Towards context specific water solutions for resilient and sustainable communities: Unconventional water delivery approaches

Council for Scientific and Industrial Research (CSIR)
PO Box 395, Pretoria, 0001

Ednah Mamakoa, Goodhope Maponya and Bongi Maposa

emamakoa@csir.co.za

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ABSTRACT

Since 1994, the South African government has focused on eradicating service delivery backlogs, and this has largely been done through the deployment of conventional solutions. However, many rural communities continue to be marginalised as most conventional solutions are expensive to implement due to the settlement characteristics of such communities. Thus, this call for a new focus on context specific solutions targeted at areas that are hard to reach with conventional systems. This paper seeks to showcase the success in the deployment of unconventional solutions in yielding promising results for sustainable water services delivery. The paper uses a case study of a community of Meidingen in Limpopo from the ASWSD project. The interventions in this village were part of a social innovation project that sought to demonstrate the role of technological innovation towards universal access to safe drinking water. The paper therefore, shows how creative out of the box approaches have potential to pave the way for sustainable service delivery in human settlements.

Keywords: appropriate technology, sustainability, water quality, rural

1 INTRODUCTION

1.1 BACKGROUND

Many of the rural areas in South Africa lack access to formal water services (DWA, 2010). Statistics South Africa's community survey report (2016) indicates that 10.1 % of households are without access to piped water, and people have no choice but to rely on other sources of water. This is attributed to the fact that water service provision through conventional water supply options that rely primarily on surface water sources, water storage and bulk reticulation network are expensive to implement due to the village characteristics, for instance a bad terrain (Nkuna, *et al*, 2014). For small municipalities, this is especially difficult considering that most rural communities cannot afford to pay for services.

This calls for a new focus on context specific solutions targeted at areas that are hard to reach with conventional systems. The rural municipalities need to change significantly, respecting local contexts (Moriarty, *et al*, 2013). This evolution towards a more context-based approach can lead to sustainable service delivery. Rural ccommunities have very rich assets in a form of practices, infrastructure, networks, natural resources, or knowledge systems that if given attention can lead to communities meeting their current and future needs. These local knowledge systems within rural communities provide a sound platform for sustainable water services (Mahlangu and Garuts, 2014).

1.1.1 Summary of demographics

The village is situated in Limpopo Province of South Africa and falls within Mopani district municipality respectively (See Figure 1).

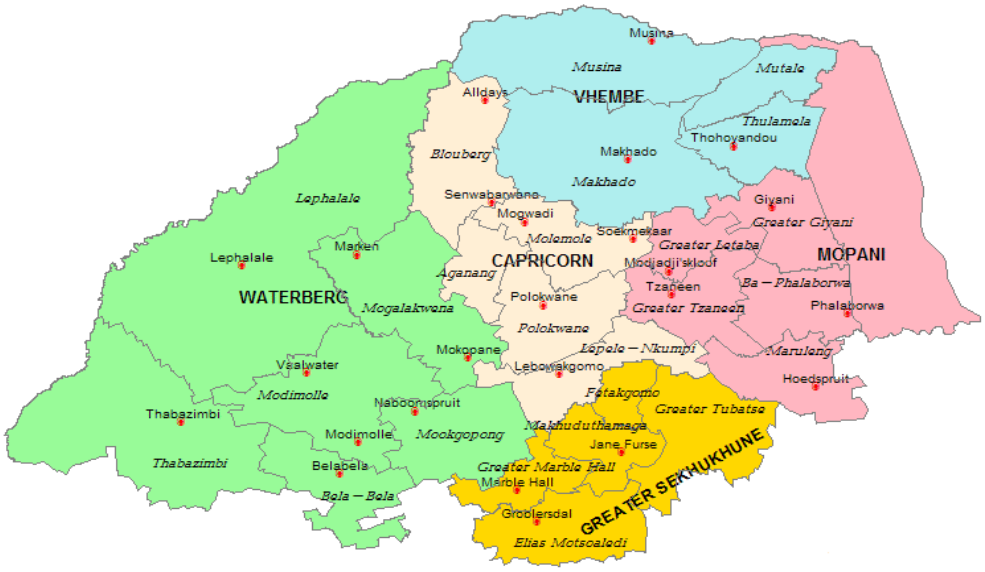

Figure 1 Map showing the location of Mopani District Municipality in Limpopo Province (Google maps)

