Potable Water Security in Rural South Africa: A Case Study of Vhembe District

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Abstract

South Africa is a semi-arid country and has limited water resources. The provision of potable water to rural communities remains a challenge. The current study assesses the provision of water services and community's perceptions of water supply amid the coronavirus pandemic in Vhembe District Municipality (VDM). A sample of 448 households was selected from 14 villages. Findings revealed that communities rely on a variety of water sources with the main water source being boreholes. Households spend a significant amount of time daily to fetch water. Of the 38 boreholes in the villages, only 28% are functional and water tankers are used in times of emergency, most of which are also unreliable. The respondents were not satisfied with the quantity, quality of the water, distance travelled and reliability of the service. Water provision in VDM remains a challenge and thus needs immediate intervention particularly in the light of curbing the spread of the coronavirus.

Keywords: Access to Water, Reliable Potable Water, Community's Perceptions, Rural Communities, Water Service Provision

Introduction

Water security can be defined as "the reliable availability of an acceptable quantity and quality of water for health, livelihoods and production, coupled with an acceptable level of water-related risks"(Asthana, 2019). The inability to access adequate potable water poses a developmental hurdle as it hampers economic growth and the fight against poverty (Tantoh & McKay, 2020). The United Nations (UN) places water at the center of sustainable development and the Millennium Development Goal (MDG) 7 targets

''reducing half the proportion of people without sustainable access to safe drinking water and basic sanitation by 2015'' (Braimah, Amponsah & Asibey, 2016).

With the coronavirus spreading in all parts of the world, it is apparent that communities which lack basic services like clean water will be severely affected (Uwizeyimana, 2021). Health authorities advise regular washing of hands to prevent the spread of the virus, yet 40% of the world's population which adds up to 2.1 billion people does not have access to essential facilities to wash their hands in the house (Hope et al., 2020) and the majority of these reside in rural areas (CSIR, 2010; Hope et al., 2020).

Despite the huge efforts in the recent decades, the availability of adequate, reliable and affordable potable water remains a huge challenge in Sub-Saharan Africa (Tantoh & McKay, 2020). In South Africa, the right for access to adequate water is enshrined in section 27(1)(b) of the country's constitution (SAHRC, 2018), yet to date, approximately 5 million residents, majority in the rural areas still lack access to safe drinking water (Hove et al., 2019).

Being a semi-arid country, South Africa has limited water resources and provision of potable water is still a challenge (Edokpayi et al., 2018) and this has an effect on the community's health and also impacts on rural economic activities such as livestock rearing and gardening. Limpopo Province is one of the most rural and poorest provinces in the country and being in a semi-arid area, has scarce water resources. Nearly all the water resources in the province are already allocated and there are no options to develop the resources further due to the undesirable topography, sandy rivers, arid climate and restricted potential for abstracting groundwater (Odiyo & Makungo, 2012).

Vhembe District Municipality (VDM) is one of the five districts in Limpopo Province and is predominantly rural, with many communities lacking reliable access to potable water and relying on alternate sources (Mudau, Mukhola & Hunter, 2017). The situation is compounded by a rapid population rise in the district and increase water demands (Nefale, Kamika & Momba, 2017).

