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INTERVENTION STRATEGY FOR EFFECTIVE WATER SUPPLY SYSTEM TO RURAL COMMUNITIES IN VHEMBE DISTRICT, SOUTH AFRICA

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Abstract. Consistent access to potable water remains a major challenge among communities in rural areas of Vhembe District Municipality (VDM). This is due to the high frequency of water supply infrastructure breakdown due to obsolete infrastructure and inadequate involvement and participation of rural communities in paying for water and maintenance which affect sustainability of water supply system in VDM. This study assesses current state of water supply, challenges and effectiveness of measures in place in order to propose intervention to improve rural water supply system in VDM. The study followed a mixed method research design, which include both qualitative and quantitative methods. Data was analysed using thematic content analysis and chi-square test. The study established that water is inconsistently supplied in VDM. As about 53.5% of the respondents received water once per week which necessitate intervention to improve the situation. All the respondents from the four local municipalities of Vhembe District were not satisfied with the quantity of water received and distance travelled to collect water. The study recommend intervention strategy which included that local management structure to be established and terms of reference agreed with communities including more water supply sources options to be added.

Keywords: potable water, rural communities, strategy, water supply systems, effectiveness

INTRODUCTION

Potable water supply is a fundamental basic human right protected by international conventions and national laws (WHO, 2014). For communities to lead a healthy, productive, and dignified lifestyle, access to an adequate supply of potable water is indispensable (Haylamicheal and Moges, 2012; WHO, 2014). In addition, the reality is that about 884 million people in the world still use unprotected potable water sources like springs, fountains, wells and ponds that are open to contamination, leading to waterborne diseases. This fact often exacerbates the spread of waterborne diseases, which cause loss of life (WHO, 2014). As a result, over one billion people were reported to be affected by waterborne diseases associated with inadequate potable water supply throughout the world (WHO, 2015; Rodriques et al., 2015).

In Latin America, people who lack potable water access are estimated at more than 36.8 million (Akhmouch, 2012; De Souza and Da Silva, 2014). De Souza and Da Silva (2014) further indicated that poor maintenance of water supply infrastructure and sources still constituted a challenge in rural communities (Tshikolomo et al., 2012). Furthermore, water loss results from ageing infrastructure and inadequate operation and maintenance of water supply systems. Southern Asia and sub-Saharan Africa countries continue to struggle with the supply of safe drinking water as significant proportions of their

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populations still use unprotected water sources such as fountains and rivers.

Marshall (2013) and Tshikolomo et al. (2012) argued that the challenge to the rural water supply is due to poor management of potable water supply sources, population growth and drought. WHO (2014) highlights the monitoring, weak capacities of countries to implement plans, insufficient funding for infrastructure and lack of enough maintenance as the root cause of potable water challenges in rural communities. In addition, Mavhungu (2011) stated that municipalities do not have cost recovery plans to collect revenue to ensure the sustainability of water systems. Therefore, the state of potable water supply seems to be a challenge in many countries resulting from the non-involvement of water users in the maintenance and cost recovery of water supply systems.

The South African government put in place various policies to address potable water supply systems in rural communities to address the legacy of apartheid. The Free Basic Services Policy of 2000 guarantees each household access to a basic supply of 25 litres of water for a person per day. Despite this fact, the country still faces difficulties in implementing water policies in most rural municipalities. Ngcamu (2019) revealed that the prevalence of water service delivery protests in South Africa is an indication that the progress made in making potable water accessible to rural communities was inadequate.

The South African Constitution (1996) and other legislation require the national, provincial and district municipality governments to provide potable water to the population. However, most rural district municipalities face numerous challenges in providing potable water to rural areas. Although Vhembe District Municipality, i.e. the study area, is one of the water service authorities in South Africa under the Water Service Act 108 of 1997, it faced numerous challenges. These include aged potable water infrastructure inherited from the previous apartheid government and the former homeland states, financial and human capacity constraints, and the geographical location of the district in a rural area (Vhembe District Municipality Integrated Development Plan, 2009). As the United Nations (2014) earlier alluded to, the intervention for potable water supply systems in rural communities requires countries to have a solid capacity to implement plans and monitor them. Additionally, Pan American Health Organisation (PAHO, 2011) indicated that weak water management strategies result in inadequate or lack of potable water supply.

According to Jagals (2012), water systems in South African rural areas are supplied from the ground through boreholes and surface water from dams; in addition, motorised, diesel and hand pumps were used to draw water from boreholes (Jagals, 2012). Furthermore, public standpipes were the most used systems in many South African rural water supply systems. The literature review suggested that the state of potable water supply systems in rural areas needs serious interventions. In addition, in some countries, effective water supply access is due to many source options to address water supply which would be useful as a baseline and comparative analysis of water supply.

