

Hydrogeology of Rwanda

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Rwanda is a small and quite densely populated country in the Great Lakes region of central Africa. It is also known as "The Land of a Thousand Hills". Rwanda has been a distinct entity from pre-colonial times. It was colonised by Germany in 1884 (as part of German East Africa), then by Belgium in 1916, before achieving independence in 1962. Ethnic tensions between the Hutu and Tutsi cultural groups led to periodic episodes of violence, including the 1994 genocide. In the aftermath of the genocide there was a period of reconciliation and justice with associated improvement in economic, health and social indicators.

Tea and coffee cultivation are the major cash crops and growth agricultural industries, facilitated by Rwanda's climate and geography. Mining is a significant contributor to export income. The services sector has started to recover after the late 2000s recession, including banking and communications, and particularly tourism, which is now the main source of foreign income and is supported by government. This sector is boosted by the presence of mountain gorillas in uplands areas.

Rwanda has relatively high rainfall and both surface water and groundwater resources. Two major river basins cover Rwanda - the Nile and the Congo basins - and there are many lakes and wetlands. Groundwater is the main source of water supply in rural and some urban areas: in mountain areas from springs, and in other areas from boreholes.

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Compilers

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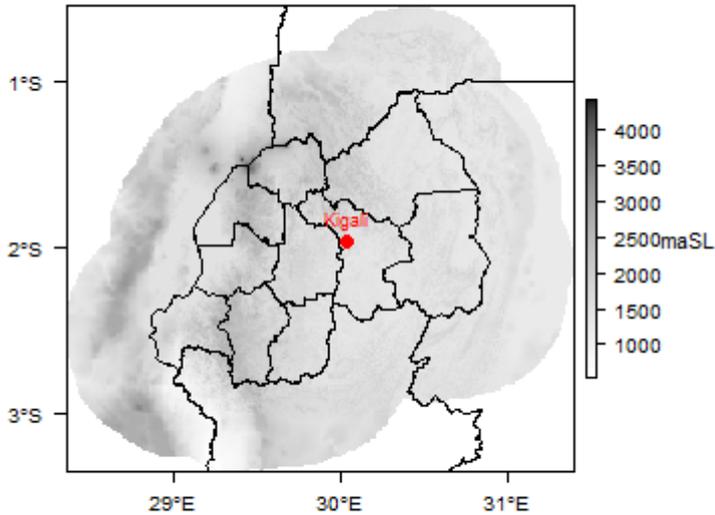
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Geographical Setting



Rwanda. Map developed from USGS GTOPOPO30; GADM global administrative areas; and UN Revision of World Urbanization Prospects. For more information on the map development and datasets see the [geography resource page](#).

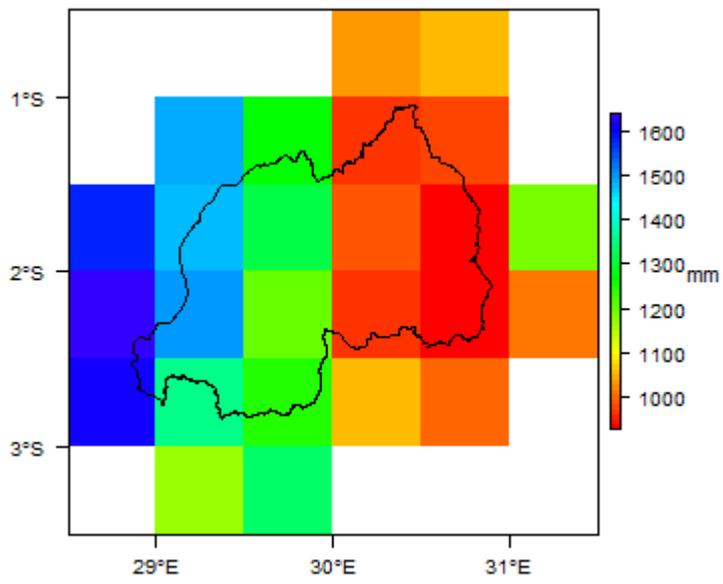
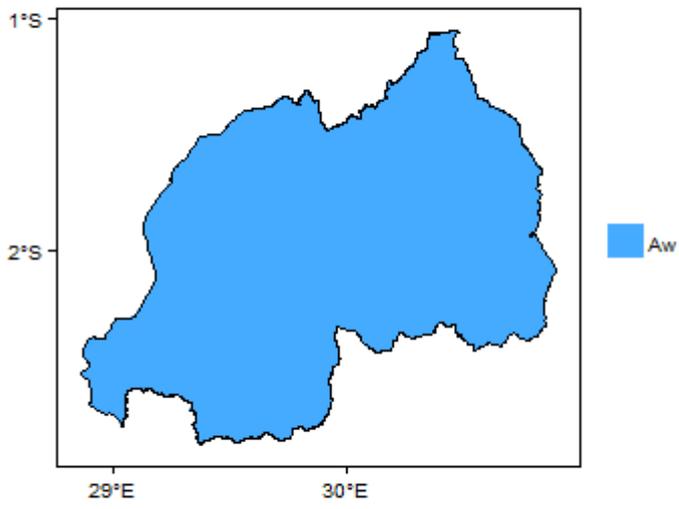
General

