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Challenges and coping strategies of potable water supply systems in rural communities of Vhembe District Municipality, South Africa

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Abstract: Challenges with respect to potable water supply in Vhembe District threaten the health and welfare of local community. This paper is aimed at assessing the challenges and residents' coping strategies to improve the potable water supply systems in rural areas in Vhembe District Municipality (VDM). Data for this paper was collected from households, councillors, traditional leaders and municipal officials through questionnaires, interviews and focus-group discussions. Qualitative and quantitative research methods were used and thematic content analysis and descriptive statistics were used to analyse data. The results showed that the main sources of water are ground water from boreholes which are used by about 45.3% of the communities, followed by tap water from the dams, by 35.3%, then rivers by 4.0%, fountains by 5.4% and water tankers by 10.0%. Among the identified challenges are: aged water infrastructure, system breakdowns, lack of funding, vandalism of infrastructure and lack of maintenance, operation of infrastructure by unskilled technicians, theft, and non-payment of water services, among others. To cope with water supply challenges, the study recommended that communities play active role in water projects which would include paying of water supply service for its sustainability. They should also play active roles in water committees that will manage, operate and maintain the water supply with the assistance of VDM officials. It was concluded that the rural water supply situation can be improved when communities, government and other relevant stakeholders cooperate and provide solutions and resources.

Keywords: coping strategy, potable water, rural area, Vhembe District Municipality (VDM), water supply systems

INTRODUCTION

Water supply is a fundamental basic human right protected by international and national legislation of many countries, including South Africa [WHO 2014]. Despite this, there are about 884 millions of people globally who continue using unprotected – and usually contaminated – water sources, such as springs, fountain, wells, and rivers, to survive.

According to WHO [2015] and Rodrigues *et al.* [2015], over one billion people globally are affected by waterborne disease due to inadequate water supply which had forced them to use unprotected sources. Mukuhlani and Nyamupingidza [2014] and Adeoye *et al.* [2013] established that potable water supply shortages in Sub-Sahara Africa can be attributed to global warming, drought and population increase. In Africa, although there are countries who are making efforts to improve the state of potable water supply, most rural communities still struggle to get clean water [Itoua 2012].

Schedule 4 and 5 of the Constitution of the Republic of South Africa (Act 108 of 1996) give water supply systems' prerogative to the district municipalities while provincial government's role is that of monitoring, evaluating and supporting. In addition, Section 27 of the Constitution of the Republic of South Africa [1996] further provides that "everyone has the right to have access to sufficient water and sanitation". The national Department of Water Affairs and Sanitation (DWS) is mandated to deliver to communities, equitable and sustained provision of water, of acceptable quality and quantity, as well as sanitation services to provincial, district and local municipalities. Various legislations, such as the "Municipal structures act" [Local

Government 1998], "Municipal systems act" [Local Government 2000] and "White paper on transforming public service delivery" [1997] have emphasized transformation of the municipalities and provision of service delivery, which includes water service.

Johannessen *et al.* [2014] reported that the badly designed and aging infrastructure is the main problem that leads to the ineffective potable water supply system in rural areas. Their study indicated that the broken infrastructure disrupts potable water supply systems in rural areas; these usually take long to fix. When that happens, communities have no option but to collect potable water from unprotected sources. Households' involvement in unplanned settlements is another cause of inadequate water supply; communities in these settlements are subjected to lack of infrastructure, shortage of financial and technical assets as there is no budget available to cater for their water supply systems.

The quality and quantity of water supplied in Africa is generally inadequate due to operators' inability to manage some of the sophisticated water technologies currently in use [Rivas *et al.* 2014]. Rural communities should have a role to play in the operation and maintenance of potable water supply infrastructure in their areas [Tadesse *et al.* 2013]. Studies have shown that the failure of water pumps, their theft and vandalism are serious challenges to potable water supply in rural areas [Cobbing *et al.* 2014; Noga, Wolbring 2013]. Poor operation and maintenance of infrastructure of most water systems are due to the lack of skilled technicians and operators in rural areas, where groundwater is the only source of water supply. In most communities in Africa, hand pumps are not operational at any given time due to lack of maintenance and inadequate supply of spare parts [Obeta, Nkwankwo 2015]. Mema and Mothetha [2013] indicated that poor maintenance of borehole pumps, reservoir and street pipes cause water supply challenges; leakages due to pipe damages also lead to water loss during distribution. The ground water supply failure, therefore, is generally, linked to inadequate operations and maintenance of water sources [Cobbing *et al.* 2014].

