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Analysis of the determinants of household's water access and payments among the urban poor. A case study of Diepsloot Township

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ABSTRACT

Currently, 91% of the world population has access to clean and safe water. Despite this encouraging development exclusion and marginalisation of the poor appear not only to be deepening but fast spreading. Low-income communities in urban areas are increasingly grappling with issues of reliability, sufficiency, and affordability of potable water. Attaining SDG 6 and its targets goal is a daunting task for most developing nations and limited evidence provide an intrinsic look at water systems for marginalised urban communities. This study investigates factors influencing household water access, its reliability and affordability among the low-income communities. The study administered a structured questionnaire to 500 households to determine key predictors of household water access. Findings show persistent high unemployment levels with most of the people surviving on less than R 3000 (198 USD) a month. Around 66% of households had access to tap water either inside the house or yard, but the water supply was irregular, and most households were not paying for the water. Household water access and payment for water services were influenced by house type, household size and water source with a p value of 0.00, 0.035 and 0.042 respectively. Other variables such as education, employment, and income were not significant predictors of household's water access. The study observed that income, employment, education, gender, drinking tap water, water interruptions, and satisfaction levels did not have a significant relationship with household water payment for water services. The findings of this study highlight the importance of policy in driving water service provision for the successful attainment of Sustainable Development Goal 6.1.

1. Introduction

Access to clean, safe and adequate amount of water is vital for human well-being, social and economic development (United Nations, 2010; Amit and Sasidharan, 2019) healthy ecosystem, dignity and gender equality (Hutton and Chase, 2016). Hygiene, improved standard of living, food security, improved educational outcomes all depend on timely water supplies (Hutton and Chase, 2016; Martínez-Santos, 2017). While substantial progress has been made in water service delivery in South Africa, more is required in poor urban communities. About 89.4% of households in South Africa have access to improved water sources (Stats, 2018). However, this is often contested, given the high levels of inequality (Cole et al., 2018; Sutherland et al., 2014). Several researchers have questioned official statistics on access to water services in South Africa (Dugard, 2012; Dugard and Tissington, 2013; Hellberg, 2014). Extensive literature has engaged with the disparities in water access levels between the urban rich and the urban poor (Yang et al., 2013; Bain et al., 2014; Sinharoy et al., 2019). Population growth and urbanisation have forced a larger proportion of the urban poor to live in peri-urban and informal settlements lacking access to essential services such as proper housing, water and sanitation (Dos Santos et al., 2017; Adams et al., 2020). According to Pierce (2017) in peri-urban and informal settlements where water and sanitation infrastructure exist, access may be uneven and irregular; as a result, water-related illness are

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common. Bartram et al. (2014) and Biswas (2006) argue that informal and low-income urban settlements have been historically left out in water developments compared to the surrounding wealthier urban areas. This study acknowledges the general paucity in understanding key factors influencing access and payments for clean water. The study investigates the determinants influencing household water access, its reliability and affordability among the urban poor, drawing lessons from the low-income urban settlement of Diepsloot in Johannesburg South Africa. The narrative of the paper is curved under the social and economic pillars with a focus on water as a human right and the cost of access to water, which are among the critical dimensions with serious policy implications.

1.1. Water a human right

In recognising the importance of water, in 2010, the United Nations General Assembly declared access to safe and clean drinking water a human right for all (United Nations, 2010). The human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic purposes (United Nations, 2010). It is, for this reason, equitable access to safe and affordable drinking water was included in the Sustainable Development Goals (SDG 6) and earlier development initiatives such as the Millennium Development Goals (MDG 7), the International Drinking Water Supply and Sanitation Decade 1881–1990 and the Dublin Principles of 1992 (Kayser et al., 2013; Hutton and Chase, 2016; Masanyiwa et al., 2017). Targets set under these international initiatives guide policy formulations and frame international monitoring (Bartram et al., 2014; Kayser et al., 2013). International monitoring programs are intended to track progress, highlight gaps and opportunities towards achieving the set targets (Lester and Rhiney, 2018).

