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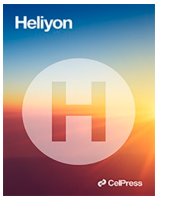

Research article

The implication of water accessibility challenges to urban water governance in Morogoro municipality, Tanzania

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ABSTRACT

This study investigates water accessibility challenges in urban and peri-urban areas and its implication to urban water governance in Morogoro Municipality, Tanzania. A cross-sectional research design was adopted using a survey of 90 randomly selected households. The key informant interview was used to collect key information. Quantitative data were analyzed using descriptive statistics. The Mann-Whitney *U* Test was employed to establish the extent to which factors affected water accessibility differently in urban and peri-urban areas. Content analysis was used to analyse qualitative information. Approximately 69% of the respondents accessed water from public piped water system. Some accessed water from public water taps while others used private boreholes and tank carts. Water supply, more so in peri-urban areas, was not reliable. In addition, water leakage, cost of connecting to the public piped water system, cost for constructing a borehole, climatic and environmental factors piled up into challenges of water accessibility suggesting poor urban water governance. The Mann-Whitney *U* Test showed that households in peri-urban areas were significantly affected by the challenges compared to households in urban areas at 5% level of significance where $p = 0.000$. The study concludes presence of challenges in water access due to multiple factors with implications on urban water governance. Therefore, urban water governance should be improved to heighten water accessibility. Further studies should focus on developing an urban water governance framework in Tanzania.

1. Introduction and background information

Water resource has multiple competing uses including drinking, washing, cooking and sanitation. Being a natural resource, water is one of the fundamental pillars of people's livelihood principally unavoidable in agricultural production, both rain-fed and irrigated agriculture. Industries, which are key for development at global, regional and national levels, depend on water for power generation, more so in developing countries like Tanzania where alternative energy sources are limited. In addition, quality health and control of diseases are anchored on access to safe and clean drinking water. The power of water to control diseases is for example predominantly demonstrated by governments' interventions to control the recent COVID-19 pandemic. This implies that water is life, and human development is hardly achieved under water crisis conditions.

The Sub-Saharan African (SSA) countries including Tanzania are blessed with existence of huge water bodies including oceans, lakes, rivers, streams and dams. Despite the existence of the natural and man-made water bodies and their importance attached to the human development, urban areas in SSA have serious challenges of accessing reliable, clean and safe water for domestic use [1–3]. There are also serious water inequalities in the region with their roots dating back to the colonial epoch when there was bias against

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supplying water to informal settlements particularly where Africans lived [3]. In addition, water quality is also an issue of concern in SSA [4]. Available studies uphold authors' disagreement on what is the suitable definition of water access. Some writers like [5] succinctly argue that water access encompasses a proportion of a population using an improved drinking water source that is protected from outside contamination. Although this definition has been criticized [6] with an argument that an improved water source does not always mean clean and safe water, this study adopted it because it is the one used to track progress of water supply and access in Tanzania. Other authors like [6] are of the opinion that a proper definition of water access should not only capture an improved water source but also reliability of the water source that supplies adequate quantity and quality water. Other authors including [7] argue that the definition of water access should also capture actual use of water.

Elsewhere in the world, research focuses on access to clean and safe drinking water. Nonetheless, 36% of the world population lives under water crisis conditions [8]. The United Nations [9] shows that out of 8.045 billion people in the world, 27% access water for domestic use from unimproved sources. Nearly half of this comes from SSA [10]. Nevertheless, different authors present different figures of water access sources vindicating that data are not reliable in the region. For example, in 2018, the World Bank published that 44% of the population in SSA accessed drinking water from unimproved sources [11]. In the same year [12], showed that 32% of the people in the region depended on unimproved drinking water sources. Despite the confusion featuring out of extant data, it is undebatable that a significant proportion of the population in SSA does not have access to clean and safe drinking water. Water access inequalities in urban, peri-urban and rural areas exacerbate the problem. For example, some pockets in urban, peri-urban and rural areas have absolutely no access to improved drinking water sources in the region [1]. This definitely goes concurrently with poor sanitation. The poor and vulnerable communities are more affected than the non-poor [13,14]. This poor water accessibility is likely to worsen by 2050 [9] if governments do not take concerted and coordinated efforts to rectify the situation.

Authors concur that the crisis of water access at different levels is a question of water governance [15], which is increasingly becoming one of the major determinants of water access. With that, literature on urban water governance has increasingly grown in the previous two decades [15]. Some authors like [16] talk of water governance in cities. Others including [15] talk about urban water governance. According to Ref. [17], urban water governance is a system of social practices working together with social structures to manage water resource. Social practices are guided by patterns of behaviour. Another most cited definition is one developed by the Organization for Economic Cooperation and Development (OECD) [18], which considers water governance, urban water governance inclusive, as one that encompasses formal institutions–laws and policies–and informal institutions principally power relations and practices. This study adopted the OECD definition and it is guided by a research question: what factors explain water access challenges in Morogoro Municipality? The study contributes to the literature in understanding water access and factors that explain access to water, for domestic use, from improved water sources in urban and peri-urban areas. The study is fundamental as it addresses the challenges of water accessibility within a specific African context, where urban water governance issues and socio-economic disparities exacerbate the problems of access to clean water. This adds value to the global understanding of water governance in different socio-economic and geographical regions. Having discussed about an introduction and background information, the next section reviews previous studies dwelling on trends in water supply options and policy-legal institutional challenges explaining water accessibility in urban Tanzania.