Lack of access to potable water has been established as a leading cause of death worldwide, mainly, through dehydration, and diarrhoeal diseases caused by drinking contaminated water [Kharraz *et al.* 2012]; this affects all countries. In Iraq, Pakistan, Afghanistan and West Africa, water scarcity has led to droughts and famine, and this has contributed to people's difficult livelihoods and the spread of waterborne diseases. According to WHO [2013], about 780 million people continue to use unimproved water facilities to satisfy their daily water needs. Kalt *et al.* [2014] confirmed that untreated water exposes humans to contaminants, and about 1.5 mln people die every year due to consumption of untreated or contaminated water. The authors continue that these deaths are preventable through access to safe drinking water in rural communities.

WHO [2013] indicated that the lack of leadership and coordination between municipalities and stakeholders makes it difficult for potable water to be supplied to communities. In some instances, the lack of managerial capacity led to funds budgeted for a diarrhoea project not being spent [Bliss, Fisher 2013]. Marshall [2013] and WHO [2014] confirmed that management and leadership are very important for the effective performance of the water supply system which ultimately leads to the satisfaction of communities with their potable water supply. WHO [2014] acknowledged that unsatisfactory management plans, poor water use planning and poor conservation contribute to the potable water shortages in South Africa. Lack of management and leadership, poor maintenance and deteriorating infrastructure, therefore, manifest themselves in the non-efficient operation of potable water supply [WHO 2014]. Similarly, there are many factors that impact negatively on the supply of potable water to rural communities in the VDM.

According to Kharraz *et al.* [2012], there is a need to establish water management strategies and committees in any region to address potable water supply in rural areas. Globally, the management of water is left to government while communities are passive recipients of water service. Kharraz *et al.* [2012] indicated that in Guinea, for example, about 4,900 people die every year due to water, sanitation and hygiene-related illnesses. About 65% of rural households throughout the world do not have access to adequate supply of water [UNICEF, WHO 2012]. This is aggravated by the fact that Africa is one of the regions where the majority of people reside in rural areas. Hove and Tirimboi [2011] and Chaminuka and Nyatsanza [2013] state that the inability to provide potable water supply in Zimbabwe's rural communities in 2009, saw 191,164 reported cases of cholera where 4,047 deaths were reported.

Recent waves of protests and spates of violence across the country, by residents over potable water service delivery received enormous media coverage and exposed the challenges which many municipalities face in terms of service delivery [Cothren 2013]. From our discussions, it can be concluded that poor budgeting and financial resources, poor management of water systems and sources, lack of ownership by water users are the main challenges in most countries which fail to achieve water supply effectiveness. This article proposes an intervene strategy to reduce or eliminate the water supply challenges in the VDM. An issue in most African countries, is that intervention strategies are not clearly articulated or available due to budgetary constraints. Instead of comprehensive long-term strategies, water service authorities implement water shedding, drilling and rehabilitation of boreholes, water tanks, building water reservoirs and conserving natural water resources as ways to address potable water supply challenges in rural communities [Ahmed *et al.* 2015; Cook 2016; Lorlumun *et al.* 2015; Mukuhlani, Nyamupingidza 2014]. The availability of potable water for use is a serious concern in VDM as many communities continue to collect water from any water sources available, therefore, this paper is aimed at investigating the challenges and coping strategies for addressing potable water supply to rural areas of VDM. The study will, hence, recommend strategies to minimise these challenges and improve the water supply system in the area.

MATERIALS AND METHODS

The study was carried out in the rural wards from each of the four local municipalities within Vhembe District (VDM) in Limpopo Province of South Africa (Fig. 1). The study was conducted from 2017 to 2020. The VDM was established in 2000 based on the "Municipal structures act" No. 117 [Local Government 1998]. VDM is located in the rural areas and comprise of four local municipalities, namely, Musina, Thulamela, Makhado and Collins Chabane (LIM345) which is a newly-named municipality covering the Malamulele area [VDM 2010/2011]. Vhembe District has a population of about 1.393,948 and covers 21,407 km^2 of land with

households numbering about 382,358 [Stat SA 2016; VDM 2016/2017]. The Vhembe District continues to struggle to try to overcome a large backlog in the provision of basic services that include provision of potable water to rural communities [VDM 2009]. Figure 1 is the map of VDM showing all four municipalities which are Makhado, Musina, Thulamela and Collins Chabane. The Vhembe District location is 22.7696° S, 29.9741° E.