Target 7c of the Millennium Development Goals (MDG) aimed at halving the proportion of world population without access to sustainable, safe drinking water by 2015. The target was met in 2010, 5 years ahead of schedule, and it is estimated that 2.6 billion people gained access to an improved drinking water source since 1990 (World Health Organisation, 2015). The proportion of the world population with access to improved water sources increased from 76% in 1990 to 91% in 2015 (World Health Organisation, 2015). Despite progress in access to clean water, substantial gaps remain. Firstly in 2017, 784 million people lacked access to basic drinking water services. At the same time, 2.1 billion people were using drinking water sources contaminated with faeces leading to the spread of water-borne diseases including typhoid, fever, cholera, dysentery and diarrhoea (World Health Organisation, 2017). World Health Organisation (2017) estimates that around 842 000 people die annually from diarrhoea due to unsafe drinking water sources, lack of hygiene and sanitation. Secondly, the global estimates mask regional disparities and inequality in access to water between the rich and the poor (Hutton and Chase, 2016). According to Nastiti et al. (2017), water supply in low and middle-income countries often does not meet the requirement of physical accessibility, quantity, quality and affordability.

Furthermore, global estimates of the proportion of people with access to improved water sources fail to take into account the fundamental dimension of human rights to water such as safety, reliability, physical affordability accessibility, sustainable access and (Bain et al., 2014; Guardiola et al., 2010; Martínez-Santos, 2017; Satterthwaite, 2016; Shaheed et al., 2014). According to Lester and Rhiney (2018), exclusion of these dimensions has serious policy implications and can mask underlying issues of social inequality, poverty and poor quality services. Sustainable Development Goals succeeded the MDGs (2000–2015) for the period 2015–2030 (United Nations, 2015). SDG 6.1 aims to achieve universal access and equitable access to safe and drinking water for all and recognises the importance of reducing inequalities as part of sustainable access. Progress for SDG 6.1 will be measured by indicator proportion of the population using safely managed drinking water sources (World Health Organisation, 2017). Safely managed water sources are defined as drinking water from improved water sources located on the premises, available when needed and free from contamination (World Health Organisation, 2017). According to Smiley (2016), and Weststrate et al. (2019), SDGs overcame the limitations of the earlier initiatives on water access.

1.2. Cost of water

Water affordability is a central element to water access. Although included in the target, affordability is not reflected in the indicator for SDG 6.1. Lack of consideration of water affordability has negative implications for achieving SDG 1 (reducing poverty), especially in low-income countries given the interrelations among the SDGs (Kroll et al., 2019; Mainali et al., 2018; Truslove et al., 2020). If water is priced at full recovery cost approximately 60% of the population in low-income countries would not be able to afford it (Banerjee and Morella, 2011). Escalating water cost and high profile cases have focused attention on household water affordability (Teodoro, 2018). It is estimated that low-income households spend as high as 15% of their monthly income to access water (Cook et al., 2016; Amit and Sasidharan, 2019). If water is such expensive, users tend to look for other options or restrict consumption and thus endangering their health and well-being (Foster and Hope, 2016; Smiley, 2016). The cost of water is estimated to quadruple in the next decades with increasing variability in water availability due to climate change and the increasing cost of water provision (Baird, 2010).

1.3. South African constitution and access to water

In South Africa, the constitution (1996) stipulates that everyone has the right to enough water. However, the major setback is the pervasive inequality. Inequality in service delivery in South Africa still follows the apartheid racial segregation act and still evident despite continued efforts by the post-apartheid government policies to address these inequalities (Dugard, 2015). The provision of basic services is mostly prioritized for affluent areas of the city as service delivery is often complemented with tax contributions and payment of municipal services (Hefetz, 2002), as a result, the poor in low income and peri-urban settlements have limited access to basic services. This is mainly evidenced by the number of service delivery protests in poor urban communities (Morudu, 2017). In-depth analysis of households water access, availability and affordability in marginalised urban areas where the majority of the urban poor reside remains scarce and yet is of utmost importance for poverty eradication and bridging the urban spatial inequality gap.

2. Methods and materials

2.1. Description of the study area

The study was conducted in Diepsloot Township, one of Johannesburg's newest low-income settlement located in the northern part of Johannesburg bordering the city of Tshwane. Diepsloot covers an area of 12 km^2 with an estimated population of 350 000 individuals (Sobantu and Nel, 2019) living in approximately 62 882 households (Stats SA, 2011). Majority of the residents are of low socio-economic class, and unemployment rates are very high.

