groups whose members have resorted to alternative sources due to long-term management failure (Koehler et al., 2018)

The theory determines how far humanity advances toward achieving universal, safely regulated drinking water supplies. The institution oversees informational campaigns, behaviour guarantees, and incentive programs. The value is to provide drinking water services that are safely managed enough for everyone and inexpensive daily (Koehler et al., 2018). The degree of self-rule in service delivery, the separation of powers between policy, delivery, and regulation, accountability, and public support and engagement all influence institutional risks. Convictions that risk can be minimised when multiple management cultures are connected at scale in a pluralist arrangement, all under a certified maintenance service (Koehler et al., 2018). This theory was used in coastal Kenya and helped understanding risk perception and environmental management in rural Kenya. It highlights how cultural values and social structures influence risk assessments (Anthonj et al., 2022; Mumbi, 2021; Mumbi & Watanabe, 2021). This helps identify dominant cultural types, inform strategies, and promote sustainable resource management. The integration of Cultural Theory helps stakeholders navigate the complex interplay between cultural and environmental issues more effectively. Rural communities that faced challenges with safely managed water provision (Koehler et al., 2018) proposed that to produce value for rural water users, pluralist institutional structures that allow dangers and obligations to be reconceptualized and reallocated between the state (Koehler et al., 2018), the market, and communities are necessary. By incorporating the study into the cultural theory of risk, we can understand how social determinants interact with cultural beliefs, social dynamics, and risk perception. The individualist culture of owning water stations can be a source of income by selling the water, ensuring a reliable water supply to the household. It will also determine the household's source of revenue and the installation and maintenance of water points. A community-based solid egalitarianism will ensure water supply in homes, regular water infrastructure maintenance, and follow-up on water access to ensure a reliable water supply to the community households. The theory relates to the availability of institutions that ensure individuals' reliability and the availability of clean water. The government ensures that the water infrastructure is maintained. Thus, it will include the government's regulatory authorities that monitor the water supply, maintain water infrastructure, and ensure quality water supply.

2.2 Empirical Review

2.2.1 Status of Household Clean Water Accessibility

The UN SDG 6 aimed to certify the availability and sustainable management of water and sanitation for all by 2030 (UN, 2015). However, progress has been uneven, with some regions and countries achieving better results than others. Most African countries were working toward achieving SDG 6 but faced various challenges, including poverty (Agudo, 2022; WHO, 2017). According to WHO/UNICEF (2023), research out of 105 countries with data, coverage of essential drinking water, sanitation, and hygiene among the richest was more than double that of the poorest in 27, 54, and 64 countries, respectively. According to (Winkler et al., 2023) study in Massachusetts, United States, low income residential water clients improvised ways to pay their water bills, and some confronted obstacles that were impossible to bear. The behavioural responses to high water bills are affected by household earnings, self-reported health status, caretaking responsibilities, and accessibility of utility assistance programs. The research (World Bank, 2018) in Tanzania shows that more Tanzanians now have safe drinking water, particularly in urban areas, where the percentage of households with improved water sources has almost doubled.

Sulley et al. (2023); reported the use of containers to fetch and store water, which is not sufficient for long term use; also, the absence of frequent repair and maintenance of clean water infrastructure led to water loss and decreased water accessibility (Sulley et al., 2023). A similar study by Vele et al. (2024) in South Africa, showed that 39.6% of households had four to six members with a balanced gender ratio. Further, rainwater harvesting mainly occurred during rainfall 64.9%, with 94.5% collecting from their roofs, and storing in JoJo tanks 41.8%, and small buckets 54.5%. The study by Kongnso et al. (2025) revealed that households rely on various water sources including open wells 48%, boreholes 31%, piped water 20%, and springs 8%, with a report of higher turbidity and chloride which may impact health.

A study by Mapuka et al. (2024), in Mbhashe and Mnquma, rural South Africa, reported the use of drums, containers, and tanks for household water conservation and practices such as reusing greywater, lifestyle changes, and harvesting rainwater. Moreover, drought, inadequate infrastructure, poverty, and attitudes are critical barriers to effective water conservation (Mapuka et al., 2024). The quantity and reliability of clean water, seasonal variabilities, and water scarcity are significant problems, especially during the dry seasons (Joshua et al., 2022). The study by Mafuwane et al. (2023) revealed several key factors contributing to water scarcity in the area such as small reservoirs, the population density in Mkhuhlu Extension F, frequent pipe leaks, and illegal water connections by residents, which are the primary drivers of the region's water shortages (Asmally et al., 2025; Mafuwane et al., 2023). Research by Kabote (2024), in Morogoro, Tanzania, reported that approximately 69% of respondents accessed water from a public piped system, with others using public taps, private boreholes, or tankers. Similarly, water supply, particularly in peri-urban areas, was often unreliable, and reported to be contaminated with emerging pollutants due to the release of contaminated effluents from agriculture (Ripanda, Rwiza, et al., 2025), industries (Makaye et al., 2022), and the reuse of effluents (Hossein & Ripanda, 2025; Miraji et al., 2021; Miraji & Ripanda, 2019). Key challenges that have been reported to decrease clean water accessibility include leaks, connection costs, borehole expenses, and environmental factors, highlighting potential issues in urban water governance.

In a similar study by Ogunbode and Ifabiyi (2017), in Oyo State, Nigeria, several characteristics were identified as predictors of home water consumption in a surveyed community. These characteristics include the ability to store water, the cost, the size of the family, the amount of water used for bathing, the availability of alternate sources, the location, the sources' dependability and accessibility, the respondents' age, and the gender composition. A similar study in Temeke, Tanzania, indicated that most respondents depend on public water sources (Munissi & Mwalilino, 2024), with 40% using public taps and 36.9% relying on public water kiosks. Among them, only 16% boil their water before drinking. In Malawi (Dupas et al., 2020), NGOs provided monthly coupons for free water treatment solutions (diluted chlorine) to households with young children.