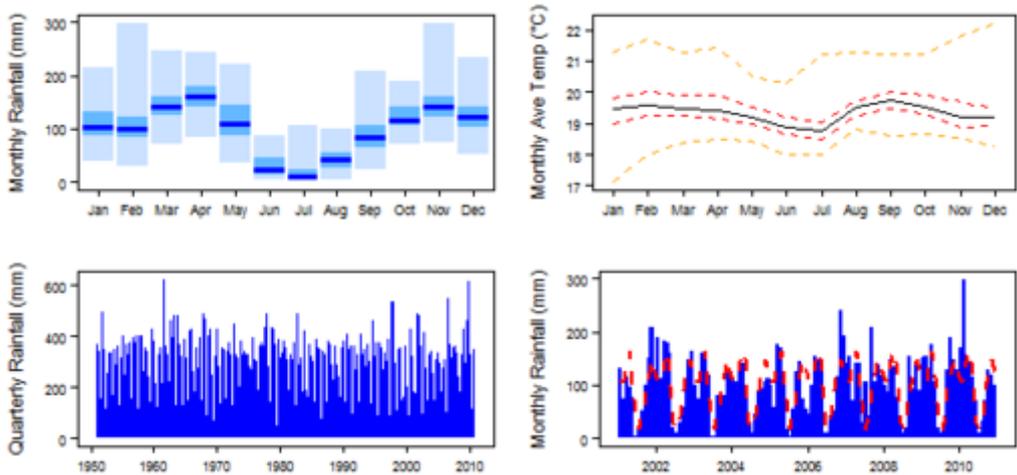
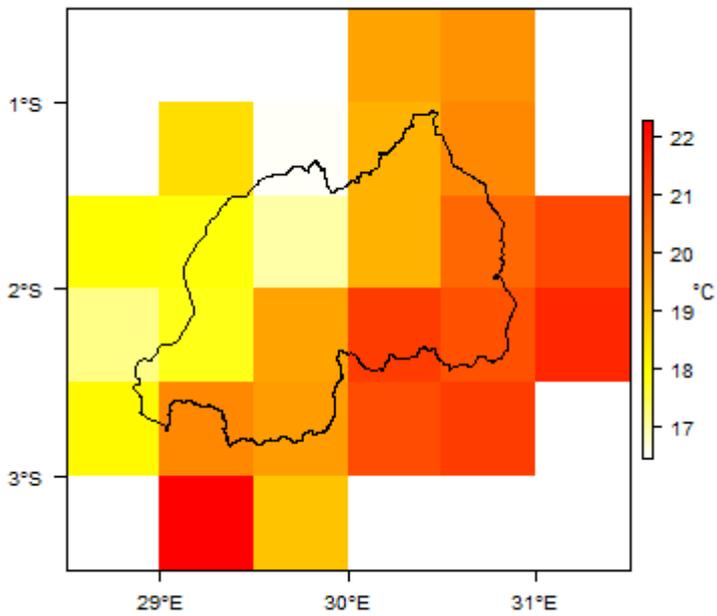
Capital city	Kigali
Region	Eastern Africa
Border countries	Uganda, Tanzania, Burundi, the Democratic Republic of the Congo
Total surface area*	26,340 km ² (2,634,000 ha)
Total population (2015)*	11,610,000
Rural population (2015)*	8,029,000 (69%)
Urban population (2015)*	3,581,000 (31%)
UN Human Development Index (HDI) [highest = 1] (2014)*	0.4832

* Source: [FAO Aquastat](#)

Climate

Rwanda's climate is classed as tropical savannah. Temperature does not vary significantly throughout the year but there are two distinct rainy seasons (February to May and October to December). Rainfall varies across the country, with drier conditions in the eastern savannah regions and much wetter conditions over the central plateau and western mountains.