Diepsloot is divided into thirteen extensions and is a mixture of both formal and informal settlements. Around 76% of the households live in informal houses, of which 45% are backyard shacks in the formal settlements (Stats SA, 2011). According to Bénit (2002), constant mass relocation and unplanned rapid expansion have resulted in unequal access to basic services among residents in the township. Within the formal areas of the township essential services such as water, electricity, and refuse removals are available while informal settlements have limited access to basic services and are mostly served via communal points (Williams et al., 2016). Around 18.4% of the households have access to tap water inside their house, and 74. % make use of a flush toilet connected to sewerage (Stats SA, 2011).

2.2. Sampling and data collection

The number of households required to give statistically sound results was estimated using an equation by Daniel and Cross (2018). The calculated sample size was 384 households. The sample size was increased to 500 to account for non-response and incomplete surveys. A total of 499 households participated in the survey resulting in a 99% response rate. Data was collected using a a pre-tested structured questionnaire adminstered by trained enumerators. The survey instrument comprised of sections on socio-demographics characteristics such as, access to basic services (water, energy and sanitation) and satisfaction levels.

2.3. Data analysis

2.3.1. Water access, and availability

According to World Health Organisation (2017), Sustainable Development Goal target 6.1 will be measured against the indicator proportion of the population using safely managed water services. Safely managed water services are defined as improved water sources that are located on the premises (house, yard or plot), available when needed and free from microbiological and priority chemical contamination (World Health Organisation, 2017). Improved sources of water include piped water into compounds/yard/plots, piped water inside the house, piped water into a neighbour's property, protected wells, protected springs, public standpipe and boreholes (World Health Organisation, 2017). The sources of water which were considered as safely managed water sources were sources located inside the house and the yard or plot, and household water access was measured against those sources.

2.3.2. Determination of water affordability

Affordability of water services is commonly measured as the proportion of the household income spent on water services (Mack and Wrase, 2017). Several international organisations use a variety of income-based benchmarks. For example, the United Nations Development Program (UNDP), International Water Association (IWA) and OECD threshold is 3%. For the United States, Environmental States Protection Agency and World Bank use a threshold of 5%. For this study OECD threshold of 3% was adopted. Indicators used to measure water accessibility, availability and affordability were adapated from (Baquero et al, 2016). The variables used for measurement were as follows:

Water Access: Piped water inside house/compund;
Avalability: Available throughout the year;
Affordability: Less than 3% of the household income;

2.3.3. Statistical analysis

Survey data was coded and captured using CSPro. The data was analysed using the Statistical Software Package for Social Sciences (SPSS). Firstly, simple frequency and descriptive statistics for all variables thought to influence household water access, availability and payments were computed. To assess factors influencing household water access and payment, a logistic regression model was applied. Three logistic regression models were carried out for accessibility and payment. Variables used in the models are presented in Table 1.

Table 1
Variables used in the logistic regression model for determinants of households accessibility and payment.

Variable	Description of variable	Variable type
Gender	1 if male,0 female	Dummy
Education level	Education level of respondents	Dummy
Income	Combined monthly household income	Dummy
Household size	Number of people living in a household	Continuous
Drinking water	1 tap water, 0 otherwise	Dummy
House type: Brick	1 brick house, 0 otherwise	Dummy
House type: Shack	1 Shack, 0 otherwise	Dummy
Interruption	1 if experienced interruptions, 0 otherwise	Dummy
Tap inside the house	1 access to tap water inside the house, 0 otherwise	Dummy
Tap outside the house	1 access to tap inside the yard, 0 otherwise	Dummy
Satisfied water supply	1 if satisfied with water supply, 0 otherwise	Dummy
Dissatisfied water supply	1 if dissatisfied with water supply, 0 otherwise	Dummy

3. Results

3.1. Households profiles

Descriptive statistics of the variables considered to have an influence on household water access, availability and affordability were analysed, and computed results are shown in Table 2. The results show that of the respondents that participated in the study, 54.2% (n = 269) were males while 45.5% (n = 225) were females. In terms of education, 68.9%, 17.9%, 9.9%, and 3.4% had secondary, primary, tertiary and no schooling respectively. The unemployment rate was very high, with only 28.7% (n = 141) employed. Around 83% (n = 410) of the households had combined monthly household income of less than R3000 (USD200). The findings corroborate Stats SA results of 2011, which showed that about 76% of households in Diepsloot had combined average household income of less than R38 200 (USD2500) a year. The average household size was three individuals per household. Nearly 50% (n = 258) of the respondents lived in shacks. Around 40.2% (n = 196) lived in houses made of bricks.