The governments have acknowledged the significance of clean water accessibility and have taken steps to tackle the matter through legislation and programs. For instance, the government of the United Republic of Tanzania has a national water policy (NAWAPO, 2002), and a national environment policy (United Republic of Tanzania, Vice President's Office [URT-VP], 2021), as different programs, plans, acts, and activities implemented by MoW to guarantee freshwater accessibility to all parts (URT-MoW, 2019, 2020; URT-WATER-ACT, 2019). The Five Year Medium Term Strategic Plan 2019/20-2023/24 aims to enhance the structures, practices, and systems that will support the management of water resources; increase access to sufficient, clean, and safe water and sanitation services; increase institutional capacity (URT-MoW, 2020); and enhance the working environment; and strengthening ties and networks in the Water Sector.

Community-based approaches, non-governmental organization interventions in several areas, and community-led projects have been critical in resolving the problems associated with clean water accessibility (URT-MERUDC, 2017; United Republic of Tanzania, Ministry of Water and Irrigation [URT-MoW&I], 2008). For example, in Arusha city communities of Tanzania, NGOs have implemented projects by participating in activities and educating communities on water hygiene practices, leading to improved access to clean water (AUWSA, 2017). To conduct infrastructure projects and capacity-building programs, they offer finance, technical help, and experience (AfDB, 2015, 2023). The African Development Bank, for instance, has funded water and sanitation initiatives in several nations to enhance the availability of clean water. For example, the (AfDB, 2015) suggested a project to upgrade Tanzania's sanitation and water supply in Arusha. Due to the city's insufficient sanitation and water supply coverage, the project's installation helps ease the current water accessibility issues in these areas.

2.2.2 Household Social Determinants of Clean Water Accessibility

Education and awareness about hygiene practices and the significance of potable water can influence behaviour and promote access to safe water. Improved awareness can lead to better utilisation of available water sources, such as piped water and other treated sources (Behera et al., 2020; Gutierrez et al., 2021), showed that some key factors influencing a household's access to safe drinking water are the exposure to media in the home, the head's educational attainment, the wealth status of the household, and the head's ethnic heritage. In addition to these variables, societal norms and residential location significantly affect household access to better sanitation and hygiene. The availability of

clean water promotes hygienic practices and sanitation (Miraji et al., 2023; Ripanda et al., 2022; Vuai et al., 2022). The study by Sajjad et al. (2025) in Islamabad, Pakistan revealed that 60-70% of respondents were aware of quality and its associated risks, with 76% of respondents recognising the link between water effluence and health problems. Those with higher education and income levels had a significantly better understanding of these issues.

Age is the factor that determines water accessibility within the household and its impact. It is not easy to access water in homes headed by older adults (Abdu et al., 2016; Wrisdale et al., 2017). The study by Simelane et al. (2020) in Eswatini, which included 4,819 families in 2010 and 4,843 households in 2014, was evaluated using Multiple Indicator Cluster Surveys (EMICSs). Complementary log-log regression studies, both bivariate and multivariate, were performed to determine what factors influence a household's ability to obtain better drinking water sources. From 73.1% in 2010 to 77.7% in 2014 ($p<0.0001$), the study revealed a considerable improvement in families' access to improved potable water sources. Access to better drinking water sources was less likely for households headed by people 55 and older in 2010 than those led by people 35–54 and older.

A study by Fejfar et al. (2024) across nine countries in Sub-Saharan Africa, identified unimproved water sources, lack of a community water committee, and domestic animal ownership, significantly associated with household drinking water contamination with *E. coli*. In contrast, water treatment, storage, sanitation, and payment practices did not correlate with *E. coli* contamination. Extensive public health activities are necessary to draw attention to the situation and the spread of diseases. Factors contributing to the spread of diseases include poverty and illiteracy. Targeted interventions are needed to slow the spread of infectious diseases in the community and ensure public health safety, such as educational campaigns on water quality, associated diseases, and improved sanitation.

Additionally, samples collected during the rainy season exhibited 2.3 times higher contamination levels. Also, the age distribution of the people may impact clean water accessibility; studies show that children under five years are particularly vulnerable to waterborne diseases; their specific needs for safe water and sanitation must be considered (Mkupete et al., 2022; Nyanza et al., 2018; Omotayo et al., 2021) also to older adults (Mafuru et al., 2023). For instance, in a study by Nyanza et al. (2018), in the Ngorongoro District, northern Tanzania, a cross-sectional study was conducted of 175 households that participated in the survey. The multivariate analysis revealed that socioeconomic status, family size, presence of children under five, history of diarrheal diseases, prior sanitation education, and motivation to improve defecation conditions are among the factors influencing access to sanitation facilities. Inadequate clean water access can increase health risks, especially for populations with weaker immune systems.

Investigation on clean water accessibility in Kikwe peri-urban areas reveals several critical gaps. First, there are limited studies focusing on specific local water sources, such as rivers and their long-term sustainability. Social and economic barriers also play a significant role, yet there is insufficient exploration of factors like gender dynamics and local customs that influence water use and management. Moreover, while some research addresses water quality, there is a noted lack of studies that investigate the direct health impacts of poor water accessibility on rural residents and the effectiveness of interventions. Finally, a gap exists in the evaluation of existing policies related to water needs, specifically concerning their effectiveness in achieving equitable access to clean water in rural regions. Addressing these gaps is vital for developing effective strategies and interventions to enhance water accessibility and management in these communities.

