The non-technical factors that affect sustainability of borehole systems in rural communities – A study on selected villages for the ASWSD project in Limpopo province

E. Mamakoa*, G. Maponya* and M. Mothetha*

* CSIR Built Environment, Meiring Naude Road, Brummeria, Pretoria, 0001
(E-mail: EMamakoa@csir.co.za, GMaponya@csir.co.za, MMothetha@csir.co.za)

Abstract Since 1994, the South African government embarked on a number of strategies, such as the Free Basic Water Support Programme and the Sustainability Guidelines for Rural Water Supply, to implement the Free Basic Water policy and speed up the delivery of basic services and the development of rural communities. To achieve this, local government then implemented water delivery programmes, mostly borehole water supply schemes in rural communities especially during the drought relief period. Today, some of the communities that benefited from such schemes are now without water or are struggling to get adequate supply due to frequent breakdowns in the borehole systems. This paper seeks to understand the non-technical factors that affect sustainability of borehole systems. It uses selected study sites of the Accelerating Sustainable Water Services Delivery (ASWSD) project in Limpopo, which is a study that is currently being done by the Council for Scientific and Industrial Research (CSIR). A detailed consultative process with relevant stakeholders was embarked upon to derive the non-technical issues. Findings indicate that municipalities struggle with getting spares for boreholes from suppliers, agreements signed with suppliers are often short term, thus continued supply cannot be guaranteed, there are challenges in planning for operation and maintenance and providing security for borehole systems, and some borehole operators have not received proper training. Addressing these non-technical issues could have far-reaching benefits, and thus this paper recommends that municipality consider revising strategies to address them. As part of the strategies, the paper also proposes a renewed approach that considers community-based initiatives in rural water supply.
Keywords Boreholes; free basic water; pumps; rural communities; sustainability

INTRODUCTION

Background

Since the dawn of the democratic dispensation in 1994, the South African government embarked on strategies that were aimed at speeding up the delivery of basic services and the development of rural communities. To achieve this, policies and programmes such as the Free Basic Water Support Programme and the Sustainability Best Practices Guidelines for Rural Water Supply were drafted among other strategies in response to the Free Basic Water policy (Department of Water Affairs and Forestry, DWAF, 2004). Local government was then tasked to implement water delivery programmes and projects, most of which were in a form of borehole water supply schemes, to serve especially remote rural communities.

Borehole systems sustainability factors

Sustainability forms a key factor to the survival of water supply technologies, and it measures performance of infrastructure placed to provide services over time. Sustainability (in water supply systems) can be defined as the reliability in water (and sanitation) services, which may be achieved through evolving and adaptive mechanisms (Montgomery, 2009). Such mechanisms may be a range of factors that considers the needs of communities that the water supply systems are being designed and implemented for. Harvey and Reed (2004) identify

eight main sustainability factors as; policy context, institutional arrangements, financial and economic issues, community and social aspects, technology and natural environment, spare parts supply, maintenance, and monitoring. This is also supported by Mackintosh and Colvin (2003) and Auckhinleck (in press) who further argue that rural water supply systems are likely to perform better and be sustainable when there is ownership in communities, and when there is enough capacity and technical support.

Key challenges affecting sustainability of borehole systems

Although there have been numerous initiatives that were meant to address the issue of the delivery of basic services, including water, it is also clear that there are still many challenges that rural communities continue to face. Some of the communities that received borehole schemes in the past are now without water or are struggling to get adequate supply due to the frequent breakdowns of the borehole systems. Very often, these communities resort to unsafe practices, such as fetching water from unprotected sources. Breakdowns within borehole systems are often due to insufficient attention given to operation and maintenance (Harvey and Reed, 2004), and largely due to the fact that many local municipalities, especially those meant to serve rural communities, do not have sufficient resources, and thus have difficulties in addressing past backlogs and meeting their goals in terms of providing free basic services to the poor (Water Research Commission, WRC, 2009). In South Africa, government has been made aware of such challenges, and structures have previously been put in place to redress these challenges. However, some of the structures have not always been successful (Berkowits, 2009). Lack of capacity local municipalities, which have constitutionally been mandated to deliver basic services, has been identified as a key issue of concern especially with municipalities operation in the rural environments. Rural water supply boreholes across Africa are generally drilled by private contractors or non-governmental organizations (NGOs) (Harvey, 2004). This could also support the argument that key municipal and technical staff has limited knowledge and/or resources (Harvey, 2004). Such resources may range from financial to human. Other studies have also shown that revenue collection, which is a huge challenge with many rural municipalities, contributes towards inconsistencies in rural water supply (Haysom, 2006). If a municipality cannot generate revenue from the investments (i.e. infrastructure) that they have implemented, there is likelihood that it will also face challenges in sustaining its systems.