3.2. Water access, availability, affordability and satisfaction

3.2.1. Access to safely managed water sources

Distribution of household's primary source of water, drinking water sources and water supplier among households in Diepsloot Township are shown in Table 3. Majority of the household represented by 99% (n = 488) primary source of water was supplied by the local municipality. Communal and taps inside the yard were the predominant sources of

Table 2
Socio-demographics characteristics of the respondents.

Variables	Response	Frequency	Percentage (%)
Gender	Males	269	54,5
	Females	225	45,5
Education level	No schooling	17	3,4
	Primary	88	17,8
	Secondary	341	68,9
	Tertiary	49	9,9
Employment	Yes	141	28,7
	No	351	71,3
Monthly income	No income	155	31,6
	Less than R1500	170	34,7
	R 1501-3000	85	17,3
	R 3001-4500	48	9,8
	R 4501-6000	28	5,7
	More than R6000	4	0,8
House type	House or brick structure on a separate stand or yard	196	40,2
	Traditional dwelling	5	1,0
	Double-storey dwelling	2	0,4
	Dwelling/House/Flat/room in backyard	26	5,3
	Shack	258	53,0

Table 3

Summary of the water supplier, primary water source and drinking water.

Variables	Response	n	Percentage (%)
Municipal supplier	Yes	488	99,0
	No	5	1,0
Primary water source	Pipped tap water in dwelling	146	29,4
	Piped tap water on-site/yard	165	33,2
	Public/Communal tap	165	33,2
	Neighbour	20	4,0
	Water carrier/tanker	1	0,2
Drinking water	Bottled water	10	2,0
	Tap water	481	98,0

water for over 66.4% (n = 330) households. The proportion of the household whose primary water source was a neighbour tap made up 4% (n = 20). Altogether, 29.4% (n = 146) of the households indicated a tap inside the house as their primary source of water. Based on the World Health Organisation (2017) definition, only 62.6% (n = 311) had access to safely managed water sources. A chi-square test was undertaken to assess the relationship between house type and water sources (Fig. 1). The results indicate a significant statistical relationship ($p < 0.000$), households in houses made of bricks are more likely to have tap water in their dwelling or at least in their yard (Fig. 1). Majority of the households staying in shacks depend on communal and neighbours taps for their source of water.

3.2.2. Water availability

Information on water availability is presented in Table 4. When asked if the respondents have experienced water supply interruptions in the last twelve months, 96.1% (n = 470) responded yes, while 3.9% (n = 19) said no. The follow-up questions were asked to bring about more information on duration, frequency and coping strategies (Table 4). The majority of the respondents represented by 90.8% (n = 425) said these interruptions regularly lasted for more than two days, while 0.9% (n = 4) did not know the duration. About 8.3% (n = 39) said interruptions they had experienced did not last for more than two days. In terms of alternative water sources during these interruptions, nearly 50% depend on stored water. Around 30% (n = 168) go to other areas not experiencing water interruptions, while only 2.3% purchased bottled water.

Table 4

Experience with interruptions, duration, frequency and alternative water sources.

Variables	Responses	N	Percentage (%)
Interruptions	Yes	470	96,1
	No	19	3,9
Longer than 2 days	Yes	425	90.8
	No	39	8.3
	Don't know	4	0.9
Alternative water source	Bottled water	11	2.3
	Water tanker	71	14.7
	River	4	0.8
	Stored water	228	47.3
	Other areas	168	34.9
Frequency monthly	1-3 times	442	92,9
	4–5	25	5,3
	Never	9	1,9

Less than 1% (n = 4) of the respondents used the nearby river as the alternative water source during water interruptions. Majority of the respondents (92.9%) experienced interruptions 1–3 times a month.