A community management strategy was used to supply rural communities with potable water (Lockwood and Smits, 2011; Tremolet, 2013). Lockwood and Smits (2011) further indicated that water users coordinated by the government establish water committees to manage potable water services, operations and maintenance, house connections, and manage fee payments in most African countries. Community management with local government structure has been legislated and professionalised according to the Indian Ministry (2011). The strategy worked for the Indians to address water shortages. The study further indicated that households have metered connections with user charges. The weakness of the model is that communities have limited capacity to manage technical complex equipment for potable water and regular payments by users. This was confirmed by Jayaramu (2014), Kativhu (2016) and Hoko et al. (2009), who pointed out that residents are willing to pay if they will get a consistent water supply. This model is used in Latin America, India, Ethiopia, and Colombia and some countries in Africa. The success of this model is that rural communities are involved in managing their potable water system.

According to Lockwood and Smits (2011), the municipal management model is a strategy where potable water was supplied, directly or indirectly, by the municipality. Countries that employ this model include Switzerland, Colombia, Latin America, and some countries in Africa, including South Africa. There have been a few successful management incidences of potable water supply using this method in rural areas. However, the weakness of the model is that communities are passive recipients of service.

Lockwood and Smits (2011) indicated that a privately-owned management model is a strategy where the private sector invests in building and operating water supply systems to serve communities. It was further suggested that governments encourage this arrangement when they cannot provide potable water. This model is used in Paraguay, Benin, Kosovo, Senegal and Nigeria. The advantage is that providers transfer water supply infrastructure and skills to communities to run their potable water supply.

According to Moriarty et al. (2013), self-supply is a method where individual households provide their own water supply. The report further indicated that individual households fill the gap where a government is unable to provide a potable water supply. This method is primarily employed in Zimbabwe and Bangladesh, where rural communities are scattered. The advantage is that individual households managed their water systems.

Rural communities struggle to access water supply due to a number of challenges, including poorly designed and ageing infrastructures, according to Johannessen et al. (2014), as this is the main cause of the potable water supply system's ineffectiveness in rural areas. Cobbing (2014) indicated that budgetary constraints hamper the effectiveness of rural water supply systems in most countries. Johannessen et al. (2014) further showed that damaged infrastructure disrupts potable water supply systems in rural areas, which take a long time to fix. Mema and Mothetha (2013) indicated lack of maintenance as the cause of the frequent breakdown of water infrastructure. Furthermore, communities have no option but to collect potable water from unprotected sources when there are water supply disruptions. The study by Naiga et al. (2015) revealed that communities walk long distances to collect water if water is not available in their areas due to the system's breakdown caused by a lack of maintenance. To cope with water supply challenges, rural communities buy water from vendors, and those that cannot afford it collect water from fountains or wells that are not protected from contamination, which is a health risk (Tshikolomo et al., 2012; Adeoye et al., 2013; Tadesse et al., 2013; Ahmed et al., 2015 and Akali et al., 2015).

The quality and quantity of water supplied to Africa are generally inadequate due to technology and costs that are difficult to manage (Rivas et al., 2014) and affect water supply. In addition, unplanned settlements cause a lack of inadequate water supply due to lack of infrastructure as well as financial and technical strength as there is no budget available to cater to the water supply systems that were not planned. Obeta and Nkwankwo (2015) mentioned the lack of operations and maintenance of infrastructure in most water institutions as the main challenge due to the lack of skilled technicians, operators and maintenance specialists in rural areas where groundwater is the only water source. Mema and Mothetha (2013) stated that poor maintenance and operation of borehole pumps, reservoirs, pipes and street pipes caused water supply challenges. The management of water supply systems in rural communities is still a challenge. The study seeks to propose an intervention strategy to improve water supply systems in rural communities of VDM. The article aims to answer the following question: What intervention strategy could improve the rural water supply system in VDM?

MATERIAL AND METHOD

Study area

The study was carried out in selected rural wards of four local municipalities in the Vhembe District (VDM) in Limpopo Province of South Africa. VDM was established in 2000 based on the Local Government Municipal Structures' Act 117 of 1998 (Vhembe Integrated Development Plan, 2010), and it is the largest and mainly rural of the five districts in the Limpopo Province (Fig. 1). The district comprises four local municipalities, namely Musina, Thulamela, Makhado and Collins Chabane (Vhembe District Municipality IDP, 2009). Vhembe District Municipality continuously struggles with a large backlog in providing essential services, including the provision of potable water to rural communities (Vhembe District Municipality IDP, 2009).