Aim of the study

This paper seeks to understand the non-technical factors that affect sustainability of borehole systems.

METHODOLOGY

This paper stems out of the Accelerating Sustainable Water Services Delivery (ASWSD) project, which is a Department of Science and Technology (DST) initiative that is currently being implemented by the Council for Scientific and Industrial Research (CSIR). The initiative aims at investigating appropriate technologies that can be used to fast track the delivery of water services especially in rural and underserved communities that are hard to reach. This paper focuses on four villages (namely; Kgotlopong, Dresden, Mailamapitsane and Mukondeni) that have been selected from the ASWSD sites in Sekhukhune and Vhembe district municipalities in Limpopo province. These villages have purposefully been selected due to their characteristics and nature of old borehole schemes that have demonstrated failures in some villages and a bit of sustainability in other villages.

As part of the overarching approach, the study sought to document details of current and planned projects in the selected sites through various platforms including but not limited to the following;

- A community mobilization and stakeholder engagement process was embarked upon to get the stakeholders' buy-in into the research process that would be followed by the CSIR. Reconnaissance meetings were held at the initial stage with municipalities while community structures meetings were held in the villages
- Situational assessments were conducted in the villages to understand the status quo with regards to current and planned water projects. This entailed engagements with key informants within the communities and the local municipalities responsible for provision of basic services in the villages.
- Community surveys were conducted to get a general feel of the water supply issues in the selected villages.
- Informal interviews were also held with some community members, councillors and municipal officials in the respective municipalities and villages to provide further information on general water supply issues in the villages.

Although technical assessments were conducted as part of the overarching approach of the ASWSD project, this paper will outline and discuss mostly the non-technical aspects. Therefore, technical assessments which included the assessments of water quality and borehole yield tests, were carried out in the broader ASWSD studies to understand any technical and fundamental challenges that my also affect the sustainability of the assessed boreholes in the four selected villages and perhaps perplex the understanding of the non-technical issues.

The data that was abstracted, excluding that of technical assessments and the community survey, was largely qualitative and was analysed using a thematic analysis approach.

RESULTS AND DISCUSSION

Key characteristics of villages

The four selected villages are all rural and are characterized by high rates of unemployment and poverty. Most households survive by means of social grants and some subsistence farming, which is also largely practiced mostly in the rainy season (Matsebe and Mamakoa, 2013a, 2013b; Nkuna, 2013). Table 1 summarizes key demographics of the villages.

Table 1: Key demographics and borehole infrastructure within the four selected villages

Village Name	Local Municipality	District Municipality	Population (households)	Working boreholes
Kgotlopong	Greater Tubatse	Sekhukhune	430	1 out of 9
Dresden	Greater Tubatse	Sekhukhune	800	3 out of 10
Mailamapitsane	Makhuduthamaga	Sekhukhune	1010	1 out of 13
Mukondeni	Makhado	Vhembe	694	1 out of 6

The four selected villages all fall under an area of low rainfall. The villages in Sekhukhune fall under the Olifants Water Management Area (WMA) while Mukondeni falls under the Levuvhu-Letaba WMA. Ground water is primarily the main source of water in all the four villages. The major surface water sources that were identified in the nearest vicinity were the

Tubatse River in Sekhukhune, which is located about 10km from Dresden village, about 35km from Kgotlopong, and about 15km from Mailamapitsane. For Mukondeni, Albasini Dam is the closest surface water source.

