

Hydrogeology of Nigeria

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Nigeria has the largest population and the largest economy in Africa. The area of present-day Nigeria has been home to a number of ancient and indigenous kingdoms and states over the millennia, with the modern state originating from British colonial rule beginning in the 19th century. After it gained independence from British colonialism in 1960, Nigeria saw civil war from 1967-70, and military rule from 1970-99, since when there has been multi-party democracy. Localised unrest continues to impede infrastructure development in some areas.

Much of Nigeria's economy depends on oil revenues from fields in the south of the country. About one third of Nigerians are employed in agriculture. The service sector is large, particularly telecommunications and financial services; and manufacturing industry is growing. Nigeria has extensive mineral resources, but the mining industry is still small.

Nigeria has extensive surface water resources, including the perennial Niger and Benue rivers and their tributaries. Groundwater is widely used for domestic, agricultural and industrial supplies. Most rural areas are dependent on groundwater, and a number of towns and cities.

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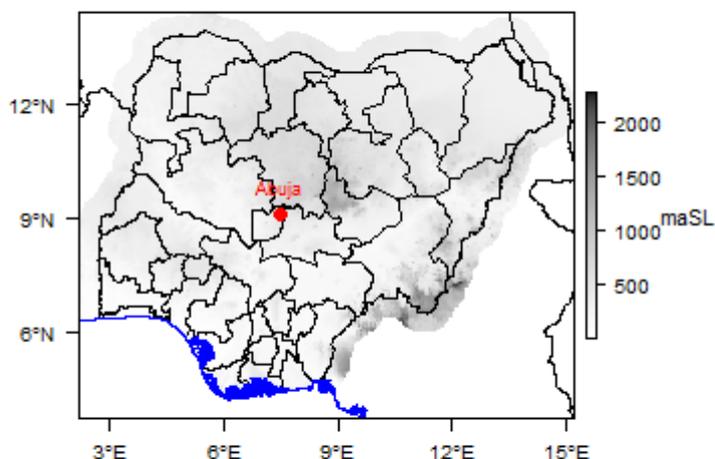
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http://earthwise.bgs.ac.uk/index.php/Hydrogeology_of_Nigeria

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Geographical Setting



Nigeria. 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](#).

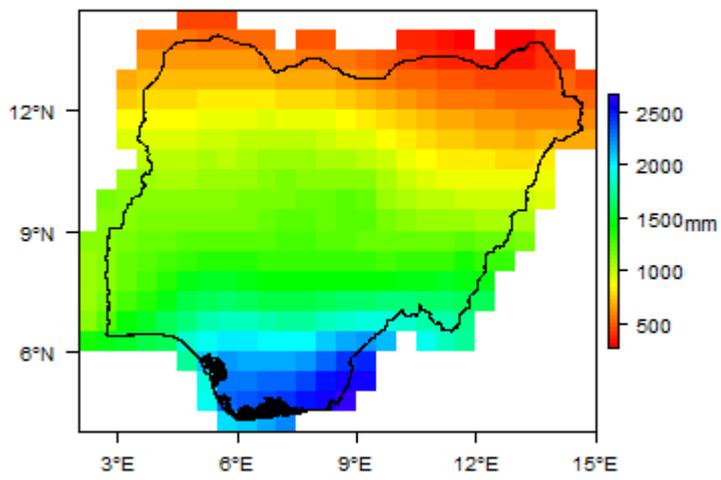
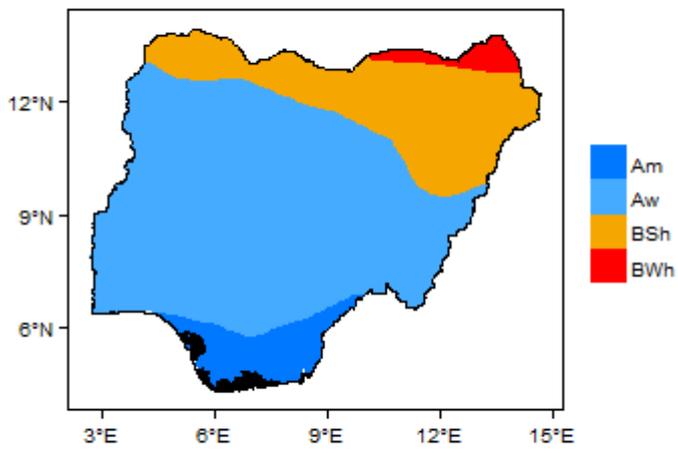
General