The district's political, administrative and commercial centre is Thohoyandou; the district has approximately 1,240,035 inhabitants, including 287,190 households according to the Vhembe Integrated Development Plan (2012/13–2016/17). Thulamela local municipality has the largest population (602,819) of the four local municipalities and covers approximately 5,835 km² (Thulamela Municipality Integrated Development Plan, 2016/17). It also has the highest number of wards (41), followed by Makhado Local Municipality (39), the newly formed Collins Chabane Local Municipality with 36 and Musina Local Municipality with only 13 wards. Rural wards are distributed as follows: 21 in Thulamela

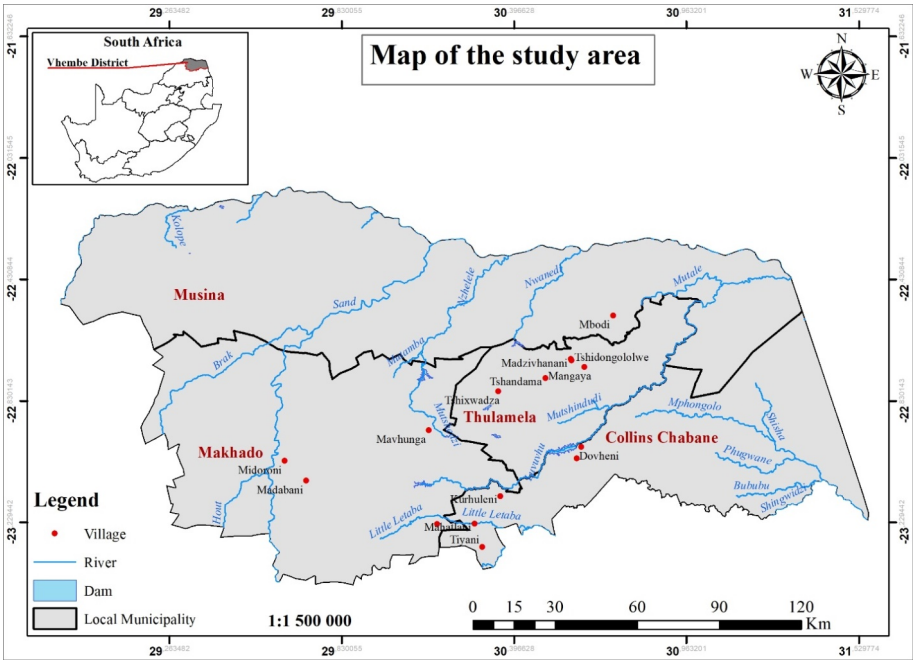

Fig. 1. Vhembe District Municipality map showing the location of selected villages
Source: www.municipalities.co.za

Local Municipality, 7 in Musina Local Municipality, 25 in Makhado Local Municipality and 36 in Collins Chabane Local Municipality (Makhado Integrated Development Plan, 2016/17; Thulamela IDP. 2016/17; Musina IDP, 2016/17 and Limpopo Provincial Government, Gazette No. 2639 and 2654).

STUDY DESIGN

448 household's heads were selected using a simple random sampling method to complete questionnaires. The household head was sampled using the statistical and acceptance protocol by Yamane (1967) sample calculator, which is as follows:

$$\text{Sample size} = \text{Total population} \div (1 + \text{total population}) \cdot (e)^2$$

The total population is 382,358 households according to the national household survey (STSSA, 2016), and 1 is a constant value and $e = 0.05$, which is the error margin. Using Yamane's formula, the answers were provided by 399.58 (which is 400); i.e. 400 households which was initially selected, was then increased by 50, to be 450 households to cater for sample error to enhance accuracy. In the end, about 448 household heads' questionnaires were considered because two were deemed invalid. A combination of qualitative and quantitative methods was used to enhance the study results and compensate for the weakness of the other method. Interviews were held with three municipal officials dealing with water services selected using purposive sampling because of their knowledge and experience in water-related information. About 14 focus group discussions were held in 14 villages selected based on the challenges of water access and availability in their villages with the aim of developing intervention measures to address the situation. Focus group discussion participants were comprised of household heads, traditional leaders or their representatives and councillors. The households were selected through a random sampling method, while councillors and traditional leaders were selected through census as their village was part of the study area. Villages were chosen due to persistent and inconsistent water supply challenges in the area. Trained research assistants distributed questionnaires and assisted when interviews were conducted. The study was conducted using thematic content analysis and

Statistical Package for Social Sciences and descriptive statistics, where frequencies and percentages were used to describe and summarise data. Inferential statistics such as chi-square and one-way ANOVA were also used to test any significant differences among the variables in the study. The Kruskal-Wallis test was used to compare the scores on the scales of satisfaction levels on the various aspects of water provision using different water sources. Significant differences ($p < .05$) were reported in all the six aspects measured to determine satisfaction levels with the water provision services based on the source of water used in VDM Focus group discussions, completed questionnaires and interview responses were transcribed, edited and coded. Tables and graphs were used to present the results.