III. METHODOLOGY

3.1 Study Area

The study was conducted in Kikwe ward, Meru district, Arusha region, Tanzania. Kikwe ward (Figure 2), has 3030 households with an area of 77.04 square kilometres, 5689 males and 5276 females, and a population of 10,965 (URT, 2022). The community mainly depends on conventional agriculture and irrigation, using rivers and irrigation canals to produce maize, beans, bananas, and vegetables. Data generated are available in Mendeley data (Ngayaga et al., 2024). A studied population of 353 was determined using the Taro Yamane formula (Adam, 2020), as shown in Equation 1 and calculated in Equation 2.

$n= N/((1+N(e^2)))$ ……. (1)

$n= 3030/((1+3030(〖0.05〗 ^2)))$ $n= 3030/8.575= 353$ ……..(2)

In this context, n represents the minimum required sample size, N denotes the population size, and e indicates the margin of error, set at 0.05. The desired confidence level is 95%, with a margin of error of ±5%.

3.2 Data Collection

This study used mixed methods in data collection to investigate the social determinants influencing accessibility to clean water in the Kikwe ward community by combining quantitative and qualitative research methods in a cross-sectional survey. This methodology enables a thorough examination of the information, encompassing the range of societal concerns and offering a profound understanding of the social determinants of household clean water

accessibility, as noted by earlier researchers (Creswell & Creswell, 2023). Data triangulation was employed and gathered from various sources.

3.3 Photography

The current study utilized a smartphone to take photographs during data collection to document activities and phenomena, with clarifications and strong captions, as area previously reported by (Rwiza et al., 2023).

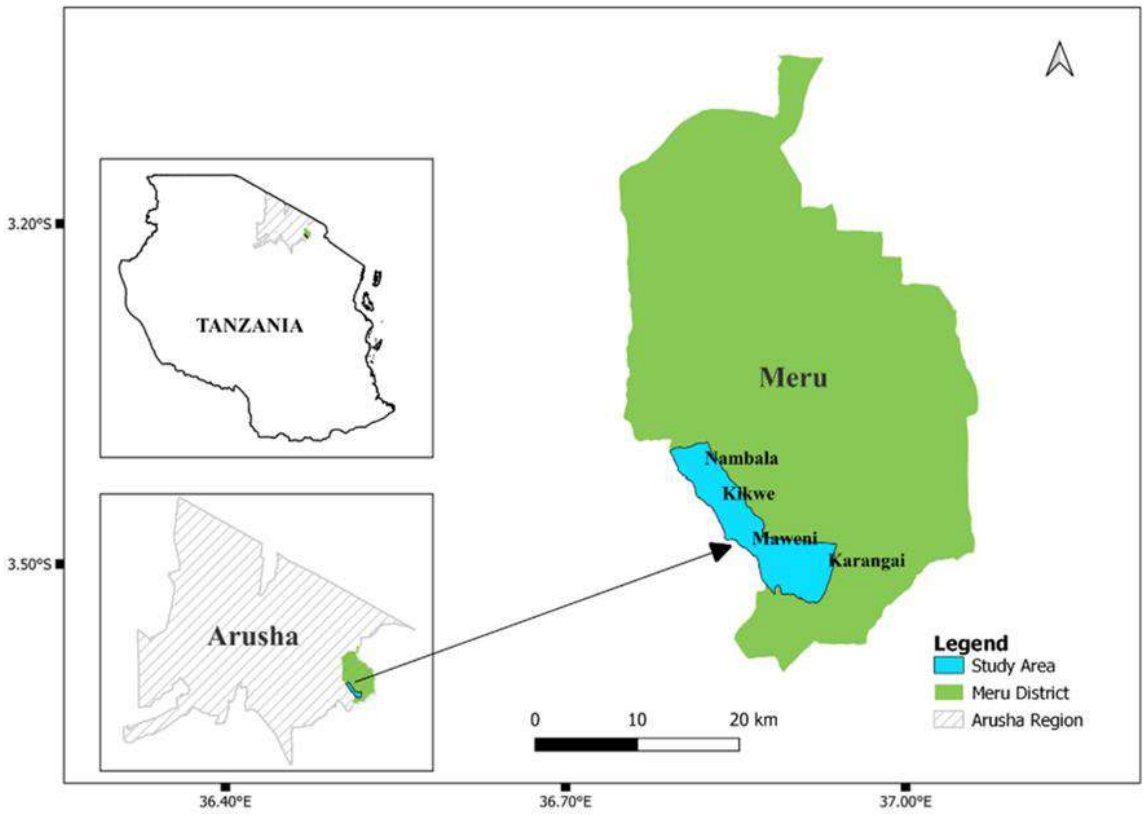

Figure 2

Map of Tanzania (Top Left), Arusha (Down left), showing Study Area Meru District (Right).

3.4 Sampling Procedure

A systematic questionnaire was created to gather quantitative data on social aspects such as family structure, age, sex, and education level. The questionnaire comprised open and closed-ended questions. The structured questionnaires were administered in person. Before the collection of data, participants' informed consent was required. Participants were guaranteed the privacy of their answers and the anonymity of themselves. The study abides by the moral standards established by the institutional review boards. This study included 353 respondents from Kikwe ward households. Simple random sampling techniques were employed in data collection to ensure that all household heads had an equal chance of selection, as reported by Creswell and Creswell (2023).

Additionally, purposive sampling is employed to identify key informants for interviews, focusing on specific units within the population. A qualitative analysis was conducted with some respondents to obtain qualitative insights into their perceptions and experiences regarding social aspects. The research data was collected through semi-structured interviews.

