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HOUSEHOLD ACCESS AND AFFORDABILITY TO PAY FOR DOMESTIC WATER SUPPLY SERVICES IN SMALL TOWNS IN TANZANIA: A CASE OF SELECTED TOWNS ALONG THE SHORES OF LAKE VICTORIA

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Abstract

Access to potable and affordable domestic water supply is a basic human right. However, in many urban areas in sub-Saharan African countries including Tanzania, many people do not have access to water due to lack of the necessary water infrastructure and inability to afford for the service. The present study examined household access and affordability to pay for domestic water supply services in small towns of Misungwi, Magu and Lamadi along the shores of Lake Victoria in Northwestern Tanzania. Specifically, the study envisaged to: (i) assess the availability of domestic water supply services in the study towns, (iii) determine the level of domestic water consumed by households, and (iii) measure household ability to pay for water supply services. The study used both primary and secondary data of quantitative and qualitative nature, collected through questionnaire survey, key informant interviews, observation and documentary review. Survey data were analyzed for descriptive statistics such as frequencies and means, chi-square tests, one-way analysis of variance (ANOVA) and multiple linear regression analysis whereas qualitative data were analyzed using qualitative content analysis technique. The study found that more than three quarters of households (77%) used improved sources and about one quarter (23%) depended on unimproved sources. Per capita water use was significantly associated with household size, type of water source, waiting time at the source and household monthly expenditure on water services. Further, close to half of the households (48%) were spending more than 5% of their household income on water services. It was concluded that most households in the study towns have limited access to domestic water supply due to low water supply coverage and unaffordability to pay for the services. Thus, interventions to improve access to water supply should focus on water supply infrastructure and household ability to pay for the services.

Key words- domestic water supply, access, affordability, small towns.

I. INTRODUCTION

Water supply is vital for ensuring sustainable economic and social development for human welfare. In 2010, the United Nations General Assembly explicitly recognized access to safe and clean drinking water as a human right and is essential for the realization of many other human rights. Everyone has the right to sufficient, continuous, safe, acceptable, physically accessible and affordable water for personal and domestic use (Garcia-Valinas *et al.*, 2010; Sultana and Loftus, 2012; Kayser *et al.*, 2013; WHO, 2016). A similar logic influenced the inclusion of equitable access to safe and

affordable drinking water in the Sustainable Development Goals (SDG 6), the Millennium Development Goals (MDG 7) and in earlier development initiatives such as the International Drinking Water Supply and Sanitation Decade 1981–1990 and the Dublin Principles of 1992 (Kayser *et al.*, 2013; Masanyiwa *et al.*, 2015).

In 2015, an estimated 91% of the world's population had access to an improved drinking-water source, thus, meeting the MDG 7 target of halving the proportion of the world's population without sustainable access to safe water (WHO, 2016). But this positive overarching picture is misleading: some regions, including sub-Saharan Africa, failed to meet the target (IIED, 2016; WHO, 2016). According to WHO (2016), 663 million people in the world, mostly in sub-Saharan Africa still lack access to safe and clean drinking water. Those who are not connected to the water supply system often resort to purchasing water from independent providers, often at very high prices. And those who cannot afford it, consume unsafe polluted water, which in turn contributes to the spread of water borne diseases including typhoid fever, cholera, dysentery and diarrhea (Prasad, 2006; UNICEF and WHO, 2012; Masanyiwa *et al.*, 2013).WHO (2016) estimates that some 842 000 people die each year from diarrhoea as a result of unsafe drinking water, sanitation and hygiene.

In Tanzania, the 2002 national water policy recognizes access to safe and clean water as a basic need and right for all, and aims to provide adequate, affordable and sustainable water supply services to the population (URT, 2002; 2008). However, as in many other sub-Saharan African countries, many people do not have access to safe and clean drinking water. Statistics show that in 2015, 77% and 46% of the urban and rural dwellers, respectively, in Tanzania had access to safe and clean drinking water (UNICEF and WHO, 2015). According to URT (2015), water supply coverage in urban areas increased from 84% in 2009 to 86% in 2011, maintained up to 2015. However, large disparities still persist between urban and rural areas, with regard to access and quality of water services. Partly because of this, more than 20,000 children die each year in Tanzania due to diarrhea and other water-related diseases(UNICEF and WHO, 2012).