2. Trends in water supply options for domestic use

Authors including [13] summarize four water provision options. The first one is public option. This is when water services are fully provided by a government. In this arrangement, water is considered both a human right and a social good. The second option is private when water is fully provided by the private sector. This arrangement considers water as an economic good or a commodity, and water users have to pay for the service. The third option is private-public partnership under which governments work with the private sector in providing water services to the citizens. In this case, water is considered both an economic good and a renewable natural resource. The last option is cooperative, which considers water a socio-ecological good, an economic good and a renewable natural resource.

Literature shows that there have been changes in water provision options in the global South alongside transformation in development ideology [10]. Which option works better than the other ones, depends on the context and governance of the water sector. For example, an attempt to privatize water supply in Dar es Salaam, the biggest city in Tanzania, ended up with poor water access to the city dwellers in the neoliberal era and so necessitated bouncing back to the public water service delivery or at least public-private partnership [3]. Other developing countries like Nicaragua and Uruguay have absolutely banned privatization of drinking water supply, and some developed countries like the Netherlands have done the same [13], implying that private option alone is fruitless.

After political independence in the 1960s, most countries in the SSA region adopted a state-led urban water supply system, which does not consider water users as actors in water supply. Therefore, designing, construction, operation, management and financing of water facilities was absolutely under control of national governments [10]. This approach failed and so, informed by the neoliberal ideology, triggered reforms in the water sector in the 1990s that introduced the private sector in order to unquestionably improve efficiency, effectiveness and sustainability of water supply interventions. The neoliberal ideology came with community participation through, among other things, cost sharing arrangement that requires water users to pay water charges for the service. Therefore, the water resource changed from a public to a private good. Regrettably, the private sector is not performing as expected in countries like Tanzania [10]. Thus, further reforms have decentralized water supply, re-emphasizing active community participation through community-based water projects [19,20].

Table 1
Development ideologies, water governance and supply options in Tanzania.

Period	Development ideology	Governance, water supply and access
1890s-1961	Colonialism era	• Clean and safe drinking water was supplied in urban areas where Europeans lived, water service provision being unequal • Rural areas were marginalized
1967–1985	Socialism and self-reliance period	• Water was managed under colonial Water Ordinances of 1959 from 1961 to 1974 • Establishment of the National Urban Water Supply Act of 1981 • Establishment of the Water Resources Utilization (Control and Regulation) Act of 1974 • Free water for all policy implemented in the 1970s • The national government provided water without involving citizens; there was lack of community participation in drinking water provision • Water was considered a public good • Supply of water included rural areas, and access to water improved a bit but not within 400 m as recommended by the rural water supply programme of 1971–1991
Mid-1980s–1990s	Decade of Structural Adjustment Programmes	• Privatization of water provision • Water policy development of 1991 – full private sector involvement • There was emphasis on participatory planning and cost sharing with beneficiary communities, but not bearing the full cost of water supply • The government became the regulator of water provision by regulating tariffs and subsidy; this did not work as expected in urban areas hence urban water supply and access worsened
1990s–2000s	Transition period and neoliberalism epoch	• Decentralization of water supply to urban water authorities • Establishment of public-private partnership in water supply • The government was seen as a facilitator, regulator and promoter • Aimed at universal metering in urban areas
2000s to date	Development strategies and programmes era	• Development of the National Water Policy of 2002 • Establishment of the Water Resources Management Act No. 11 of 2009 that repealed the Water Resources Utilization Act of 1974 • Establishment of the Water Supply and Sanitation Act No. 12 of 2009 that also repealed the Water Resources Utilization Act of 1974 • Establishment of the Water Supply and Sanitation Act No. 5 of 2019 • Emphasis on community-based water projects • Emphasis on multi-stakeholders' participation in water provision • Implementation of the water sector development programme 2006–2025 • Access to improved water sources increased compared to other development epochs. However, more work needs to be done in urban and rural Tanzania to eliminate inequalities in water access

Source: Summarized from [21–23].

2.1. Transitions in water supply and access: Policy-legal and institutional framework in Tanzania

Water access is possible when water is adequately available and has been supplied to the households. In the colonial era, urban water supply concentrated in areas where Europeans lived. Therefore, only areas where missionaries lived accessed water supply from improved sources. Africans accessed water for domestic use from unimproved sources like rivers and streams. In the post-independence epoch, especially in the socialism and rural development era, which was proclaimed as part of the Arusha Declaration in 1967, the national policies targeted to provide free drinking water to all citizens to counteract the urban bias that had been lingering on since the colonialism era [21]. Table 1 summarizes transitions in water supply and access regulations in Tanzania.

