FROM SCIENCE TO SOCIETY – Finding innovative solutions towards deep rural water supply

Working in deep rural communities from the Eastern Cape to Limpopo, a group of scientists from various disciplines are harnessing science and technology in a way which effectively engages with – and responds to – people's values, beliefs and cultural practices at the nature-society interface.
Article by Wiida Basson.

Led by the CSIR, scientists are seeking ways to provide safe, secure water supply to deep rural communities.

Guy Stubbs/Africa Media Online

Funded by the CSIR, the aim of the 'Sustainable water for rural security' project is to link different research disciplines together to provide the appropriate science base to enable the provision of clean water to rural communities. This must be achieved in partnership with the communities and local municipalities involved, to ensure uptake and the long-term sustainability of the intervention.

This is easier said than done, however. Over the past three years, three case studies in Limpopo, the Eastern and Northern Cape have delivered more than its share of what sustainability scientists call 'wicked problems'. A 'wicked problem' is the term used for problems that are unique, very difficult to define and constantly changing.

Such problems, which defy any single, final solution, typically arise in complex systems, explains sustainability expert Dr Michelle Audouin. "A complex system is different from a complicated system. Although a complicated system may have many parts, it can be understood through an analysis of those parts – like taking apart a computer and putting it back together again to understand how it works."

A complex system, in turn, is an open system with intricate sets of non-linear relationships. These relationships give rise to emergent properties that cannot be investigated through analysis. For example, the smell and beauty of a rose cannot be found by taking apart the rose and examining it, Audouin wrote in a 2011 user guide on 'Transdisciplinary research for sustainability'.

To sum it up, problems that arise in complex systems are 'wicked' in every sense of the word. Access to drinkable water in rural South Africa is not only a wicked problem but it is also in a crisis. Of the six million South Africans who lack reliable drinkable water, and the 13 million who lack decent sanitation, the rural poor are the most affected and vulnerable, says CSIR microbiologist and project leader, Bettina Genthe.

Rural areas are the most difficult to service and maintain. This leads to high incidences of waterborne diseases (up to 90% in areas lacking services), with diarrhoea being the third-highest cause of natural death after HIV and Aids and respiratory illnesses. In many instances this creates a poverty trap for individuals in these communities, impacting on the country's economic growth and development.

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So how does one address a wicked problem like rural water security and free communities from this poverty trap? In this project, researchers selected three representative rural areas in South Africa where they knew there were problems with access to safe drinking water.

THE CASE OF FOUR EASTERN CAPE VILLAGES

The four villages of Nqileni, Folokwe, Tshezi and Mgodjweni in the Mbashe Local Municipality are situated in one of the most remote and poorest districts in South Africa. In 2011, researchers approached the community through the district municipality and a non-governmental organisation (NGO) – the Bulungula Incubator – working in the area. After several workshops with the villagers, and additional

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CSIR geohydrologist Sumaiya Clarke (fourth from left) with a group of villagers from Nqileni, Tshezi and Folokwe.

Women and children in Kgotlopong, in Limpopo fetching water from a communal tap.

input from the municipality and the NGO, researchers were faced with seemingly insurmountable problems and challenges.

"The area is incredibly rural," explains case study leader and geo-hydrologist Sumaya Clarke. "There are no toilets, no taps, no electricity, and the only source of water – from a few springs in the area – is polluted by grazing animals and children playing in the water."

An immediate concern, and something that needed to be addressed urgently, was the high infant mortality rate: "Through household surveys, the Bulungula Incubater NGO concluded that the child mortality rate in the villages is high, with a minimum mortality rate of one child per household, and a maximum of nine children in one household.

"And yet people do not always make the link between specific health issues and lack of clean water. We first had to understand the issues from the community's perspective, and then to work with them to find workable and sustainable solutions," Clarke says.

While the Bulungula Incubator is running health awareness days, showing the villagers the 'unseen' bacteria and viruses in their water through microscopes, the CSIR project team will be working with volunteers from the community to secure the springs by using raw material from the area.

The springs are vulnerable to pollution with the children playing in them and animals drinking water directly from the springs. People typically use the 'bush system' for excreting bodily wastes as there are no toilet facilities in these parts. Heavy downpours in the summer months wash human and animal excretions from the surrounding hills into the springs and the river.

