Groundwater quality in Africa

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Contents

Introduction to Groundwater Quality in Africa

Groundwater quality can be influenced by both natural and anthropogenic processes. At present there are few studies on groundwater quality for Africa, and no regional or national assessments. Some of the key issues related to groundwater quality in Africa are described below, with some key sources of more information.

Drinking water guidelines

The World Health Organisation sets out **guidelines for drinking-water quality** (2011).

Groundwater quality fact sheets

The British Geological Survey collaborated with WaterAid to summarise the inorganic quality of groundwater in countries where WaterAid works.

Download **fact sheets for groundwater quality** for Burkina Faso, Ethiopia, Ghana, Madagascar, Malawi, Mali, Mozambique, Nigeria, Tanzania, Uganda and Zambia. These fact sheets aim to identify inorganic constituents of risk to health that may be present in groundwater.

Download **water quality fact sheets by element** for **arsenic**, **fluoride**, **iodine**, **manganese** and **nitrate**. These element sheets aim to explain the nature of the health risk for each constituent, the origin and occurrence in groundwater, the means of testing and available methods of mitigation.

Download **fact sheets on the impact of agriculture, industry and urbanisation**. These

complement the fact sheets on specific groundwater quality parameters and countries, and should be read together with these.

Groundwater Quality: Burkina Faso

This is one of a series of information sheets prepared for each country in which WaterAid works. The sheets aim to identify inorganic constituents of significant risk to health that may occur in groundwater in the country in question. The purpose of the sheets is to provide guidance to WaterAid Country Office staff on targeting efforts on water-quality testing and to encourage further thinking in the organisation on water-quality issues.

Background

Burkina Faso is a landlocked country in the Sahel region of West Africa. It has an area of around 274,000 square kilometres and is bordered to the south by Cote d'Ivoire, Ghana and Togo, to the east by Benin and Niger and to the north by Mali (Figure 1).

The terrain is mainly flat or undulating with some small hills in the west and south-eastern parts. The highest point is Tena Kourou (749 m), close to the Mali border, and the lowest point on the Black Volta River (200 m) in the south-eastern part of the country. The Volta Basin occupies around two-thirds of the country and the Black Volta (Mouhoun), Red Volta (Nazinon) and White Volta (Nakambé) Rivers all have their sources in Burkina Faso. The Black Volta is the only perennial river. Many of the river courses are dammed in order to accumulate water in the rainy season.

The climate varies from arid in the north to tropical savannah in the south. The country has warm dry winters resulting from northerly Saharan air masses and hot, wet summers from moist Atlantic air. Average annual rainfall decreases from around 1200 mm in the south to 650 mm in the north (around 850 mm in Ouagadougou) and the rainy season lasts from June to October. However, rainfall is often irregular and the region is prone to droughts, especially in the north. Average daytime temperatures range from 30°C in the south to 40°C in the north.

Land use comprises mainly woodland, forest and pastureland with around 13% used for arable agriculture. Some 90% of the population is engaged in subsistence farming. Principal crops produced are peanuts, shea nuts, sesame, cotton, sorghum, millet and corn. The principal industries are cotton lint, beverage manufacture, brewing and agricultural and leather processing.

Geology

The geology of Burkina Faso comprises dominantly ancient (Precambrian) crystalline rocks, consisting of metamorphosed sediments, meta-igneous rocks and abundant intrusive granite. The backbone of the country is composed of Archaean (3000–2700 million years old) crystalline rocks but intercalations of younger (Birimian) crystalline rocks are also common. These are similar to the formations developed in neighbouring Ghana and other parts of West Africa. The margins of a large ancient sedimentary basin (Precambrian to Ordovician age) occupy the western border area. This formation is represented by sandstone, shale and dolomite (limestone). Younger rocks (Mesozoic to Quaternary age) are restricted to sedimentary basins in the extreme north of the country (Gondo Plain), along the border with Mali. Much of this area accommodates the Tertiary Formation of the 'Terminal Continental' (UN, 1988).

Figure 1. Relief map of Burkina Faso (courtesy of The General Libraries, The University of Texas at Austin).