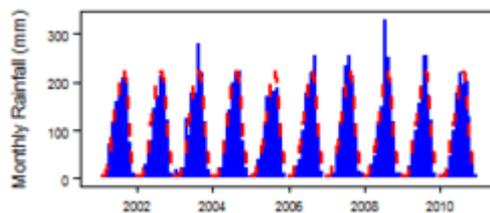
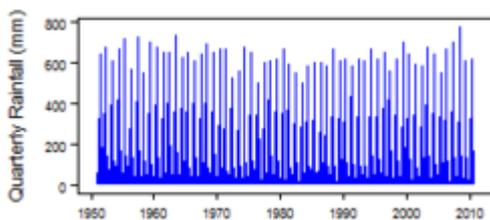
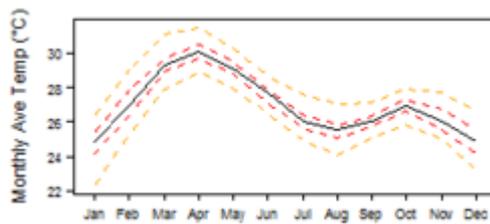
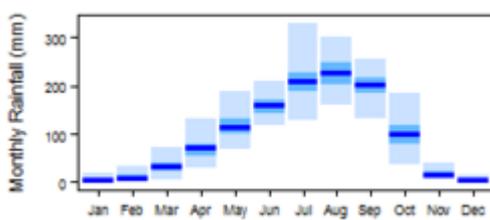
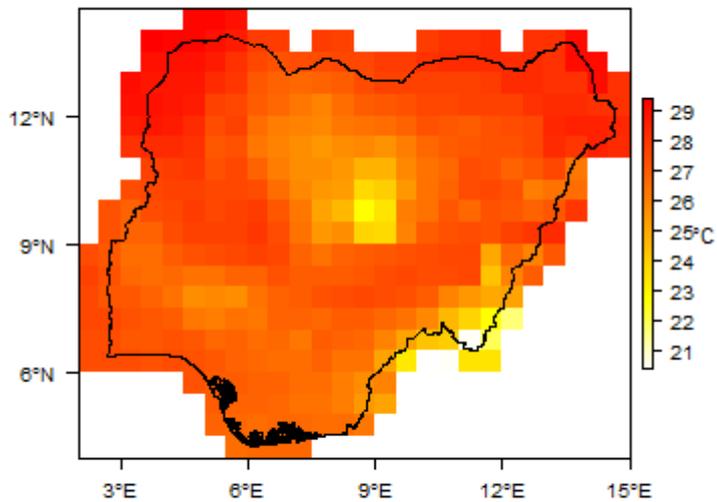
Capital city	Abuja
Region	Western Africa
Border countries	Benin, Chad, Cameroon, Niger
Total surface area*	923,770 km ² (92,377,000 ha)
Total population (2015)*	182,202,000
Rural population (2015)*	94,522,000 (52%)
Urban population (2015)*	87,680,000 (48%)
UN Human Development Index (HDI) [highest = 1] (2014)*	0.514

* Source: [FAO Aquastat](#)

Climate

Nigeria's climate is highly variable, from tropical in the south to semi-arid in the north. Temporal variations in temperature and rainfall are illustrated by the graphs below.