RESULTS AND DISCUSSIONS

Main water sources in local municipalities of Vhembe District

Boreholes (45.3%) are the most common water sources in VDM rural areas. This shows that communities rely on underground water from boreholes for survival in VDM as the primary source. The main sources, according to household heads in the order of availability, were the boreholes. The results from local municipalities of VDM are indicated below: boreholes were used in Musina Local Municipality (100%) as the main source, followed by Makhado Local Municipality at 56.3% and 48.8% in Collins Chabane Local Municipality. Dams were also used as the primary source of water supply: 50% of Collins Chabane use dams as their main source, followed by Thulamela Local Municipality at 42.2%. Rivers were only used by Thulamela Local Municipality as the main source (14.1%). Fountains were used as the main source in Thulamela Local Municipality (18.8%). In Makhado Local Municipality, 25% of households used water tankers as the main source, followed by Thulamela Local Municipality (8.6%) and Collins Chabane Local Municipality (1.3%) (see Table 1). In Makhado Local Municipality, the majority of the people use boreholes as their primary water source. In Makhado Local Municipality, there were three source options: boreholes, piped water from dams and water tankers.

Table 1. Main sources according to VDM local municipalities

Main source	Collins Chabane	Makhado	Musina	Thulamela	Total
Boreholes					
Count	78	72	32	21	2,013
%	48.8	56.3	100	16.4	45.3
Dams					
Count	80	24	0.0	54	158
%	50.0	18.8	0.0	42.2	35.3
Rivers					
Count	0.0	0.0	0.0	18	18
%	0.0	0.0	0.0	14.1	4.0
Fountains					
Count	0.0	0.0	0.0	24	24
%	0.0	0.0	0.0	18.8	5.4
Water tankers					
Count	2	32	0.0	11	45
%	1.3	25	0.0	8.6	10.0
Total	160	128	32	128	448

Source: survey, 2019.

The use of water tankers as the main source is a serious concern in Makhado Local Municipality, according to 25% of the respondents, which indicates that the water supply is in poor condition and needs urgent intervention. Water tankers are only used as an emergency when primary sources are dysfunctional.

In Thulamela Local Municipality, most households depend on piped water from the dams (42.2%), and about 18.8% of respondents indicated their main source as fountains, while about 16.4% relied on boreholes. From the results, it is interesting to note that fountains are the second most used source in Thulamela Local Municipality to supply water in rural areas after surface piped water from dams. The use of fountains and rivers as sources is a serious concern as water from these sources has poor quality and is not protected from contamination. As a result, rural communities contract waterborne diseases. The positive side of the results concerning Thulamela Local Municipality is that they have all five water source options that can supply households with water consistently if managed well. Consequently, Tshikolomo et al. (2012) affirmed that using less safe water sources is dangerous to our health, and this calls for an urgent intervention.

Collins Chabane Local Municipality has three source options. The primary water source was piped water from dams, according to 50% of respondents, followed by boreholes as the other water source mentioned by about 48.8%. Collins Chabane Local Municipality is situated next to the newly built Nandoni dam. In Musina Local Municipality, 100% of respondents indicated boreholes as the main water source. This clearly suggests that Musina Local Municipality has only one source option that might be problematic in times of breakdown, leaving communities stranded. There is a need for more source options to be introduced so that when one option breaks down, another one supplies water to communities. The results were consistent with the study by Doria (2006) findings that boreholes are the main source of water supply in most rural communities.

Frequency of water from main water sources

The findings of the study show that the majority of households (about 53.6) access water sources once a week (Table 2), while 30.1% of households indicated that they have access to water on a daily basis. However, it is concerning that a significant proportion of households stated that they accessed water at least once a month (14.7%), once in six months (1.3%) and once per year (0.2%) (Table 2). The results indicate that the rural water supply system in VDM is under pressure to ensure that rural communities get frequent water access as the majority struggles to fetch water daily.

Table 2. Frequency of use of the main water source

Frequency of use	Frequency	Percentage
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	0.3
Total	448	100.0

Source: survey, 2019.

Level of satisfaction with the sources of water according to household heads

The Kruskal-Wallis test was used to compare the scores on the scales of satisfaction levels on the various aspects of water provision by different water sources. Significant differences ($p < .05$) were reported in all the six aspects measured to determine satisfaction levels with water provision services based on the source of water used in VDM (Table 3). For example, with regards to satisfaction with the quantity of water provided, borehole, dam, and river water users expressed dissatisfaction (mean score rating below 5) (Table 3). This was because they did not receive water daily, whereas users of spring/wells and water tankers expressed satisfaction (mean score ratings above 5).

The findings in Table 4.9 show that users of boreholes and river water were not satisfied with the quality of water (mean score ratings below 5). In contrast, users of dams, fountains and water tankers were satisfied (mean score ratings above 5). Some households seemed not to understand the meaning of water quality, with the users of water tankers being the most satisfied (mean score of 8.0). When it comes to satisfaction with the distance travelled to collect water, users of water from dams, springs/wells and water tankers were satisfied with the distance they travelled (mean score ratings above 5) compared to users of boreholes and river water, who were not satisfied with the distances they had to cover to fetch water (mean score ratings below 5) (Table 3).