These maps and graphs were developed from the CRU TS 3.21 dataset produced by the Climatic Research Unit at the University of East Anglia, UK. For more information see the [climate resource page](#).

In Rwanda, rainfall data are collected by MeteoRwanda. More detailed information on rainfall at a catchment scale is described in the [Rwanda Water Resources Master Plan](#) (2014).

Surface water

Rwanda is divided into two major river basins: the Nile in the east and centre, and the Congo in the west. Both are shared with neighbouring countries.

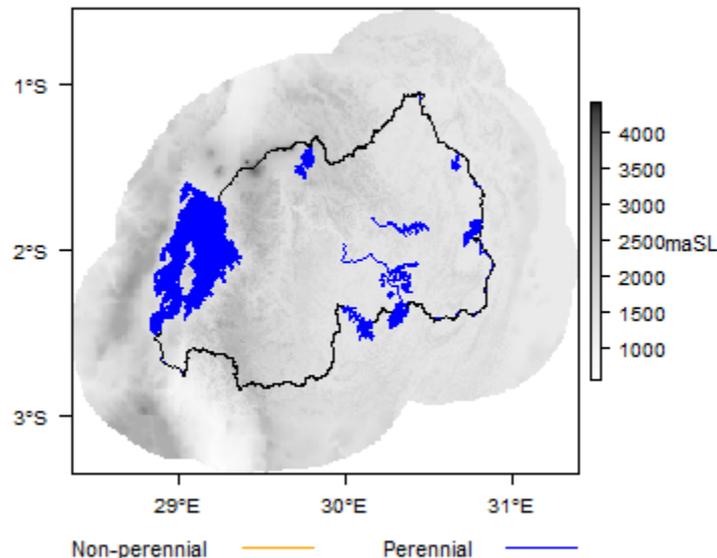
Within the Nile and Congo basins in Rwanda, smaller river catchments include the Rusizi and Akanyaru rivers (shared with Burundi); the Akagera River (shared with Tanzania and Burundi); the Muvumba River (shared with Uganda); and Lake Kivu and the Rusizi River (shared with the DRC). There are many smaller lakes, rivers and associated wetlands. The Akagera River, and its tributary the Nyabarongo, are two of the main rivers, both part of the upper Nile basin.

Surface water resources, as other water resources in Rwanda, are managed by the [Rwanda Water and Forestry Authority](#), previously the Rwanda Natural Resources Authority, which is affiliated to the [Ministry of Environment](#).

Nine Level 1 surface water catchments have been classified for Rwanda (see the [Rwanda Water Resources Master Plan \(RNRA 2014\)](#), page 10).

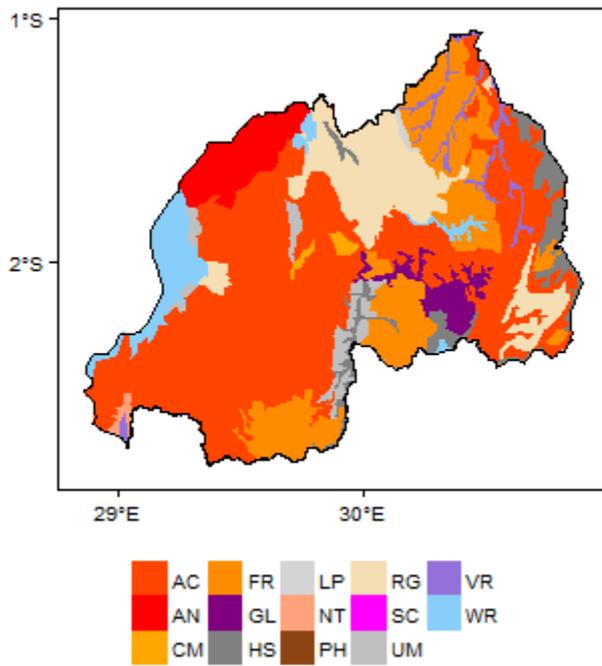
Surface water monitoring is generally good for the large catchments, but less well established for smaller catchments (RNRA 2014).