For this study, wards with the most households and which are remotely situated and with frequent water supply interruptions were selected. Purposive sampling method was used for wards and villages; purposive sampling was used to select councillors and municipal officials, while data was collected from household heads who were to participate and they were selected through simple random sampling. Interviews were held with three municipal officials; questionnaires were distributed to 448 households, 14 councillors and 14 traditional leaders, while household heads formed part of the focus-group discussions. There were 14 focus-group discussions held to seek convergence across qualitative and quantitative methods as supported by Creswell [2014]. Data was analysed through content analysis and descriptive statistics.

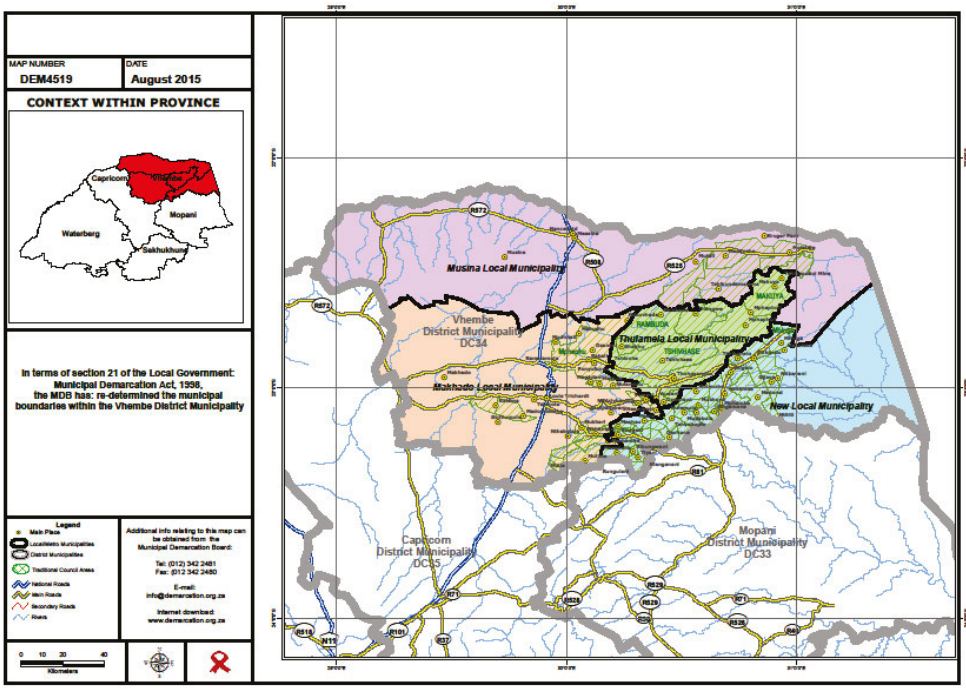

Fig. 1. Vhembe District Map, source: own elaboration based on www.dermarcation.org.za

RESULTS AND DISCUSSION

MAIN WATER SOURCES IN VDM

Table 1 indicates that most of the household in the rural areas of VDM rely on borehole (45.3%) and 35.3% make use of tap water from dams (treated) and supplied by the local municipalities for their water supply. This is supported by Olugbamila and Ogunyemi [2015] who reported that rural communities mainly rely on boreholes as their main system of water supply. There are a few villagers who rely on rivers (4.0%) and fountains (5.4%) which are used as alternative sources when water is not available in some areas. There are also some communities where the main source is not functional, and in that case they relied on water tankers to supply them with water (10%). There is a challenge especially for people using water collected from unprotected sources like rivers or fountains with high potential health risks of waterborne diseases. Tshikolomo *et al.* [2012] cautioned that using unprotected sources is dangerous to health and well-being, and hence should be avoided.

Table 2 shows that out of the 38 boreholes in the villages of VDM, only 11 are functional and the majority, which is 27, are not functional; this poses a serious problem in terms of water supply in the area. The malfunctioning boreholes in most villages expose people to diseases as they end up collecting water from rivers and fountains which are contaminated. Most of these boreholes are older than 10 years, except one borehole in Mashamba which was donated by Phalaphala FM Radio and was installed in 2017. There are 15 water tankers for the VDM, although, at the time of the data collection visits only two water tankers were functional; this, as mentioned earlier, poses a serious risk for communities.

Table 1. Main sources of water

Main source of water	Number of instances	Percentage
Borehole	203	45.3
Dam	158	35.3
River	18	4.0
Spring/fountain	24	5.4
Water tanker	45	10.0
Total	**448**	**100.0**

Source: own study.

