# GROUNDWATER AND RURAL WATER SUPPLY IN AFRICA

The Millennium Development Goals (MDGs) for water will only be achieved in Africa by increased development of groundwater for rural water supply. However, the role that groundwater plays in achieving the MDGs is underrated and rarely articulated. This briefing note explores the main groundwater issues related to rural water supply in Africa.

1. Groundwater is the only realistic water supply option for meeting dispersed rural demand.
2. Hydrogeological capability makes water supply programmes more effective.
3. Expertise on African groundwater is dwindling and existing knowledge and research are not readily accessible.
4. Critical research gaps need to be addressed to help develop groundwater effectively. In particular: developing groundwater in difficult areas; variations in natural groundwater quality; the effect of drought and climate change on groundwater; and the impact of sanitation on community water supplies.

*Ten African rural water supply experts have contributed to this briefing note. They form the IAH Burdon Groundwater Network and are from government, NGOs and academia in Uganda, Tanzania, Ethiopia, Nigeria, Senegal, South Africa, Germany, UK, Norway and Ireland.*

## Rural water supply and the MDGs

There are still at least 1.1 billion people across the world that do not have access to safe drinking water. Many of these people live in rural areas and are among the poorest and most vulnerable to be found anywhere in the world. In sub-Saharan Africa, 300 million people have no access to safe water supplies – approximately 80% live in rural areas.

Therefore, significantly increasing the coverage of rural water supply in Africa is fundamental to achieving many of the internationally agreed Millennium Development Goals (MDGs). Without safe water near to dwellings, the health and livelihoods of families can be severely affected; children's education suffers as the daily tasks of survival take precedence over all other concerns.

## Why groundwater?

Over much of Africa, groundwater is the only realistic water supply option for meeting dispersed rural demand. Alternative water resources can be unreliable and difficult or expensive to develop: surface water is prone to contamination, often seasonal, and needs to be piped to the point of need; rainwater harvesting is expensive and requires good rainfall throughout the year.

The characteristics of groundwater make it well suited to the more demand responsive and participatory approaches of rural water and sanitation programmes:

- Groundwater resources are often resistant to drought.
- Groundwater can generally be found close to the point of demand (if you look hard enough with appropriate expertise).
- Groundwater is generally of excellent natural quality and requires no prior treatment.
- Groundwater can be developed incrementally, and often accessed cheaply.
- Technology is often amenable to community operation and management.
- Groundwater is naturally protected from contamination.

*Groundwater resources are generally the only realistic method of meeting dispersed rural demand.*

## Successful investment in rural water

Having an understanding of the groundwater resources (hydrogeology) of an area can have many benefits and is critical to developing successful, safe and sustainable water supplies.