3.2.3. Water payments

When asked if the households paid for water supply, 21.3% (n = 104) responded yes, while 78.7% (n = 385) said no (Table 5). Of the 21.3% that paid for water, 52% (n = 25) of the households paid less than R200 for water monthly. Around 29.2% (n = 14) spent between R201-400 while 18.8% spent more than R600 a month. Cited reasons for non-payment of water included, free water source (33.3%), use of communal tap (24.8%) and permission from the municipality not to pay (7.5%) (Table 5). Overall, 17 0.1% of the households could not afford to pay for water services. Households using free water sources and those who have been granted permission by the municipality not to pay are beneficiaries of the national free basic water policy. Household's dependent on communal water taps are by law not required to pay for water services. This is due to the fact that water is not provided individually and therefore, individual household's consumption cannot be measured.

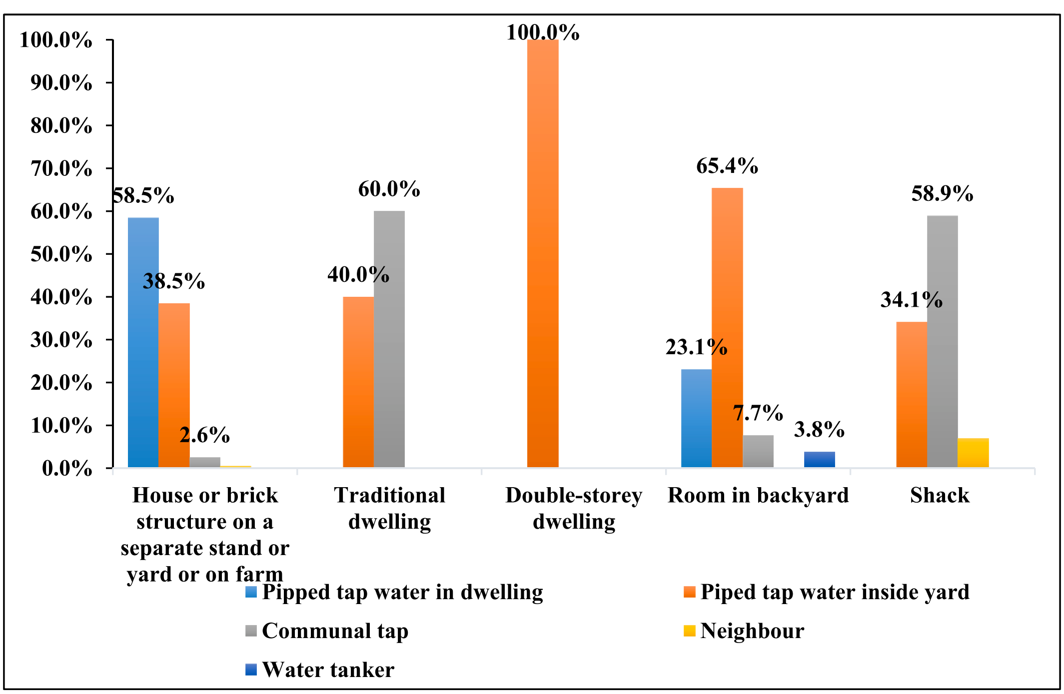

Fig. 1. The influence of house type on primary water sources.

Table 5
Distribution of respondents based on payment for water, reasons for non-payment and monthly water expenditure.

Variables	Response	N	Percentage (%)
Water payments	Yes	104	21,3
	No	385	78,7
Reasons for non-payment	Use free water source	126	33,6
	Use communal tap	93	24,8
	Payment included in rent	64	17,1
	Cannot afford to pay	64	17,1
	Permission from the municipality	28	7,5
Monthly water expenditure	R 0-200	25	52,1
	R 201-400	14	29,2
	R 401-600	6	12,5
	R 601-800	3	6,3

3.2.4. Water affordability

Affordability to pay for water services was measured by the ratio of household water expenditure to its income. A threshold of 3% was used in the study. A chi-square test was undertaken to assess whether there was a significant relationship between household income and monthly household water expenditure (Fig. 2). The results indicate that there was a statistically significant relationship at $P < 0.000$. Findings of this study show that over 60% of the households paying for water cannot afford to pay as they are spending more than 3% of their income on water. As a result, these households are termed as water-poor.

3.2.5. Water satisfaction

Fig. 3 presents data on the water supply satisfaction levels of the respondents. When it came to satisfaction with the water supply, 23.5% (n = 117), were very satisfied, 48. 9% (n = 243) satisfied, 5.0% (n = 25) neither satisfied nor dissatisfied, 19% (n = 95) were dissatisfied and 3, 4% (n = 17) were very dissatisfied.