Table 2. Water sources per village in Vhembe District Municipality

Village	Water received from boreholes			Water received from			
	number of boreholes	functional boreholes	not functional boreholes	tap water from dam	rivers	water tankers	fountains
Mangaya	0	0	0	+	–	–	–
Tshandama	0	0	0	+	+	–	+
Madzivhanani (Tshidongololwe)	0	0	0	+	–	–	+
Tshixwadza	3	1	2	–	–	–	+
Mbodi	2	1	1		+	–	–
Kurhuleni	4	1	3	+	–	–	–
Mahathlani	1	1	0	+	–	–	–
Akani (Tiyani)	5	2	3	+	–	–	–
Dovheni	1	1	0	+	–	–	–
Khakhanwa	3	0	3	+	–	–	–
Madabani	3	0	3	–	–	+	–
Midoroni	12	3	9	–	–	–	–
Mashamba	3	1	2	–	–	–	–
Mavhunga	1	0	1	+	–	–	–
Total	**38**	**11**	**27**	**–**	**–**	**–**	**–**

Source: own study.

CHALLENGES OF RURAL WATER SUPPLY SYSTEMS IN VDM

Limited functional water sources

It is clearly indicated that boreholes as the main source of water are not enough to cater for an increasing population (Tab. 2). When the recognised sources are not functional, this poses a serious potential health risk to communities, as they tend to collect water from unprotected sources like rivers and fountains. In Makhado and Thulamela municipalities about 25% of the water challenges were due to insufficient water sources, as articulated by traditional leaders. Table 3 indicates that 47% of water challenges, according to heads of households, were also from lack of enough sources to cover all rural households. The challenge outlined by municipal officials was a shortage of underground water in some areas, especially, in areas like Makhado; this impacts negatively on water access as the boreholes consistently dry up from over-use.

Municipal officials pointed out that there have been some minor improvements in water services in VDM, although, this has been nullified by the population increase; this point was asserted by the heads of households that the demand for water in VDM is higher than the amounts the available sources can supply. In addition, the other cause for this shortfall was the chronic droughts that have affected southern Africa for some time now; these have been attributed to climate change problems. Water shortages in many African countries are due to global warming, drought and population increases, which culminate in water stress [Adeoye *et al.* 2013].

Table 3. Water service challenges

Challenge	Number of instances	Percentage
System breakdown, lack of maintenance, old infrastructure, vandalism and poor security	204	46
Insufficient sources	212	47
Few operation hours and low pressure of water supplied	32	7
Total	**448**	**100.0**

Source: own study.

Breakdown of water supply systems

The study revealed that 100% of water supply challenges in Collins Chabane (LIM345) were due to systems breakdown from factors like lack of maintenance, aged infrastructure, vandalism of the infrastructure due to poor security, as stated by councillors (Fig. 2). In Makhado, 75% of the challenges faced by communities were also due to breakdown of water supply systems, according to the councillors' views. This was confirmed by 47% of the household heads, in all the local municipalities who indicated breakdown of the systems as the main problem with supplying water (Tab. 3). In Musina and Thulamela, 100% of water challenges experienced were mainly due to the systems' breakdown according to the councillors. In addition, the quality of water received from the main sources were in some areas not safe for drinking as claimed by most respondents.

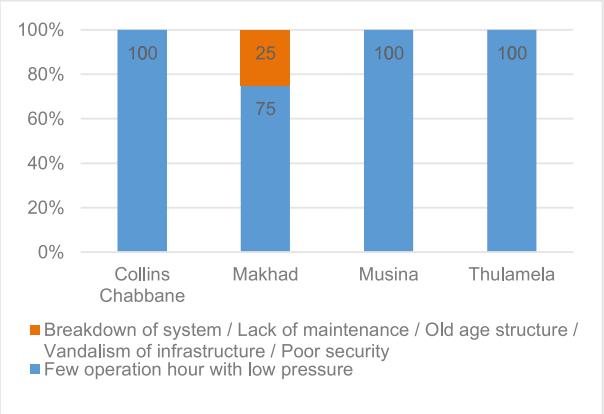

Fig. 2. Water supply challenges; source: own study

The same sentiment was expressed by the household heads (Tab. 3), that water supply systems challenges were mainly due to constant breakdown of the systems, lack of maintenance, aged infrastructure, vandalism and poor security. Akhmouch [2012] supported by indicating that frequent breakdown, lack of maintenance and old infrastructure affect negatively water supply systems in rural communities. Municipal officials also indicated breakdown of the water infrastructure as a hindrance to the effective supply of water to communities. The water infrastructure is old and dilapidated, hence, there is a need to replace it with new and modern ones so as to meet the ever-increasing demand for more water supply; this was also confirmed by the heads of households (Tab. 3).