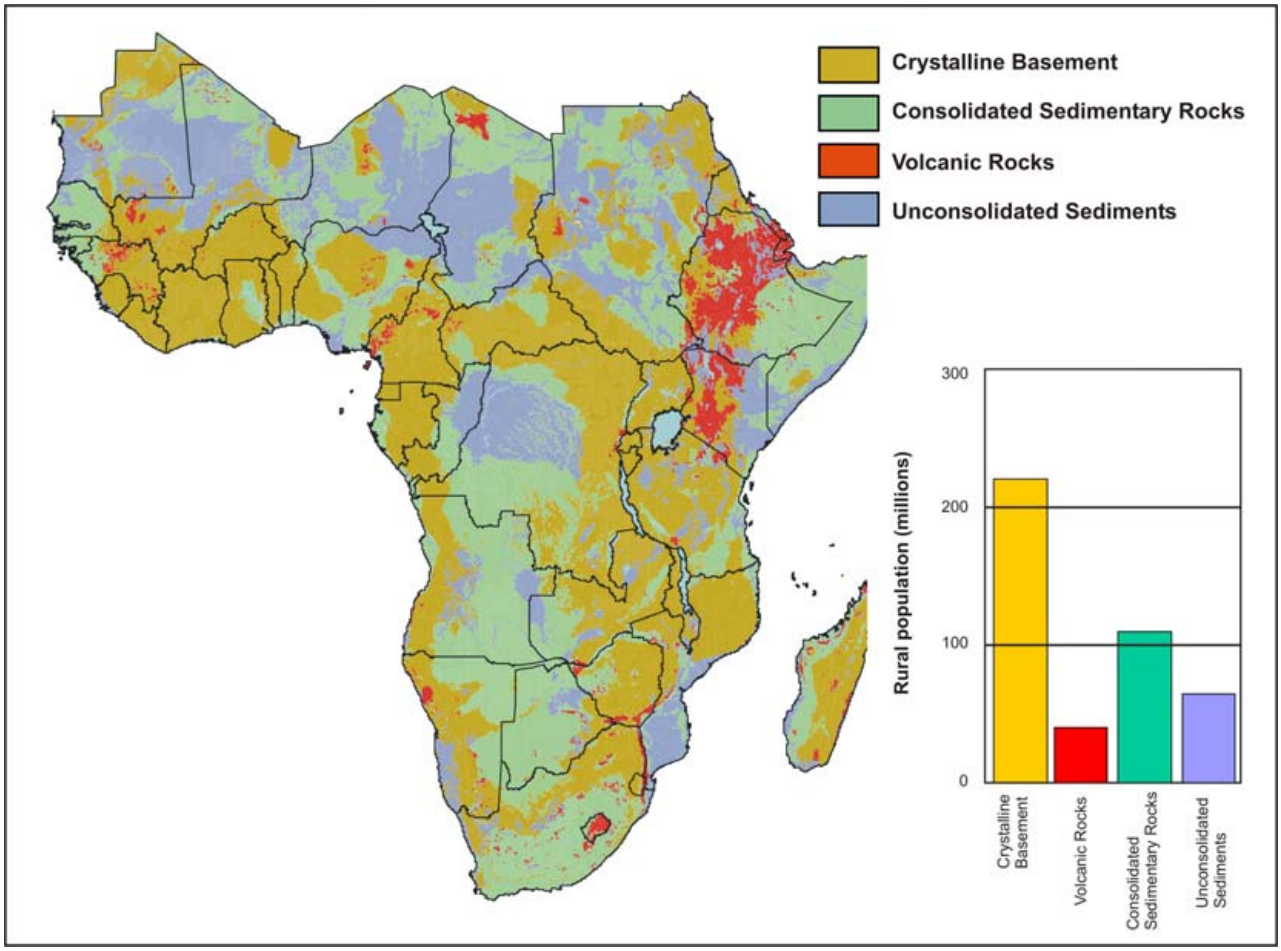
**The cost of failure.** Due to the many advantages of using groundwater, many rural water supply projects rely on developing groundwater, but do so blindly, with little regard to the groundwater resources. Boreholes are sited at random, or by socioeconomic criteria alone, the water supplies are assumed to be safe and sustainable with no water quality testing or understanding of the nature of the resource The high failure rate from such an approach not only has high cost implications, but also has much wider implications caused by community expectations being raised and not met.

**Increasing cost-effectiveness.** The nature of groundwater resources changes from place to place. Therefore, to avoid installing many dry or failing sources, both the technology and socio-economic approaches must be appropriate to the groundwater environment. For example, in some areas only boreholes will be successful, in others large diameter wells will be the most appropriate source. In some environments, boreholes can be sited anywhere and drilled by hand, in other areas sophisticated geophysical techniques are the most cost effective method to site successful water points.

**Understanding sustainability**. Much is staked on the sustainability of individual water points. Understanding the hydrogeology is the key to identifying how the water point will behave under stress and also the long-term sustainability of groundwater resources under the impact of drought and climate change. A well-planned community supply, that takes into account the nature of the groundwater resources, will be sustainable.