Lack of access to water is, however, not only due to lack of infrastructure, but also to lack of sufficient purchasing power of households to afford access to the service (Garcia-Valinas *et al.*, 2010; IIED, 2016). Studies show that most households in sub-Saharan Africa live on very modest budgets and spend more than half of their resources on food. Even the most affluent households spend about half of their monthly budget on food and that share rises up to 65% among the poorest households (Banerjee *et al.*, 2008). In Tanzania, the 2011/2012 household budget survey found that more than a quarter of the population (28.2%) lives below the basic needs poverty line and 9.7% below the food poverty line (NBS, 2013). This means that poor households are less able to afford water supply services. A recent study by IIED (2016) in Harare, Blantyre, Windhoek and Dar es Salaam concludes that water services for low-income urban communities remain variable and often unaffordable because even where access is provided, costs often remain prohibitive.

Rogerson (1996) contends that one of the principal challenges in domestic water supply is not the technological questions – the 'hardware of water supplies' but the 'software' issues, most notably questions relating to the organisation and financing of water. One key software issue concerns the issue of household affordability to pay for water supplies. Since the Dublin Principles of 1992 that, in part, framed water as an economic good, studies have shown that full cost recovery improves access for those

who can afford to pay, excluding the poor from water provision (Sultana and Loftus, 2012; IIED, 2016). Thus, the 'right' to water is to affordable water, hence, subjective and ambiguous (Masanyiwa *et al.*, 2015).Indeed, as IIED (2016) argues, affordable and easily available water significantly reduces poverty, by saving time and money and improving family health and people's ability to work. That is why 'affordability to pay' or 'ability to pay' for water supply services is a critical issue that warrants investigation. Improved understanding of household's affordability to pay for safe and clean drinking water can help identify the preferred water service level, and help designing appropriate policies for recovering operation and maintenance costs to make water supply systems sustainable (Vasquez *et al.*, 2009; IIED, 2016).

Although affordability as a criterion to measure access to services has been recognized for decades in various global and national water declarations and statements (OECD, 2003; Kayser *et al.*, 2013), information regarding the demand for water by the urban poor, including where they find it, the amount they pay, how and their ability to pay remains relatively scarce. There are very few empirical studies that have explored the level of household income or expenditure that households spend on domestic water supply services. For example, IIED's (2016) study found that low-income urban households in Dar es Salaam and Blantyre spent more than 13% of their income to meet minimal water needs. However, there is paucity of information on access and affordability to domestic water services in other low-income urban areas in the country. To address this knowledge gap and contribute to the academic and policy literature in Tanzania, this paper examines household access and affordability to pay for domestic water supply services in small towns using the cases of Misungwi, Magu and Lamadi towns along the shores of Lake Victoria in Northwestern Tanzania. The specific objectives of the study are threefold: (i) to assess the availability of domestic water supply services in the study towns, (iii) to determine the level of domestic water consumed by households, and (iii) to measure household ability to pay for water supply services.

Theoretically, the paper draws on the equity perspective on access to domestic water supply services. According to Garcia-Valinas *et al.* (2010), equity is often considered as based on two principles: benefit and ability-to-pay principle. On the one hand, the benefit principle requires that different users should pay the same for the same water quantity and quality of water supplied. On the other hand, the ability to pay principle recommends inversely linking water payments to income levels. OECD (2003) states that charges for at least basic water services (including sewerage) should be affordable to poorer water consumers. The implication is that they should not have to pay a disproportionately larger part of their disposable income for water services than better-off water consumers do. Additionally, water tarrifs must simultaneously pursue different objectives: efficiency, cost recovery and environmental protection.

Affordability or ability to pay for water supply services has been defined and measured differently. This study adopts the most commonly used definition by OECD (2003) which defines affordability in terms of the level of prevailing charges for water services in relation to the disposable income of consumers. It is related to consumers' 'ability to pay' as distinct from 'willingness to pay'. Affordability is measured by the ratio of a household's water expenditures to its income (Wang *et al.*, 2010). According to OECD (2003), water consumption expenditures should not exceed a 'burden threshold' of household's total income. Different 'burden thresholds' for different countries and income

groups have been suggested. In general, water price is considered affordable as long as water consumption expenditures do not exceed 3-5% of the household's total expenditure (OECD, 2003; Wang *et al*., 2010). Affordability influences access, and vice versa. If water is priced beyond what a consumer can afford, this excludes him or her from access to the service. The next section describes the methodology of the study.

