Africa Groundwater Atlas
Making African groundwater information more visible and accessible

Sean Furey

Groundwater in Africa
Availability of groundwater and rates of extraction vary widely from place to place

L’eau souterraine en Afrique
La disponibilité et les taux d’extraction de l’eau souterraine varient considérablement d’un endroit à l’autre.
The true size of Africa

Most global map projections give a false impression: Africa is much bigger than we often think...

Diverse People
Diverse Geology & Groundwater

2012: first quantitative continent-wide maps of aquifer storage and potential published

- 0.66 million km$^3$ of storage (not all available for abstraction)
What is the Africa Groundwater Atlas?

- Brings together *existing groundwater information* from many sources in a *consistent* way

- A consistent overview of groundwater resources, status & management for **51 African countries**

- A starting point for *understanding groundwater at a country-scale*

- A *gateway* to more detailed information

- In collaboration with IAH & hydrogeologists across Africa
Why is the Atlas important?

- For safe, sustainable groundwater development we need to **understand groundwater**
- To understand groundwater we need **good information** – which is hard to find!
- **BUT** there is lots of good information out there – it’s just not always easily visible and accessible
Background to the Atlas

- Publication of continental-scale maps of aquifer productivity, groundwater storage and depth to groundwater
- Demand for country-scale information
- Increased spending from UK government on development cooperation research e.g. UPGro

1 http://www.bgs.ac.uk/research/groundwater/international/africanGroundwater/maps.html
Developing the Africa Groundwater Atlas

- 1:5M USGS Geology Map of Africa > BGS Geology & Hydrogeology Map of Africa > country hydrogeology maps
- Country profiles for 51 countries
- Co-written with hydrogeologists from across Africa
- Online and free
- Offline version available
What’s inside the Atlas: Climate, Soil, Land Cover

- Derived from 3rd party data
- Easy to compare from one country to another

Answers to questions like:
- When is the recharge season?
- Have there been droughts in recent years?
- Are there areas with no surface water resources?
What’s inside the Atlas: Geology

Summary of main geological formations

<table>
<thead>
<tr>
<th>Key Formations</th>
<th>Period</th>
<th>Lithology</th>
<th>Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kalahari Group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alluvium</td>
<td>Recent (Quaternary)</td>
<td>Unconsolidated alluvial soil, sands and gravels, and some clay near lakes</td>
<td></td>
</tr>
<tr>
<td>Zambesi Formation</td>
<td>Tertiary - Recent</td>
<td>Ferromagnetics, evaporites, conglomerate and gravel</td>
<td></td>
</tr>
<tr>
<td>Barotse Formation</td>
<td>Tertiary</td>
<td>Sandstone, Chert, Quartzite</td>
<td>Sedimentary bedding</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper Karoo Group and Karoo Basalt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luano, Sivanga, Kato, Luvungi and Baluba formations</td>
<td>Jurassic - Early Cretaceous</td>
<td>Most of the sequence consists of consolidated sediments: mudstone, sandstone, siltstone, coal, gritstone, tills, marl, and conglomerate. The uppermost Baluba Formation consists of basalt with interbedded sandstone, distinguished on the geology map above as Karoo Basalt.</td>
<td>Sedimentary bedding, laminations and ripple marks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Karoo Group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bavundu, Gwerere and Mibembe formations</td>
<td>Carboniferous - Jurassic</td>
<td>Consolidated sediments: sandstone, gritstone, siltstone, mudstone</td>
<td>Sedimentary bedding, laminations and ripple marks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Katanga Supergroup</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Including Upper Ruzizi, Luvungi, Kambwe and Chitabezhi formations and Kungurian Limestone</td>
<td>Precambrian (570-620 Ma)</td>
<td>Various metamorphosed sediments: schist, argillite, quartzite, dolomite and limestone.</td>
<td>Sedimentary bedding, metamorphism, foliation, and folding</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mvula Supergroup</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kankaywe, Rutshuru and Chalawa River formations</td>
<td>Precambrian (1355±28 Ma)</td>
<td>Metamorphic rocks: gneiss, quartzite, amphibolite, granodiorite and schist</td>
<td>Metamorphic foliation, folding, and metamorphism</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chiwite, Kabwezama, Nama and Ithala formations</td>
<td>Precambrian (1355±28 Ma)</td>
<td>Variously metamorphosed conglomerate, quartzite, limestone and carbonates</td>
<td>Metamorphic foliation, folding and metamorphism</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basement Complex: Granite</td>
<td>Majority older Precambrian</td>
<td>Granite</td>
<td>Quartz veins</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basement Complex: undifferentiated</td>
<td>Majority older Precambrian</td>
<td>Metamorphosed rocks: gneiss, mafic, granite, diorite, aplite, anorthosite</td>
<td>Quartz veins, faulted, folded and metamorphosed</td>
</tr>
</tbody>
</table>
What’s inside the Atlas: Hydrogeology