3.5 Data Analysis Methods

The data was collected through semi-structured interviews, and thematic analysis was employed to study the qualitative data. SPSS program and Microsoft Excel were used for quantitative data analysis. Inferential statistics were used to find correlations between clean water accessibility and social factors variables, while descriptive statistics, like frequency, percentages, and chi-square tests, were computed. A qualitative analysis was conducted with some respondents to obtain qualitative insights into their perceptions and experiences regarding social aspects.

IV. FINDINGS & DISCUSSION

4.1 Background of Respondents

Evaluating social determinants of accessibility to clean water in the Kikwe ward was essential to highlight the status of informed decisions and public health safety. This will aid in developing successful plans to increase water availability and understanding these societal aspects. Stakeholders may design more inclusive policies and initiatives that guarantee clean water access for all, promoting healthier communities and supporting sustainable development in the area by addressing the underlying social factors. This area has poor accessibility to clean water and long lines at residential water taps, which are attracting attention. The results of this current study were presented in Table 1.

Table 1

Background of Household Head

		Name of the villages				Total Frequency	Total %	P-Value
Variable	**Category**	**Nambala**	**Kikwe**	**Maweni**	**Karangai**			
Gender (%)	Male	**38** 10.8	**63** 17.8	**34** 9.6	**52** 14.7	**187**	53.0	0.001
	Female	**64** 18.1	**36** 10.2	**21** 5.9	**45** 12.7	**166**	47.0	
	Below 24	**2** 0.6	**0** 0.0	**1** 0.3	**2** 0.6	**5**	1.4	
Age (%)	25-34	**17** 4.8	**19** 5.4	**11** 3.1	**16** 4.5	**63**	17.8	
	35-44	**20** 5.7	**24** 6.8	**9** 2.5	**22** 6.2	**75**	21.2	0.920
	45-54	**23** 6.5	**25** 7.1	**19** 5.4	**24** 6.8	**91**	25.8	
	55-64	**21** 5.9	**15** 5.1	**8** 2.3	16 4.5	**63**	17.8	
	Above 64	**19** 5.4	**13** 3.7	**7** 2.0	**17** 4.8	**56**	15.9	
	Non-formal	**5** 1.4	**3** 0.8	**3** 0.8	**0** 0.0	**11**	3.1	
Education (%)	Primary	**55** 15.6	**56** 15.9	**33** 9.3	**82** 23.2	**226**	64	
	Secondary	**19** 5.4	**20** 5.7	**12** 3.4	**9** 2.5	**60**	17	
	College	**13** 3.7	**8** 2.3	**4** 1.1	**5** 1.4	**30**	8.5	0.003
	Bachelor's degree	7 2.0	**7** 2.0	**3** 0.8	**1** 0.3	**18**	5.1	
	Masters & PhDs	**3** 0.8	**5** 1.4	**0** 0.0	**0** 0.0	**8**	2.3	
Total		**102** 28.9	**99** 28.0	**55** 15.6	**97** 27.5	**353**	100	

Bolded are frequent

The result of the current study indicated that most of the respondents (187) 53% male and (166) 47% females. Majority aged (91) 25.8% were between 45 and 54, (75) 21.2% 35 to 44, (63) 17.8% were between 25-34 and 55-64, (56) 15.9% were above 64, and (5) 1.4% were 24 years old and below. About (226) 64% completed elementary school, (60) 17% completed secondary education, (30) 8.5% completed a college education, (18) 5.1% had a bachelor's degree, (11) 3.1% non-formal, (8) 2.3% had Masters and PhDs (Table 1). Females were primarily responsible for fetching water in the Kikwe community, and only 47% of the respondents filled out the questionnaire during the survey, which is statistically significant. Some women were unwilling to complete the questionnaire because their spouses were absent. In contrast, others required permission from their partners and were engaged in domestic and development activities, including farm activities. This aligns with a study by Vele et al. (2024) in South Africa, about 55.5% of the questionnaires were responded to by males. A study is in line with (Ocholla et al., 2022) on the formal settlement of Arina in Kenya. Most respondents were between 45 and 54 years old, and the group was actively engaged in community activities and water-related initiatives. They were well-informed about the village's historical water issues and local management practices and served as household decision-makers. In contrast, the limited representation of those under 24 may suggest that they are primarily occupied with work, school, or family responsibilities. These findings align with the research of (Mapuka et al., 2024) in South Africa; the majority were between 50 and 69 years old. It was found that, in the study area, secondary education was not widely accessible in rural areas despite the effort made by the government of Tanzania

to establish Secondary schools in every ward in recent years to ensure that rural and marginalized communities have access to secondary education. A similar study by Sesabo (2024), reported that secondary education, college education, and water costs were found to influence household sanitation status (Sesabo, 2024). Further, water accessibility, and sanitation-related diseases influence household livelihood significantly at 0.167 ($p<0.01$) and -0.649 ($p<0.1$), this indicates that neglecting the urban gap would continually worsen the welfare of the people living in rural areas.

The predominance of people with primary education might imply a gap in educational options, affecting their socioeconomic status and access to information. The findings concur with other researchers who found that the people in rural areas might not have had enough education or experience to deal with issues related to the availability of clean water, such as filtering and using other sources (Rwehumbiza & Hyun, 2024; Terefe et al., 2024). In a study by Alvarado et al. (2022), 22% had primary school education in Mexico while 43% did not complete education. In Ghana, 42.9% had no formal education (Baddianaah et al., 2024). Customized communication tactics are necessary because the majority's inadequate educational background might make it challenging to understand the concerns about clean water accessibility.

Community members strongly perceive the local water resources as communal property, asserting that their ancestors were the original founders of these water sources. Respondents expressed a sense of entitlement to free water access, seeing it as a shared good rather than a service that requires payment. According to interviews in this study, this viewpoint is well ingrained in the customs and beliefs of the area, where people consider water as a shared asset rather than a commodity. There is a need for educational campaigns to educate the communities in the study area on clean water and the fact that the payment of bills aids in maintaining the infrastructure and, hence, the sustainability of water projects and accessibility of clean water for all.