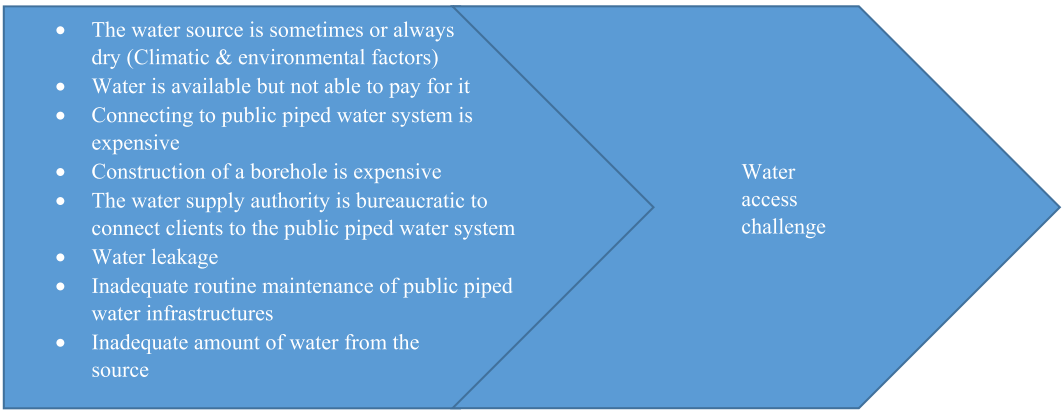

Fig. 1. Water accessibility challenges in urban Tanzania (Authors' construction).
Source [2,9,10,13,21,22,30]:

The water policy of 1991 hardly improved the situation in urban water supply and access. The changes in development ideology from socialism to neoliberalism triggered review of the water policy to formulate the National Water Policy (NAWAPO) of 2002 that accommodated global level development and ideological changes in the water sector like re-emphasizing on cost sharing that was re-introduced in the mid-1980s and also was practised during the colonial period [23]. The NAWAPO also re-introduced community participation in the water sector [22], to address three key issues: water resources management, rural water supply, and urban water supply and sanitation, implying Tanzania government's commitment in ensuring water supply and accessibility in urban and rural areas. While the international target is to achieve water access and sustainable management of water and sanitation for all by 2030; Tanzania, through the NAWAPO, targets universal access to clean and safe drinking water in urban areas and 90% access in rural areas by 2025 [9,23]. To achieve that target, the commitment of the multi-stakeholders' participation is over emphasized such that it practically does not match with the reality in the country.

In addition to the NAWAPO, regulations and water Acts, water supply in the current era of development strategies and programmes is guided by the Water Supply and Sanitation Act No. 5 of 2019 (Table 1). This policy-legal framework aims at improving clean and safe drinking water access targeting sustainability, effectiveness and efficiency. In urban Tanzania, water supply and sanitation is under control of the Water Supply and Sanitation Authorities (WSSAs), established by the government through the Ministry of Water. Operationalization of the Water Supply and Sanitation Act No. 5 of 2019 and its regulations is detailed in the Water Supply and Sanitation operational guidelines, developed in 2022 [24]. Briefly, the Water Supply and Sanitation Authority has three levels: The Ministry of Water, Board of Directors, and management headed by the managing director.

Unlike in urban Tanzania where water for domestic use is, by law, supplied by the Water Supply and Sanitation Authorities, water supply in rural Tanzania is under the custodian of the Rural Water Supply and Sanitation Agency (RUWASA), established under the