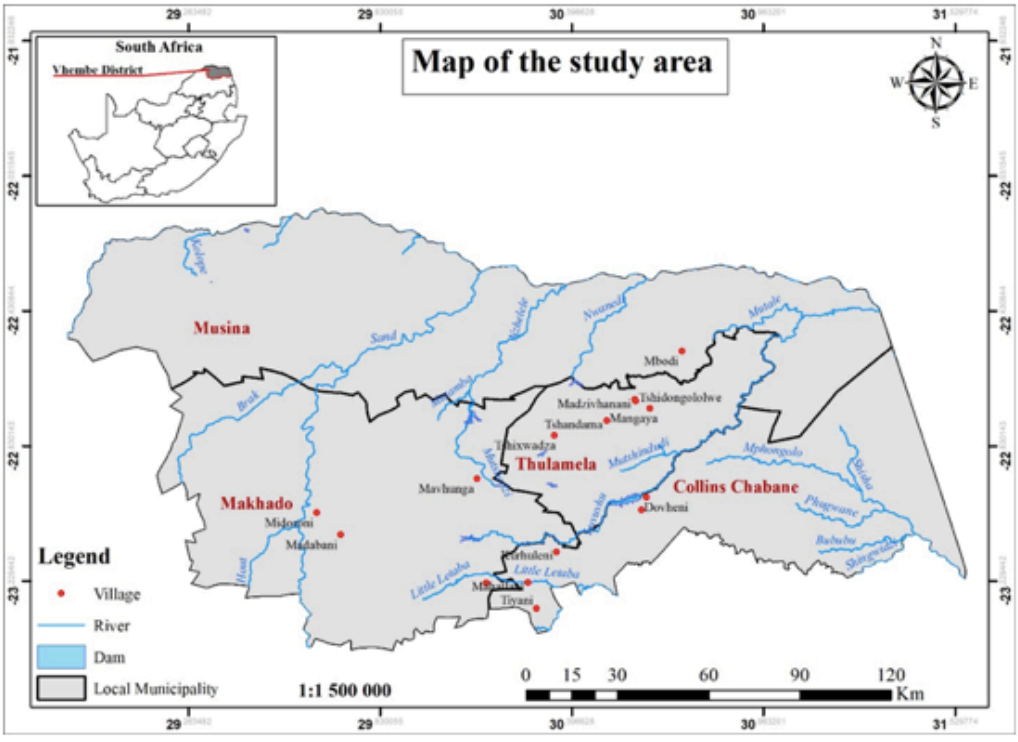
The current study assesses the existing provision of water services and community's perceptions of the water supply amid the coronavirus pandemic. Inasmuch as data on per capita consumption is available in some of the villages, the information remains fragmented and does not give a clear picture of the complex situation on the ground. Findings of the study are thus of importance to the wider community as they identify some of the challenges hampering water provision in the local municipalities and how these can be addressed.

Research Approach

Study Area Description

The study was carried out in selected rural wards of the four local municipalities in VDM in Limpopo Province of South Africa. VDM was established in 2000 and is the largest of the five Districts in Limpopo Province (Figure 1). The district is mainly rural (85%) and consists of four local municipalities, namely Musina, Thulamela, Makhado and Collins Chabane. The District has a population of approximately 1 240 035 people and 287 190 households.

Figure 1: Vhembe District Municipality Map showing the location of the selected villages



Data Collection

Structured questionnaires were used to collect information from the heads of households. The questionnaire collected information on the respondents' demographics, the extent and effectiveness of supply of portable water, challenges related to accessing potable water and community's copying strategies. The questionnaires were administered to the

household heads by the researcher with the aid of two field assistants during the period February 2020 to April 2020. To ensure validity, triangulation of the sources of data was applied by using data from the secondary sources and field observation to substantiate and complement data collected from the household survey with household heads.

Calculation of Sample Size

From the 89 rural wards in the 4 municipalities, 14 wards were proportionally and purposefully chosen based on their history of potable water challenges. The 14 wards were distributed as follows: 5 from Collins Chabane, 4 from Thulamela, 4 from Makhado and 1 from Musina local municipality. From these wards, households relying solely on municipal water were identified with the aid of the ward councilors.

Raosoft online sample calculator (Raosoft, 2020) was used to determine the sample size as presented in Table 1. The population was set as determined by a preliminary survey with the aid of the ward councilors, the response distribution was set at 50%, the power at 80% and margin of error and confidence interval were set at 5% and 95% respectively.

Table 1. Distribution of the population and the sample size

Municipality	Households eligible	Calculated sample size	Percent in the sample
LIM 345	273	160	35.7
Makhado	190	128	28.6
Musina	34	32	7.1
Thulamela	191	128	28.6
Total	688	448	100

To select the households, a convenience approach was used based on the ease of accessibility of the household heads until the desired number of households was achieved in the respective wards.

