THE OVERBURDEN AQUIFER AND ITS POTENTIAL CONTRIBUTION TO REACHING TARGETS FOR SAFE WATER SUPPLY COVERAGE IN NORTHERN UGANDA

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Hypothesis

The overburden aquifers in Uganda are underutilised causing an unnecessarily slow increase in the water supply coverage, felt hardest in the poor post-conflict northern region of Uganda.

Introduction

Springs and shallow wells are the cheapest technology options for safe water supply in rural areas in Uganda. There has however been a considerable decrease in the Government funded (District Water and Sanitation Conditional Grant) total number of protected springs and shallow wells over the last financial years (FY), whereas the number of drilled boreholes is generally stable.

In northern Uganda, a region recovering from an emergency conflict situation, the water supply coverage is lower than in other parts of the country, and mostly deep boreholes are drilled. Comparison of best-served and least served district shows that lowest served districts have variably successful deep boreholes with problems of success rate as the most predominant source (Government of Uganda, 2007). Cost analyses demonstrate that deep boreholes are far more expensive than shallow boreholes, yet the average number of people served per hand pump equipped source is the same.

Why is the overburden aquifer underutilised

The suggested underutilisation of the shallow aquifer in northern Uganda is thought to be the result of:

A. Poor image with development institutions, users, etc.:

- as a supposedly seasonal, and therefore unsustainable source.
- has poor bacteriological water quality due to anthropogenic sources (pit latrines, animal husbandry) .
- climate changes affect the recharge potential.

B. Misconception of the shallow motor-drilled borehole as a shallow well.

General borehole characteristics

Augured and dug shallow wells tap water from laterite aquifers and/or perched aquifers found in the first few metres below ground level, often close to swamps. The motor-drilled shallow wells on the other hand are actually shallow boreholes, which tap most water from the contact zone between the overburden and the weathered hardrock. This aquifer is found at greater depth, not necessarily in valley bottoms, and is much less prone to contamination. Table 1 gives an overview of the descriptions of the different source types.

Table 1: Description of shallow borehole and shallow well types

Type	Description	Depth (m)
Deep borehole	A deep borehole is a machine drilled (mud-drilling or down the hole hammer [DTH]) well with a depth greater than the maximum depth defined for a shallow borehole. It is installed with 4-8" PVC casing/screens.	30 -100
Shallow borehole	A shallow borehole is a borehole drilled with a drilling machine to an undefined depth. It is installed with 4-6" PVC casing/screens. It can either be drilled with the mud rotary method or DTH. If the machine is only equipped with the mud drilling equipment hardrock cannot be penetrated as this can only be done by using the DTH equipment.	10-30
Dug shallow well	A dug well is a shallow well usually with a diameter of 1 m. It is dug with small tools that are not motor drilled. It is installed with concrete rings or lined with bricks. Depths range from 4-5 m in valleys to depths of 30 m further away from the valleys	4-30
Hand augured shallow well	A hand augured shallow well is a well, drilled with human power down to a specified depth. In reality typical depths are between 4-5 m in valleys and 10-15 m further away from the valleys. It is usually installed with 4" PVC casings / screens.	5-15

Methodology

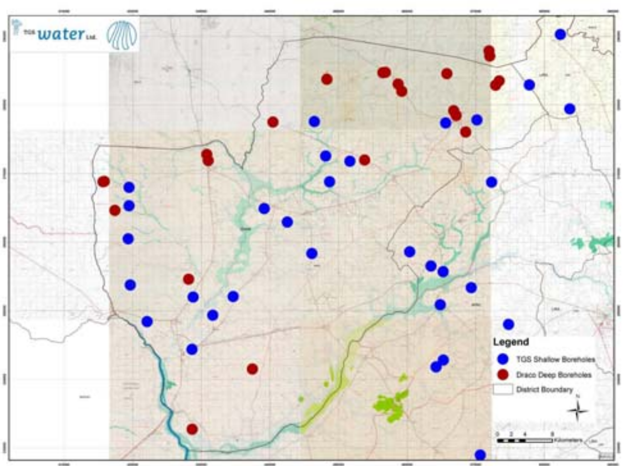
Use the results of an ongoing programme of shallow well drilling in northern Uganda to assess the viability of shallow aquifers in the overburden to provide long-term sustainable potable water. The programme is using the PAT301TP drilling equipment, which has capacity to drill in the range of 10-30 m.

The main focus is to:

1. Analyse the shallow well success-rate in northern Uganda using information from the ongoing shallow well drilling by TGS Water Limited in northern Uganda, and compare to the success-rates of a deep borehole programme carried out under CESVI.
2. Analyse the costs involved for shallow well drilling as compared to deep well drilling.
3. Check the viability of the shallow well image.