Monitoring data are collected and stored as part of the Water Management Information System. Data from 65 surface water monitoring stations is now available via the [Rwanda Water Portal](#).



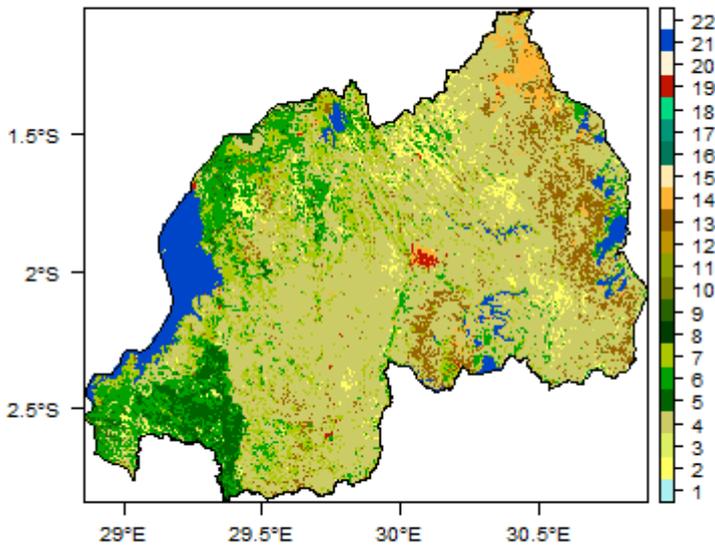
Major surface water features of Rwanda. Map developed from World Wildlife Fund HydroSHEDS; Digital Chart of the World drainage; and FAO Inland Water Bodies. For more information on the map development and datasets see the [surface water resource page](#).

Soil



Soil Map of Rwanda, from the European Commission Joint Research Centre: European Soil Portal. For more information on the map see the [soil resource page](#).

Land cover



Land Cover Map of Rwanda, from the European Space Agency GlobCover 2.3, 2009. For more information on the map see the [land cover resource page](#).

Water statistics

	2000	2005	2014	2015
Rural population with access to safe drinking water (%)				71.9

Urban population with access to safe drinking water (%)				86.6
Population affected by water related disease	No data	No data	No data	No data
Total internal renewable water resources (cubic metres/inhabitant/year)			818.3	
Total exploitable water resources (Million cubic metres/year)	No data	No data	No data	No data
Freshwater withdrawal as % of total renewable water resources	1.128			
Total renewable groundwater (Million cubic metres/year)			7,000	
Exploitable: Regular renewable groundwater (Million cubic metres/year)	No data	No data	No data	No data
Groundwater produced internally (Million cubic metres/year)			7,000	
Fresh groundwater withdrawal (primary and secondary) (Million cubic metres/year)				
Groundwater: entering the country (total) (Million cubic metres/year)	No data	No data	No data	No data
Groundwater: leaving the country to other countries (total) (Million cubic metres/year)	No data	No data	No data	No data
Industrial water withdrawal (all water sources) (Million cubic metres/year)		20.5		
Municipal water withdrawal (all water sources) (Million cubic metres/year)		61.4		
Agricultural water withdrawal (all water sources) (Million cubic metres/year)	102			
Irrigation water withdrawal (all water sources) ¹ (Million cubic metres/year)	No data	No data	No data	No data
Irrigation water requirement (all water sources) ¹ (Million cubic metres/year)				
Area of permanent crops (ha)			250,000	
Cultivated land (arable and permanent crops) (ha)			1,400,000	
Total area of country cultivated (%)			53.15	
Area equipped for irrigation by groundwater (ha)	85			
Area equipped for irrigation by mixed surface water and groundwater (ha)	No data	No data	No data	No data