Data Analysis

Data analysis was conducted using Statistical Package for Social Sciences (SPSS version 25.0). Percentages and frequencies were used to report descriptive data and Chi square test was used to report association between independent and dependent variables. Gender, age, municipality, and the source of water being used were used as independent variables and respondents' satisfaction with the water provision service as the outcome variable to identify factors associated with satisfaction. Statistical significance was established at $p < 0.05$.

Results and Discussion

Respondents' characteristics

The demographics of the sample are presented in Table 2. The sample was dominated by females (57.1%) compared to males (42.9%), since the study area has a lot of female-headed households. Age groups 30-39 years (45.3%) and 40-49 years (29.7%) dominated the sample. With regards to education, most of the respondents; 32.4% completed matric, with 31.9 having attained secondary school education and 22.3% having attained primary school education. Approximately half of the respondents (42.9%) had households of more than four members, 35.5% had households of four members, 17% had households of three members and only 4.7% had households of two or less members.

These findings were in line with De Cock et al. (2013) who found that most rural households in the province had a size of 6.5 members, the average household head was 56.1 years old and most household heads generally had low level education.

Table 2. Description of Respondents

	Household heads	
Characteristics	**N**	**%**
Gender		
male	192	42.9
female	256	57.1
Age		
18-29yrs	54	12.1
30-39yrs	203	45.3
40-49yrs	133	29.7
≥50yrs	58	12.9
Household size		
2 people	21	4.7
3 people	76	17
4 people	159	35.5
>4 people	192	42.9
Level of education		
None	5	1.1
Primary	100	22.3
secondary	143	31.9

matric	145	32.4
tertiary	45	10
Postgraduate	10	2.2

Extent and Effectiveness of Supply of Portable Water in the Villages

Findings of the survey in Table 3 show that most of the households 45.3% and 35.3%, rely on borehole and municipal (piped) water respectively, for domestic use, with a few relying on rivers, springs/wells, and water tankers. More than half (54.5%) of the households have their main water source outside the yard. Regarding the frequency of use of the water source, only 30.1% indicated that they used the source daily and the majority (53.6%) indicated that they used the source at least once a week.

South Africa being a dry country (Mutamba, 2014) has many rural communities that rely on untreated ground and surface water for their day to day use (Amis & Lugogo, 2018). Rural dwellers of Limpopo Province have limited water options due the province's unfavorable topography, arid climate and sandy rivers (Odiyo & Makungo, 2012). According to Makaya et al. (2020), the vulnerability of the province to droughts means communities rely on a variety of sources of water for both irrigation and domestic use.

Table 3 also shows that more than half of the households have their main water source outside of their yards. It was thus not surprising that only 37.3% of the households spend less than an hour collecting water, with some (9.6%) spending more than five hours to collect water on daily basis. Contrary to our findings, Coetzee et al. (2016) found that approximately 98% of the rural households that participated in their study sourced water from a tap which was within their yards. Consistent with our finding, a study by Edokpayi et al. (2018) in rural areas of Limpopo province found that school children and some adults spend long hours collecting water from different sources due to prolonged periods without tap water.

In this study, the majority of the respondents were spending between 1-5 hours to collect water daily. In line with these findings, Tantoh & McKay (2020) reported that residents of Northwest Cameroon were spending 72 minutes daily in fetching water and in some instances the times were longer when there were long queues at the community taps. Hove et al. (2019) found that rural residents in the Mpumalanga Province (South Africa) were spending 103 minutes on average (for a round trip) when they had to collect water from alternative sources. According to Tantoh & McKay (2020), the World Health Organisation (WHO) regards distances under one hour as reasonable.

Table 3 shows that the households relied on buying water as an alternative when their main water source fails. Quantities collected from alternative sources were found to be less than 100 liters per day. Consistent with these findings, Hove et al. (2019), found average consumption of 42 liters per individual per day and Tantoh and McKay (2020) reported 24.7 liters per person per day.