**Targeting the difficult areas**. Many of the areas facing severe poverty and poor health are where it has proved difficult to develop safe water supplies. Water supply projects in these areas have a history of failure and are now often avoided because of their low success. However, spending time understanding how groundwater occurs in these difficult areas has led to successful water project being developed in areas once avoided.

**Identifying quality issues**. Although natural groundwater quality is generally excellent, problems such as naturally occurring arsenic and




*A simplified hydrogeological map of Sub-Saharan Africa (after MacDonald et al 2005). The insert shows the number of rural people living on each of the hydrogeological environments.*

fluoride are coming more to the fore (for example arsenic in Bangladesh and fluoride in east Africa). Only by routine testing, and understanding the nature of the geology and groundwater resources can such problems be understood and mitigated.

**Avoiding resource degradation.** Although groundwater is generally well protected, increased development and the greater use of on-site sanitation, can threaten the quality of groundwater. Understanding the hydrogeology can help predict areas where this may be a problem and allow alterations in design, mitigation, or improved groundwater management stategies.

## Groundwater in Sub-Saharan African

As discussed above, the availability of groundwater depends primarily on the geology and the nature of the rainfall. The map shows the distribution of the most common aquifer types in Africa.

The diagrams opposite summarise how groundwater can occur in three hydrogeological environments in Africa. For each environment different techniques are required to develop wells and boreholes.

- In some environments groundwater is shallow and ubiquitous and hand drilling can be used to easily access the resource.
- In many other environments, however, groundwater is more difficult to find and specialised expertise and techniques must be used to develop safe community supplies.
- In some environments there are particular problems that must be addressed prior to development; e.g. poor groundwater quality, or scarce resources.

## Re-building groundwater expertise

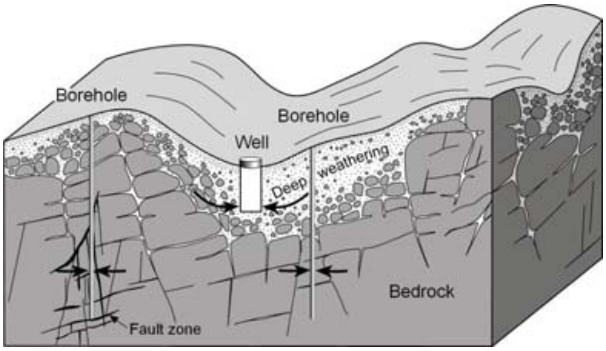
Despite the importance of hydrogeology to successfully developing rural water supplies cross Africa, available expertise has declined in recent years. Various factors have contributed to this:

- Groundwater expertise is often undervalued in rural water supply programmes. This underlies many of the other reasons why expertise has declined.
- Lack of appropriate training throughout Africa. There are few institutes where hydrogeology is taught.
- Funding for research of African groundwater resources is at an all time low.
- Throughout much of the rest of the world, hydrogeologists are in demand for other issues, such as environmental protection, urban water supply and safe nuclear waste disposal.

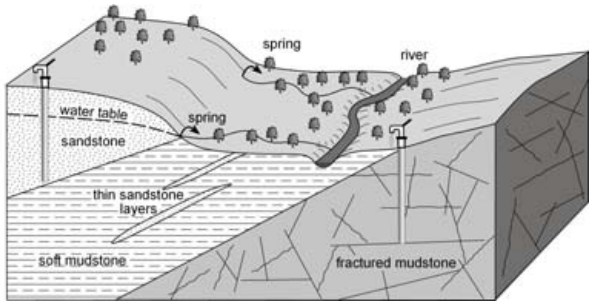
*Groundwater expertise must be placed much more at the heart of African rural water supply.*

To help rebuild the necessary groundwater expertise, and focus hydrogeologists on the pressing issues the MDGs, their expertise must be placed much more at the heart of African rural water supply.