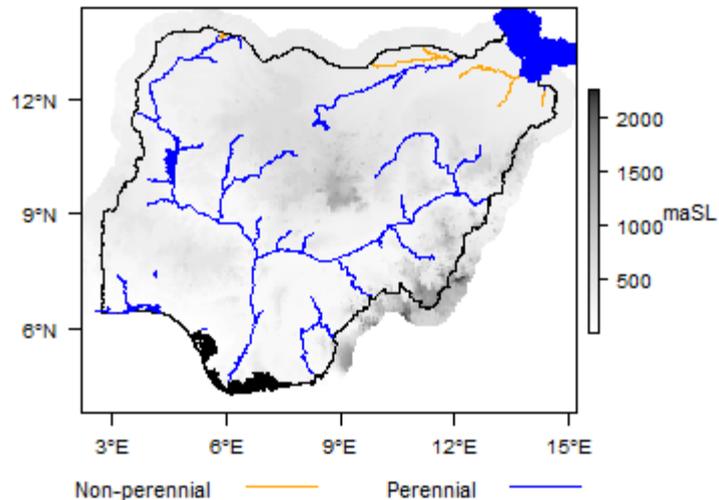


More information on average rainfall and temperature for each of the climate zones in Nigeria can be seen at the [Nigeria climate page](#).

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](#).

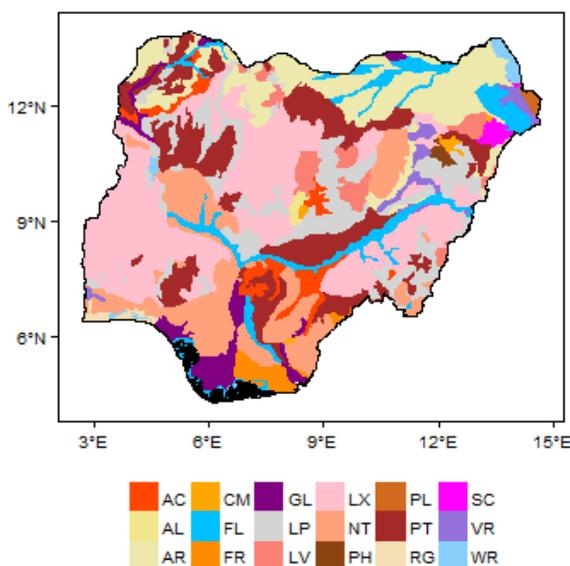
Surface water

The main rivers in Nigeria are the Niger and the Benue, which converge and flow together into the Niger Delta, one of the world's largest river deltas. There are both national and regional bodies responsible for river flow gauging and data storage. The Nigeria Hydrological Services Agency (NIHSA) is responsible for assessment of surface water resources through collection of data such as river stage, discharge, water quality and sediment transport. NIHSA maintain a nation-wide network of hydrological stations. The Niger Basin Authority (NBA) is also involved in river flow gauging of the River Niger at 18 stations in Niger, and store the data at their headquarters in Niamey, Niger Republic. The Lake Chad Basin Commission gauges river flow at 2 stations on the Komadugu-Yobe River in the Chad Basin Catchment. The Power Holding Company of Nigeria (PHCN) also maintains river flow gauging stations along the River Niger at Kainji and Jebba; they hold these data for use in operating their hydropower systems.



Major surface water features of Nigeria. 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](#).