Table 3. Extent and effectiveness of supply of portable water

	Household heads	
Issue	**N**	**%**
Main Source of water		
borehole	203	45.3
Municipal (piped)	158	35.3
rivers	18	4
springs/wells	24	5.4
water tanker	45	10
Location of water source		
inside yard	204	45.5
outside yard	244	54.5
Frequency of use		
daily	135	30.1
once a week	240	53.6
once a month	66	14.7
once in 6 months	6	1.3
once per year	1	0.2
Time spent collecting		
< 1 hour	167	37.3
1- 2 hours	112	25
2-5hours	126	28.1
>5hours	43	9.6
Alternative source		
buy	330	73.7
water tanker	17	3.8
aquifer	31	6.9
river	38	8.5
other	32	7.1
Quantity of alternative		
<100 litres	250	55.8
100-250 litres	137	30.6
251-500 litres	38	8.5
501-1000 litres	19	4.2
Above 1000 litres	4	0.9
Cost to buy water		
< R10	230	51.3

R10-R35	97	21.7
> R35	48	10.7
free	73	16.3
Challenges		
system breakdown	204	45.5
lack of skills	212	47.3
ageing infrastructure	32	7.1
Suggestion		
more source	299	66.7
maintain systems	149	33.3

Availability and Maintenance of Infrastructure

- *Boreholes and Water-Points*

Findings of the field survey in Table 4 show that, of the thirty-eight (38) boreholes in the sampled communities in VDM, only eleven (11) (28.9%) were functional and twenty-seven (27) (71.1%) were dysfunctional. In addition to non-functionality of the boreholes, provision of piped water was observed to be erratic due to the ageing infrastructure and poor maintenance. These findings were also supported by the findings of the survey in Table 3 where 45.5% of the respondents pointed to system breakdowns and lack of skills within the municipalities to maintain the systems (47.3%) were pointed as the main causes of potable water problems. To remediate these challenges, the communities suggested installation of more water points (sources) (66.7%) and better maintenance of the system (33.3%) to avoid water problems in the villages (Table 3).

Mudau et al. (2017) also found unavailability of potable water in VDM as a common phenomenon and this was attributed to failure of infrastructure and the reduced capacity of boreholes and wells. Hove et al. (2019) also reported malfunctionality and unreliability of water infrastructure in rural Mpumalanga. Long durations without repairs and maintenance, lack of community ownerships and vandalism of infrastructure were also reported by Hove et al. (2019). The WHO & UNICEF (2013) agrees with these findings that lack of capacity of officials to maintain infrastructure remains the main problem affecting water supply especially in the rural areas.

- *Water Tankers*

The VDM records showed that they have fifteen water tankers to deliver water to the communities particularly when there are breakdowns to the system. Of these fifteen water tankers that service households in the VDM only two (2) were functional during the time of data collection, making the situation dire when there is breakdown of boreholes and severe water shortage like in drought seasons. The constant breakdown of the water tankers is an indication of ageing infrastructure and lack of maintenance thereof.

Coetzee et al. (2016) also reported the dependence on municipal water trucks in rural Northwest Province due to inconsistent water supplies and infrastructure related problems. The same was reported by Hove et al. (2019) who found that water tankers in most cases relieve rural communities in Mpumalanga Province. However in a study by Mudau et al. (2017), rural dwellers of VDM expressed disappointment with the inconsistent delivery of water by tankers which sometimes disappear for up to two weeks.