Moreover, respondents expressed disapproval of the water infrastructure in their areas. Insufficient education on water resources contributes to issues like infrastructure damage. This theme draws attention to a significant obstacle to implementing water billing systems. It emphasizes the importance of using culturally sensitive methods and educating when discussing community water management and payment arrangements. Future research could investigate how a person's level of education affects their views and actions on the matter at hand. The study went on to investigate marital statuses and sizes of the families in the households studied. The findings were presented in Table 2.

Table 2

Marital Status and Size of the Family in the Household

		Name of the village				Total Frequency	Total %
Variables	**Category**	**Nambala**	**Kikwe**	**Maweni**	**Karangai**		
		5	**9**	**7**	**5**	**26**	
Marital HH	Single	1.4	2.5	2.0	1.4		7.4
		76	**72**	**35**	**77**	**260**	
	Marriage	21.5	20.4	9.9	21.8		73.7
		3	**4**	**0**	**5**	**12**	
	Divorced	0.8	1.1	0.0	1.4		3.4
		14	**11**	**11**	**8**	**44**	
	Widowed	4.0	3.1	3.1	2.3		12.5
		4	**3**	**2**	**2**	**11**	
	Separated	1.1	0.8	0.6	0.6		3.1
		21	**33**	**18**	**28**	**100**	
	Less than 4	5.9	9.3	5.1	7.9		28.3
		67	**50**	**28**	**52**	**197**	
	4 to 6	19.0	14.2	7.9	14.7		55.8
Family size		**11**	**13**	**9**	**13**	**46**	
	7 to 10	3.1	3.7	2.5	3.7		13.0
		2	**2**	**0**	**2**	**6**	
	11 to 14	0.6	0.6	0.0	0.6		1.7
		1	**1**	**0**	**2**	**4**	
	Over 14	0.3	0.3	0.0	0.01		1.1
		102	**99**	**55**	**97**	**353**	
Total %		28.9	28.0	15.6	27.5		100

Bolded is the frequency number.

The findings in Table 2 results indicate that most respondents (260), 73.7%, are married, while (11) 3.1% are separated from their spouses and live differently; 3.4% are divorced; 7.4% are single, and 12.5% are widowed. About (197) 55.8% of respondents live with an average of 4 to 6 individual family members in the household, 1.1% are more than 14 people living together, 1.7% comprised 11 to 14 people, 13% live with 7 to 10 people, and 28.3% live below four people (Table 2). It was observed that most respondents were married and lived with their partners. In contrast, few were separated by distance due to their job responsibilities and other productive activities. This study aligns with Rwehumbiza & Hyun (2024), who revealed that married households frequently work together to manage resources to distribute clean water among family members. This is consistent with Soeters et al. (2021), who reported that married couples lived together, occasionally separating for work in Indonesia and finding (Baddianaah et al., 2024) 92.8% of marriages. These cultures may impact household roles and water resource management, such as increased demand and competition for limited water resources. Most household family members had four to six occupants in their homes. These results perfectly match (Vele et al., 2024). Vele et al. (2024) state that family members consume more water for daily chores like drinking, cooking, cleaning, and bathing. This growing demand may pressure local water supplies, especially in locations where the community only allocates water once or twice a week. The results also agreed with (Mapuka et al., 2024) that the majority lived with up to five family members.

4.2 Primary Sources of Water

Many households rely on rivers as their primary water source for domestic and irrigation purposes. They use irrigation canals and some constructed ponds called ("dimbwi") to store water from the canals and rainwater, and the ponds were found a few kilometres or within their surroundings. This is comparable to the other sources listed by (Terefe et al., 2024), demonstrating that rural areas frequently lack accessibility to dependable, clean water infrastructure, leaving them susceptible to diseases spread by water. A smaller percentage of households have access to rainwater harvesting as a backup source, and other sources include public standpipes (Kabote, 2024; Munissi & Mwalilino, 2024). The study is opposite to a survey by (Arcipowski et al., 2017) in rural Appalachia, United States of America. The piped water supply was limited in some community areas, forcing residents without tap water to rely on local wells and springs, often contaminated due to poor waste management. Notably, 36% use wells as their primary drinking water source, while 57% rely on public municipal water. Health concerns can arise from using river water, especially after severe rains when runoff can contaminate the water source.

Table 3

Primary Sources of Clean Water for Household Use in Kikwe Ward

Variables	Villages				Frequency Total	Percentage Total	P-Value
	Nambala	Kikwe	Maweni	Karangai			
Piped on premises%	**43** 12.2	**10** 2.8	**5** 1.4	**3** 0.8	**61**	17.3	
Public pipes%	**24** 6.8	**54** 15.0	**20** 5.7	**22** 6.2	**119**	33.7	
Neighbour pipes%	**12** 3.4	**5** 1.4	**1** 0.3	**0** 0.0	**18**	5.1	(χ^2 = 137.217; df = 15; p = 0.000)
Spring/well%	**7** 2.0	**3** 0.8	**2** 0.6	**4** 1.1	**16**	4.5	
River %	**15** 4.2	**24** 6.8	**26** 7.4	**67** 19.0	**132**	37.4	
Rainwater %	**1** 0.3	**4** 1.1	**1** 0.3	**1** 0.3	**7**	2.0	
Total %	**102** 28.9	**99** 28.0	**55** 15.6	**97** 27.5	**353**	100	

Bolded is the frequency number.