3.3. Determinants of household water accessibility and payment

3.3.1. Water accessibility

Logistic regression was performed to determine the influence of gender, employment, education, income, household size and house type (brick and shacks) on household water access (Tables 6 and 7). The logistic regression model was statistically significant at $x^2 = 70.909$, p=<0.000. The model correctly classified 76. 6% of the cases. Income, house type (brick and shack house) and household size were statistically significant in influencing household water access (Table 6). Income and shack house had a negatively correlated relationship with the household's water access, implying that households without income are 0.39 times less likely to have access to safely managed water sources inside the house. Furthermore, households staying in shack houses are 0.4 times less likely to have access to safely managed water sources inside the house. Household size had a significant positive relationship with

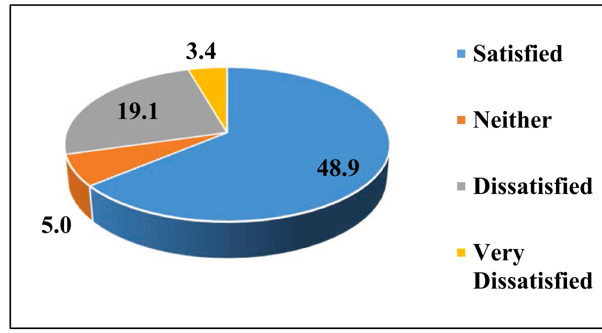

Fig. 3. Percentage distribution of respondents based on satisfaction levels with the water supply.

Table 6
Logistic regression analysis results of factors influencing household's access to tap water inside the house.

	B	SE.	Wald	Df	Sig.	Exp(B)
Gender	0,009	0,245	0,001	1	0,969	1,009
Education			5,830	3	0,120	
No schooling	−0,949	0,926	1,049	1	0,306	0,387
Primary	0,550	0,489	1,263	1	0,261	1,733
Secondary	0,687	0,418	2,697	1	0,101	1,988
Employment	0,107	0,291	0,135	1	0,713	1,113
Income			7,596	4	0,108	
No income	−0,923	0,537	2,950	1	0,085*	0,397
Less than R1500	−0,834	0,519	2,586	1	0,108	0,434
R1501-3000	−0,194	0,541	0,128	1	0,721	0,824
R3001-4500	−0,162	0,590	0,076	1	0,783	0,850
Brick	1,781	0,452	15 496	1	0,000**	5,933
Shack	−0,862	0,485	3,155	1	0,075*	0,422
Household size	0,158	0,075	4,440	1	0,035**	1,172
Constant	−1,886	0,719	6,885	1	0,008**	0,152

**P < 0.05.
*P < 0.01.

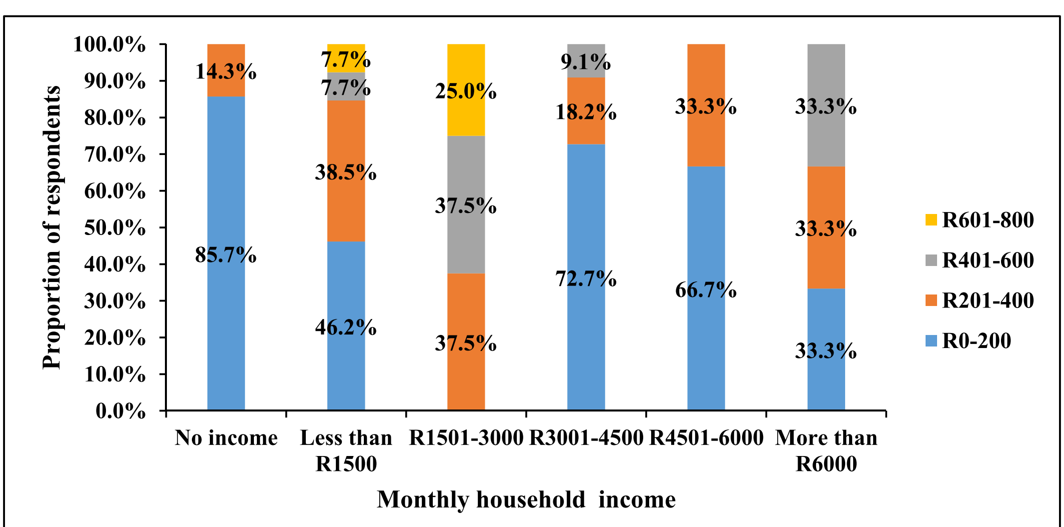

Fig. 2. The influence of monthly household income on water expenditure.