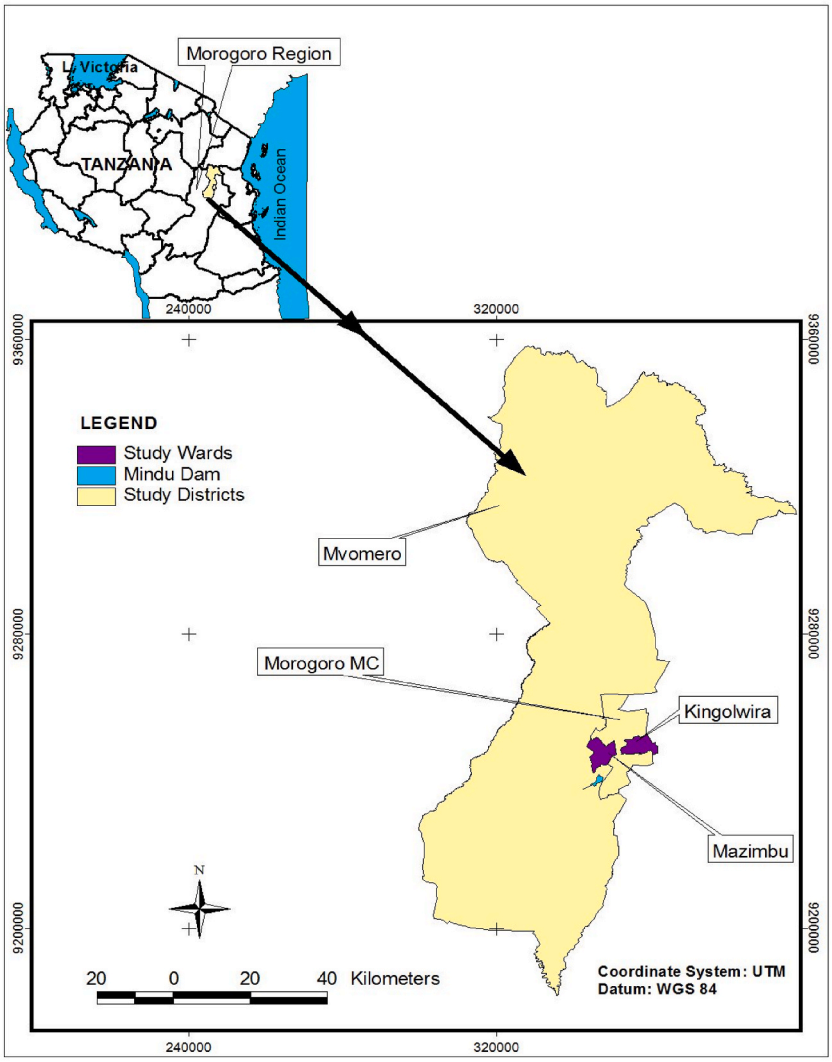

Fig. 2. The study sites.
Source: Author's construction

Water Supply and Sanitation Act No. 5 of 2019. The core functions of the agency are twofold: first, establishment of water supply and sanitation projects in rural areas and ensuring sustainability of the projects. Second, the agency ensures provision of water supply and sanitation services in rural Tanzania [25]. RUWASA delegates its responsibilities to Community Owned Water Supply Organizations (COWSOs), recently transformed into Community-Based Water Supply Organizations definitely to improve governance.

Despite a clear policy-legal and institutional water supply and access framework in Tanzania, studies like one by Ref. [10] have reported unjust, inequitable and uneven water access between rural and urban areas and also within urban areas in Tanzania. A considerable proportion of urban dwellers access drinking water from informal water providers whose water quality is questionable, and water is available at a relatively higher cost than that available through public piped water networks. This has two implications: first, it implies ineffectiveness of urban water governance, and second it shows a public and private water provision model, which is not working appropriately. Impliedly, the universal access to clean and safe drinking water in urban Tanzania and 90% in rural Tanzania by 2025 is increasingly becoming questionable. For example, official statistics show that in June 2020, the water supply coverage in urban areas stood at 84%, and it was 70.1% in rural Tanzania [26]. This implies that between 16 and nearly 30% of the population in Tanzania access water for domestic use from unimproved sources in urban and rural areas respectively. Disparities are also lingering, with some urban areas accessing public piped water 24 h a day while others cannot see a drop of water in a month and others completely not connected to the public piped water system [27–29]. It is from curiosity, this study examined factors explaining water access challenges in Morogoro Municipality, whose population is growing at 3.7% higher than 3.2% at the national level [24].

2.2. Water accessibility challenges: the conceptual framework

The challenge of access to clean and safe water for domestic use is attributed to many factors including limited governments' capacity to expand and maintain public piped water infrastructures [2,10,13,21,22]. Competing uses of water, climatic and environmental factors [9], population growth, pollution and water quality, poor allocation and distribution of water exacerbate the problem and thus causing inefficient, unaffordable and unsustainable water accessibility to all citizens as summarized in Fig. 1.

Based on Fig. 1, this study grouped the factors explaining water accessibility challenges into three major categories. One is poor urban water governance, explained by the limited capacity and bureaucracy of the Morogoro Water Supply and Sanitation Authority (MORUWASA) to connect households to the water supply system. Others include poor routine monitoring of the piped water system and maintenance, which may result into serious water leakages. The second category of factors is climatic and environmental factors. This includes drought, causing fluctuation of water from the source particularly during dry seasons. Environmental factors, mainly soil erosion and sedimentation, contribute to reducing size of the water source that in turn may cause inadequate amount of water supply [31]. Another category of factors is socio-economic condition of the households. For example, the low income households hardly pay for expensive utilities like water. Expensive installation costs for public piped water system and boreholes aggravate the problem causing challenges in access to water supply. Having discussed previous studies about urban water governance in the introduction, background and literature review sections, the next section dwells on the methodology including context of the study area.

3. Methodology and context of the study area

This section describes methodology employed in this study. It begins by describing the study area and its context followed by research design, sampling, data collection, and analysis techniques. The study was conducted in Morogoro Municipality, one of the typical urban areas of Tanzania (Fig. 2). Data were collected between May and June 2023 from two purposefully selected wards out of 29: Mazimbu Ward represented urban areas whereas Kingolwira Ward represented peri-urban areas. Table 2 shows population characteristics of the wards involved in the study [32]. The purposive sampling technique was employed to select an urban ward that is well connected with the public piped water system. Thus, Mazimbu Ward was selected to represent urban wards because it is one of the wards that are well connected with public piped water system compared to the wards that are increasingly becoming urbanized like Kihonda Ward. The same technique was used to select a peri-urban ward where some households are connected while others are not, in order to assess other drinking water sources. The fact that respondents were randomly selected, the two wards categorically represented each category of the wards in the urban and peri-urban areas.