From the focus-group discussions with councillors and traditional leaders, it was also noted that the breakdown of the water supply system (including pipe system and boreholes) was affecting the water supply in their areas. This is consistent with Obeta and Nkwankwo [2015] who discovered that the poor maintenance of infrastructure is the main problem which substantially contribute to the water supply systems' failure and breakdown. Another finding from the discussions was that theft of transformers and other vital components of the system connections, as well as the badly designed and ageing water infrastructure are the causes of the ineffectiveness of the rural water supply systems Johannessen *et al.* [2014].

These findings are supported by Akhmouch [2012] who revealed that inadequate water supply in rural communities is the direct result of the frequent breakdown of water infrastructure, lack of maintenance, old infrastructure, vandalism of water infrastructure and the poor security around the water supply systems which results in stolen pumps. Johanessen *et al.* [2014] concur that water supply problems were caused by dysfunctional systems due to their constant breakdown. The VDM [2009] also identified insufficient financial and human resources as the main challenges in addressing concerns about rural water supply systems. During the discussions, borehole breakdowns were also cited as the major reason for the inconsistent water supply.

Water tankers in areas with water scarcity

According to municipal officials, the VDM uses water tankers when there are major water supply crises, especially, where the water source is constantly being disrupted or where there is no water source at all. The officials explained that there are fifteen water tankers, however, only two were operational at the time of the data-collection visit, due to the lack of maintenance. This is a serious concern, especially, in rural communities where all the water sources are dysfunctional and they depend solely on assistance from the tankers. This unfortunate situation can be directly traced to poor funding of the Maintenance Department which services the trucks.

Illegal connections and vandalism

The focus-group discussions touched on illegal water connections and vandalism of infrastructure as having a negative impact on the supply of water to communities as these are prevalent. Mema and Mothetha [2013] supported the discussants that water leakages due to damaged pipes lead to water loss, hence, affect the reliability of water supply systems.

Municipal official also mentioned illegal water connections, vandalism and stealing parts of the water infrastructure as challenges of concern. Heads of households also indicated vandalism and poor security as the main problems in rural water supply systems; the breakdown of the system was a major problem mentioned by all participants of the study. Cobbing *et al.* [2014] as well as Noga and Wolbring [2013] confirm that the failure of water supply systems in rural areas are mainly due to wear and tear, theft and vandalism, therefore showing consistence with the current study's findings that theft and vandalism hamper effective water supply.

Inadequate resources for water supply systems

The discussants listed other problems, such as insufficient fuel to operate the engine-powered boreholes and salty water pumps. Among the household heads, 47% mentioned insufficient resources to run and maintain the water supply systems as a problem (Tab. 3). The demand for water by villagers is also becoming greater than the water supplied due to continual increase in the population in villages. Adeoye *et al.* [2015] assert that the population increase, and droughts make it difficult for municipalities to effectively deliver water services to communities; due to the population increase, water is being disproportionately supplied to villagers.

Municipal officials also mentioned the shortage of diesel and spare parts as some of the problems; they continued that spare parts take too long to be bought, particularly when it comes to replacing vandalised and stolen parts of the infrastructure. Johannessen *et al.* [2014] mention that broken infrastructure due to wear and tear as well as lack of spare parts, disrupt rural water supply systems, for extended periods of time; these findings are in line with those of the current study.

Maintenance of water infrastructure

It was also noted from the focus group discussions that lack of maintenance of the machinery as another major challenge in the supply of water to communities. Maintenance of the water supply systems, therefore, is hardly done by the municipality according to the focus-group discussants and heads of households (Tab. 3). Obeta and Kwankwo [2015] agree with the findings that poor maintenance of infrastructure is the main problem which contributes to water supply systems' failure. Tadesse *et al.* [2013] and Obeta and Kwankwo [2015] posit that the lack of maintenance is the reason why many rural water supply systems are dysfunctional, and this aligns well with the findings. In addition, the consequences of this are serious unhygienic

practices which result in villagers suffering from deadly water-borne diseases. The focus-group participants added that water leakages and low water pressure are also challenges that make the water supply systems unreliable.