Table 7
Logistic regression analysis results for factors influencing household's access to tap water inside the yard.

	B	SE.	Wald	Df	Sig.	Exp(B)
Gender	0,060	0,206	0,085	1	0,771	1,062
Education			1,639	3	0,651	
No school	0,506	0,607	0,696	1	0,404	1,659
Primary	0,073	0,407	0,032	1	0,858	1,075
Secondary	−0,105	0,349	0,090	1	0,765	0,901
Employment	−0,198	0,243	0,666	1	0,414	0,820
Income			2,838	4	0,585	
No income	−0,031	0,465	0,004	1	0,948	0,970
Less than R1500	−0,228	0,454	0,252	1	0,615	0,796
R1501-3000	−0,541	0,486	1,240	1	0,265	0,582
R3001-4000	−0,215	0,526	0,167	1	0,683	0,807
Brick	−0,992	0,368	7,288	1	0,006**	0,371
Shack	−1,636	0,366	19 994	1	0.000**	0,195
Household size	−0,149	0,068	4,787	1	0,028**	0,862
Constant	1,255	0,604	4,317	1	0,037**	3,507

**P < 0.05.
*P < 0.01.

access to tap water inside the house. Implying that as household size increases, the likelihood to have access to improved water source inside the house also increases. Households staying in house made of bricks are 5.933 times more likely to have access to tap water inside the house. According to the logistic regression analysis household size and house type (brick and shack) were statistically significant in determining household access to tap water inside the yard (Table 7). They all had a negatively correlated relationship with household access to tap inside the yard.

3.3.2. *Payment*

The analysis of the result form the logistic regression model indicated that the model on predictors of households' payment for water services was statistically significant at $x^2 = 141.269$, $P < 0.000$ (Table 8). The Cox and Snell R^2 was 22.6% while Nagelkerke R^2 was 35%. The model accurately predicted 79.7% of all the cases. The results of this study show that only three variables were statistically significant in influencing payment for water. Those variables were, tap inside the house, brick house and shack house (Table 8). They were found to have a positive and significantly correlated relationship with the payment of water. Households whose main sources of water was a tap inside the house were 8.73 times more likely to pay for water. Households living in houses made of bricks were 9.47 times more likely to pay for water while those staying in shacks were 4.2 times more likely to pay. Gender, education, employment, income, water interruptions and satisfaction levels did not have a significant influence on household payment for water services.

Table 8
Logistic regression analysis results for factors influencing household payment of water.

	B	SE.	Wald	Df	Sig.	Exp(B)
Gender	0,069	0,258	0,072	1	0,789	1,071
Employment	0,206	0,292	0,498	1	0,481	1,229
No money	−0,172	0,299	0,329	1	0,566	0,842
R3001-4500	0,367	0,395	0,866	1	0,352	1,444
Tap water	−0,358	0,727	0,242	1	0,623	0,699
Water interruptions	0,340	0,505	0,453	1	0,501	1,405
Tap inside house	2,167	1,069	4,107	1	0,042**	8,734
Tap outside house	1,685	1,061	2,524	1	0,112	5,393
Public tap	−2,002	1,441	1,929	1	0,165	0,135
Household size	−0,022	0,075	0,081	1	0,775	0,979
Brick house	2,249	0,758	8,807	1	0,003**	9,476
Shack house	1,453	0,778	3,483	1	0,062*	4,274
Satisfied	−0,077	0,279	0,075	1	0,784	0,926
Dissatisfied	0,040	0,420	0,009	1	0,924	1,041
Constant	−4,589	1,580	8,435	1	0,003**	0,010