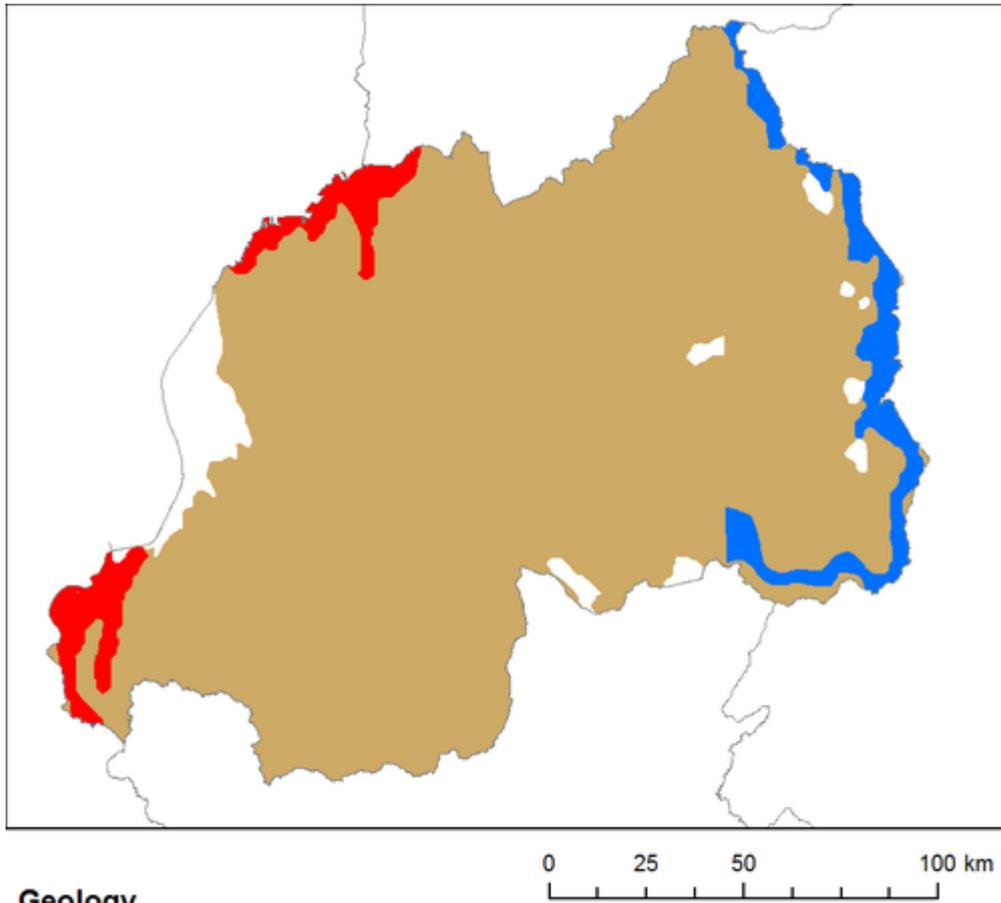
These statistics are sourced from [FAO Aquastat](#). They are the most recent available information in the Aquastat database. More information on the derivation and interpretation of these statistics can be seen on the [FAO Aquastat website](#).

Further water and related statistics can be accessed at the [Aquastat Main Database](#).

¹ More information on [irrigation water use and requirement statistics](#)

Geology

The geology map shows a simplified overview of geology at a national scale (see the [Geology resource page](#) for more details). More information is available in the report [UN \(1988\)](#) (see References section, below).



Geology

- Quaternary unconsolidated sedimentary
- Cenozoic Volcanic
- Precambrian basement undifferentiated

Geology of Rwanda at 1:5 million scale. Based on map described by Persits et al. 2002/Furon and Lombard 1964. For more information on the map development and datasets see the [geology resource page](#).

Geological environments

Key formations

Period

Lithology

Unconsolidated sedimentary

Alluvium and lake sediments

Quaternary

Unconsolidated alluvium infilling valleys and forming floodplains; and lake sediments, which mainly comprise sands, silts, gravels and clays. The most significant alluvial sediments occur in the Akagera River floodplain along the eastern border with Tanzania. Smaller outcrops of alluvium are also present in river valleys across the rest of the country, but are too small to be shown on this map.

Volcanic rocks

Northern lavas;
Southwestern basalts

Cenozoic (some possibly Cretaceous)

Volcanic rocks crop out in the north and the far west of the country, largely lava flows. Schlüter (2006) divides them into northern lavas (of Quaternary age) and southwestern basalts (of Cenozoic-Cretaceous age).