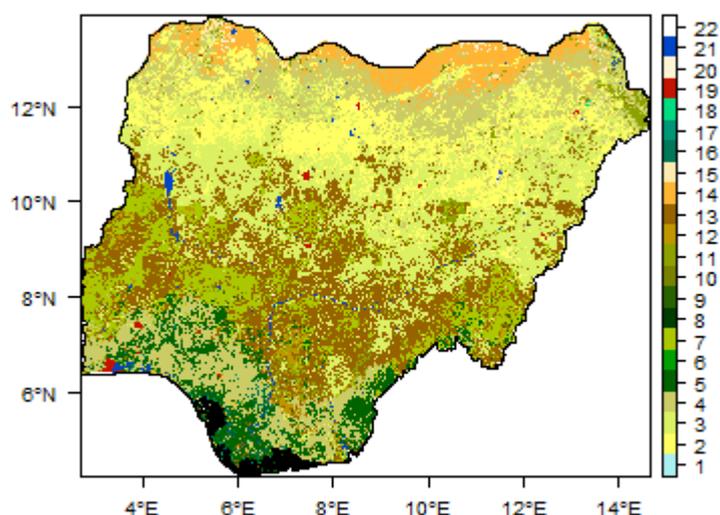
Soil



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

Land cover

Nigeria has highly variable land cover, including tropical rainforest, Sahel savanna, mountain plateaus and coastal plains.



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

Water statistics

	2004	2010	2012	2014	2015
Rural population with access to safe drinking water (%)					57.3
Urban population with access to safe drinking water (%)					80.8
Population affected by water related disease	No data	No data	No data	No data	No data
Total internal renewable water resources (cubic metres/inhabitant/year)				1,213,000	
Total exploitable water resources (Million cubic metres/year)	No data	No data	No data	No data	No data
Freshwater withdrawal as % of total renewable water resources		4.357			
Total renewable groundwater (Million cubic metres/year)				87,000	
Exploitable: Regular renewable groundwater (Million cubic metres/year)			59,510		
Groundwater produced internally (Million cubic metres/year)				87,000	
Fresh groundwater withdrawal (primary and secondary) (Million cubic metres/year)					
Groundwater: entering the country (total) (Million cubic metres/year)					

Groundwater: leaving the country to other countries (total) (Million cubic metres/year)					
Industrial water withdrawal (all water sources) (Million cubic metres/year)	1,965				
Municipal water withdrawal (all water sources) (Million cubic metres/year)	5,000				
Agricultural water withdrawal (all water sources) (Million cubic metres/year)	5,510				
Irrigation water withdrawal (all water sources) ¹ (Million cubic metres/year)	5,549				
Irrigation water requirement (all water sources) ¹ (Million cubic metres/year)	1,695				
Area of permanent crops (ha)			6,500,000		
Cultivated land (arable and permanent crops) (ha)			40,500,000		
Total area of country cultivated (%)			43.84		
Area equipped for irrigation by groundwater (ha)	66,800				
Area equipped for irrigation by mixed surface water and groundwater (ha)	No data	No data	No data	No data	No data

These statistics are sourced from [FAO Aquastat](#). 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](#).