Studies on access to clean and safe drinking water in urban Tanzania including ones by Refs. [1,27–29,33] principally focus on the biggest city, Dar es Salaam, leaving out other urban areas and municipalities that possibly experience challenges in access to water for domestic use because of different factors shown in Fig. 1. For example, in Morogoro Municipality, about 75% of the population depends on the Mindu Dam for water supply. The dam is also critical for freshwater fishery production in urban and peri-urban areas of the municipality. Nonetheless, literature shows mixed results about quality of water from the Mindu Dam. For example, a study conducted in the previous decade shows insignificant pollutant levels in the water, sediments and fish from the dam [34]. This vindicates that the public health for the urban dwellers who depend on water supply from the Mindu Dam is not at risk. However, recent

Table 2
Population variables in the selected wards.

Ward	Total population	Female (Per cent)	Number of households	Average household size
Mazimbu	19,499	52.8	6101	3.2
Kingolwira	15,823	52.4	4547	3.5

Source: United Republic of Tanzania [24].

studies including [31,35,36] demonstrate eutrophication due to high concentration of nitrate and phosphate despite efforts done by the water supply and sanitation authority to improve water quality [30]. Similarly, studies including [35,36] confirm brownish water colour because of soil erosion and sedimentation that are also attributed to a decreasing water level over time. This is not good news because eutrophication may negatively affect public health while decreasing amount of water in the reservoir translates into water accessibility challenges.

3.1. Research design, sampling and data collection techniques

The study used cross-sectional research design with a survey method to collect data. This research design enabled assessment of an existing situation of the selected variables in the study sites (Fig. 1), while the survey method enabled establishment of relationship between the variables using statistical analysis techniques to enhance academic rigor of the study. Forty-five (45) households were randomly selected from urban and peri-urban areas, making a total sample size of 90 households. The sub-sample in each ward was above the 30 minimum cases recommended in the literature by Refs. [37,38] as adequate sample size for statistical analysis. The fact that respondents were randomly selected, it was economical to adopt a minimum sample size regardless of the village sizes to avoid unnecessary wastage of time and other resources likely to occur when proportionate sampling techniques that could consider size of a village as a stratum, was adopted. Therefore, the 45 cases were adequate to make statistical inferences and arrive at a reasonable conclusion. In addition to the survey method, the study employed key informant interviews to collect qualitative data. A total of three key informants were interviewed, one from Morogoro Water Supply and Sanitation Authority (MORUWASA) and one from each ward. Mixing quantitative and qualitative methods for data collection provided a comprehensive view of the research issue. The approach was pertinent for collecting information including amount of water supplied from the source, water demand, and amount of water that reached the clients. This helped to understand whether or not there was water leakage in the public piped water infrastructures implying challenges in accessing the water from the source.

3.2. Data analysis techniques

Descriptive statistics was used to compute percentage distribution on agree and disagree categories that enabled comparison of responses on the extent of factors explaining water accessibility challenges between urban and peri-urban areas. With SPSS version 21, the Mann-Whitney *U* test was used to compare the differences in the total scores on water accessibility between urban and peri-urban areas at 5% level of significance. This non-parametric test was used because the study used ordinal data. Non-parametric tests compare median based on the mean ranks, not means as it is for parametric statistical tests like the independent samples *t*-test [39]. According to the literature including [40], ordinal data are appropriately analyzed using non-parametric tests like the Mann-Whitney *U* test when comparing two independent groups, in this case, urban and peri-urban groups. This statistical test does not require stringent normality distribution assumptions from where the sample was drawn.

The study hypothesized that there was no difference in water accessibility challenges between households in urban and peri-urban areas. The Mann Whitney *U* test is an alternative statistical test for an independent samples T-test, a parametric test, which is used when data are normally distributed. Therefore, normality distribution tests like Shapiro wilk test and Levene's test could be

Table 3
Respondents' socio-economic and demographic characteristics (n = 90).