II. STUDY AREA AND METHODOLOGY

2.1 The Study Area

This paper is based on an empirical study that was conducted in three selected towns of Misungwi, Magu and Lamadi along the shores of Lake Victoria. These towns were selected for the study because have more or less similar characteristics in terms of access to domestic water supply. Domestic water supply is mainly obtained from Lake Victoria; the towns lack water treatment plants, and experience acute shortages of domestic water supply mainly due to low water production and supply compared to the actual demand (COWI, 2015a, b, c; UN Habitat, 2016). Misungwi is one of eight districts in Mwanza Region, which is located along the Mwanza- Shinyanga highway with a population of 30 728 people. Magu township is located 61 km from Mwanza City along the Mwanza-Musoma road and has a population of 23 822. Lamadi is a small but fast growing township in Busega District in Simiyu Region about 70 km from Magu town along the Mwanza – Musoma road. The present population of Lamadi is estimated to be 22 062 people (URT, 2013). Water supply in Misungwi and Magu is managed by category 'C' water utilities: Misungwi Urban Water and Sewerage Authority (MIUWASA) and Magu Urban Water and Sewerage Authority (MAUWASA), respectively. Lamadi town has no water authority since is not a township authority. In this town, water supply is managed by Community Water Supply Organisation (COWSO) and a private service provider known as BIJA.

2.2 Study Design

The study adopted a cross sectional design, using mixed methods of data collection. Data were collected at a single point in time, which is one of the characteristic features of a cross sectional design (Kothari, 2009). Both primary and secondary data of quantitative and qualitative nature were collected so as to adequately address the study objectives. Primary data were gathered from households and key informants including district officials, community leaders and water utilities' officials in the study towns. The household was used as the unit of analysis because it is an arena where much of daily life, including provision of domestic water supply takes place (Niehof and Price, 2001; Masanyiwa, 2014). Secondary data were gathered from relevant documents at district councils and water utilities to complement the primary data.

2.3 Sampling and Sample Size

This study employed multistage sampling techniques using a combination of purposive and random sampling methods. The first stage involved purposive sampling of villages and *mitaa* within the urban centres of the study towns. In Misungwi, the villages selected were Misungwi, Iteja, Ng'wambola, Mapilinga and Nange. In Magu, Ilungu, Kipeja, Isandula 'A', Isandula 'B' and Isandula 'C' while in Lamadi, Kalago, Makanisani, Lamadi and Sokoni were selected. Most of the selected villages and *mitaa* were located along the water supply network from the water intakes to town centres and distribution

tanks. The second stage entailed simple random sampling of at least 30 households within each village/*mtaa* for the survey. Simple random sampling technique was used because itprovides equal chance for households to be involved in the study, thus, reducing biasness and enhancing reliability of the findings (Kumar, 2005).

Since the population of the study towns was large to have an optimum sample size which is manageable and meets the requirements of efficiency, representativeness, reliability and flexibility (Kothari, 2009), a sample size calculator using the Creative Research System (2012) was used to determine the sample size. A confidence interval of 5 was used because the higher the confidence interval the higher the accuracy of the answers to be picked and 95% confidence level was used as is commonly used by researchers (Creative Research System, 2012). Based on this, a sample size of 417 households was selected (Table 1). From each village or *mtaa*, a minimum of 30 households were surveyed, which is a reasonable sample for statistical analysis and comparison across the villages/*mitaa* (Grinnell, 2001).

Table 1: Household sample size

Town	Total Population	Number of Households	Sample size
Misungwi	30 728	5 179	169
Magu	23 822	4 326	121
Lamadi	22 062	5 391	127
Total	76 612	14 896	417

2.4 Data Collection Methods

As indicated earlier, this study used mixed methods of data collection from multiple sources of evidence to get deeper insights and contribute to reliability and validity of the findings. Mixed methods are data collection strategies that combine elements of quantitative techniques such as surveys and elements of qualitative methods such as key informant interviews, either simultaneously or sequentially. This study used the following data collection methods: questionnaire survey, key informant interviews, documentary review and observation.