Table 3. The satisfaction level with the source of water used

	Borehole Mean (SD)	Dam Mean (SD)	River Mean (SD)	Fountain Mean (SD)	Water Tanker Mean (SD)	Significance
N	203	158	18	24	45	
Quantity satisfaction	2.90(1.69)	4.67(2.3)	4.89(0.58))	6.63(0.92)	5.58(1.96)	< 0.0001**
Quality satisfaction	2.60(1.42)	5.81(2.17)	4.94(0.24)	6.08(0.41)	8.0(0.88)	< 0.0001**
Distance satisfaction	3.97(1.83)	6.13(2.74)	4.94(0.24)	6.08(0.41)	6.0(1.80)	< 0.0001**
Quality of alternative	3.46(1.95)	7.06(2.07)	6.28(0.46)	7.75(0.85)	8.8(1.08)	< 0.0001**
Reliability of system	2.71(2.58)	2.55(1.07)	5.39(0.50)	6.0(0.0)	4.87(1.44)	< 0.0001**
Community involvement	4.26(1.65)	6.73(1.12)	7.67(0.49)	8.42(0.50)	7.56(1.22)	< 0.0001**

* P < 0.05, ** P < 0.01.
Source: survey, 2019.

Users of all water sources, except boreholes, were satisfied with the quality of their alternative sources (mean score ratings above 5). With regards to reliability, river water and fountain/spring/well water sources were reported as reliable (mean score rating above 5), whereas boreholes, dam water and water tankers were considered unreliable (mean score ratings below 5).

Water source options

From 38 of the boreholes in the sampled communities of VDM, only 11 are functional, and 27 dysfunctional. In summary, about 27 out of 38 boreholes are dysfunctional in the selected communities of VDM. This was observed during the fieldwork research in sampled villages. This poses a severe water supply challenge in the district, considering that the boreholes are primary water sources. The water sources were inadequate compared to the increased population of 13,875 households available. The results of the study indicate that the potable water supply system in VDM is ineffective.

Furthermore, the water supply system is in a better state compared to Thulamela Local Municipality and Makhado Local Municipality, where the water supply is also ineffective and includes fewer functional boreholes. Although Thulamela Local Municipality has a mix of water supply options, rural communities cannot cope with water demands and population growth. The reason why communities struggle to get water access is due to the fact that water demand exceeds supply. In Makhado Local Municipality, water tankers temporarily provide water supply to rural communities when such a situation happens. In addition, some of these challenges, according to the focus group, however, had taken many years to be addressed. The non-functionality of boreholes in most villages exposed people to diseases as they had to collect water from rivers and fountains, which are not protected from contamination.

According to municipal officials, out of fifteen (15) water tankers that service households in VDM, only two (2) were functional during data collection. When there is a breakdown of boreholes and drought, the water tankers cannot service the households as few are active. Often the water tankers break down as a result of overuse. The constant breakdown of water tankers is an indication that their life span is reduced or affected as a result. Therefore, water supply remains a problem in some rural communities of VDM. From the results, one can conclude that the water supply system in VDM is ineffective and unsustainable.

Distance travelled to collect water from a water point

Another crucial factor that the study sought to investigate is the water source's distance from the villagers. This was done to gain an insight into the location of the water points in the context of villagers who were older and had no helpers to assist them by fetching water. In VDM, on average, about 59.2% of respondents indicated that the location of the sources is 200 metres away from where they stay, while about 40.8% indicated that

Table 4. Distance between a source and water point by household

			Local Municipality				VDM
			Collins Chabane	Makhado	Musina	Thulamela	
Distance to a water source	More than 200 metres	Count	29	124	18	94	265
		% within municipality	18.1%	96.9%	56.3%	73.4%	59.2%
	Less than 200 metres	Count	131	4	14	34	183
		% within municipality	81.9%	3.1%	43.8%	26.6%	40.8%
	Total	Count	160	128	32	128	448
		% within municipality	100.0	100.0	100.0	100.0	100.0

Source: survey, 2019.

the location of the source is within 200 metres from where they stay. In Collins Chabane Local Municipality, 81.9% of respondents (see Table 4) indicated that water sources are located within the yard, which is 200 metres and below. The results show that Collins Chabane Local Municipality complies with the Water Service Act (1997), suggesting that water is effectively supplied if the distance to its source is within 200 m from the yard. In Makhado Local Municipality, 96.9% of respondents said that their water sources are located more than 200 metres away from the water point (yard). The results in Makhado Local Municipality suggest that household members walk distances in search of water as sources are far from the yard. The implication is that much time is lost for other domestic activities while travelling distances to search for water. In addition, about Musina Local Municipality, 56.3% of respondents revealed that the location of the water point is 200 metres away from the water point. In Thulamela Local Municipality, about 73.4% of respondents indicated that the location of the water point was 200 metres away from the water point.