Source: Ngayaga et al. (2025b)

Most of the respondents (132) 37.4% depend on water from rivers as the primary source of clean water for various domestic activities in the household, but only 2% depend on rainwater; 4.5% use springs and wells; 5.1% rely on their neighbours; 17.3% have pipes in their premises and 33.7% use public standpipes as the primary source of water (Table 3). According to the results, most respondents, over 60%, agreed that mothers are primarily responsible for gathering water from sources and helping their daughters. They make an average of five to ten daily trips to the source, carrying buckets weighing 20 litres. During the interview, most of them responded that women and girls have been responsible for fetching water since immemorial, as this community's tradition and custom, and very rarely for men. We observed that males used to fetch water only if there were no women to fetch it or if they could not.

Women and girls bear responsibility, which could have grave implications for the individuals' safety (UNESCO, 2022), educational opportunities (Gomez et al., 2019), and overall welfare. In rural Mexico, (Alvarado et al., 2022)

indicated that Households in poor rural areas face significant water quantity and quality deficiencies due to inadequate infrastructure, posing health risks. The burden of water fetching affects women and children, hindering sustainable development efforts. They were significantly impacted by this, engaging in constructive activities and, for the girls, improving their academic achievement. Future research might investigate how enhancing women's access to water, for example, through community wells, could lessen their burden and improve their social and economic chances, focusing on constrained communities like Kikwe ward.

Plate 1
Women and Girls were Mainly Responsible for Fetching Water from Sources in Kikwe Ward
(Pictures were taken from the field).

The survey indicated that (290) 82.2% of respondents reported accepting the use of unsafe water for their regular requirements, and (63) 17.8% responded using safe water, which is statistically significant (Table 4). Most respondents cited a lack of alternatives to relying on rivers due to insufficient access to clean water, and the acceptance of unsafe water reflects a critical challenge in the study area where limited access to clean water forces communities to compromise their safety, impacting public health, especially in limited resources. A study by Sesabo (2024), reported that urban households (0.111, $p<0.01$), age (-0.305, $p<0.05$), household size (0.159, $p<0.01$), education level, water cost (-0.249, $p<0.01$), and employment (0.166, $p<0.01$) influence water accessibility, requiring intervention.

During the survey, respondents added that there is more significant environmental pollution than usual, which was also in line with other studies; for instance, people dump hazardous trash into water sources (Miraji et al., 2023), and rice farmers spray pesticides on their fields causing contamination of water in the rivers where most of the residents depend on. These findings align with a study by (Daly & Harris, 2022), showing that societies without reliable water infrastructure often resort to unsafe sources, leading to growing health risks such as waterborne diseases, which may affect weak residents, including the aged and children.

Similarly, about (229) 84.7% of users do not treat water for domestic purposes; (54) 15.3% treat the water for domestic purposes, which may result in waterborne diseases. During the survey, the respondents interviewed added that the majority used untreated water. The large proportion of unsafe water users highlights a severe public health issue because water is polluted with contaminants and pathogens. The findings aligned with other researchers (Zhao et al., 2024), show that untreated water led to contamination. According to research conducted in rural South Africa by Mapuka et al. (2024), people who depend on rivers and streams for their water have to boil them before consuming them because of animal and human waste that may be deposited in the waterways. Negligent use of unsafe water poses significant health hazards, especially for vulnerable populations, as it can result in gastrointestinal disorders and other waterborne infections. In communities of color in the San Joaquin Valley, California, a study by Boyden et al. (2023) reported that qualitative analysis revealed that most community informants reported a limited awareness of the health effects of drinking water contaminated by elevated arsenic levels. We observed some respondents drinking water directly from the canal during the survey (Plate 2).

Furthermore, many respondents claimed water from the rivers and canals led to outbreaks of diarrhoea, typhoid, and other diseases resulting from untreated water. Additionally, they said they used to draw water from the river and wait for it to settle to separate from the dirt, then drink. Very rarely did people agree to boil water before drinking. They believe boiling water loses its good taste when it is used for drinking. Future research should investigate the pollutants found in canal waters, how the community views the safety of the water, and possible steps to increase access to clean drinking water.

Plate 2

The Respondent was Drinking Water Directly from the Canal, and a Picture was taken from the Field

Most of the respondents, 34.3%, reported using less than 15 minutes to fetch water per bucket from the rivers, most canals, artificial ponds, and those who have pipes around their premises; 5.7% use between 45 to 59 minutes to get water from the source per bucket (Figure 3). At the same time, they found that approximately 44% used much time and challenges faced by walking kilometres to find clean water for more than half an hour, which may lower production, while girls fail to attend school on time; the findings are similar to the study by Fleifel et al. (2019), A survey by Sulley et al. (2023) in Kondoa, Dodoma region in Tanzania noted that more than 50% of respondents took more than 30 minutes to find water from the sources due to poor water infrastructure, unavailability of water and poor utensils used to fetch and store water for future use.