Relationship with the household head					
Location	Head	Spouse	Son	Daughter	Tenant
Urban	14(15.6)	2(2.2)	15(16.7)	6(6.7)	8(8.9)
Peri- urban	15(16.7)	25(27.8)	2(2.2)	3(3.3)	0(0.0)
Total	29(32.2)	27(30.0)	17(18.9)	9(10.0	8(8.9)
Respondents' age					
Location	20–30	31–40	41–50	51–60	61–70
Urban	28(31.1)	5(5.6)	5(5.6)	5(5.6)	2(2.2)
Peri-urban	24(26.7)	15(16.7)	4(4.4)	1(1.1)	1(1.1)
Total	52(57.8)	20(22.2)	9(10)	6(6.7)	3(2.2)
Marital status					
Location	Married	Divorced	Separated	Never married	Widow
Urban	15(16.7)	2(2.2)	3(3.3)	24(26.7)	1(1.1)
Peri-urban	33(36.7)	2(2.2)	3(3.3)	6(6.7)	1(1.1)
Total	48(53.3)	4(4.4)	6(6.7)	30(33.3)	2(2.2)
Respondents' education level					
Location	Primary	Secondary	Tertiary		
Urban	4(4.4)	14(15.6)	27(30.0)		
Peri-urban	20(22.2)	23(25.6)	2(2.2)		
Total	24(26.7)	37(41.1)	29(32.2)		
Respondents' sex					
Location	Male		Female		
Urban	30 (33.3)		15 (16.7)		
Peri-urban	9 (10.0)		36 (40.0)		
Total	39(43.3)		51(56.7)		

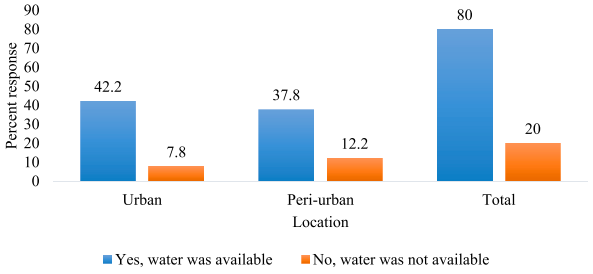

Fig. 3. Percentage responses on water supply and accessibility.

appropriate if the data were measured at a ratio level. In addition, cross tabulation was done to establish differences in which each factor explained water access in urban and peri-urban areas. The analysis of qualitative data was done through content analysis. A combination of quantitative and qualitative data analysis techniques provided a comprehensive view of the research issue and hence methodological rigor for the study.

3.3. Limitations of the study

The fact that the study adopted the cross-sectional research design, and that data collection took place towards the end of a wet season in May 2023; did not capture water accessibility challenges based on wet and dry seasons. Climatic, environmental and socio-economic factors also did not consider seasonal variations. In addition, funding constraints limited coverage of the study area. Therefore, although the study exemplifies academic rigor in terms of the methodology, the results may not be generalised across the municipality, in different municipalities in Tanzania and also across seasons in a year. The next section presents and discusses the results for this study. The paper ends up by providing conclusions and policy recommendations.

4. Results and discussion

4.1. Respondents' characteristics

Table 3 shows socio-economic and demographic characteristics of the sample involved in the survey. The number of female (56.7%) was slightly higher than the male respondents, and the majority were either spouses or heads of household. Other household members who responded to the questions were sons, daughters and tenants. In terms of age, 80% fell in the age group between 20 and 40 years. Combining primary and secondary education levels accounted for 67.8%, and 53.3% of the respondents were married. These statistics imply that the sample used in this study involved mature people with possibly responsibility to fetch drinking water at a household level.

4.2. Water supply and accessibility in the previous seven days

The study shows that water was accessible to 80% of the households in the previous seven days from date of the interview (Fig. 3). However, this does not mean continuous water supply per day in the study area. Exactly 20% of the respondents did not access water in the previous seven days more so in the peri-urban ward (Fig. 3). The results suggest intermittent water supply and access in the study wards, particularly from public water supply infrastructures. This was more prominent in peri-urban than urban areas (Fig. 3). Therefore, to survive, some households in urban and peri-urban areas used alternative sources of water supply in addition to the public water supply system under control of the Morogoro Water Supply and Sanitation Authority (MORUWASA). This is also interpreted that urban and peri-urban households needed a mechanism for water storage to be used when water was not supplied through public piped water infrastructures. Regrettably, water from storage devices has been confirmed to be contaminated with *E. coli* in the municipality that affects water quality [41]. The results are in line with the Millennium Challenge Corporation [41], which is of the view that in

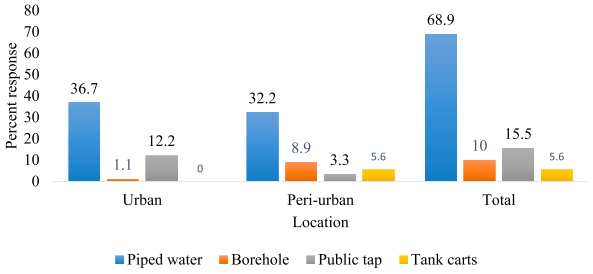

Fig. 4. Percentage responses on sources of access to water resource.

Table 4
Factors explaining water accessibility (n = 90).