Table 4. The State of boreholes per village in VDM

Municipality	Villages	Number of boreholes	Functional
Thulamela	Mangaya	0	0
	Tshandama	0	0
	Madzivhanani	0	0
	Tshidongololwe		
	Tshixwadza	3	1
Collins Chabane	Kurhuleni	4	1
	Mahathlani	1	1
	Akani (Tiyani)	5	2
	Dovheni	1	1
	Khakhanwa	3	0
Makhado	Madabani	3	0
	Midoroni	12	3
	Mashamba	3	1
	Mavhunga	1	0
Musina	Mbodi	2	1
Total		38	11

Community's Perceptions on Water Provision Services

Respondents were asked to evaluate the water provision services they are receiving from their respective municipalities based on the quantity of water received, the quality of water received, the distance travelled to collect water, the quantity of water from alternative sources, reliability of water supply system and effectiveness of community participation. Table 5 shows the gender-based perceptions/evaluation of the water provision services. Based on the findings of the survey in Table 5, a higher proportion of females were satisfied with the six aspects of the water provision services compared to

males. Except for satisfaction with quantity of water received and reliability of the water supply system, the majority of the females (more than 50%) were satisfied with the other aspects of the service.

Since most women and children are responsible for collecting water in the villages, it can be deduced that the households are satisfied with the quantities and the reliability of the water provision service. However, Coetzee et al. (2016) did not find any association between perceptions related to water and also the Sarah Slabbert Associates (2016), did not find any gender differences in the perceptions of the safety of municipal tap water.

Table 5. Gender–based perceptions on water provision services

Responses	Proportion of respondents who are satisfied, (count)% (n=448)		Cramer's V	Significance
	male (n=192)	female (n=256)		
Satisfaction with quantity of water received	(10)5.2[a]	(95)37.1[b]	0.373[2]	***
Satisfaction with the quality of water received	(0)0.0[a]	(164)64.1[b]	0.658[2]	***
Satisfaction with the distance travelled to collect water	(26)13.5[a]	(157)61.3[b]	0.481[2]	***
Satisfaction with quantity of water from alternative source	(7)3.6[a]	(230)89.8[b]	0.855[3]	***
Reliability of water supply system	(10)5.2[a]	(68)26.6[b]	0.279[1]	***
Effectiveness of community participation	(33)17.2[a]	(227)88.7[b]	0.717[3]	***

*= P < 0.05, **= P < 0.01, ***= P < 0.001, n.s= not significant; Proportions with similar superscripts are not statistically different from each other; [1]=no/weak relationship; [2]= moderate relationship; [3]= strong relationship; ( ) = count and outside bracket is the percentage

It is possible that water-based perceptions can vary among generations (for example some traditional practices may be more common in older people that young people), so it was deemed necessary to evaluate the age-based perceptions of the water provision services in the study area. Findings of the survey in Table 6 show that generally younger respondents (age groups 18-39 years) were significantly not satisfied with the six aspects of water provision evaluated in the study. On the other hand, the older participants (40

years and above) were satisfied with the quantity of water they were receiving from both the primary and alternative sources and the effectiveness of community participation.

In a related study, Drimili et al. (2019) looked at practices and perceptions of residents of Athens (Greece) and their satisfaction with the water being supplied. Unlike our findings, where the majority of the respondents were not satisfied with both the quality and quantity of the water being supplied, Drimili et al. (2019) found that the majority of Athenians (66.9%) were satisfied with the quantity and only 33.2% were satisfied with the water quality.

Unlike our findings, the Water Research Commission (2016) found that most South African are generally positive about the safety of tap water. The Sarah Slabbert Associates (2016) also found that young people (age 16-34 years) were more satisfied and positive about the safety of municipal tap water compared to older people (age 50+ years), unlike our findings which showed the opposite (Table 5). When it comes to the general perception with the municipal service, the Sarah Slabbert Associates (2016) found that age group 35-49 had significantly negative perceptions about the service and the older age group (50+ years) were the most positive. Our findings can thus be explained by the fact that young people in the study area are better informed due to their exposure to the internet and science in school and likely to have a better understanding of issues related to water provision in the area.