Summary of key aquifers

Answers to questions like:

- Where are the high yielding aquifers?
- Is groundwater storage and flow in pores or weathered zones or fractures?
- What are typical borehole yields from an aquifer?
- What is the groundwater quality?
What’s inside the Atlas: Additional GW Info

- Quality
- Status
- Use
- Management

Answers to questions like:

- What are the main uses of groundwater?
- Are there any big groundwater problems? (water quality? over-abstraction?)
- Which institutions are involved with groundwater management?
- Is there groundwater monitoring?
- Are there national groundwater databases?

Groundwater use and management

Groundwater use

There are currently inadequate data to make an accurate assessment of Zambian groundwater availability and use. Personal experiences and estimates would put groundwater usage at about 60% – 70% of total national water supplies, although this is highly variable spatially.

The groundwater resource has greatly suffered from unregulated exploitation and exposure to pollution – aspects that may threaten it as an important source of water in the future.

The National Water Master Plan (UNICEF-MIWA, 1995) estimated that the breakdown of groundwater use was:

- 30% irrigation
- 27% total water supply
- 22% livestock
- 13% urban supply

Groundwater is accessed from a variety of sources; boreholes equipped with electric pump, hand pumps, windmills, solar pump, diesel pumps and rope and bucket. There are no recent statistics on the different pump technologies employed, but a nationwide inventory carried out by government in 1996 produced an estimated total of 11,300 boreholes (electric and hand pump) and 22,000 protected wells in the country (National Water Policy 2010).

Groundwater management

The key groundwater institutions are:

- Department of Water Affairs – for water policy formulation
- Ministry of Local Government and Housing – for rural water supply
- Water Resources Management Authority (WRMA) – for water resources development, utilisation and management

The legal framework for groundwater monitoring in Zambia comprises the following:

- The Revised National Water Policy of 2010
- The Water Resources Management Act of 2011, which stipulates that there shall be no private owning of water and that any permission to use water will be time-limited. The Act provides for permits to drill and abstract groundwater, but these have not yet been implemented. The greatest challenges to effective groundwater resources management in the country is posed by poor institutional and legal frameworks, inadequate water resources data and information systems, poor coordination of various ministries, departments and institutions dealing with water; centralised management of water resources, and lack of monitoring and evaluation of programmes and projects relating to water (National Water Policy 2010).

There is much good information on water points, including boreholes and wells, but it is fragmented across several institutions. For example, there is a well-organised borehole database for the Southern region, including geological logs, related to a project carried out by GTZ.

Transboundary aquifers

Zambia has two transboundary aquifers identified by the SADC Hydrogeological Mapping Project (SADC, 2016). The “Medium Zambezi Aquifer” crosses the border with Zimbabwe, and the “Sand and gravel aquifer” crosses the border with Malawi.

For further information about transboundary aquifers, please see the Transboundary aquifers resource page.

Groundwater monitoring

Groundwater level measurements are taken automatically at some stations in Lusaka on a daily basis; while in other places, these are read fortnightly.

There is no national or regional groundwater quality monitoring.
What’s inside the Atlas: Additional Resources

Groundwater use

Groundwater monitoring

Groundwater quality

Recharge
Where to find more information:  
**Africa Groundwater Literature Archive**

- The most comprehensive yet index of African groundwater literature: \(~7000\) entries (so far!)
- **Full text download** if available; or for copyrighted documents, **link to online abstract** if available
- Full bibliographic references
- Complements other literature archives: e.g. WRC; IRD; SADC Grey Literature Archive
What’s new and coming?

- Digital (GIS) hydrogeology and geology maps should be ready in November.
- Translation into French of all Francophone countries.
- Increasing relevant social science information.
- Adding new references & documents to the Literature Archive – as many as possible with full text digital copies.
- Water statistics (from AQUASTAT) on each country page.
- Case studies illustrating a range of GW issues, and demonstrating how GW info can be used practically for management purposes at different scales.
The Consortium Projects (2015-19)

Working in Benin, Burkina Faso, Ethiopia, Ghana, Kenya, Malawi, Niger, Nigeria, South Africa, Tanzania, Uganda
If you have any comments on the Atlas or Archive, please get in touch.

Email us on AfricaGWAAtlas@bgs.ac.uk

The Africa Groundwater Atlas is at: http://www.bgs.ac.uk/africagroundwateratlas/index.cfm