This area was identified during the Accelerating Sustainable Water Services Delivery II (ASWSD) project. Meidingen is located on a hilly terrain on the outskirts of Kgapane Township in Greater Letaba Local Municipality about 45km from Tzaneen town and about 20km from Modjadjiskloof. The steep and hilly terrains make the village difficult to access especially during the rainy season.

Figure 2: Meidingen village (3D Aerial Photograph)

The most spoken language in the village and in the surrounding areas is Khelobedu, which is another dialect of Sepedi language. The demographics are summarized in table 1

Table 1: Summary of key demographics of Meidingen village

Village Name	WSA/Provider	Population (households)	Average HH size
Meidingen	Mopani	783	5.3

Meidingen village is characterized by high unemployment rates, people rely on social grants and subsistence farming. About 55% of households in Meidingen are female headed with the highest educational qualification Diploma in 22% of the households and the average was Grade 12.

1.1.2 Aims and objectives

The aim of the study is to show how creative out of the box approaches have potential to pave the way for sustainable water service delivery in human settlements, particularly in rural communities in South Africa. It seeks to show how focusing on the context can yield sustainable solutions to the delivery of free basic water in remote and rural communities. The study was part of a project that sought to demonstrate the role of technological innovation towards universal access to safe drinking water without replacing or duplicating municipal services. The study specifically used qualitative and quantitative approach to gather data for the case study.

1.1.3 The findings of the study

The study indicated that community involvement and focusing on the context can yield promising results for sustainable water services. The community of Meidingen currently receive drinking water whilst still awaiting the municipal service of piped water.

2 LITERATURE REVIEW

2.1 WATER SERVICE DELIVERY CHALLENGES IN RURAL MUNICIPALITIES

Basic delivery of services can be imperative in the reduction of poverty, unemployment and strengthening of social capital. It can also serve to stimulate agriculture, tourism and other rural enterprises. An example being: A road infrastructure which connects rural areas to urban centres and eases the mobility of goods and people within the area, and water infrastructure, which depending on the nature and scale of technology has great potential for boosting small and large scale agricultural activities (National Treasury , 2011).

Substantial progress has been made delivering basic infrastructure in rural municipalities. However, there is a lot still to be done. The challenge is that the supply of these services has often been attempted using urban based technologies, which have proved expensive due to the dispersed nature of rural settlements. There has been a concern that the Municipal Infrastructure Grant that rural municipalities receive is not designed and managed in a manner that allows for eradication of backlogs in rural villages sustainably. Municipalities have a tendency to use it for upgrading and rehabilitating network infrastructure in towns, due to the fact that town-based households are more likely to pay for services. It is also suspected that there is a general lack of understanding with alternative, appropriate technology options that can be used to provide services to villages, given water shortages, low population density, and typology that render conventional technologies costly to install and operate (National Treasury, 2011).

It is indicated that the municipalities' inability to provide reliable water and sanitation services is mainly due to the lack of capacity, the misuse of funding, and/or the lack of funding for operation, maintenance, refurbishment and management of water and waste water infrastructure assets (National water and Sanitation Masterplan, 2018)

2.2 LEGISLATIVE FRAMEWORK FOR WATER SERVICES IN SOUTH AFRICA

The constitution of South Africa states in chapter two of the Bill of Rights, that everyone has the right, to have access to sufficient food and water and social security. Section 152 further indicates that it is the responsibility of local government to ensure the provision of services to communities in a sustainable manner; to promote social and economic development; and to encourage the involvement of communities and community organizations in the matters of local government. In South Africa water is recognised as a common asset whose trusteeship lies with the state. There are two Acts that guides the water sector in South Africa, namely water resources management, guided by the National Water Act (1998), and water services provision, guided by the Water Services Act (1997). The National Water Act (Act 36 of 1998) mandates the Department of Water and Sanitation to ensure that all water resources are well managed and protected, developed and conserved "for the benefit of all persons" and in accordance with the constitution.