Figure 1: PAT 301TP drilling a 30 m borehole

Study area



Objective of Poster

The objective of this poster is to show that properly sited, motor-drilled shallow boreholes area preferred rural water supply option in the districts studied in northern Uganda.

General findings

Success rates : A total of 80 shallow boreholes were drilled in Oyam, Apac, Dokolo and Lira Districts by TGS Water Ltd. with a 71% success-rate. Boreholes were drilled to a point of resistance, which usually coincides with the active weathering zone of the sap rock. Since completion three years ago, none of the shallow boreholes has reportedly dried. A drilling programme consisting of 30 deep boreholes was also completed in the same area that had a success rate of 94%. In both programmes, drilling locations were based on prior detailed site surveys that included detailed geophysical exploration. A summary of the results of the two programmes is given in Table 2.

Table 2: Results of both shallow and deep drilling programmes in northern Uganda

Type of borehole programme	No. of sources	Success-rate*	Average airlift yield [m3/hr]**	average drilled depth [m bgl]	Average borehole cost [US$]***
Shallow	80	71%	0.7 - 5.0	21	5,000
Deep	30	94%	2.0	46	10,625

* Success-rate is based on generally accepted minimal yield of 700 l/hr
** as reported in the driller's records
*** including costs failed boreholes

Seasonal sustainability: The Directorate of Water Resources have been monitoring water levels and rainfall on a regular basis over the past six years at their Apac station. Data (Figure 2) for two separate monitoring wells show water levels responding relatively quickly to intense rainfall events. Seasonal water level fluctuations are limited to range of up to about 3 m.

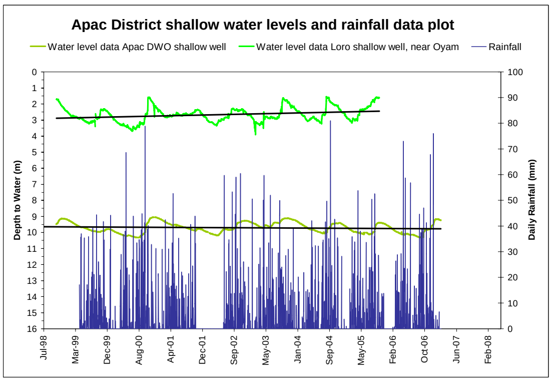


Figure 2: Water level shallow wells and rainfall Apac (DWRM data)

Microbial water quality: There is no readily available data on microbial quality of groundwater for the area. It can be assumed that if water sources are located sufficiently far away from anthropogenic sources of pollution (pit latrines) the potential for contamination is minimal, as the resident time should allow for effective die-off and predation. It is important that the borehole construction is of a high standard including appropriate low permeable seals and surface completion

Sustainability and climate change: Under the Nile Basin Initiative (NBI) several numerical models were used to determine the effect of climate change on the general hydrological regime in the Lake Victoria basin. All models predict increased rainfall and temperature figures across Uganda. According to Wright (1992) there is a positive correlation between aquifer recharge and Mean Annual Rainfall. Consequently, increases in rainfall as predicted by the models should lead to an increase in recharge of shallow aquifers to the aquifer systems in the area.

Costs: As shown in Table 2, the average costs for a successful drilling location in northern Uganda greatly depend on the selected technology, with deep boreholes being more than twice as expensive as shallow boreholes. This is due to much less investment costs for the drilling equipment (75,000 US$ for a PAT301TP rig) as compared to 250,000 US$ for a typical rotary/DTH drilling rig), and a lesser drilled depth and amount of required installation materials for the boreholes.

Conclusions / Recommendations

- ✓ Shallow boreholes are a good alternative for deep wells in large areas of northern Uganda and will be perennial water sources with good water quality if properly constructed, tested and managed. In Uganda they are not expected to dry due to climate change.
- ✓ Shallow motor drilled boreholes should be advocated for whenever feasible, especially since the unit costs for successful shallow boreholes are much less than for deep boreholes (both actual drilling and materials).
- ✓ The drilling should always be based on proper siting.
- ✓ Shallow borehole drilling requires medium capital investment as compared to a much higher capital investment for deep borehole drilling equipment.

References:
1.Government of Uganda, Ministry of Water and Environment, (2006). Water and Sanitation Sector - Performance Report 2006.
2.Government of Uganda, Ministry of Water and Environment, (2007). Water and Sanitation Sector - Performance Report 2007.
3.Nile Basin Initiative, Nile Equatorial Lakes Subsidiary Action Programme, (2007). Strategic/sectoral, social and environmental assessment of power development options in the Nile equatorial lakes region..
4.Wright, E.P., and W.G. Burgess (1992). Hydrogeology of Crystalline Basement Aquifers in Africa. Geological Society Special Publication No. 66.