Variables	Urban		Peri-urban		P-value
	Agree	Disagree	Agree	Disagree	
The water source is sometimes dry	37(41.1)	8(8.8)	44(48.8)	1(1.1)	0.032
The water source is always dry	10(11.1)	35(38.8)	21(23.3)	24(26.6)	0.051
The water is available but I am not able to pay for it	13(14.4)	32(35.5)	34(37.7)	11(12.2)	0.000
Connecting to public piped water system is expensive	42(46.6)	3(3.3)	42(46.6)	3(3.3)	0.132
Construction of a borehole is expensive	42(46.6)	3(3.3)	45(50)	0(0.0)	0.083
MORUWASA is bureaucratic to connect clients to the public piped water system	37(41.1)	8(8.8)	44(48.8)	1(1.1)	0.004
Water piped system infrastructure is poor causing leakage of water	43(47.7)	2(2.2)	41(45.5)	4(4.4)	0.529
Inadequate routine maintenance of public piped water infrastructure	44(48.8)	1(1.1)	45(50)	0(0.0)	0.499
Inadequate amount of water from the sources	37(41.1)	8(8.8)	43(47.7)	2(2.2)	0.112

Note: Numbers in brackets are percentages.

2015, water supply per day in Morogoro Municipality was 8 h after it decreased from 15 h in 2013. This implies that even in places where water was available during data collection for this study, it was not necessarily accessible for a period of 24 h. Sporadic water supply is common in urban and cities in the global South [2].

The question of water access for domestic purposes in urban areas is inseparable to water supply because in order to access the water, first it has to be supplied and available. The results of this study show that 94.4% of the respondents accessed water for domestic use from improved sources including water pipes, boreholes, and public tap (Fig. 4). This per cent is higher than 87.8% recorded at the national level in 2020 [25]. Nearly 69% of the respondents were connected to the public piped water system and therefore accessed water supply from the public water supply infrastructures (Fig. 4). This means that the piped water supply was the leading water source in the study area. The results showed that, although not yet achieved, there was good progress in line with the long-term policy-legal target of accessing drinking water within 400 m in Tanzania [25]. Another public water source was public tap, while private sources included boreholes. Tank carts were only available in peri-urban areas (Fig. 4). Unlike in urban areas where tank carts were not reported, 5.6% of the respondents accessed water through tank carts in peri-urban areas, justifying intermittence of water supply or some households were not connected to the public water infrastructures in peripheral areas of the municipality.

Inequalities in water supply and access are common in urban areas in the global South where some households access water from public piped water system, while a considerable proportion of the population purchases water for domestic use from private vendors at a higher cost than that for public piped water [1,29]. This inequality triggers stealing of water from public water connections [1], implying poor urban water governance. Data from key informants showed that households connected to the public piped water system paid TZS 1600 per unit of water equivalent to 1000 L of water or TZS 1600 per cubic metre. This charge was in line with MORUWASA tariff adjustment order of 2019 [42]. In addition, the key informants noted that some households in the peri-urban ward purchased water from neighbours who were connected to the public piped water system. The price of water ranged from TZS 100 to 500 per 20 L of water, and so was very expensive compared to water charges collected by MORUWASA from households connected direct to the public piped water system.

4.3. Water accessibility challenges

Informed by the conceptual framework for this study, the variables that explained water accessibility challenges are shown in Table 4. Overall, the results show multiple factors including high installation cost for the public piped water system. This, according to the key informants, was aggravated by high labour charges paid by the clients on cost-sharing arrangement between households and the water supply authority, in this case MORUWASA. In the views of the key informants, bigger pipes were positioned by MORUWASA up to about 100 or 150 m away from a household, households paid for the cost of small pipes from where MORUWASA ended to the household. The key informants showed that the households paid between TZS 300,000 and 450,000 to get connected to the public piped water infrastructures. This includes cost for the pipes and everything required for the connection. There was also a question of the water supply authority being bureaucratic to get households connected to the public water system more so in the peri-urban areas

Table 5
Mann-Whitney U Test results comparing factors in urban and peri-urban (n = 90).

Variable	Water accessibility
Mann-Whitney U	1441.000
Wilcoxon W	2476.000
Test Statistic	1441.000
Standard Error	122.637
Standardized Test Statistic	3.494
Mean rank in urban areas	35.98
Mean rank in peri-urban	55.02
P = value	0.000

at p = 0.004 (Table 4). The cost sharing arrangement came with the neoliberal development ideology in utilities including water service [10]. Although the cost sharing is important for households to participate in water resource management, it was a serious concern in the study area, particularly among low income peri-urban households. Even when the water was available 34 out of 45 households in the peri-urban ward hardly afforded for the water charges to access the water because they perceived it was expensive for them. There was significant difference between urban and peri-urban households in affordability to pay for the water charges at p = 0.000 (Table 4), implying that urban households were able to pay for the water charges compared to peri-urban households possibly those who purchased water from households connected to the public piped water infrastructures.

Similarly, households perceived high cost for constructing a borehole well (Table 4). Based on the views of the key informants, the cost ranged from TZS 5 to 15 million. Literature shows that 75% of the population is connected to the public piped water system in the Morogoro Municipality [34,30], implying that close to 30% of the households are not connected. This proportion of the population is likely surviving through different strategies like borehole wells, reserve tanks, buying water from vendors, buying or begging water from neighbours, and illegal water connections and stealing [1].