A structured questionnaire with closed and open-ended questions was used for the household survey. The questionnaire aimed at collecting data on household socio-economic characteristics and access to domestic water supply including the payment arrangements for water services. The questionnaire was designed and inputted into a web based mobile application (Poimapper). Compared to paper work, using the mobile application resulted into more accurate and reliable data, made it faster to train enumerators and data entry was done directly during interviews. Key informant interviews were organized with relevant stakeholders, including ward and *mtaa*/village leaders, district council staff and water utilities officials. Non-participant observation, which involved visiting and observing water sources and intakes, was also used.

2.5 Data Processing and Analysis

Quantitative data collected using the questionnaire survey was exported from the mobile platform application (Poimapper) into the Statistical Package for Social Sciences (SPSS) to make them amenable for analysis. Most of the household survey data were analyzed for descriptive statistics such as frequencies and means. Chi-square tests were used to establish whether there were significant variations

across the three towns on a number of variables. One-way analysis of variance (ANOVA) was performed to compare means on per capita water use, household incomes and affordability to pay for water services, and to determine statistically significant differences across the towns. Multiple linear regression analysis was used to determine the factors associated with per capita water use.

The qualitative data obtained from observation, key informant interviews and the open-ended questions in the questionnaire were transcribed and analyzed using qualitative content analysis technique. This involved transcribing and reading through the field notes and transcripts to identify key themes and patterns relevant to the study objectives and questions. Because quantitative and qualitative data are mutually dependent and tend to complement each other, the presentation and discussion of the findings weaves together the quantitative and qualitative data, as presented in the following sections.

III. RESULTS AND DISCUSSION

3.1 Availability of Domestic Water Supply Services

In this study, domestic water supply was defined as "water used for all usual domestic purposes including consumption, bathing and food preparation" (Howard and Bartram, 2003:2). Consequently, household access to domestic water supply was measured in terms of type of water source, distance and time spent on collecting water. The study findings show that about one third of the households collected water from either protected dug wells (34%) or public taps/stand pipes (31%).A significantly (*p*=0.000) larger proportion of households in Misungwi (62%) obtained drinking water from protected dug wells than in other towns. The main sources of water in Magu were public taps, stand pipes or communal taps (34%) and protected dug wells (31%). In Lamadi, close to two thirds of households (61%) depended on public taps, stand pipes or communal taps, which was significantly (*p*=0.000) larger than in other towns. Household connections were generally few and accounted for only 7%, 10% and 4% of the respondents in Misungwi, Magu and Lamadi, respectively. Water vendors were also an important source of drinking water especially in Magu and Lamadi, each accounting for 5% of the water users in the respective towns (Table 2). This shows that water supply coverage in the study towns in terms of household connections and public stand pipes is inadequate. Thus, households draw water from various sources, some of which are not suitable for drinking and other domestic uses. In fact, the observed lack of access to domestic water supply in the study towns is in part due to lack of the necessary water infrastructure (Garcia-Valinas *et al.*, 2010), as discussed later.

Table 2: Main sources of drinking water for the household (n=417)

Source	Misungwi	Magu	Lamadi	All	Chi-square value
Piped into the house	2(1.2)	3(2.5)	0(0.0)	5(1.2)	
Piped to yard/plot	10(5.9)	9(7.4)	5(3.9)	24(5.8)	
Public tap/stand pipe/communal tap	13(7.7)	41(33.9)	78(61.4)	132(31.7)	
Borehole	16(9.5)	0(0.0)	1(0.8)	17(4.1)	
Protected dug well	105(62.1)	37(30.6)	1(0.8)	143(34.3)	χ^2=209.811
Unprotected dug well	11(6.5)	3(2.5)	3(2.4)	17(4.1)	df = 22
Unprotected spring	7(4.1)	11(9.1)	19(15.0)	37(8.9)	*p*=0.000
Protected spring	1(0.6)	0(0.0)	1(0.8)	2(0.5)	
Rain water collection/harvesting	1(0.6)	0(0.0)	0(0.0)	1(0.2)	
Lake/river/stream	1(0.6)	9(7.4)	13(10.2)	23(5.5)	

Water tanker	0(0.0)	2(1.7)	0(0.0)	2(0.5)
Other sources	2(1.2)	6(5.0)	6(4.7)	14(3.4)