Table 4

Primary Responsible For Collecting Water from the Sources

		Name of the village				Total Frequency	Total %	Chi-Square
Variables	**Category**	**Nambala**	**Kikwe**	**Maweni**	**Karangai**			
		3	**6**	**4**	**5**	**18**		
	Boys	0.8	1.7	1.1	1.4		5.1	
		19	**11**	**6**	**6**	**42**		χ^2=20.031; df= 12; p=0.067
	Girls	5.4	3.1	1.7	1.7		11.9	
		9	**13**	**9**	**15**	**46**		
Collecting (%)	Father	2.5	3.7	2.5	4.2		13.0	
		61	**61**	**30**	**70**	**222**		
	Mother	17.3	17.3	8.5	19.8		62.9	
		10	**8**	**6**	**1**	**25**		
	Vendors	2.8	2.3	1.7	0.3		7.1	
		33	**15**	**4**	**11**	**63**		
	Yes	9.3	4.2	1.1	3.1		17.8	χ^2=22.125; df= 3; p=0.000
		69	**84**	**51**	**86**	**290**		
Safe to drink? (%)	No	19.5	23.8	14.4	24.4		82.2	
		21	**14**	**3**	**16**	**54**		
	Yes	5.9	4.0	0.8	4.5		15.3	
		81	**85**	**52**	**81**	**229**		χ^2=6.525; df= 3; p=0.089
Do you treat? (%)	No	22.9	24.1	14.7	22.9		84.7	
		102	**99**	**55**	**97**	**353**		
Total %		28.9	28.0	15.6	27.5		100	

Most of the women (222), 62.9%, are primarily responsible for collecting water in the household from the source, only 5.1% of the boys support bringing water; 7.1% bought water from vendors, followed by girls 11.9% and men for 13.0% fetch water for their homes. Women and girls were primarily responsible for water collection and domestic activities that used water (Table 4) and (Plate 1). In this study, more than half of the respondents who responded to using less than thirty minutes daily said they used to fetch only one bucket, which is insufficient for household consumption. When they repeated the process, they used it twice or more times and discovered that they used more time than necessary. Some residents obtain water for drinking only from the communal tap when a pipe falls loose. In this study, they also get water from worship houses and educational institutions like Karangai Primary School. The findings align with (Koehler et al., 2018), who indicated that worship houses and academic institutions become the best places for communities to access water where water is scarce.

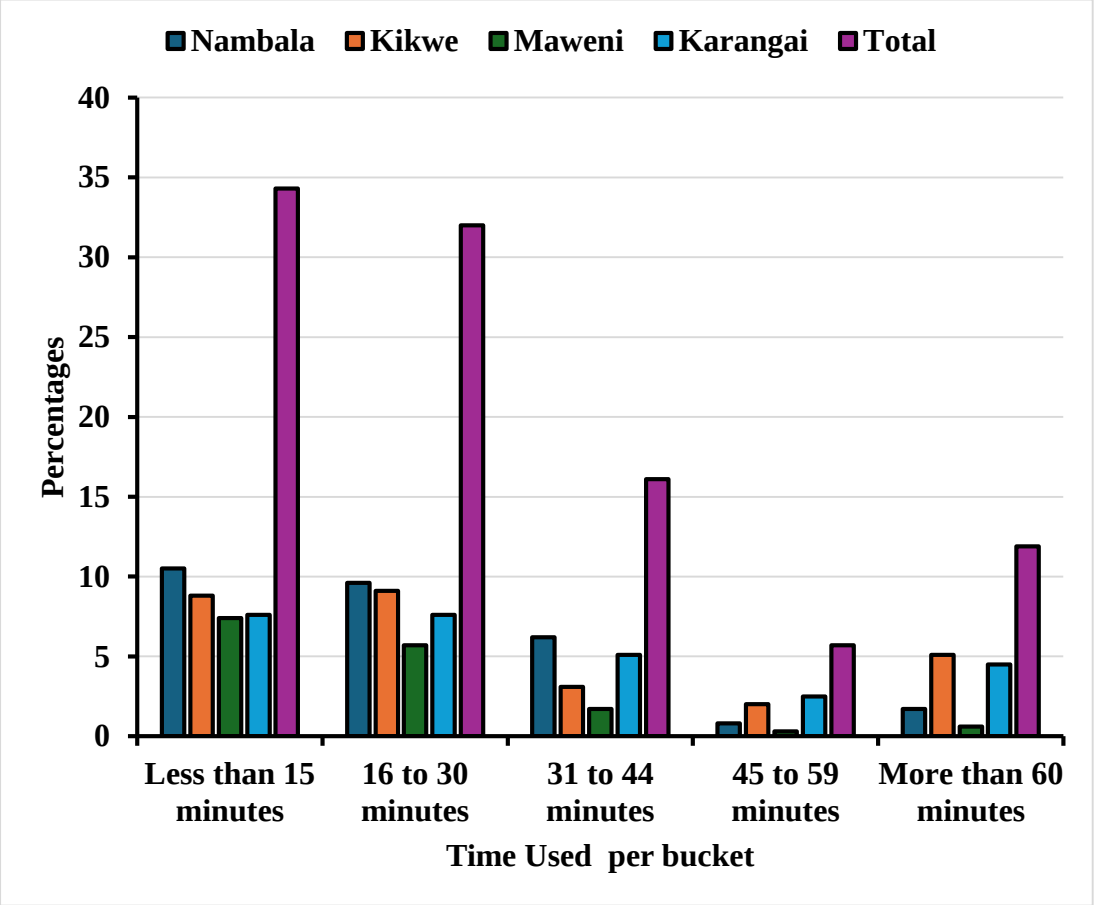

Figure 3
Responsibility for Fetching Water from the Source

Moreover, we observed insufficient water infrastructure, so using 10 to 20-litre buckets and cubes from water sources might take too much time. The respondents added that using unsafe water led to an eruption of waterborne diseases like diarrhoea in previous years. The most affected group of people in the community were children in primary schools, and the waterborne diseases reported in earlier years were typhoid and amoebic dysentery. These findings align with a study by Onditi (2024), which shows that children under five years of age were affected by accumulating unimproved water. In Plate 3, we observed that washing vegetables in a water canal and washing clothes along the canals directly is a regular habit in the studied community, which can result in water contamination.