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Geogenic contamination

Geogenic contamination refers to **naturally occurring elements** that are generally present in groundwater due to dissolution of the aquifer material. Geogenic contaminants in groundwater can have a negative effect on human health, particularly when consumed over prolonged periods of time. The most common geogenic contaminants are fluoride and arsenic. More than 300 million people worldwide are thought to use groundwater contaminated with fluoride or arsenic as a source of drinking water.

The British Geological Survey **fact sheets** give an overview of arsenic, fluoride, iodine and manganese, all of which can be geogenic contaminants in groundwater.

The Swiss Federal Institute of Aquatic Science and Technology (**Eawag**) has developed a method to assess the risk of groundwater contamination by fluoride or arsenic in a given area, using geological, topgraphical and other environmental data. The **Groundwater Assessment Platform** (GAP) enables users to upload their own data and generate hazard maps for specific areas. The Groundwater Assessment Platform also hosts a Wiki site where you can find and share information about geogenic contamination, associated health risks, and mitigation options.

Further information on the methodology used by Eawag can be found in these publications:

Amini, M, Mueller, K, Abbaspour, K C, Rosenberg, T, Afyuni, M, Moller, K N, Sarr, M, and Johnson, A. 2008. Statistical modeling of global geogenic fluoride contamination in groundwaters. Environmental Science and Technology, Vol. 42, 3662–3668.

Amini, M, Abbaspour, K C, Berg, M, Winkel, L, Hug, S J, Hoehn, E, Yang, H, and Johnson, A. 2008. Statistical modeling of global geogenic arsenic contamination in groundwater. Environmental Science and Technology, Vol. 42, 3669–3675.

Salinity

Salinity is an important groundwater quality issue that can be driven by both natural and anthropogenic processes. Processes such as sea-level rise and intense evaporation can lead to naturally high salinity in groundwater, while overabstraction, irrigation and waste disposal can exacerbate groundwater salinity issues. Salinity has important consequences for human health and agricultural productivity.

IGRAC have compiled a **global map of groundwater salinity** by extrapolating documented cases into larger areas of high probability of saline occurrence.

Nitrate

Nitrogen occurs naturally in the environment and is essential for plant growth. Nitrogen-based fertilisers are therefore often applied to increase crop yields. Leaching from agricultural land can lead to high concentrations of nitrogen in groundwater, which can have a negative impact on both the environment and human health.

A British Geological Survey **nitrate fact sheet** is available giving an overview of nitrate in groundwater.

IGRAC have carried out a **global assessment of nitrate contamination**, working towards global scale maps of nitrate in groundwater.

Urban pollution

Urban and peri-urban areas are expanding in many parts of Africa, particularly across sub-Saharan Africa. Groundwater is often a very important source of improved drinking water in urban and peri-urban environments, but high population densities put pressure on urban groundwater resources, not only in terms of quantity but of water quality.

Groundwater quality can be influenced by a large number of contaminants in the urban environment, from microbiological pathogens and heavy metals to macronutrients, herbicides and pesticides.

Some of the key sources of urban pollution include:

- pit latrines, which are often located close to abstraction points, particularly in densely populated peri-urban or unplanned urban settlements
- sewer leakage and sewage effluent
- uncontrolled disposal of household and industrial waste
- peri-urban agriculture, which includes pesticides/fertilisers and livestock waste

- storm water runoff
- vehicle emissions, power stations and mine waste

There are few studies looking at urban groundwater issues in Africa and those that have been carried out mainly focus on large cities and include only basic chemical and microbiological parameters.

Some studies of urban groundwater quality in Africa are:

Kulabako, N R, Nalubega, M, and Thunvik, R. 2007. Study of the impact of land use and hydrogeological settings on the shallow groundwater quality in a peri-urban area of Kampala, Uganda. Science of the Total Environment, 381 (1-3), 180-199. doi:10.1016/j.scitotenv.2007.03.035

Sorensen, J P R, Chibesa, M, Pedley, S, Lapworth, D J, Nkhuwa, D C W, Stuart, M E, Gooddy, D C, Bell, R A, Chirwa, M, Kabika, J, and Liemisa, M. 2015 [https://www.bgs.ac.uk/africaGroundwaterAtlas/atlas.cfc?method=ViewDetails&id=AGLA050013 Emerging contaminants in urban groundwater sources in Africa]. Water Research, 72, 51-63.

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