Lack of skilled personnel in water sector to do systems repairs

The lack of skilled technicians was raised by the discussants as a challenge to water sources as the systems operate for years without being maintained, due to unavailability of technicians. Household heads also mentioned lack of resources which include personnel in the water section as the main problem that hampers water delivery (Tab. 3). The lack of skilled technicians was raised as a contributory factor by WHO [2015], hence, the need for effective training on the systems for them. The responses by the groups are consistent with the study by Cobbing *et al.* [2014] who indicated that without funding to operate and maintain boreholes, the water supply systems collapse, thus, they are unable to consistently supply water to communities. Cothren [2013] sees the shortage of technicians to maintain the water supply systems as the leading problem which needs to be urgently addressed by the authorities.

The shortage of staff due to non-replacement when they go for pension was also outlined by the municipal officials as a hindrance to the effective supply of water to communities. The officials complained that there are budget constraints in the funding of maintenance of the system, aging staff members who are not replaced, and the shortage of transport to take officials to the areas where there are water supply problems, as some of the areas of concern.

Lack of water committees

The discussants added that there are no water governance structures to address water issues in their village. In many successful rural water supply systems in Africa and globally, there are water governance structure at village level; they are the ones that manage, operate, maintain and make sure that user-costs are paid [Lockwood, Smits 2011; Tremolet 2013].

Poor response by government officials

During the focus-group meetings, it was mentioned that there is always poor response to the water problem from the authorities, particularly in case of areas without water connections. Rural communities are not happy when their complaints are not attended to and no feedback is given; this impacts negatively on the relations between the municipality and communities [Jayaramu 2014]. Most of these challenges occur on a daily basis, however, and the VDM does not intervene to address the said problems. The lack of a link between the district and the rural communities, therefore, is another challenge identified by the focus-group participants. This is evident when communities' complaints are not responded to for a period of more than a year. When this happens, communities lose hope in the water supply systems, and resort to their own means of accessing water, although, in some cases, water is collected from unprotected sources [Kalt *et al.* 2014].

Fewer operating hours

In Makhado, 25% of the challenges identified by councillors arose from the limited operational times for water access. The discussants were of the opinion that the operational times for them to access water were not feasible, adequate and inconsistent; this was in line with the findings by councillors and traditional leaders. They argued that there is no specific time for them to access water and this clearly indicates lack of proper leadership and agreement on operational times for water management and this needs to be addressed. Heads of households also mentioned the operational hours as the other challenge to rural water supply (Tab. 3).

Financial constraints to address water-related problems

Municipal officials indicated that the budget they receive to deliver and maintain rural water supply systems is by far inadequate, and this hampers their efforts to make sure that rural water supply is effectively implemented. The heads of households also indicated resources, which include both financial and human resources, as the main challenge for rural water supply systems (Tab. 3). This speaks to what Obeta and Kwankwo [2015] observed when they stated that rural municipalities are not fully funded to effectively deliver efficient water supply systems in rural communities. They assert that if financial and human resources are made available and residents are encouraged to pay for water services, the systems would be enhanced and sustainable. Municipal officials also mentioned poor budgeting by the municipality as another problem. WHO [2014] concurs with the findings that there are serious gaps in planning, monitoring and funding of water supply initiatives, therefore, in some areas, there is a lack of piped-water supplies or water sources. The approximate annual expenditure for rural water supply is at ZAR216,628,604.05 (ZAR1 ≈ USD0.07) which is insufficient; officials also indicated that the communities are not paying for water which aggravates the situation.

Lack of proper planning

It can be argued that there is a lack of planning by both the communities and the municipality when new villages are established. When new sites are established in rural areas, in most cases no assessment is done to check which services, including water, will be needed. When proper planning is not done, services like water will remain a challenge to communities. Another observation was that there is a lack of leadership from the community and the municipality to guide in terms of planning, when new sites are established. The finding is consistent with Marshall [2013] and WHO [2014] that management and leadership are vital for the effective planning and implementation and the performance of any organisation, which in most municipalities are found wanting. In most municipalities, unplanned settlements are the order of the day in most rural areas, consequently, the municipality fail to plan for the provision of water services in most areas. WHO [2015] also added that unplanned settlements, which are common in developing countries, contribute to inadequate or lack of water supply to rural communities; this point is consistent with this finding. Municipal officials confirmed that water supply planning is poorly done.

Period of time taken to resolve water supply challenges in VDM

After soliciting for the respondents' views regarding the issue of intervention by the authorities regarding water challenges, the researcher sought to find out how long it takes for either the VDM or the community to intervene once a problem crops up.