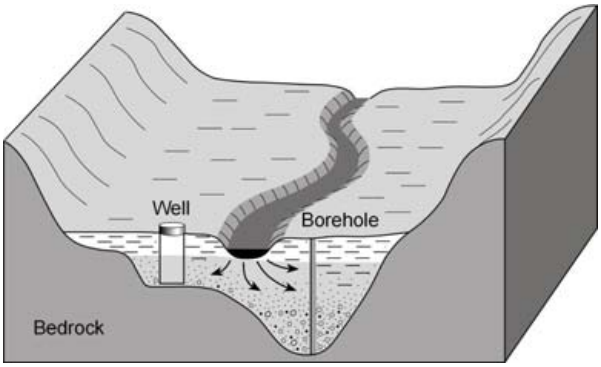
Hydrogeological training must not be allowed to decline further. Easier access to research funds would also help groundwater researchers to focus on rural water supply issues, rather than the many other issues for which funding is more easily available.




*Groundwater occurrence in basement rocks*




*Groundwater occurrence in sedimentary rocks*




*Groundwater occurrence in riverside alluvium*

*For the many areas where people still have no access to safe water, groundwater expertise can be fundamental in helping to develop new water points.*

## Knowledge and Data are not readily available

Existing information that is vital for developing groundwater resources is not readily accessible. Lessons learnt from successful or unsuccessful projects are not being used incrementally as a basis for new projects.

- Basic information, such as geological and groundwater maps, are missing or difficult to get.
- Grey literature, such as consultants reports, are not collated and the knowledge is lost to other projects and future generations.
- Databases of borehole data and water quality, which have proved so useful in many countries, have now fossilised – or been lost.

As a result, some are drilling boreholes almost blind, with often very poor success rates and poor quality water – this is an ineffective use of funds. Even in new projects, the lack of groundwater expertise referred to above often does not allow proper collection of new data – which in its turn would support future work.

## Critical Research Gaps

The required increase in development of groundwater resources to help meet the MDGs for water has raised the significance of several research questions. These research issues must be addressed to increase effectiveness of rural water supply projects and to ensure security and sustainability of supply.

**Finding groundwater in difficult areas**. Areas where sustainable groundwater sources are hard to find (such as poorly weathered bedrock and mudstone areas) often have the greatest problems with health and poverty. Helping to solve water problems in these difficult areas may have greater impact on reducing poverty in sub-Saharan Africa than drilling many more boreholes in areas where it is relatively easy to find water.

**Groundwater quality and health**. Elevated concentrations of naturally occurring elements in water, such as arsenic and fluoride, can have catastrophic health impacts on local communities. Little is known about the distribution of these elements across Africa and the environmental factors which control their distribution at a village level. Much more needs to be known about where these elements are likely to be elevated and how to mitigate the impacts.

**Drought and climate change.** How sustainable are water points during periods of drought? Initial research has indicated that there are many factors that determine how resilient groundwater resources are to drought. Little is know about the variation of these factors, and in particular how renewable groundwater resources are. New research is critical to stop groundwater resources being exploited unsustainably, and to help design water supplies which are drought resistant.

**Protecting groundwater resources.** On-site sanitation, although critical to the success of water projects and health of communities, can contaminate local groundwater resources. With the current focus on increasing access to sanitation, urgent research is required to ensure that this is done without compromising the quality of groundwater resources on which community water supplies depend.

## Further Reading


Black M 1998. Learning what works: a 20-year retrospective view on international water and sanitation cooperation 1978-1998. UNDP – WorldBank water and sanitation programme, http://www-wds.worldbank.org.

Foster SSD et al. 2000. Groundwater and rural development. WorldBank Technical Paper 463
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International Association of Hydrogeologists
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MacDonald AM 2005. Developing groundwater – a guide for rural water supply. ITDG Publishing.
http://www.developmentbookshop.com/


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The aim of the IAH Burdon Groundwater Network is to provide hydrogeological support to those involved in helping to meet the MDGs for water.