In Collins Chabane Local Municipality, the majority (about 80% of respondents) stated that water sources were within 200 metres of their households, which is somewhat consistent with the standard requirements specified in the Water Service Act of 1997. On the other hand, the majority of Musina Local Municipality and Makhado and Thulamela Local Municipality residents said that they (more than 50%) travel more than 200 metres in search of water. In Makhado Local Municipality, most households revealed water scarcity as a problem in the area. The results clearly show that in three out of four local municipalities of VDM, household members travel long distances to search for water as the primary source is 200 metres away from the yard, which is inconsistent with the requirements of the Water Service Act (1997), indicating that a water source should be located within 200 metres from the yard. Thulamela, Makhado and Musina Local Municipalities, in terms of location of the water source, the distance travelled to collect water from main sources are not compliant with the constitutional requirements of 200 metres of water point within the yard. This means that communities walk long distances to search for water which then indicates that the water supply system in VDM fails to provide water to the majority of rural communities as per legislative requirements. This calls for the VDM to correct this failure.

This was also confirmed by the findings of the study by Naiga et al. (2015), who pointed out that some rural residents still need to walk more than 200 metres from their yards to fetch water. This shows that VDM has a lot to do to eradicate this discrepancy and provide an adequate water supply system.

Participation of communities in water supply payment

More than 57.4% of respondents in VDM (Table 5) indicated that they are not willing to pay for water services. One of the key reasons stated was that they do not receive water supply consistently in their areas. Only about 46.2% of respondents in VDM indicated they are willing to pay for water services as long as they consistently received the water supply service and correct

Table 5. Willingness to pay for water services expressed by household heads

Willingness to pay	Frequency	Percent
Yes	191	42.6
No	257	57.4
Total	448	100.0

Source: survey, 2019.

billing statements provided monthly. A study carried out by Mavhungu (2011) suggested that failure by the municipality to recover costs from rural water users was the cause of the most public water supply system failure. Jayaramu (2014) revealed that communities are ready and willing to pay for water services when there is a consistent water supply service in their area.

The results from municipal officials indicated that there are communities that paid for the installation of the standpipe inside the yard but did not continue to pay for water supply services. The Statistics South Africa (2016) report indicated that most rural communities are poor and unable to pay; hence water infrastructure was limited as it is not sustainable. The results were inconsistent with findings by Kativhu (2016) and Hoko et al. (2009), who established that rural communities in Zimbabwe make financial contributions to the success of water project through water user committees, including poor households. The literature review indicates that it is possible to convince rural communities to pay for the sustainability of the water project despite their social status. This is contrary to the South African situation where only those that afford it should be made to pay for water services, and in the current circumstances, none are paying in rural areas.

Thus said, there is no set formula on how water users may be involved in paying for water provision services in order to make its availability sustainable. The culture of non-payment has been rife among the rural communities for a long time, and there is a need to engage communities to ensure a sustainable and adequate water supply. Table 6 outlines the views of respondents on payment for water services in VDM. As there are financial constraints due to non-payment for water services by those who can afford to pay for it, the district struggles to provide an adequate water supply to communities.

Maintenance of water infrastructure of the water supply system

The views of the majority of households, councillors and municipal officials suggested that there is a lack of maintenance of water infrastructure in VDM, resulting in frequent breakdowns of the water supply system. Musina Local Municipality is the only local municipality where the maintenance officers were always available to assist households when called to address water problems. The respondents believed that one of the reasons the technicians are reluctant to respond swiftly to the water supply-related concerns is the old and dilapidated water supply infrastructure. In some cases, tear and wear and lack of spare parts contributed to delay in resolving water supply challenges as outlined by municipal officials. The challenges faced by VDM include the ageing water infrastructure, which made it difficult to supply water consistently to the communities living in rural areas, as confirmed by Cothren (2013).

Lack of skilled technicians, operators and maintenance specialists remains the major challenge regarding the supply of potable water in rural areas where groundwater is the primary source of water supply, as cited by respondents in the focus group and municipal officials. The studies by Obeta and Nkwankwo (2015) and WHO (2014) agree with the findings that unskilled and incompetent officials are the main problem affecting rural water supply systems. Cobbing (2014) emphasised that most municipalities have an inadequate budget to cater for the operational and maintenance needs of water supply systems. The results were confirmed by Mema and Mothetha (2013), who observed that poor maintenance of borehole pumps, reservoirs and pipes hampers water supply systems in rural areas.

Challenges of the rural water supply system in VDM

To better understand the water supply situation in the district, a stock of available water sources was taken. It was found out that the district had 38 boreholes in sampled villages. Out of 38 boreholes, only 11 were functional at the time of data collection (Table 6). Compared to the total population of 13,875 in the district, 11 boreholes cannot sustainably provide potable water to such a number of people, posing a significant challenge. It is no wonder that a considerable number of households still depends on unsafe water sources like spring or fountains and rivers. Most of these boreholes

Table 6. Water service-related challenges (household heads)

Challenges	Frequency	Percent
System failure, lack of maintenance, old infrastructure, vandalism and poor security	204	46
Lack of enough resources such as sources, staff and funding	212	47
No communication operating hours and low pressure of water supply	32	7
Total	448	100.0

Source: survey, 2019.