Figures in brackets are percents

To understand the suitability of water from these sources for drinking and other domestic uses, the sources were classified as either 'improved' or 'unimproved'. WHO and UNICEF (2012) define improved drinking water sources that by nature of their construction or through active intervention are protected from contamination, particularly faecal matter. These comprise piped water on premises such as piped household water connection located inside the users' dwelling, plot or yard. Other improved drinking water sources are public taps or stand pipes, tube wells or boreholes, protected dug wells, protected springs and rain water collection. This definition is also used by the Tanzania national water policy (URT, 2002) and national water sector development strategy 2006–2015 (URT, 2008). When this definition was used, it was found that more than three quarters of households (77%) used improved sources and about one quarter (23%) depended on unimproved sources. A significantly (p=0.000) larger majority of households in Misungwi (87%) obtained drinking water from improved sources than their counterparts in Magu (74%) and Lamadi (67%). One in every three households in Lamadi (33%) and slightly over one quarter of them in Magu (26%) relied on unimproved sources mainly unprotected springs, lake, rivers and streams (Table 3). Information obtained from the water utilities in Misungwi (MIUWASA) and Magu (MAUWASA) showed that water supply coverage was 31% and 23% in Misungwi and Magu, respectively. In Lamadi, water supply coverage was estimated at 35%. There were 1263 household connections in Misungwi, 1068 in Magu and 102 in Lamadi. This shows that water supply coverage in the study towns is below the national average for urban areas of 86% (URT, 2015). This could also mean that the substantial proportion of households which rely on unimproved sources are likely to be consuming water which is contaminated, hence, susceptible to water related diseases (Prasad, 2006; UNICEF and WHO, 2012; Masanyiwa*et al.*, 2015). Thus, these findings support earlier arguments that lack of lack of the necessary water infrastructure is one of the reasons contributing to limited access to domestic water supply in the study towns (Garcia-Valinas *et al.*, 2010).

Table 3: Categories of drinking water sources for the household (n=417)

Category of source	Misungwi	Magu	Lamadi	All	Chi-square value
Improved source	147(87.0)	90(74.4)	85(66.9)	322(77.2)	χ^2=17.356
Unimproved source	22(13.0)	31(25.6)	42(33.1)	95(22.8)	df = 2 p=0.000

Figures in brackets are percents

The presence of an improved water source does not adequately measure whether households have access to water. The effort required to fetch water may favour some households and exclude others from using the source. Since most households in the study area did not have household connections, distance and time were used as indicators of the water collection effort. Whereas the national water policy uses the indicator 'within 400 metres' from the household, the commonly used coding bracket is 'within less than 1 km' (MoWLD *et al.*, 2002). In this study, both distances were used to compare with previous studies and ascertain the extent to which the policy target has been achieved. The findings in Table 4 show that more than one third of the respondents (38%) collected water from within 'within 400metres', with a significantly (p=0.000) larger proportion in Lamadi (51%) than in Magu (36%) and Misungwi (28%). More than half of the respondents in Misungwi (53%), about 41% in Magu and 15% in Lamadi walked more than one kilometer to the main water source. This means that most of the

households in the study towns do not access drinking water within the recommended national standard of 'within 400metres' as per the national water policy (URT, 2002).

Table 4: Distance to the main source of drinking water (n=417)

Distance	Misungwi	Magu	Lamadi	All	Chi-square value
0-400m	48(28.4)	44(36.4)	65(51.2)	157(37.6)	
401-1000m	32(18.9)	28(23.1)	43(33.9)	103(24.7)	χ^2=63.478
1001-1500m	31(18.3)	27(22.3)	5(3.9)	63(15.1)	df = 8
1501-2000m	30(17.8)	16(13.2)	3(2.4)	49(11.8)	*p*=0.000
2001-3000m	6(3.6)	2(1.7)	10(7.9)	18(4.3)	
Above 3000m	22(13.0)	4(3.3)	1(0.8)	27(6.5)	