Kgotlopong

A total of nine boreholes were identified and assessed, of which only one was operational at the time of assessment and was used by the local primary school. It was also established that a diesel engine had been stolen from a borehole that was supplying the community. After eight months the municipality then replaced the engine with a movable motor that was mount on a trailer that could be towed by hands (see figure 1). To counter the risk of theft, the community came with an idea of wheeling the engine to and from the local chief's house on a daily basis. This posed further challenges to the community as the borehole operator (who was paid by the municipality) could not tow the motor and therefore needed assistance from the community. Since community members were not being paid to operate boreholes, they became reluctant to assist the operator. This resulted in water not being pumped during some days. Other challenges that the community of Kgotlopong faced with the municipality were related to communication – the municipality taking long to attend to breakdowns and also failing to address the issues of theft.

Figure 1: A wheeled borehole diesel motor in Kgotlopong

Dresden

Ten boreholes were identified and assessed in Dresden, of which only three were functional. Of the three functional, two were operated using wheeled diesel motors (see figure 2) while the one was a hand pump. The hand pump is only serving about five households that are located in a part of the village that is divided from the rest of the village by a working railway line and therefore difficult to access. The two boreholes with diesel motors both had an operator each, one male and one female. The female operator had challenges with wheeling the motor to the borehole as the motor was heavy and had to be pulled through an uneven terrain using bare hands. As a result, she relied on the help that some of the community members gave her. When no one was available or willing to help her to wheel the motor to the borehole, it meant that she would not pump water on that particular day. The male operator did not have any challenges with wheeling his diesel motor, and this was also partly so because his homestead was located very close to the borehole.

Figure 2: A wheeled borehole diesel motor in Dresden

Other challenges that were faced by the operators were skills related. For example, the diesel motor operated by the female operator had reportedly a lot of breakdowns compared to that of the male operator. According to the technical services officials responsible for maintenance from the municipality, some of the breakdowns that were reported by the female operator were unknowingly of her own wrong doing – such as not aligning the motor with the borehole pump correctly and thus increasing the wear on the fan belt and the pulley of the borehole. It was also reported that she did not perform minor checks such as checking and cleaning the air filters when necessary, and as a result the diesel motor would clog the air filter with dust and not start properly. The municipality would have then had to send technicians to site only to make such discoveries. On the other end, the female operator was adamant that such routine checks did not form part of her training as the operator.

Ga-MailaMapitsane (Modiketse)

In Ga-MailaMapitsane there was only one hand pumped boreholed (out of 13) that was functional (see figure 3). This is also in a village that has a population of over 1000 households. The first observation that was made in the entire community, which was undoubtedly a response by the community to address this challenge, is the presence of a community-based water supply initiative which uses a mountain water source to get water to the community through trenching and water channelling (see figure 4). A large proportion (unknown) gets water from the community-based initiative than from the single borehole.

Figure 3: The only operational hand pumped borehole in Mailamapitsane

Figure 4: A community-based mountain water harvesting initiative in Mailamapitsane

Challenges that have been reported by the municipality with regard to maintenance and repairs of the borehole systems in Mailamapitsane was the fact that the municipality is struggling to get spares for the type of borehole hand pumps that are in the area; they are very old technologies for which spares are no longer made and therefore they struggle getting spares from the suppliers. However, the municipality also indicated that they did not have any plans to replace the current broken boreholes with newer technologies for which they can get spares. The municipality also did not have any signed agreements with suppliers from which they procured the old borehole technologies. For newer technologies that they currently implement elsewhere, agreements that they have with suppliers are short term; only lasting less than two years and regulated by the Public Finance Management Act (PFMA).