Precambrian

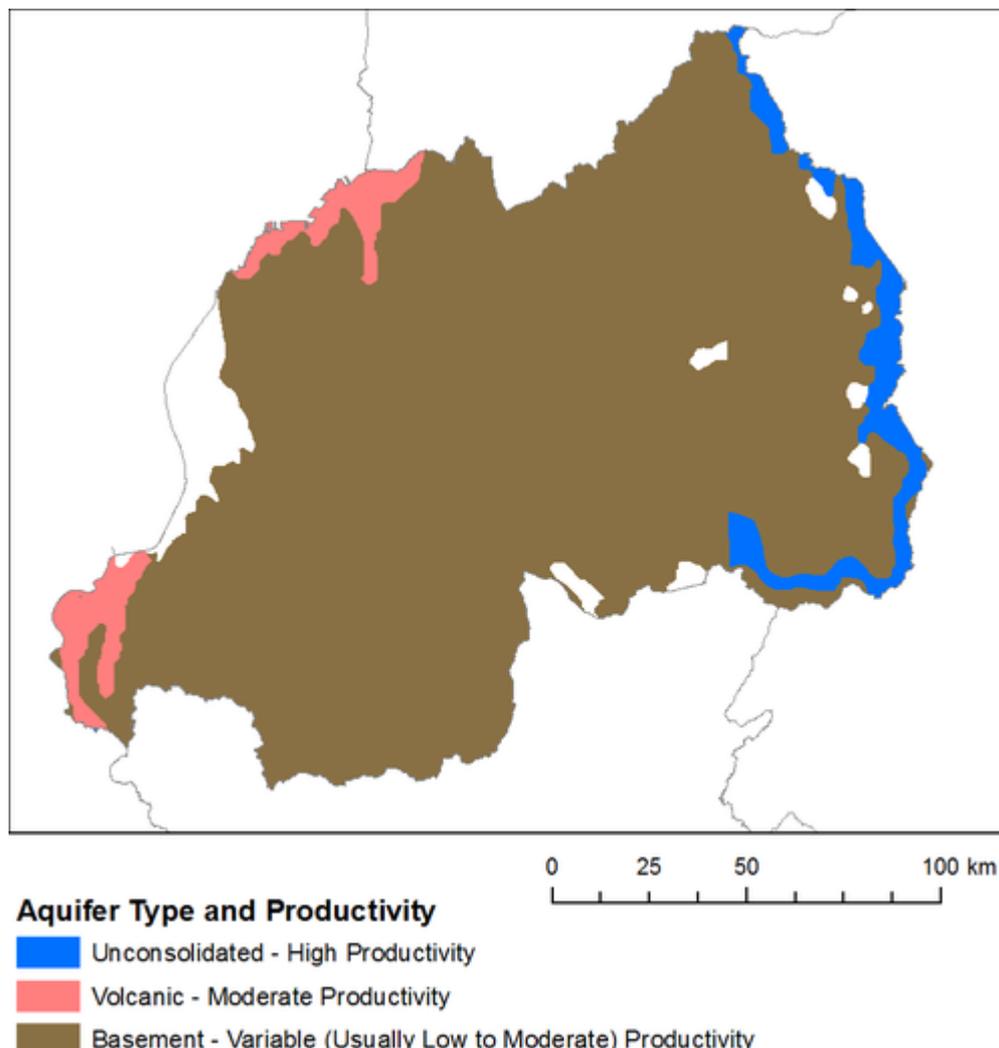
A number of different units within the Precambrian are named, with complex outcrops across the country (e.g. see Schlüter 2006). These are not distinguished on this geology map because of its small scale. The main divisions are described below.

Metasedimentary rocks, including the Burundian Supergroup	Middle Proterozoic	Metasedimentary rocks, largely quartzites, metamorphosed sandstones and shales of the Burundian Supergroup, which are locally intruded by granite. These are seen across much of the country. Named geological units within the Burundian Supergroup are the Byumba, Miyove and Lower series (Schlüter 2006).
Granites and associated other basement rocks	Lower Proterozoic	These are sometimes called 'older granites', along with granitic-gneisses and migmatites. They are seen in parts of eastern and southern Rwanda.

Hydrogeology

The hydrogeology map below shows a simplified overview of the type and productivity of the main aquifers at a national scale (see the [Hydrogeology map resource page](#) for more details).