**P < 0.05.
*P < 0.01.

4. Discussion

This study investigated key factors influencing household drinking water security in low-income settlements using Diepsloot Township as a case study. The findings reveal some of the critical complexities underlying water security in low-income communities which are not included in global statistics and yet have serious policy implications. About 62% of the household's primary source of water was located on the premises. The results of this study provide more insights beyond national statistics of the number of people with access to tap water but adds important elements of the human right to water such as accessibility, availability and affordability. Similar to results by Adams et al. (2020), having access to tap water does not guarantee a continuous supply of water. Unreliable water supply forces households to adopt a variety of coping strategies. Majority of households relied on stored water to cope with unreliable water supply. This result conforms to the study of Vásquez (2012), Vásquez (2016) and Trudeau et al. (2018) which showed that household store tap water at home to cope with unreliable water supply. This places households at risk of drinking contaminated water as storing water can introduce contaminants (Bivins et al., 2017; Kumpel and Nelson, 2016). Results from the logistic regression analysis of factors influencing household's access to safely managed water sources based on the World Health Organisation (2017) definition show that household income, house type and households size had a statistically significant influence. The results correlate with findings by Mahama et al. (2014), Abubakar (2019) and Saroj et al. (2019) whose studies found a significant statistical relationship between house type and income and access to safely managed water sources. Our study did not find any significant statistical relationship between gender, education, employment status and households water accessibility. The results conform to results by Mahama et al. (2014) and Lester and Rhiney (2018), which also did not find any significant statistical relation between those variables and households water access. Other studies which found a significant statistical relationship between education (Saroj et al., 2019), gender, ethnicity and spatial location (Abubakar, 2019). Lester and Rhiney (2018) argue that although employment, gender and education might not have any statistically significant influence on household's water access in some areas, they are of utmost importance as they may cause inequalities and still influence water access. For example in this study, majority of people relying on communal water taps stay in shacks and are unemployed and therefore cannot afford to buy or rent in brick houses which may have access to tap water inside the house or in the yard.

In terms of water payments, findings from this study shows that 21.3% of the households were paying for water. A study by Akinyemi et al. (2018) using South African Living Conditions survey 2014/2015 showed that 34% of South Africans paid for water services. According to 2018 South African General Household Survey, 40% of the South African households were paying for water. Reasons for low payments in our study might be explained by a lack of affordability and the fact that our study area is a low-income settlement with high unemployment rate. Of those paying for water, over 60% were spending more than 3% of their income on water, implying that they were too poor to afford water. During the survey, no households mentioned the issue of water cuts due to non-payment.

Logistic regression model analysis results showed that payment of water was influenced by house type and water source. Residing in brick or shack houses positively influenced payment of water services. The results of our study are similar to results by Aslam et al. (2018), Nkoana et al. (2019), Makwinja et al. (2019) and Abualtayef et al. (2019) which also found a statistically significant relationship between income and water payments. In this study, the lack of income had a negative influence on water payment as households with no sources of income were less likely to pay for water. A study by Akinyemi et al. (2018) on factors influencing payment for water services in South Africa showed that gender and income positively influenced payment of water services while water interruptions, negatively influenced payment for water services. In their study, households headed by males were more likely to pay for water than those headed by females. Education, water interruptions, water supply satisfaction, income and household size did not have any significant influence on payment in this study. Findings emanating from this study emphasise the importance of socio-economic conditions as well as the need to look beyond access, as national and global statistics seldomly mention quality of infrastructure, functionality and affordability.

5. Conclusion

The study provides insights into households water access, reliability and affordability in urban low-income communities which have implications for monitoring and achieving target SDG 6.1. Findings from this study provide important lessons for governments departments involved in water policy formulation and implementation. Household water security is threatened by irregular supply, accessibility, affordability and inequality. Moreover, such findings are concealed in national and global surveys and have severe implications for policies and interventions programmes. Water accessibility was influenced by the type of house the household lives in, household size and income. Payment for water services was influenced by water source and house type. To attain SDG target 6.1; we should not only look at expanding access but also need to address the issue of inequality within urban areas, thus enable affordability and reliability of service. Greater emphasis should be on bridging water access inequality gap between informal settlers and those formal settlements. Interventions on expanding water access should be accompanied by housing, employment, and economic development as our study has shown that access to safely managed water sources is influenced by socio-economic characteristics.

Author statement

We are grateful for insightful comments and for the opportunity to revise our manuscript. We are pleased to inform you that we have reflected on all the reviewers' comments and revised the manuscript accordingly. All changes made are highlighted within the manuscript. The table below show point by point response to the comments raised by the reviewers. We hope that this will now be accepted for publication.

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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