Mukondeni

Mukondeni has six boreholes with only one that is operational. The operational borehole has been equipped with an electrical motor/ pump and has an operator who pumps water for the community on a daily basis. Water supply challenges that have been reported in Mukondeni were issues related to infrastructure handover. For some time since Mukondeni village was re-demarcated to Vhembe district, Vhembe, which is also both the Water Services Authority

(WSA) and Provider (WSP), did not have a full list of infrastructure from Mukondeni that would belonged to it. As a result, Vhembe was not aware of the borehole and hence did not pay the electricity bill, which came to R25, 000 for operating the borehole and as a result power was cut off for some time. In that time, the community did not have any alternative means to get water as the remaining boreholes were all broken. Another challenge that was established is that often when changes are made and borehole systems are upgraded, operators are not awarded the opportunity to be trained in order to stay abreast and at par with the newest technologies. This was the case with the operator in Mukondeni. At some point, the pump of the operational borehole was changed and replaced with a modern submersible pump, which was supposed to be operated differently from the previous pump. However, the operator continued operating the new pump using the old methods. This could have jeopardized the performance of the new pump and thus could affect its sustainability in the longer term.

SUMMARY AND CONCLUDING REMARKS

The findings indicate that there are many factors that affect the sustainability of borehole systems in the four selected villages. Most borehole systems that were found were implemented before 1994 and were old technologies that had exceeded their lifespan. However, some systems that were not very old were also found to be in a bad state. This was as a result of challenges that can be summarized as follows; municipalities struggle with getting spares from suppliers; previously, no agreements had been signed with suppliers to guarantee continued supply of spares; new agreements that are being signed are also short term; municipalities face challenges with planning and budget allocations for operation and maintenance, and provision of security for borehole systems; and some borehole operators have not received sufficient training to keep to date with new technological advancements in borehole systems.

Addressing these non-technical issues could have far-reaching benefits, and thus this paper recommends that municipality consider revising strategies to address them. As part of the strategies, the paper also proposes a renewed approach that considers community-based initiatives in rural water supply.

References

Auckhinleck, K.A. (in press). Borehole sustainability and poverty reduction in rural communities – Practical experiences from boreholes provision in Atebubu and Afram Plains District of Ghana. Department of Geography and Rural Development, Kwame Nrumah University of Science and Technology (KNUST), Kumasi, Ghana.

Department of Water Affairs and Forestry. (2004). Sustainability Best Practices Guidelines for Rural Water Services. The Department of Water Affairs and Forestry, Pretoria, Republic of South Africa.

Harvey, P.A., (2004). Borehole Sustainability in Rural Africa: An analysis of routine field data. 30th WEDC International Conference, Vientiane, Lao PDR, 2004.

Harvey P. and Reed B., (2004). Rural Water Supply in Africa: Building blocks for handpumps sustainability. Water, Engineering and Development Centre, Loughborough University, UK.

Haysom, A. (2006). A study of the factors affecting sustainability of rural water supplies in Tanzania. Institute of Water and the Environment, Cranfield University, Silsoe.

Mackintosh G. and Colvin C., (2003). Failure of rural schemes in South Africa to provide potable water, Cape Water Programme, CSIR, Stellenbosch, Republic of South Africa

Montgomery M.A., (2009). Increasing Functional Sustainability of Water and Sanitation Supplies in Rural Sub-Saharan Africa. Department of Chemical Engineering Program, Yale University, New Haven, Connecticut. World Health Organisation, Switzerland

Matsebe G. and Mamakoa E., (2013a). Situational Assessment of Kgotlopong Village. ASWSD II Report, March 2013, Council for Scientific and Industrial Research (CSIR), Pretoria, South Africa. [Report available on request]

Matsebe G. and Mamakoa E., (2013b). Situational Assessment of Dresden Village. ASWSD II Report, March 2013, Council for Scientific and Industrial Research (CSIR), Pretoria, South Africa. [Report available on request]

Nkuna Z., (2013). Situational Assessment Mukondeni Village. ASWSD II Report, Council for Scientific and Industrial Research (CSIR), Pretoria, South Africa. [Report available on request]

Water Research Commission. (WRC, 2009). A planning framework to position rural water treatment in South Africa for the future. WRC Report No. TT 419/09, September 2009