Figures in brackets are percents

In theory, the time spent on collecting water should be closely related to the distance from the source. However, distance does not truly measure the collection effort because in many cases users spend long times on queuing (Thompson *et al*., 2003; Masanyiwa *et al*., 2015). Hence, household respondents were asked about the time it takes on a round trip to the water source. Since most surveys in Tanzania use '30 minutes' as a cut-off point in defining access to improved water source (MoWLD *et al*., 2002; URT, 2007; 2010; 2012). This scenario was also adopted in this study for reasons of comparison. It was found that close to two thirds of the respondents (64%) spent less than 30 minutes. A significantly (*p*=0.000) larger proportion of water drawers in Lamadi (80%) spent less than 30 minutes compared to two thirds (67%) in Magu and half in Misungwi (50%). Few respondents reported to spend more than one hour on a round trip and were mainly found in Misungwi (15%) and Magu (7%) as shown in Table 5.

Table 5: Time to walk to and from the source of drinking water (n=417)

Time	Misungwi	Magu	Lamadi	All	Chi-square value
0-30 min	85(50.3)	81(67.0)	102(80.3)	268(64.2)	χ^2=63.478
31-45 min	37(21.9)	8(6.6)	10(7.9)	55(13.2)	df = 8
46 - 60 min	22(13.0)	24(19.8)	15(11.8)	61(14.6)	*p*=0.000
Above 60min	25(14.8)	8(6.6)	0(0.0)	33(7.9)	

Figures in brackets are percents

Waiting time at the water point, partly because of queuing, was another indicator that was used to measure water access. Thus, respondents were asked to estimate waiting time at the water sources. Overall, close to half of the respondents (48%) spent less than 30 minutes waiting to draw water at the source. Waiting times in Misungwi were relatively short with 63% of the respondents reporting to be spending less than 30 minutes compared to 34% in Magu and 27% in Lamadi. However, more than half (55%) of the water users in Magu and 44% in Lamadi spent more than 60 minutes in queuing. This shows that despite the seemingly short distances and time used for a round trip to water sources, waiting times at water sources were generally high. This was probably due to the limited number of public taps and irregular flow of water at the taps. This increased the water collection effort contributing to limited access to domestic water supply. Spending longer times in fetching water also implies less time for other domestic and productive activities among household members (Thompson *et al*., 2003, Masanyiwa *et al*., 2015).

Table 6: Waiting time at the water source (n=417)

Time	Misungwi	Magu	Lamadi	All	Chi-square value
0-30 min	107(63.3)	41(33.9)	47(27.0)	195(47.8)	χ^2=63.478
31-45 min	16(9.5)	4(3.3)	11(8.7)	31(7.4)	df = 8
46 - 60 min	14(8.3)	9(7.4)	13(10.2)	36(8.6)	*p*=0.000
Above 60min	32(18.9)	67(55.4)	56(44.1)	155(37.2)	

Figures in brackets are percents

3.2 Quantity of Domestic Water Collected

The quantity of water collected and used by households is an important measure of domestic water supply because it depends on accessibility as determined by distance, time, reliability and cost (Howard and Bartram, 2003). There is no universally agreed amount of water required to meet domestic uses and promote good health. However, WHO recommends 20 litres per person per day (World Bank, 2004; IIED, 2016). The national water policy in Tanzania (URT, 2002) recommends a minimum threshold of 25 litres per capita per day (lpcd). Howard and Bartram (2003) propose four 'service levels' instead of a specific quantity of water used: no access (less than 5 lpcd), basic access (unlikely to exceed 20 lpcd), intermediate access (50 lpcd) and optimal access (100 lpcd). In this study, the mean quantity of water collected was 26 lpcd, which was not significantly ($F_{(2,412)}$ = 0.012, *p*=0.989) different between the towns (Table 7). Impliedly, water consumption in the study towns meets both the WHO and Tanzania national water policy minimum thresholds of 20 lpcd and 25 lpcd, respectively (URT, 2002; World Bank, 2004; IIED, 2016).

The findings further show that more than half of the surveyed households (58%) collected 5-20 lpcd, the basic access level. Slightly above one third of households (34%) collected 21-50 lpcd, the intermediate access level, with significantly (*p*=0.003) larger proportions in Lamadi (44%) and Magu (39%) than in Misungwi (23%). It can be argued from these findings that most of the households in the study towns were only able to meet the basic access, which according to Howard and Bartram (2003), can ensure consumption and food preparation needs but inadequate to meet hygiene uses including hand washing, bathing and laundry. Few households met the intermediate and optimal levels of access, which enabled them to consume enough water in quality and quantity to guarantee healthy conditions (Howard and Bartram, 2003; Garcia-Valinas *et al.*, 2010; Kayser *et al.*, 2013).