Table 6. Age–based perceptions on water provision services

Responses	Proportion of respondents who are satisfied, (count)% (n=448)				Cramer's V	Significance
	18-29yrs (n=54)	30-39yrs (n=203)	40-49yrs (n=133)	≥50yrs (n=58)		
Satisfaction with quantity of water received	(4)7.40[a]	(13)6.40[a]	(62)46.60[b]	(26)44.80[b]	0.461[2]	***
Satisfaction with the quality of water received	(0)0.00[a]	(31)15.30[b]	(79)59.40[c]	(54)93.10[d]	0.635[2]	***
Satisfaction with the distance travelled to collect water	(4)7.40[a]	(85)41.90[b]	(64)48.10[b]	(30)51.70[b]	0.262[1]	***
Satisfaction with quantity of water from	(0)0.00[a]	(72)35.50[b]	(111)83.50[c]	(54)93.10[c]	0.621[2]	***

alternative source						
Reliability of water supply system	(4)7.40[a]	(13)6.40[a]	(34)25.60[b]	(27)46.60[c]	0.37[2]	***
Effectiveness of community participation	(0)0.00[a]	(79)38.90[b]	(123)92.50[c]	(58)100.0[d]	0.688[2]	***

*= P < 0.05, **= P < 0.01, ***= P < 0.001, n.s= not significant; Proportions with similar superscripts are not statistically different from each other; [1]=no/weak relationship; [2]= moderate relationship; [3]= strong relationship; ( ) = count and outside bracket is the percentage

According to the study conducted by the Sarah Slabbert Associates (2016), communities mostly rely on their municipalities for the provision of potable water and the testing to assess the quality. Findings of the survey in Table 7, show that respondents in the four municipalities were not satisfied with the quantity of water they were receiving except for respondents drawn from Musina municipality. Similarly, households drawn from Musina were also significantly satisfied with the reliability of the water provision.

With regards to satisfaction with the quality of the water they were receiving, Table 7 shows that respondents from all the 4 municipalities are not satisfied with the quality of the water but a significantly high proportion of the respondents from Musina are satisfied with the quality. Satisfaction with quantities of water in respondents from Musina can be attributed to the fact that the other three municipalities rely mainly on municipality treated piped water and residents of Musina rely mainly on groundwater.

Omarova et al. (2019) also reported differences in satisfaction levels based on the respondents' location because used water sources differed with locations. They, Omarova et al. (2019) found that respondents who resided in areas where boreholes and wells were the main source were mostly satisfied with the reliability and the quality of the water, unlike respondents in areas where they relied on open sources.

The general dissatisfaction with the water provision services among the respondents is a common phenomenon with many rural districts and municipalities in South Africa. Contrary to our findings, the Water Research Commission (2016), found that approximately 72% of urban water users are positive about the competency of their municipalities in providing safe water and basic sanitation. Our findings corresponded to Sartorius & Sartorius (2016), who reported the endemism of poor service delivery in South Africa's poor rural districts. Sartorius and Sartorius (2016) blame this to lack of resources, skills and infrastructure in these rural municipalities.

When it comes to satisfaction with the reliability of the service, respondents in the four municipalities were not satisfied with the quantity of water they were receiving except for respondents drawn from Musina municipality. This is mainly due to the fact that these respondents relied on boreholes and did not experience many breakdowns compared to respondents from other municipalities who relied mainly on treated water from reservoirs which was supplied by municipalities. When it comes to the distance being travelled to fetch water, except for respondents from Collins Chabane, the respondents from the other three municipalities were not satisfied with the distances they were travelling to collect water.

Another important aspect in rural water provision is community participation and a sense of ownership. Regarding satisfaction with community participation, a significant majority of the respondents from Musina and Thulamela municipalities (>50%), indicated satisfaction compared to less than 50% of the respondents from Collins Chabane and Makhado who expressed satisfaction. This was expected as the respondents from these two municipalities also expressed higher satisfaction levels with the quantity of water they were receiving and the reliability of the system. According to Tantoh & McKay (2020), the participation of rural communities is important in many projects as it gives them a sense of belonging and is a mandatory requisite for sustainable and reliable water systems in rural setups.