The Water Services Act 108 of 1997 governs the water use in South Africa, and recognises that everyone is entitled to a basic water supply and basic sanitation.In the late 2000 the Free Basic Water (FBW) policy came into effect (Muller, 2002). This policy stipulates that households are entitled to up to 6000 litres of drinking water every month at no cost (i.e. 25l per person per day). According to the Water Services Act, the water services provider should implement this policy. Furthermore, the FBW policy recognises that in most remote rural areas the cost of water service provision is too high, therefore providing 25l per person might not always be feasible. In this way WSA/Ps have discretion over the amount based on the water source or technology available to provide water. This makes provision for the municipalities to identify alternative sources of water to meet the needs of rural communities.

The National Water Resources Strategy II provides the framework for the protection, use, development, conservation, management and control of water resources for South Africa, as well as the framework within which water must be managed at catchment level. It also seeks to address the current and future water demands for South Africa (DWA, 2013).The strategy suggests using alternative sources of water (i.e. rain water harvesting, storm water harvesting) as opposed to relying on surface water schemes. This is a great advancement in that it allows for out of the box thinking when coming up with solutions.

Reconstruction and Development Programme (RDP) is a South African socio-economic policy framework implemented by the ANC government, this policy was aimed at correcting the injustices of the apartheid government. The policy makes provision for the infrastructure necessary to supply 25 litres of potable water per person per day within 200 metres of a household and with a minimum flow of 10 litres per minute (in the case of communal water points) or 6000litres of potable water supplied per formal connection per month (in the case of yard or house connections.

2.3 OVERCOMING THE WATER SERVICE DELIVERY CHALLENGES

According to the National Treasury, (2011) the rural communities need to be aware of the importance of using alternative technologies in order to optimise access to water given existing affordability levels of rural municipalities, and the availability of resources. There is greater need for innovation is required in the development and deployment of technologies that are appropriate to rural areas. These include water harvesting, ground water supply through boreholes for water; on-site sanitation options, and non-grid energy options. Managed properly, these are not only environmentally friendly service options, but could provide a more efficient and affordable way of supplying rural services (National Treasury (2011).

3 RESEARCH METHODOLOGY

The study is part of the Department of Science and Technology funded project "Accelerating Sustainable Water Services Delivery II project which was a social innovation project that sought to demonstrate the role of technological innovation towards universal access to safe drinking water. The paper uses qualitative and quantitative methods of data collection for the case study of a village where unconventional approaches to water services delivery were implemented in Meidingen community in the Limpopo province. The study used interviews, water quality and quantity analysis.

, this included

- informal interviews with municipal officials in order to understand the institutional arrangements for water service provision, as well as challenges that the relevant municipality is facing with regards to providing water services to its respective rural communities
- Informal interview with the local leadership as well as meetings or focus group discussions with individual community members in Meidengen village in order to understand the water services in that community.
- Detailed field survey to assess the water sources and associated infrastructure in the village followed by recommendations on the most appropriate context based intervention to address the water challenges.
- The geo-hydrological and hydro-physical assessments were conducted to understand the feasibility of the identified springs in providing water to the specified households. The hydro-physical measurements were done to quantify the flow rate and these was done out using an OTT C20 current meter with OTT Z400 signal counter set and impellor # 1-239627 (diam. = 125 mm, pitch = 0.25 m) mounted on a 20 mm diameter steel rod.
- Hydro-chemical analysis were also conducted to assess the water quality, the physical parameters that were measured were temperature, electrical conductivity (EC), pH, Eh and oxidation reduction potential (ORP). The measurements were carried out using a Hanna model HI9828 multi-parameter probe.
- Microbiological samples were sent for analysis to the nearest laboratory