Planned intervention have to be acceptable to the community: "We have to ensure that community members take ownership and responsibility for whatever we are going to do to ensure sustainability of the intervention. With a number of volunteers from the community, we plan to walk through the villages and identify sources of pollution. The plan is then to collect raw materials, such as cobbles and boulders, and pack these around the springs to protect them."

Other interventions include promotion of the use of water-filters, addressing community questions and identifying their effectiveness.

KAMIESBERG IN THE NORTHERN CAPE

In the remote Kamiesberg Local Municipality in Namakwaland, researchers were faced with several of the typical rural water supply challenges facing district municipalities, exemplified by the dramatic drop in their Green Drop status from 83% in 2009 to only 5.4% in 2011. According to Ashton Maherry, leader for the Northern Cape case study, this is a typical example where things were starting to go wrong in terms of poor maintenance and lack of funding, capacity and especially skills.

"The artificial groundwater recharge site at Tweerivier is one of the oldest in South Africa and a signature example of its type – small scale, but effective and easy to maintain. Yet it failed. The same goes for the reverse osmosis plant at Soebatsfontein. This area has the highest density of reverse osmosis plants in the country – these plants are extremely expensive to erect, yet there are no long-term funding in place for maintenance."

A third typical challenge has to do with the repair and upgrade of the Nourivier Dam wall: "Local farmers at Nouwrivier need a water license to get water from the dam. But in order to get a water license, the dam first needs to be registered with the Department of Water Affairs. But the dam cannot be registered because the dam wall first needs to be fixed," Maherry explains.

One of the main problems identified was the fact that these issues were not part of the municipal framework or any of their development plans. In other words, a municipality cannot obtain funding from the Department of Water Affairs unless water infrastructure and maintenance is part of their integrated development plans.

"We are now at the stage where we will present an implementation

plan to the elective council so that it becomes part of the formal special development framework and integrated development plans. And hopefully we will be able to get that Green Drop score back to where it belongs," Maherry concludes.

A TRULY 'WICKED' PROBLEM: THE CASE OF KGOTLOPONG, LIMPOPO

The third case-study site, Limpopo, epitomised the concept of a 'wicked' problem, with the following ingredients:

- Very remote area with little water supply and rainfall, and as such susceptible to droughts and sporadic floods;
- Individual households do not have water connections;
- Water from the Kgotlopong River is used for domestic purposes, compromising community health;
- Lack of municipal funding and skills to effectively implement water supply systems;
- Measures that have been undertaken are frequently vandalised and infrastructure is stolen;
- Area is governed by both a tribal authority and an elected local municipality, who often do not see eye to eye.

As a first step, researchers worked with the local water committee during multiple workshops and follow-up meetings to craft a shared vision for effective water provision. According to case study leader Karen Nortje, the next step is to determine which technologies will work best in the context of the community: "There are boreholes, but no pumps. Some may have to make use of water from the river or springs, but these have to be kept clean and protected from outside contaminants. We now need to work with the community to determine what would work best for them."

A typical unprotected spring from where villagers collect water for household use.

At the same time two anthropology students from the University of Johannesburg are working with the project team in this community: "There is very little capacity in the social sciences to work on this level. By involving the students, we hope to interest more and more students in this kind of work," Nortje concluded.

SCIENCE AT THE COALFACE

Currently in its third year, the research team will now focus on monitoring the sustainability of current interventions, as well as the implementation of site-specific interventions. This will be done in close partnership with the communities and municipalities involved.

From a research perspective, the team plans to identify critical design criteria that can ensure the sustainability of rural water supply systems in South Africa. This, concludes Audouin, is what the emerging field of sustainability science is all about, namely to harness science and technology in a way which effectively engages with – and responds to – people's values, beliefs and cultural practices at the nature-society interface:

"As we increase our understanding of coupled social-ecological systems, we can better address the sustainability concerns of particular places and regions. These concerns are the practical problems facing human beings at the nature-society interface, such as access to water, food, housing and energy. ❑

At times simple maintenance rather than complex scientific solutions are required to provide sustainable services. Here CSIR geohydrologist, Sumaiya Clarke, is assisting to repair a handpump.