Table 7. Municipality–based perceptions on water provision services

Responses	Proportion of respondents who are satisfied, (count)% (n=448)				Cramer's V	Significance
	Collins Chabane (n=160)	Makhado (n=128)	Musina (n=32)	Thulamela (n=128)		
Satisfaction with quantity of water received	(36)22.5[a]	(0)0.0[b]	(32)100.0[c]	(37)28.9[a]	0.571[2]	***
Satisfaction with the quality of water received	(73)45.6[a]	(57)44.5[a]	(0)0.0[b]	(34)26.6[c]	0.272[1]	***
Satisfaction with the distance travelled to collect water	(131)81.9[a]	(4)3.1[b]	(14)43.8[c]	(34)26.6[c]	0.664[2]	***
Satisfaction with quantity of water from alternative source	(108)67.5[a]	(60)46.9[b]	(0)0.0[c]	(69)53.9[a,b]	0.339[2]	***
Reliability of water supply system	(0)0.0[a]	(5)3.9[a]	(32)100.0[b]	(41)32.0[c]	0.702[3]	***
Effectiveness of community participation	(79)49.4[a]	(61)47.7[a]	(25)78.1[b]	(95)74.2[b]	0.257[1]	***

*= P < 0.05, **= P < 0.01, ***= P < 0.001, n.s= not significant; Proportions with similar superscripts are not statistically different from each other; [1]=no/weak relationship; [2]= moderate relationship; [3]= strong relationship; ( ) = count and outside bracket is the percentage

Findings of the survey in Table 3 reflected that, regardless of the municipality, households use different sources of water both as primary and alternative sources. Such sources included borehole, municipal (piped), rivers, springs/wells, and water tankers. It was thus important to evaluate the household's satisfaction with the water provision based on the sources of water they were using. Findings of the survey in Table 8 show that, except for users of spring/wells, the respondents indicated dissatisfaction with the quantity of water they receive. Normally water services from other sources such as boreholes, tankers and municipal treated water are limited or pay as you use services and thus quantities are expected to be limited. In addition, sources such as springs where most users expressed satisfaction with the quantities ordinarily offering uninterrupted supply, whereas other sources are subject to breakdowns and cuts hence significantly higher satisfaction levels in both quantities and reliability as shown in Table 8.

Levels of satisfaction with the quality were significantly high in users of water tankers (100% of the respondents), users of springs/wells (95.8% of the respondents) and users of dam water (60.1% of the respondents). There was dissatisfaction with the quality of water received by users of borehole and river water (0.5% and 0.0% respectively expressed satisfaction) (Table 8). Generally, the quality of river water or any other unprotected source for domestic use is undesirable as it is subject to various forms of pollution. High satisfaction levels with the quality of water tankers and municipal piped water are attributed to the fact that these two water sources are the same as they are both chemically treated and regularly tested to ensure consumer safety. A study by Edokpayi et al. (2018) supports these findings as they found municipal tap water in various villages of Limpopo to be complying with the South African regulations. However, borehole water in many villages of Limpopo has been reported to be contaminated with various contaminants ranging from chemical to microbial. High fluoride levels in groundwater has been reported by Mudzielwana et al. (2016) and Odiyo & Makungo (2012) and significant levels of coliform bacteria mainly from septic tanks contamination have been reported by Odiyo & Makungo (2012).

A very strong relation was reported between level of satisfaction of distance travelled to collect water and water source used. A huge proportion (95.8%) of the springs/wells users expressed satisfaction with the distance they travel to collect water and this can be compared to 50.6% of the respondents who use dam water, 37.8% of respondents who use water tankers, 31.0% of respondents who use borehole water and 0.0% of respondents who use river water who expressed satisfaction with the distance. Except for users of borehole water (14.8% who expressed satisfaction), users of other sources expressed satisfaction with the quantity of water they get from alternative sources (Table 8).

Previous studies have also shown a correlation between water source and the perceived quality. A study by Wright et al. (2012) found that contrary to our findings, consumers of groundwater associated it with good quality and safety and users of municipal tap water did not associate it with safety and good quality. Omarova et al. (2019), however found that households which used wells and other open sources were not satisfied with the quality and reliability of their water sources compared to users of borehole and municipal tap water. Hove et al. (2019) on the other hand, did not find any differences in the satisfaction levels with regards to reliability and quality among users of groundwater, in-house taps and communal taps.