4 FINDINGS AND DISCUSSION

4.1.1 Access to water services

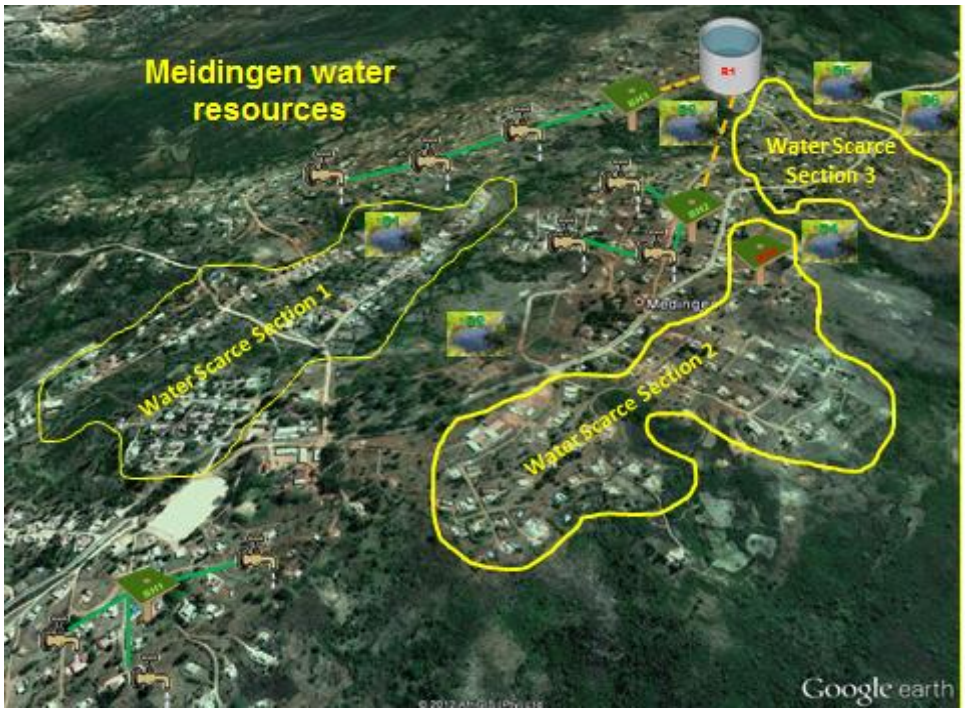

Figure 3: Water sources in Meidingen village

The main source of water in Meidingen village is groundwater, in the form of boreholes (4) and springs (5). Only three of the four boreholes are working and supplying the village. The boreholes have been networked and connected to two reservoirs of 100kl each. The network system is designed to have a single supply line that also serves as a reticulation line. This design has created a supply problem as the two reservoirs cannot fill up due to a lot of street tap connections that are directly connected to the supply line. As a result, the taps have become an unreliable source of water. There are also informal connections on the reticulation line. Figure 4 shows the concrete reservoirs and street tap.


Figure 4: Tap connected to the two reservoirs serving Meidingen village

The area is also characterized by a lot of natural springs. A total of five springs were identified. Some of the springs have had human intervention in order to harness the water, such as the Majonini spring, the yield tests conducted on this spring revealed that the spring produces an average of 0.36L/s, and was serving more than 50 households on a daily basis.


Figure 5: Ha khelowa and Majonini springs

The hakhelowa spring located about 50m from the nearest household was identified and a yield potential of 0.1l/s was established. The spring is perennial and difficult to access. The spring was developed further in order to harness water. Springs are regarded as sacred in 100% of the households sampled, and as such are respected. Most of these springs in the area are perennial. All households indicated using water from springs for more than 20years and continue to collect water from springs since it is the most reliable source of water. Households are able to collect water amounting to more than 100L per household on a daily basis. It should be noted that although the springs are a reliable source of water for the community, the water quality analysis showed the presence of faecal matter and high levels of nitrates (see Table 2). The high levels of nitrate could be attributed to the use of unsafe sanitation facilities in the village and lack of solid waste management (Figure 6). This water was thus not suitable for drinking and requires treatment.