are older than ten years. Due to wear and tear and lack of maintenance, most of them had become dysfunctional. What can be concluded from the state of the main water sources in the study area is that they are not enough to safeguard water and sanitation needs and also that there is frequent breakdown of the system in rural communities of the Vhembe District Municipality. This has a profound implication for the country's vision 2030 developmental aspirations as well as its commitments towards sustainable development goal related to safe drinking and secure water. The logical conclusion of the study is that water infrastructure in the area is old and dilapidated and needs to be replaced with new and modern infrastructure as the VDM's mandate, as stated in the Constitution, is to provide water effectively to communities. VDM relies on groundwater collected through boreholes and surface water from dams as the system. Table 6 shows that 47% of respondents in VDM experience a lack of funds and sources as the main problem in the water supply to households in rural areas. This was followed by the system failure, lack of maintenance, old infrastructure, vandalism and poor security of water sources articulated by 46% of respondents as the main challenges for rural water supply. VDM is responsible for the maintenance of the water supply system in the area.

Coping strategies used when there are water supply problems

To survive water supply challenges, households (about 73.7%) stated they buy from water vendors. Other respondents indicated they collect water from water tankers, fountains (about 3.8%), and other households (8.5%) collect it from rivers. This was confirmed by the following studies by Cook (2016), Ahmed et al. (2015), Akali et al. (2015), Tshikolomo et al. (2012), Cook (2016) and Adeoye et al. (2013) when they pointed out that some failures of the public water supply system force the residents of rural areas to come up with coping strategies that include buying water from vendors, drilling own boreholes and collecting water from rivers and fountains while wealthy residents sink boreholes in their own households compounds. In addition, the focus group results indicated that residents resort to storing water in tanks and containers to cope with water challenges. Table 7 summarises the statistical information about alternative sources when the primary source is not available.

Table 7. Alternative water source in VDM

Alternative source	Frequency	Percent
Buying	330	73.7
Water Tanker	17	3.8
Fountain	31	6.9
River	38	8.5
Other (specify)	32	7.1
Total	448	100.0

Source: survey, 2019.

Proposed intervention strategy to overcome water supply challenges in rural communities of VDM

Based on the findings, the following intervention strategy (Fig. 2 below) is proposed to improve the water supply system in VDM. The following five pillars constitute the proposed strategy suggested as a measure to overcome the water supply system challenges in the Vhembe District Municipality and beyond.

(i) Establishment of a local management structure for its water supply system

There is a need for VDM to establish a Local Water Supply System Management Committee to manage the water supply system from village, ward and local municipality level up to VDM. It is necessary to deepen community involvement in managing the water supply

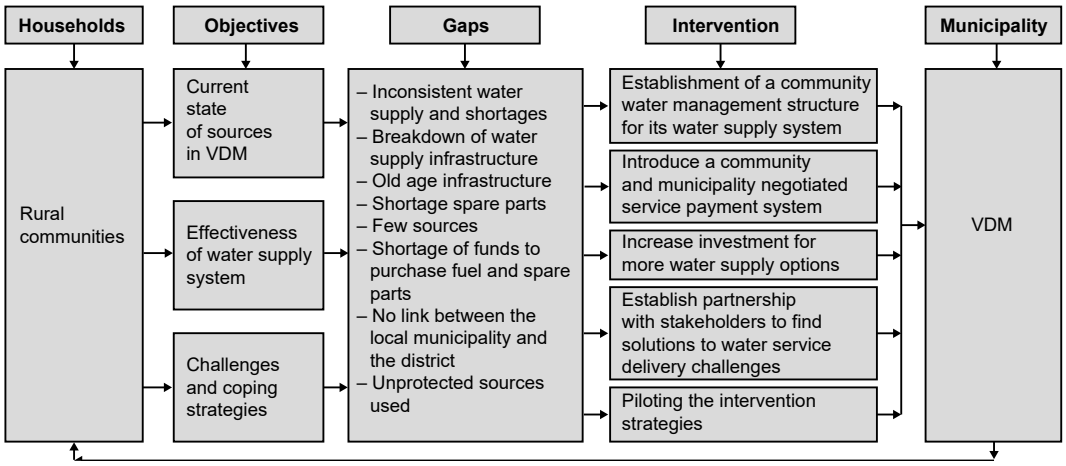

Fig. 2. Intervention strategy to improve VDM water supply in rural communities
Source: survey, 2019.

system in their area. This will assist in resolving many of the water supply gaps in VDM and turn around the response rate by VDM. There is a need for legislative review and amendment to include water committees and their functions in villages in the Local Government: Municipal Systems Act 32 of 2000 and Water Service Act 108 of 1997. There is also a need to link the local municipality and VDM in water supply-related activities for synergy in resolving water challenges. It is required as the current legislation only indicate the district municipality as the water service authority and silent on the local municipality. The structure should assist in reducing illegal connection and unplanned settlement. A toll-free number should be established to report water-related challenges so that they can be speedily resolved.

