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The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

TECHNICAL BRIEF

Groundwater

Factors influencing the success of groundwater schemes

A completed Water Research Commission (WRC) study investigated the factors influencing the long-term success of groundwater schemes for domestic water supplies.

Background

This study was undertaken to assist local municipalities to develop groundwater resources for water supply. It investigated the success or failure of water supply systems to South African households reaching beyond the traditional 'discourse of shortage'- i.e. water supply failures in South Africa are due to a shortage of water, a shortage of skills, a shortage of spare parts, a shortage of funds, and so on. Usually, they are not.

While shortage of one or other commodity may indeed be the immediate cause of many water-supply failures, this is usually a 'downstream' consequence of many other issues combined. Many of these issues can be grouped under the heading of 'operation and maintenance', and they can combine in ways that can be unexpected.

The overlapping factors governing groundwater sustainability, and the way in which they extend beyond the traditional concerns of hydrogeologists, should be considered a 'complex problem'.

Groundwater vs surface water

Groundwater cannot usually be 'seen' in the same way as a dam or river, and many misconceptions about the resource still persist, such as that groundwater flows in 'underground rivers', that it is mysterious and unreliable, or that water diviners are needed to locate it.

In fact, groundwater can be understood and managed in much the same way as other natural resources. This does, however, require specific techniques and expertise. Misconceptions about the physical resource are often amplified by poor choices of technology (e.g. unsuitable pumps) and a lack of appropriate operation and maintenance to result in unreliable groundwater schemes.

Study area

This study concentrated on the 119 local municipalities which together make up the 24 'priority' district municipalities as defined by the Department of Water and Sanitation. These priority municipalities include those areas of South Africa with the most severe water-supply backlogs.

Most of the findings are more widely carried out in four provinces in South Africa, with a range of respondents. Interview material was supplemented by existing hydrogeological data, census data, literature reviews, and other information.

Results of the study

Case studies of rural boreholes in Chris Hani District Municipality in the Eastern Cape and urban groundwater supplies in Mahikeng, North West Province, show that groundwater is reliable when managed appropriate, and that costs are comparable with surface water resources.

On the other hand, poor understanding of the resource and a failure to translate groundwater data into management actions can result in groundwater sources failing and continuity of water supplies being put into doubt. The situation is often exacerbated by poor communication

and misunderstanding between the various interlocking organisations tasked with water-supply management.

It is argued that all domestic water-supply installations using groundwater as a raw water resource need input from a qualified hydrogeologist (groundwater scientist). Even where the resource is easy to find and the quantities needed are small, there are many additional issues such as delineation of protection zones, O&M recommendations based on water quality and other factors, pump duty cycles and other operating rules, the possibility of artificial recharge and so on which need expert assistance.

Since O&M costs often exceed installation costs over the lifetime of a groundwater source, a professional approach to groundwater supply installation in the first place, including appropriate O&M recommendations, will save resources in the long term.

An examination of the various sources of funding for the provision of water supplies at municipal level found that shortage of funds was not normally a constraint on water-supply infrastructure provision. There are, however, discrepancies between the levels of funding aimed at capital projects, and the amounts allocated to ongoing operation and maintenance.

The capacity of local government to absorb and allocate funding can have a bearing on the type and scale of water-supply infrastructure chosen. New types of grants, with greater involvement of the national sphere of government, are gaining in importance.

Detailed breakdowns of budget spent at local level, particularly with respect to spend on operation and maintenance of water-supply systems, are either not available or are difficult to obtain.

Main research outputs

Drawing on the finding that physical/hydrogeological factors are only a minor part of groundwater scheme sustainability, a range of other factors was explored. In the end, four main groups of factors were considered in an attempt to characterise and predict the difficulty of the talk ahead of each of the priority 119 local municipalities in providing domestic water supplies, as follows:

1. Actual or existing water-supply backlogs
2. Demographic indicators, such as unemployment
3. Indicators of financial 'health' for the relevant water service authority (e.g. audit scores)
4. Geographical factors, such as community accessibility by road.

A series of maps was prepared showing relative rankings for a series of sub-factors which together are considered to make up each of the four groups of factors. For example, the geographical factors included road density, average distance to a town of reasonable size, fragmentation of communities in each local municipality, and so on.

By combining the groups of factors into one main map, it is possible to arrive at a relative ranking for the 119 local municipalities, and to suggest the 20 most challenged local municipalities in terms of the task of providing domestic water supplies to households in the years that lie ahead (see table 1).

Table 1: Most challenged municipalities in terms of sustainable groundwater supply

Rank	Local Municipality	Province
1	Elias Motsoaledi	Limpopo
2	Engcobo	Eastern Cape
3	Greater Tubatse	Limpopo
4	Hlabisa	Kwazulu-Natal
5	Indaka	Kwazulu-Natal
6	Intsika Yethu	Eastern Cape
7	Jozini	KwaZulu-Natal
8	Makhuduthamaga	Limpopo
9	Mbhashe	Eastern Cape
10	Mbizana	Eastern Cape
11	Mhlontlo	Eastern Cape
12	Mnquma	Eastern Cape
13	Ngquza Hill	Eastern Cape
14	Ntabankulu	Eastern Cape
15	Nyandeni	Eastern Cape
16	Port St Johns	Eastern Cape
17	Thulamela	Limpopo
18	Umhlabuyalingana	KwaZulu-Natal
19	Umzimkhulu	KwaZulu-Natal
20	Umzimvubu	Eastern Cape

The local municipalities with the biggest water-supply backlogs (and sanitation backlogs too, although this is not covered in this report) tend to be in the Eastern Cape, KwaZulu-Natal and Limpopo provinces, and overwhelmingly in former homeland areas.

Households without improved water supplies tend to be rural and impoverished, with high levels of unemployment, and lack of access to other types of infrastructure, such as roads and healthcare facilities. An examination of available hydrogeological data at national scale for groundwater occurrence shows that there is little or no correlation between regional groundwater occurrence (utilisable potential) and the proportion of households with access to improved water supplies.

Conclusion

This study argues that neither absolute shortage of groundwater nor shortage of funds is the cause of domestic water-supply backlogs in South Africa, and that **adequate and professional operation and maintenance of water-supply systems (including groundwater) is in fact the key to sustainable water supplies.**

There is a danger that failure to adequately operate and maintain groundwater supplies in South Africa will result in the resource being characterised as unreliable or undesirable, and that more expensive options, such as desalination or long pipelines to bring surface water will be chosen instead.

Alternatively, domestic water-supply failures will continue to be characterised in terms of the 'discourse of shortage'- South Africa is a dry country, and therefore it is not surprise that water supplies fail or are inadequate. Both of these outcomes have already happened in parts of South Africa, and there is an urgent need to shift away from a narrow focus on 'technical' hydrogeological factors to a wider appreciation of the varied strands related to O&M that really determine whether domestic water supplies from groundwater are reliable or not.

Further reading:
To order the report, ***An appraisal of diverse factors influencing long-term success of groundwater schemes for domestic water supplies, focusing on priority areas in South Africa*** (**Report No. 2158/1/14**)
contact Publications at Tel: (012) 330-0340,
Email: orders@wrc.org.za or Visit: www.wrc.org.za
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