Figure 3 shows the councillors' responses on the length of time it takes to solve the said problems. About 20% of problems in Collins Chabane (LIM 345) take a month to be solved according to councillors, 60% of the problems take three months and 20% of them take more than a month. In Makhado, 25% of problems take a month to be resolved while 75% of the problems take more than a year to be addressed. In Musina, about 100% of challenges take only a week to be solved. In Thulamela there was a split, some participants said 25% of problems were addressed in a month, the other 25%, said within three months, while 50% of their problems were solved after a year of their occurrence. The summary of statistics is indicated in Figure 3.

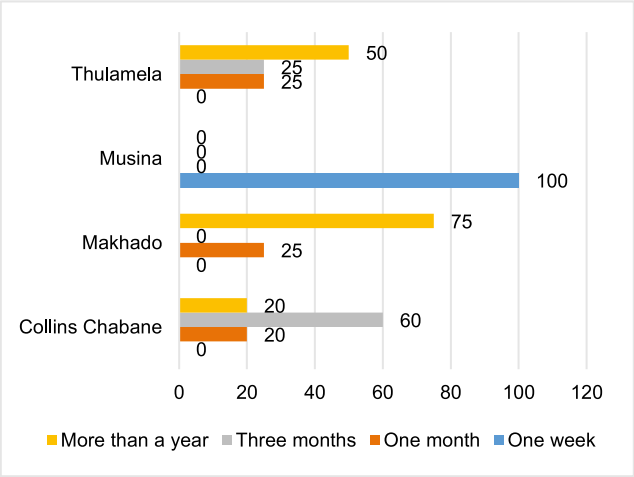

Fig. 3. Time taken to solve water problems; source: own study

The above responses indicate that the VDM takes a while to respond to rural communities' challenges. That is, it takes between months to years to have certain water problems fixed. This is due to the lack of staff (where some are too old), old infrastructure (which breaks down daily) and the lack of spare parts to repair dilapidated infrastructure. This concurs with the findings of Cothren [2013] and Johannessen *et al.* [2014] that ageing infrastructure and lack of spare parts affected the normal functioning of water supply systems which then resulted in frequent systems' breakdown. The other issue which is negatively affecting the response rate to the VDM water challenges is that, the link between VDM and the local municipalities is not strong enough. In the satellite offices, for example, there is no manager who can take urgent decisions to address the water problems. This is contrary to the Water Affairs' [2013] guidelines that state that water interruptions should be less than 48 h at any given time and less than 15 days in a year cumulatively. This situation, therefore, shows non-compliance by the VDM when addressing rural communities' water challenges. This could be attributed to several factors, such as lack of spare parts and personnel [WHO 2015].

Water challenges are addressed after a long period which poses serious risks to residents who are forced to fetch water from unprotected sources which affects their health. This is an indication that the water supply situation in the VDM is dysfunctional and ineffective as it fails to supply residents consistently with water on a regular basis. The responses by councillors confirm that VDM takes longer than necessary to respond to water-related problems which are reported by communities. This leaves villagers frustrated. Sandeva *et al.* [2015] contend that the cause of delay to address these problems is a sign of poor leadership and the VDM's lack of institutional capacity to deal with them. On the other hand, Jayaramu [2014] claims that the regular update on water services and, timely and accurate responses to enquiries leave rural people satisfied, despite challenges.

COPING STRATEGIES USED WHEN THERE ARE WATER SUPPLY PROBLEMS

This section outlines the communities' coping strategies when there are water supply challenges in VDM. When water is not available from the main source, communities collect water from any alternative source available. These coping strategies were identified from councillors, traditional leaders and household heads within the VDM.

Alternative sources when water is not available from the main source

The first alternative water source, according to the discussants, is a community borehole, which is free; alternatively, villagers buy water from water vendors when everything else have failed. Some participants indicated that they use rivers and fountains as alternative water source.

The views from heads of households clearly indicate the alternative sources used by rural communities of the VDM. As outlined in Table 4, the majority of communities (74%) buy from water vendors or those with boreholes during the time when the main sources is not supplying water. About a few respondents get 4% of water for survival from the water tanker when the water fountain, river and other sources are not available. This is a concern as water from the river and fountain/spring are not protected from waterborne diseases and also that residents have to walk distances to collect this water, which is an additional burdem. This assertion is supported by Cook [2016], Ahmed *et al.* [2015] and Akali *et al.* [2014] who said that to survive lack of water, residents have to buy from vendors, drill their own boreholes and collect water from rivers and fountains. This was also confirmed by Tshikolomo *et al.* [2012] and Adeoye *et al.* [2013] who assert that the failure of the public water supply system forces residents in rural areas to buy water from water vendors, rely on fountains and wealthy residents with boreholes in their households.