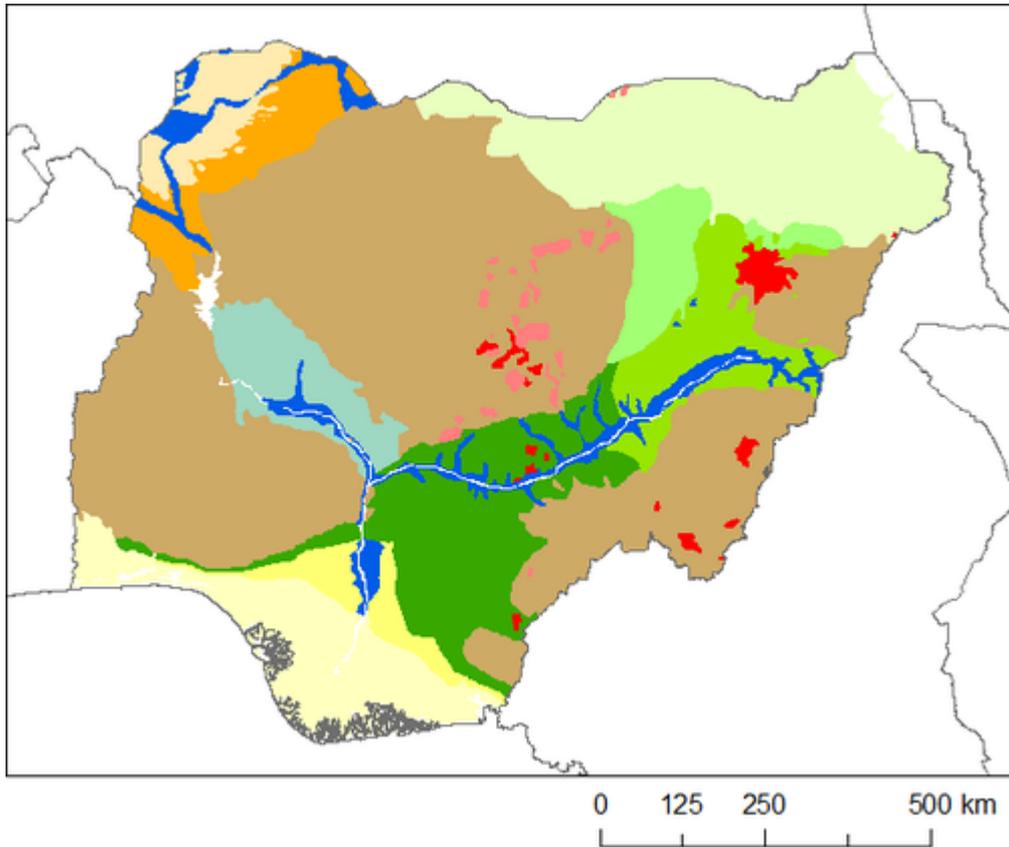
¹ More information on [irrigation water use and requirement statistics](#)

Geology

The following section provides a summary of the geology of Nigeria. More detailed information can be found in the key references listed below: many of these are available through the [Africa Groundwater Literature Archive](#).

The geology map on this page shows a simplified version of the geology at a national scale (see the [Geology resource page](#) for more details).

[Download a GIS shapefile of the Nigeria geology and hydrogeology map.](#)



Nigeria - Geology

- Unconsolidated sedimentary - Quaternary
- Igneous - Volcanic - Tertiary
- Niger Delta Basin - Unconsolidated sedimentary - Tertiary-Quaternary
- Niger Delta Basin - Sedimentary - Tertiary
- Chad Basin - Sedimentary - Tertiary-Quaternary
- Nupe Basin - Sedimentary - Cretaceous-Tertiary
- Sokoto Basin - Sedimentary - Tertiary
- Sokoto Basin - Sedimentary - Cretaceous
- Upper Benue Basin - Sedimentary - Tertiary
- Upper Benue Basin - Sedimentary - Cretaceous
- Lower Benue Basin - Sedimentary - Cretaceous
- Sedimentary - Cretaceous - east
- Igneous - Younger granite - Jurassic
- Basement Complex

Geology of Nigeria at 1:5 million scale. Developed from USGS map (Persits et al. 2002). For more information on the map development and datasets see the [geology resource page](#). [Download a GIS shapefile of the Nigeria geology and hydrogeology map](#).

Geological Environments

Key Formations

Period

Lithology

Structure

Unconsolidated

Alluvium	Quaternary	Deposits vary in thickness and lithology, with sands, gravels, silt and clay all present in varying proportions. These occur along the main river valleys and are thickest (15 - 30 m thick) in valleys associated with the rivers Niger and Benue (Adelana et al. 2008).
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Igneous - volcanic

Basalts, pyroclasts	Tertiary - Quaternary	Basalts, pyroclasts
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Chad Basin - Sedimentary

The dominant lithologies in the Chad Basin, in the northeast of Nigeria, are sandstone, siltstone and shale.

The Quaternary age Chad Formation is up to 840 m thick and consists of poorly sorted fine to coarse-grained sand, with sandy clay, clay and diatomite (Adelana et al. 2008).