Figure 6: Unsafe practices around springs

Table 2: Location and water quality of springs in Meidingen Village:

Name of spring	Coordinates/Position		Elevation (m amsl)	Water Quality				
				Variables detected				
	Latitude (dd.ddddd)	Longitude (dd.ddddd)		EC (mS/m)	pH [–log10(H+)]	Turbidity	Microbiological	Other parameters out of spec variables
Raophala Seep	23.63665	30.25220	1 068	19.7	5.9	4.9	Ecoli&Ttotal coliforms (TC)	Nitrate + nitrite N Turbidity
Khelowa Seep	23.63332	30.25042	1 099	8.2	6.0	1.1	Ecoli&TC	Nitrate + nitrite N Turbidity
Majonini Spring	23.63593	30.24307	1 060	11.9	6.3	0.31	Ecoli& TC	Nitrate + nitrite N
Masekhekhe Seep	23.63895	30.24457	1 036	14.0	6.4	<0.2	Ecoli,HPC,&TC	Iron Fe Aluminium Al
Ke sa hlapa(1)	23.630417	30.256350	1072	11.2	7.2	2.2	Ecoli, HPC &TC	Nitrate + nitrite N Aluminium,
Ke sa hlapa (2)	23.630967	30.255233	1080	22.1	6.4	0.61	Ecoli,HPC, TC	-

4.1.2 Traditional Practices and local beliefs around water sources in Meidingen

There are strong cultural beliefs surrounding the springs in the community. The springs are regarded as sacred and it is believed that there is a snake that controls the yield of the spring. In all the springs that were identified there were certain indigenous trees called Mogo and villagers are discouraged from cutting it irrespective of where it is growing within the village. The most sacred spring, is the Majonini spring, it has been protected with concrete slabs and fencing and women and unmarried men are not allowed to enter the spring. It was also strongly encouraged to protect the springs using locally acceptable materials and methods, as this could interfere with the yielding potential of the spring.

4.2 Interventions in Meidingen village

The inefficiency of the municipal system resulted in the community of Meidingen relying on springs for their daily water needs. Evidently, protection of springs was an obvious intervention guided by the value that the community of Meidingen attaches to the springs, and the reliability that springs have. This option entailed protecting the major spring (majonini with a yielding potential of 0.36l/s) to prevent external contamination, such as contamination by domestic animals, and installing small reticulation lines (gravity lines) from the springs to some storage tanks with communal collection points (See figure 7)

Figure 7: Interventions at Majonini spring

4.2.1 Health and hygiene intervention

The evidence from the study indicated a strong need to educate the community of Meidingen on health and hygiene issues. The key focus areas of the health and hygiene education programme the safe collection and storage of household drinking water. Other relevant hygiene risk behaviours such as sanitation including waste disposal were also addressed. The method used were posters and presentation to communicate good health and hygiene practices as it is the common approach used by Environmental Health Practitioners (EHPs) to communicate with the community to address such issues. The importance of ownership and taking responsibility of the infrastructure was emphasized during the workshop. It was indicated that the community need to look after the infrastructure, use water wisely, report any breakdowns and make sure that there is no vandalism and informal connections.

5 CONCLUSION AND FURTHER RESEARCH

It is recognised that a lot has been done to improve water service delivery challenges in rural communities. However, there is still more to be done to improve and ensure sustainable service provision by municipalities. In this study the municipality is failing to provide sustainable water service to the community due to poor system design, insufficient water sources, inadequate funding and the dispersed and hilly terrain nature of the village. People in this community have no choice but to rely on springs that were found to be reliable but unsafe and have the potential to cause diseases. Upon further investigation, taking into account the needs of the community, and available water resources, springs proved to be a viable low cost option for delivering water to this community.

This further proves that the ‘one size fits all” system of governance does not work and that community involvement in implementing solutions for them yield better results. It is therefore, necessary for the policy on technology choices to promote and recognise alternative technologies/sources as service coverage and not temporary solutions.

This paper therefore, recommends that the findings from studies such as this be reflected in national policy positions as means to promote their uptake and adoption. Policy should put more emphasis on initiatives that improve the capabilities of small municipalities so that the very objectives of growth and development (RDP) can be met.

6 ACKNOWLEDGEMENTS

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