Plate 3
Respondent A Washing Vegetables, B Washing Clothes along the Canal, and C Surveyors at the Community Standpipe in Kikwe

4.3 The Correlation Matrix Coefficient between Variables

The Bivariate (Pearson) correlation matrix coefficients between the variables of the household head social determinants of clean water accessibility were analysed and presented in (Table 5). The correlation analysis illustrates the connections between several social variables and having access to clean water. Notably, there is a weak correlation between the main supply of clean water and several characteristics, which may have significant ramifications for community health and water management. The negative relationship between the primary source (-0.202**) and the education level of the household head indicates that lower educational levels could be associated with reliance on less safe or unreliable water sources. In the Kikwe community, water was an essential commodity, and supply and distribution do not consider individual status; they are accessed equally. This implies that enhancing education might result in less informed choices about water sources. There is a weak positive correlation between a primary source and (210**) if the water source is not from the tap or standpipe and is safe to drink, and (201**) if yes, do you treat your drinking water? Most rely on the river source as their primary source, using it without treatment. These may lead to an increase in waterborne diseases. This aligns with a survey by Terefe et al. (2024), which shows that the river is an unimproved source. The pollution of effluent and different chemicals from industries and homes into river water is mentioned in the study (Ogunbode et al., 2024b). There is a need to invest in clean water infrastructures that the community can easily access.

There is a positive correlation (0.310**) between education and awareness of access to clean water and primary sources and a strong. These indicate that communities with greater awareness tend to pursue safer water options, resulting in better health outcomes. Moreover, a moderate positive correlation (0.425**) exists between elders having difficulty finding clean water and children being most affected by using unclean water. Elders experiencing difficulties and children being affected are concerned with clean water, as observed by (Wrisdale et al., 2017).

Table 5

The correlation coefficients between social determinants and clean water access variables

Variables	Primary source of clean water	Gender	Age	Education level	Marital status	Responsible for water collection	Is it safe to drink?	If No, do you treat your drinking water	Education and awareness on clean water	Children most affected	Elders difficulty getting clean water
Primary source of clean water	1										
P											
Gender	**-0.008**	1									
P	0.886										
Age	**0.106***	**-0.061**	1								
P	0.047	0.25									
Education level	**-0.202****	**-0.158****	**-.282****	1							
P	0.000	0.003	0.000								
Marital status	**0.057**	**0.348****	**0.328****	**-0.217****	1						
P	0.282	0.000	0.000	0.000							
Responsible for water collection	**0.075**	**0.222****	**-0.059**	**-0.1**	**0.034**	1					
P	0.161	0.000	0.268	0.06	0.53						
Is it safe to drink?	**0.210****	**0.054**	**-0.023**	**0.013**	**0.084**	**0.112***	1				
P	0.000	0.314	0.66	0.808	0.116	0.035					
If No, do you treat your drinking water	**0.201****	**0.164****	**-0.019**	**-.116***	**0.039**	**0.136***	**0.172****	1			
P	0.000	0.002	0.723	0.029	0.470	0.011	0.001				
Education and awareness on clean water.	**0.310****	**0.123***	**0.001**	**-0.314****	**0.011**	**0.097**	**0.175****	**0.159****	1		
P	0.000	0.021	0.987	0.000	0.832	0.069	0.001	0.003			
Children most affected.	**-0.075**	**-0.002**	**0.055**	**0.019**	**0.037**	**-.164****	**-0.083**	**0.012**	**-0.02**	1	
P	0.162	0.967	0.300	0.721	0.494	0.002	0.118	0.819	0.706		
Elders difficult to get clean water	**-0.109***	**-0.124***	**-0.04**	**0.108***	**-0.086**	**-0.064**	**0.044**	**-0.012**	**0.058**	**0.425****	1
P	0.04	0.019	0.459	0.042	0.106	0.232	0.413	0.821	0.276	0.000	

**Correlation is significant at the 0.01 level, * significant (P) at the 0.05 (2-tailed); Bolded correlation number

This indicates that the frequency of child illnesses brought on by contaminated water rises in tandem with the difficulties reported (UNESCO, 2022); older people face getting access to clean water (Wrisdale et al., 2017). It highlights the connection between water access and public health across age groups by implying that challenges faced by one group may increase health concerns for another. The correlation analysis results have many implications for community actions and policy, including investing in educational initiatives to raise awareness of safe water practices and facilitate access to higher-quality water sources. Hugho et al. (2024) reported that the community's understanding improved after COVID-19 and excellent personal hygiene. Encouraging water treatment and raising water safety awareness can significantly improve public health, especially for vulnerable populations like children and older adults. Reducing the time spent fetching water through infrastructural improvements can lessen burdens on families, primarily women, and children; the findings are similar to a study (Rwehumbiza & Hyun, 2024) that reported using filters to get clean water.

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

Understanding how social factors affect access to clean water in the Kikwe ward is crucial for improving public health and supporting fair development. Issues such as gender roles, age, education levels, unequal access to water sources, and limited community involvement have a direct impact on who gets clean water and who do not. These challenges highlight the need to consider the daily realities of individuals and households when planning water access

solutions. Recognizing and addressing these human-centered challenges can lead to healthier communities and more equal opportunities for all.

5.2 Recommendations

To improve clean water accessibility for residents of Kikwe ward, several key actions are necessary. First, community-based education and awareness campaigns should be introduced to promote safe water practices and encourage gender-neutral shared responsibility in water collection and use. Additionally, local water systems need to be upgraded and expanded using practical and affordable technologies tailored to the specific needs of the community. Active involvement of residents especially women and vulnerable groups in the planning and management of water resources is essential to ensure inclusive and sustainable solutions. Strong collaboration between local authorities, public services, and development partners is also crucial for building and maintaining reliable water infrastructure. Finally, increased government commitment is needed to ensure fair and consistent access to clean water for all households, both now and for future generations.

Conflict of Interest

No conflict of interest.

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