Table 8. Source of water–based perceptions on water provision services

Responses	Proportion of respondents who are satisfied, (count)% (n=448)					Cramer's V	Significance
	Borehole (n=203)	Dam (tap) (n=158)	River (n=18)	Springs/wells (n=24)	Water tanker (n=45)		
Satisfaction with quantity of water received	32(15.8)[a]	34(21.5)[a]	2(11.1)[a]	24(100.0)[b]	13(28.9)[a]	0.442[2]	***
Satisfaction with the quality of water received	1(0.5)[a]	95(60.1)[b]	0(0.0)[a]	23(95.8)[c]	45(100.0)[c]	0.785[3]	***
Satisfaction with the distance travelled to collect water	63(31.0)[a,b]	80(50.6)[c]	0(0.0)[b]	23(95.8)[d]	17(37.8)[a,c]	0.357[2]	***
Satisfaction with quantity of water from alternative source	30(14.8)[a]	120(75.9)[b]	18(100.0)[b,c]	24(100.0)[b,c]	45(100.0)[c]	0.716[3]	***
Reliability of water supply system	32(15.8)[a]	0(0.0)[b]	7(38.9)[a]	24(100.0)[c]	15(33.3)[a]	0.600[2]	***
Effectiveness of community participation	30(14.8)[a]	143(90.5)[b]	18(100.0)[b]	24(100.0)[b]	45(100.0)[b]	0.801[3]	***

*= P < 0.05, **= P < 0.01, ***= P < 0.001, n.s= not significant; Proportions with similar superscripts are not statistically different from each other; [1]=no/weak relationship; [2]= moderate relationship; [3]= strong relationship; ( ) = count and outside bracket is the percentage

Conclusion

VDM being a dry and semi-arid area, the communities rely on a variety of water sources with the main water source being boreholes and most households have their main water sources outside of their yards. Residents still spend a significant amount of time travelling to fetch water with some spending more than five hours daily to collect water. Many boreholes in the participating communities were not functional and in most cases water tankers were used to assist communities in times of system failures, but these were also not well maintained and, in most cases, unavailable. Among the major constraints to the local municipalities' ability to provide a reliable service were lack of skilled manpower, planning and inadequate allocation of resources and infrastructure. Generally, the respondents were not satisfied with the quantity, quality of the water, distance travelled and reliability of the service. Female and older respondents had positive perceptions about the water service compared to males and younger respondents. Respondents relying on springs, water tankers and municipal tap water had positive perception about their water quality compared to respondents relying on boreholes, and respondents relying on boreholes were happier with the quantities compared to the other groups.

The findings indicated that water provision in rural VDM remains a serious challenge and thus needs immediate intervention in the light of curbing the spread of the coronavirus. It is thus recommended that both the municipalities and the provincial government prioritize interventions aimed at improving household's access to potable water. Such interventions need to be tailor-made to suit the unique situation of each local municipality and/or village and should focus on maintaining and upgrading the existing infrastructure. It is also recommended that Local municipalities hire skilled personnel and improve their planning and resource allocation towards the maintenance and operation of water infrastructure. In addition, the local municipalities also need to involve communities more in water related issues for better planning and sustainable provision of a reliable water service in rural areas.

There is no silver bullet in addressing the issues of water service delivery by the local municipalities, but as suggested by previous researchers such as Mubangizi (2019), for the municipalities to deliver on their service delivery mandate, they will need to work with various stakeholders such as community members, civil organizations and NGOs. The involvement of local communities is also mandated by section 152(1) of the South African constitution. The "service delivery and implementation networks" model as suggested by Mubangizi, (2022) would probably be a suitable model for the district and local municipalities to adopt as this advocates for a web of interconnected role players who will be sharing ideas and resources such as funds, skilled manpower, bringing community

members together and ensure that municipalities work together with different role players to achieve optimum water provision services.

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