(ii) Introduce a community and municipality negotiated service payment system

The result revealed that a large number of households are ready to pay for water services if they would grant a consistent water supply. Based on this result, the district municipality should negotiate a position with grassroots communities and together come up with a water payment structure that is acceptable to both sides to improve the water supply. VDM should ensure active community participation and involvement of the grassroots community in terms of payment of water service and maintenances of the system. This will create a sense of ownership of the water supply system. Additionally, there should be the training of the local management committee on minor maintenance, collection of user fees at the village level, and labour to assist in the effective functioning of the systems irrespective of their social status by VDM. Furthermore, communities also need to be involved in monitoring and reporting the water systems on a monthly basis. An option that may be pursued by both the district municipality and the grassroots communities includes seeking donor funding to develop water sources. This would go a long way in increasing the budget to improve the water supply and management of the water supply system. Availability of funds would help the municipality to maintain boreholes, water tankers and piped water system regularly.

(iii) Increase water source options

Additional water source options are necessary where few sources are available, like in Musina and Makhado Local Municipalities. In Musina Local Municipalities, and collaboration with the community members, alternative sources should be identified and established, and the households encouraged to look after such water infrastructure. There is a need to provide additional water source options where there are few or where source options are dysfunctional. Such water options include piped water, boreholes and water tankers for an emergency in case of failure. This will ensure that the distance to a water source is reduced and also quantities of water received will be improved. The use of unprotected

sources will no longer be there if there is a consistent water supply, discouraging the use of unprotected and unsafe water sources.

(iv) Partnership with stakeholders on water service delivery

In order to ensure a seamless and sustainable water supply system, there is a need to introduce a decentralised water supply system management. This could be done by introducing a partnership between the local community members, local municipality, and the district municipality to manage the grassroots community water supply system. Partnerships between the district municipality with the institutions of higher learning like universities and technical and vocational education and training (TVET) colleges need to capacitate communities and place students for internships to improve rural water supply systems. In addition, partnerships with universities and TVET colleges in the area will help provide the needed capacity by local communities and the newly formed water supply management teams or committees to effectively deliver the water project and assist in the placement of their students for experiential learning. Furthermore, the university would continuously engage VDM in research on diverse water-related issues with a view to improve the rural community lifestyles as well as explore placement opportunities for students in water-related activities. Such an endeavour would help speed up the resolution of water-related challenges. There is a need to establish community service for graduates to assist in monitoring, maintenance, and research and data collection for water projects to ensure their maximum functioning rate as more water sources are damaged. Universities and colleges should be responsive to the communities they serve and should assist in addressing community challenges.

(v) Piloting intervention strategies

With the municipality's approval, the proposed intervention strategy will be pilot-tested in selected villages to gauge its effectiveness in addressing the rural water supply challenges before introducing it on a broader scale in the district municipality. Pilot testing will be done in order to establish areas for adjustment before it is implemented in VDM. When the district municipality adopts the pilot-tested strategy, implementation will be initiated to address the water supply challenges. Below is the intervention strategy proposed to improve the water supply in VDM.

CONCLUSIONS

The main sources of water supply in the Vhembe District Municipality are boreholes, followed by piped water from dams. The number of water sources is not proportionate to the population increase. This has largely contributed to their frequent breakdown, rendering communities waterless in the process. The maintenance of infrastructure is not regularly done in both the surface piped water from dams and borehole water from underground, which causes frequent failures of water infrastructure and negatively affects the water supply. The water supply in VDM is not in good shape, and there is a need for intervention to speed up water service delivery. The most difficult situation is observed in poor households, as they end up collecting water from unprotected sources. This is more prevalent in the Makhado Local Municipality, where water is scarce, needing urgent intervention. As Makhado Local Municipality is a drought-prone area, the situation can be resolved by the active involvement of VDM and communities through the provision of more water tankers and the construction of additional dams.

There is a need for VDM to have a specific budget for the construction of new water sources, maintenance, and the purchase of spare parts and the hiring of additional staff. Due to the breakdown and water system source challenges, water supply effectiveness achieved by VDM is still a dream in most rural communities.

Non-payment for water services by households who can afford to pay for it renders the system unsustainable and ineffective. This phenomenon has contributed to the inadequate supply of potable water to rural communities, as VDM struggles to mobilise funds to provide effective portable water services. The most important way to address this anomaly is for VDM to take action against those who default on their water bills payments, especially those who can afford to pay for water services. Also, VDM should establish and help train communities and water committees on the proper management of the water supply system.

This study did not examine the influence of seasonal factors on the water supply system. Also, this study was only limited to VDM's local municipalities. Thus, its findings may not be generalised to the urban settings as it was confined only to VDM's rural communities. In conclusion, VDM may need to adopt the intervention strategy to improve the water supply situation in

the area. Then the strategy may be piloted in some villages experiencing water supply challenges to examine its effectiveness.

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