Information on groundwater in Rwanda is still relatively limited, but further detail can be found in the reports listed in the references section below, including a more detailed hydrogeological map, which is published in the [Rwanda Annual Water Status Report 2016-2017](#).



Hydrogeology of Rwanda at 1:5 million scale. For more information on how the map was developed see the [hydrogeology map](#) resource page

Summary

The most common aquifer type in Rwanda is fractured, weathered Precambrian basement. Small outcrops of volcanic rocks form aquifers in the Western Province, in the far west and on the northern border. There are many local Quaternary unconsolidated alluvial aquifers, generally forming narrow, shallow aquifers along river valleys, with the largest outcrop in the east of the country.

Unconsolidated

Aquifer Productivity	Named Aquifers and General Description	Recharge
High Productivity	Most of the Quaternary unconsolidated aquifers are river alluvium, and form narrow linear aquifers along river valleys. Their aquifer properties are variable, depending largely on lithology, but where alluvium is dominated by coarser grained sediment (gravel and coarse sand), storage capacity and transmissivity can be high. Aquifers are usually unconfined with a shallow water table (<15 mbgl) and form locally important water supply sources.	Recharge is generally high due to close connection with rivers and wetlands.

Volcanic

Aquifer Productivity	Named Aquifers and General Description
Moderate Productivity	Little is known about groundwater in the volcanic rocks in Rwanda. Highly permeable basalt layers are documented in the Sebeya catchment in north-west Rwanda (Water for Growth Rwanda, 2018c).

Weathered, Fractured Basement

Aquifer Productivity	Named Aquifers and General Description
Variable Productivity (generally Low to Moderate)	The productivity of the basement aquifer depends on the localised nature and extent of fracturing and weathering - how thick is the weathered zone and how developed are water-bearing fractures? In the eastern and western provinces groundwater is mostly found in low productivity fractured granite, gneiss and the generally more productive quartzite. A north-south trending belt of more productive metasedimentary basement rocks, including schist and quartzite, extends along the border of the western province.

Groundwater Quality

Groundwater quality is monitored by the Rwanda Water and Forestry Authority (RWFA). Noted problems with groundwater quality are usually caused by poor agricultural and mining practices, or by wastewater discharge from both domestic and industrial sources. Further detail on specific groundwater quality issues identified by the monitoring programme are summarised in [Rwanda Water and Forestry Authority \(2017\)](#).

Groundwater use and management

The [Ministry of Environment](#) and the [Rwanda Water and Forestry Authority \(RWFA\)](#) have responsibilities for managing water resources in Rwanda.

The [Rwanda Water Resources Master Plan](#) (2014) contains detailed recommendations for integrated water resources management, including setting up and operating a groundwater monitoring network. This has now started and data from the monitoring stations are available through the

[Rwanda Water Portal](#). An Annual Water Status Report was produced for 2016/17 and is available through the Water Portal (see References below). This contains a more detailed hydrogeological map of the country.

The Water Resources Master Plan estimated that total groundwater storage in Rwanda is around 162,176 Million Cubic Metres. There are no reliable estimates of total groundwater abstraction, but in 2005, groundwater was reported to account for 86% of safe drinking water supply in rural areas (Ministry of Natural Resources 2011). In the Eastern and parts of the Southern Province, most people depend on groundwater from boreholes. Extensive borehole drilling and shallow well construction have been done, mostly in the Eastern Province, since 1994. As of 2009, there were at least 400 boreholes and wells in various parts of the country (Ministry of Natural Resources 2011). In upland areas, groundwater from springs is a key resource, including via many piped water supply schemes. Spring supplies can be threatened by deforestation and erosion.

Transboundary aquifers

For general information about transboundary aquifers, please see the [Transboundary aquifers resources page](#).

References

References with more information on the geology and hydrogeology of Rwanda may be accessed through the [Africa Groundwater Literature Archive](#).

Online resources

Further information on Rwanda's water and groundwater resources can be found via:

[Rwanda Water and Forestry Authority](#)

[Rwanda Water Portal](#)

[Water for Growth Rwanda](#) - a joint Rwanda-Netherlands Initiative to promote improved integrated water resources management in Rwanda

Further geological information can be obtained from the [Rwanda Mining Board](#).

Documents

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