Table 7: Quantity of water collected by households (n=417)

Service level	Misungwi	Magu	Lamadi	All	Chi-square value
Less than 5 lpcd	2(1.2)	2(1.7)	0(0.0)	4(1.0)	
5-20 lpcd	116(69.5)	60(50.0)	63(49.6)	239(57.7)	χ^2=19.956
21-50 lpcd	39(23.4)	47(39.2)	56(44.1)	142(34.3)	df = 6
51-100 lpcd	10(6.0)	11(9.2)	8(6.3)	29(7.0)	*p*=0.003
Mean	26.3	26.5	25.9	26.2	

Figures in brackets are percents

Further analysis using multiple linear regression showed that per capita water use was significantly associated with household size, type of water source, waiting time at the source and household monthly expenditure on water services (Table 8). For example, an increase in one unit of household size significantly (*p*=0.000) reduced quantity of water collected by 2.644 units. Drawing water from improved sources significantly (*p*=0.030) increased the possibility of collecting large

quantity of water by 9.276 units. This means that drawing water from improved sources increased the chances of meeting household water requirements. Although not significant, an increase in one unit of distance to the water source resulted into a decrease of 1.935 units of water. This was possibly because large households required large quantity of water which were unable to collect due to limited water availability or inability to pay for the service. Since distance is one of the indicators of collection effort, the implication of these findings is that the higher the collection effort the less the quantity of water collected. These findings mirror the observation by Mellor *et al.*(2002) that those who have poor access due to collection efforts will likely not use as much water.

Table 8: Factors associated with per capita water use

Explanatory variable	*B* coefficient	Std. Error	*p*-value
Household size	-2.644	0.350	0.000***
Household monthly income (Tsh)	1.088E-005	0.000	0.093NS
Water source (1=improved)	9.276	4.234	0.030**
Distance to water source (1=within 400m)	3.853	3.591	0.285NS
Time used to fetch water (1= less than 30 min)	-1.935	4.604	0.675NS
Waiting time at the source (1= less than 30 min)	7.215	3.252	0.028**
Monthly water bills (Tsh)	0.000	0.000	0.041**

$R^2 = 0.266$, $F_{(7,188)} = 9.708$, p=0.000, **Significant at 5%, ***Significant at 1%, NSNot Significant

3.3 Affordability to Pay for Domestic Water Supply Services

About half of the surveyed households (50%) reported that were paying for water services whereas as the other half did not pay possibly because they obtained water from sources like hand dug wells and springs. Significantly (p=0.000) larger proportions of the water users in Lamadi (76%) and Magu (64%) were paying for water services than in Misungwi (Table 9). The majority of these in Lamadi (88%) and Magu (52%) paid as they fetched water at the public taps or water kiosks. In Misungwi, 42% of the respondents paid monthly bills to the water utility and another 36% paid as they fetched water at communal/public taps. Buying water from water vendors was common in Magu (22%), and to some extent in Lamadi (7%) but less in Misungwi (3%). Water utilities in Misungwi and Magu used different tarrifs for metered and unmetered customers. Metered customers paid TZS 800/m^3 and TZS 300/m^3 in Misungwi and Magu, respectively. Non-metered customers in Magu paid a flat rate of TZS 4500 per month. However, due to infrequent flow of water in the taps, many users depended on water vendors. Prices by water vendors varied from TZS 200 to 500 depending on the season and distance between the water source and household where water was sold. This reflects the observation by Rogerson (1996) that poor urban dwellers are often driven to rely on water vendors because of lack of convenient stand pipes.