More than 70% water from alternative source is bought from water vendors according to councillors, traditional leaders

Table 4. Alternative sources

Alternative source	Number of instances	Percentage
Water vendor	330	74
Water tanker	17	4
Fountain	31	7
River	38	9
Other	32	7
Total	**448**	**100**

Source: own study.

and heads of households, followed by those who collect water from rivers, fountains and water tankers; this makes water supply systems failure a financial burden on rural communities.

Cost to buy water from alternative water sources according to household heads

This study indicates that the majority of respondents spend not less than ZAR10[1] per day to get water from alternative sources. Some of those from rural households, spend between ZAR10 and ZAR35, or even more, per day to buy water from water vendors or from those with boreholes to survive water shortage. Those who are unable to buy resort to collecting water from unprotected sources where their lives are threatened by waterborne diseases. Jayaramu *et al.* [2014] posit that communities are not satisfied when they are forced to pay dearly to get water for survival, whereas it is the responsibility of the municipality to do so (Tab. 5).

Table 5. Cost to buy water per day for one household

Cost to buy water (ZAR)	Number of instances	Percentage
<10	230	51.3
10–35	97	21.7
>35	48	10.7
Free	73	16.3
Total	**448**	**100.0**

Source: own study.

water as it is. This results show that majority of rural communities are at a high risk of contracting waterborne diseases by using poor quality water without it being treated. The municipalities which are most affected are Makhado (74%), Musina (84%) and Thulamela (64%). Makhado is the most affected due to the fact that its alternative sources are rivers and fountains. There are those (42%) who boil the water before using it; the burden of buying electricity or wood for this is another issue for these people. In addition, the time taken to boil water could have been used for other domestic activities.

Municipal officials also indicated that when water is of poor quality, like from fountains, the VDM treats and purifies that water when requested by communities; however, in some areas the responsibility to purify water lies with the communities. In some areas, the fountains are connected through pipes to the water tanks and then supplied to the villages, according to the municipal officials.

CONCLUSIONS

In order to cope with water challenges, rural communities buy water from water vendors or those with boreholes and keep water in water tanks. Rural communities without financial capacity collect water from rivers and fountains to survive. Most communities do not treat water collected from unsafe sources, which is a health risk. The majority of the rural communities are not satisfied with the quantity of water services they receive due to few sources available. These are not catering adequately for the population increase as currently; the demand is more than the supply. There is a need to establish water committees in rural communities as the non-existence of such structures to manage and operate water projects in rural area has been identified as the gap. Poor response rate to problems, by the Vhembe District Municipality was also another challenge; this was usually caused by lack of spare parts. Inadequate financial resources to properly maintain and upgrade their ageing infrastructure is another challenge identified. Therefore, the municipality is unable to provide a sustainable water supply services in an efficient, equitable and accessible manner (in terms of distance, time and affordability) to all its rural communities. Lack of water recovery plans and unplanned settlement are problems that require urgent intervention. There is no replacement of staff when they retire which causes delay in addressing water issues due to staff shortage. When communities actively participate in decision-making on water supply systems in their areas and contribute financially or otherwise, the systems is bound to be sustainable and efficient.

Table 6. Treatment of poor water quality as advised by the respondents (percentage of households) in Vhembe District Municipality (VDM)

Treatment	Municipality				VDM
	LIM345	Makhado	Musina	Thulamela	
We boil / We use disinfectant	42	23	16	35	29
Use as is it (untreated)	45	74	84	64	67
We have good quality water	13	3	0	1	4
Total	**100**	**100**	**100**	**100**	**100**

Source: own study.

Storing and collecting water from unprotected sources

Residents store the water collected from unprotected sources like fountains and rivers in tanks and containers to address their immediate water supply challenges. Adeoye *et al.* [2013] explain that the failure of the public water supply system forces residents to rely on fountains and rivers to address their water supply problems. The VDM supply water using tankers in times of serious water challenges in rural communities.

Treatment of water in times of poor water supply

The respondents were given question to answer as to what they do when they receive poor quality water from unsafe sources; the heads of households gave their responses in (Tab. 6). Their responses show that, the majority of VDM households (67%) use

[1] ZAR1 = USD0.07

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