Leakage of water from the main supply to the households and lack of maintenance of the public piped water infrastructure (Table 4) also explained water accessibility challenge. Maintenance of the water pipes supplying water to the households was left to the hands of the clients as an element of cost sharing while the water supply authority provided expertise. Nonetheless, monitoring of water infrastructures was inadequate such that the water supply authority hardly identified areas with water leakage until it was informed by the clients affected by the leakage. In case no one was affected, leakage continued for a very long time. For example, information from key informant at the water supply authority showed that the amount of water supplied from the Mindu Dam was 35,000,000 L/day while water demand was 67,086,000 L/day. The amount of water received by clients was nearly 70% of the total water supplied, implying that about 30% of the water supplied got lost along the way through leakages. In Dar es Salaam, Tanzania, leakage stands at 55% [23], indicating that the problem is prevalent in urban Tanzania. This also implies not only loss of revenues collected by the water supply authorities but also loss of the public money spent to supply water, which does not reach the point of destination. This implies poor accountability of the government funds and so poor urban water governance.

Furthermore, climatic factors, particularly drought in some years was reported. Respondents perceived decreasing amount of water from the dam particularly during dry seasons. Households in peri-urban areas perceived occasional dryness of the Mindu Dam compared to households in urban areas (Table 4). This difference was significant at p = 0.032, implying that fluctuation of water in the dam affected more water accessibility in peri-urban households than urban households. However, previous studies, like that of Melchioly [31], are of the view that, in the period of three decades up to 2021, the water level decreasing trend in the Mindu Dam was insignificant, standing at 0.95% per year. Similarly, the decreasing trend in rainfall was insignificant. Therefore, one can argue that, although drought is happening, it does not contribute to a significant water shortage to the extent of affecting water accessibility in the municipality. This can also be interpreted that, although the amount of water in the dam fluctuated depending on seasons it has almost remained the same. This is explained by the changing rainfall pattern such that some seasons experience rainfall above average and sometimes floods while others experience drought. There is also a question of soil erosion and sedimentation, which is very likely contributing to decreasing size of the water reservoir, which in turn may reduce the amount of water in the Dam [34]. This implies that environmental factors are likely to affect water accessibility. However, those changes can be controlled in a situation where institutions, in this case, policies and regulations are working effectively to curb environmental impact.

Putting together all factors that explained water accessibility challenge, urban and peri-urban areas were affected differently. The non-parametric test using the Mann-Whitney *U* test showed significant difference in the mean ranks of the total scores for the factors that explained water accessibility in urban and peri-urban areas at 5% level of significance (p = 0.000). The mean ranks in peri-urban areas were higher than that in urban areas (Table 5). This implies that the factors more affected water accessibility in peri-urban than in urban areas.

5. Conclusions and policy recommendations

The aim of this study was to understand the factors explaining water accessibility challenges in urban and peri-urban areas. The study confirmed challenges in water accessibility from different sources. Majority of the households accessed water for domestic use from public piped water system. Some sources were public taps and boreholes, while water tank carts were only available in peri-urban areas mainly for households that were not connected to the public piped water system that also could not access water from public taps due to intermittent water supply. Some periods absolutely lacked water supply from the public piped water system. Water supply was not continuous throughout the day, more so in peri-urban areas justifying intermittent in water supply. Nonetheless, this did not substantiate an acute water shortage because a lot of water got lost through leakages.

The study categorized factors that explained water accessibility challenges into three major groups: first is climatic and environmental factors that include fluctuation of water from the source during dry seasons. The second factor is poor urban water governance reflected through a number of factors like water leakage, inability to regulate water charges from individual water sellers, poor or no routine maintenance of the water piped system, and bureaucracy and inability of the water supply authority to connect every household with the public piped water system. The last category is socio-economic factors, which encompasses household affordability to pay for water charges and also to pay for connection to the public piped water system. The challenges were more conspicuous in peri-urban than urban households. Combining all the factors implies poor urban water governance. Therefore, the question of poor urban water governance noticeably featured out as a prominent factor that explained water accessibility challenges in the selected urban and peri-urban areas of Morogoro Municipality. In other words, it was a question of poor urban water governance that explained water accessibility challenges in urban and peri-urban areas in the study areas.

Based on the conclusions, the study recommends improvement of urban water governance by developing a policy-legal framework for an effective water supply to address the challenges that piled up into inadequate water accessibility. This is a policy issue that needs high consideration to improve water accessibility to an increasing population in the study area. For example, an improved urban water governance is likely to control water leakage, soil erosion and sedimentation, ensure sustainable water supply and contribute to the increasing revenues collected from water supply. Therefore, institutions; referring here to policy, regulations and bylaws; should be effectively implemented, to improve urban water governance. In addition, as the human population increases while changing rainfall patterns are escalating, expanding the reservoir or constructing another dam to ensure sustainable, effective and efficient water supply is also a policy issue of concern in the municipality. Further studies should focus on developing urban water governance framework for an effective water accessibility.

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Available on request.

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Samwel J. Kabote: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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