Table 9: Payment arrangements for water services(n=417)

Variable	Response	Misungwi	Magu	Lamadi	All	Chi-square value
Pay for water services	Yes	33(19.5)	77(63.6)	97(76.4)	207(49.6)	χ^2=107.106 df = 2 p=0.000
Payment modality	Monthly bills to the	14(42.4)	11(14.3)	4(4.1)	29(14.0)	

water utility					
Pay as you fetch per bucket at communal taps	12(36.4)	40(51.9)	85(87.6)	137(66.2)	χ^2=61.688 df = 6 *p*=0.000
Buying water from vendors	1(3.0)	17(22.1)	7(7.2)	25(12.1)	
Others	6(18.2)	9(11.7)	1(1.0)	16(7.7)	

Figures in brackets are percents

The average household average monthly expenditure on water services was TZS 19 179, which is equivalent to USD 8.6[1]. Comparatively, household monthly water expenditures in Magu (TZS 29 965, approximately USD 13.4) were significantly ($F_{(2,198)} = 8.571$, p=0.000) higher than in Misungwi (TZS 13 264, equivalent to USD 5.9) and Lamadi (TZS 12 325, about USD 5.5). The high expenditure in Magu was possibly because of the low water supply in the town, which necessitated most households to obtain water from water vendors at a relatively higher price. As reported, water supply coverage in Magu was only 23%. These findings support the findings by Rogerson (1996) that distribution of water by water vendors is expensive, irrespective of whether vehicles are powered people, animals or engines. Additionally, beyond cost implications, water vending is also linked to health problems as hawkers may sell water from polluted sources or from fouled containers.

Affordability to pay for water services was measured in two ways: based on water users' views and as a percentage of household income. The findings on the users' views show that two thirds of water users (67%) indicated that were able to afford to pay for water services: 71% in Lamadi, 65% in Magu and 57% in Misungwi. When affordability was determined using the affordability index as a percentage of the household income that is spent on water, it was found that households in Misungwi, Magu and Lamadi spent 17%, 17% and 9% of their monthly incomes on water, respectively. These findings corroborate those of IIED (2016) in Dar es Salaam and Blantyre which found that households spent more than 13% of their income to meet minimal water needs. Overall, water consumption expenditures in the study towns exceed the 3-5% threshold (OECD, 2003; Wang *et al*., 2010), suggesting that water price in the study towns is unaffordable. This means that a substantial proportion of households are excluded from access to domestic water services because cannot afford to pay for the same. This denies their right to affordable water, which is contrary to the equity principle described earlier (Garcia-Valinas *et al.*, 2010).

The findings further show that close to half of the households (48%) were spending more than 5% of their household income on water services, with significantly (p=0.003) higher proportions in Misungwi (62%) and Magu (60%) than in Lamadi (33%). More than one quarter (29%) spent less than 3% and 23% used 3-5% of their monthly incomes on water services (Table 10). The implication of these findings is that over half of the households in the study towns could be considered as 'water-poor' because they spend more than 3% of their income for paying water charges (Garcia-Valinas *et al.*, 2010). Thus, lack of purchasing power could be seen as another cause of limited access to domestic water supply in the area. This also challenges the equity principle, which demands that poorer households should not be disapropriately burdened with water expenses (Smets, 2009).

[1] Based on exchange rate of one USD = 2233.95 TZS in January, 2017

Table 10: Affordability for domestic water as a percentage of household income (n=197)

Affordability index	Misungwi	Magu	Lamadi	All	Chi-square value
Less than 3%	7(24.1)	19(25.3)	32(34.4)	58(29.4)	χ^2=15.986 df = 4 *p*=0.003
3-5%	4(13.8)	11(14.7)	30(32.3)	45(22.8)	
More than 5%	18(62.1)	45(60.0)	31(33.3)	94(47.7)	

Figures in brackets are percents

IV. CONCLUSIONS

This study has examined household access and affordability to pay for domestic water supply services in small towns in Tanzania using the cases of Misungwi, Magu and Lamadi towns along the shores of Lake Victoria. The main conclusion emerging from the findings is that there is limited access to domestic water supply in the study towns due to low water supply coverage and unaffordability to pay for the services for most of the households. The study found that a substantial proportion of households depend on unimproved sources, which are likely to be contaminated, hence, contributing to the burden of water related diseases. Although the present water consumption levels meet the recommended minimum thresholds, most of the households are only able to meet the basic access, which does not enable them to consume enough water in quality and quantity to guarantee healthy conditions. Further, inability to pay for the services excludes some households from access to domestic water services. This means that interventions aimed at improving access to domestic water supply in the study towns should focus on improving water supply infrastructure and household ability to pay for the services by introducing water tarrifs that are commensurate of their economic status.

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