The Tertiary age Kerri-Kerri Formation consists of lacustrine or fluvio-lacustrine loosely cemented cross-bedded coarse- to fine-grained sandstones, with locally occurring claystones, siltstones, ironstones, lignites and conglomerates. It rests unconformably on the Gombe Sandstone Formation, and thickens towards the centre of the Chad Basin, where it is overlain by the Chad Formation (Adelana et al. 2008).

Chad, Kerri-Kerri and Gombe formations	Cretaceous - Quaternary
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The Cretaceous age Gombe Sandstone Formation consists of estuarine and deltaic sediments, deposited on marine shales with sandstone/shale intercalations. The lower deposits of siltstone, mudstone and ironstone are overlain by well-bedded sandstones and siltstones. The upper part of the formation contains coals and cross-bedded sandstones (Adelana et al. 2008).

Niger Delta Basin - Sedimentary

Unconsolidated: Deltaic Formation	Tertiary - Quaternary	Tertiary to Quaternary unconsolidated sediments at the top of the Niger Delta Basin sequence comprise coarse to medium grained unconsolidated sands and gravels with thin peats, silts, clays and shales (Adelana et al. 2008).
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Benin, Agbada and Akata formations	Tertiary	<p>There are three main deeper sedimentary formations in the Niger Delta Basin. The oldest is the Akata Formation, and is predominantly shaly, with sandstone lenses in the upper parts. The Agbada Formation is predominantly sandy in its upper part, with shale and sandstone beds in roughly equal proportion in its lower part. It may be over 3000 m thick in places, and contains petroleum. The youngest is the Benin Formation, which comprises predominantly (over 90%) sand and gravelly sandstone with shale and clay intercalations.</p>	The Niger Delta sedimentary rocks are over 10 km thick in total.
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Sokoto Basin - Sedimentary (Iullemeden)

Sokoto Group (Gwandu, Kalambaina and Dange formations)	Tertiary	<p>Nigeria's Sokoto Basin represents the southeastern part of the Iullemeden basin, which stretches across parts of Mali, Niger, Benin and into northwest Nigeria. The Tertiary rocks of the Sokoto Basin are mostly interbedded sandstones, clay and some limestone (Pavelic et al. 2012). The Gwandu Formation (of Eocene-Miocene age) crops out in the west of the Sokoto Basin and comprises interbedded semi-consolidated sand and clay. It unconformably overlies the Kalambaina Formation in the north and centre of the basin (Adelana et al. 2008). The Kalambaina Formation consists of clayey limestone with modular crystalline limestone, and is underlain by the Dange Formation, a marine clay shale. The Kalambaina and Dange Formations are collectively known as the Sokoto Group and are of Paleocene age (Adelana et al. 2008).</p>	The total thickness of the Sokoto Basin is over 1250 m
Rima Group (Wurno, Dukamaje and Taloka formations), Illo/Gundumi Formation	Late Jurassic - Cretaceous	<p>The uppermost Rima Group comprises a series of marine fine-grained sand and friable sandstone, mudstones, and some marly limestone and shale (Adelana et al. 2008). The group is divided into three formations north of the River Sokoto, which from younger to older are Wurno, Dukamaje and Taloka formations. The lower formations are similarly marine sandstones, clays and limestones (Adelana et al. 2008).</p>	The total thickness of the Sokoto Basin is over 1250 m

Nupe Basin - Sedimentary

Nupe, Patti and Lokoja sandstones	Cretaceous	<p>The Nupe Basin is alternatively known as the Bida or Niger Basin. The basin contains largely continental sandstones, siltstones, claystones and conglomerates (Adelana et al. 2008).</p>
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Upper Benue Basin - Sedimentary

Bima Sandstone	Tertiary	The Upper Benue Basin consists of a thick succession of continental sandstones overlain by marine and estuarine shales and limestones. The basal formation is the Bima Sandstone (Adelana et al. 2008).	
Bima, Yolde, Pindija and Kerri-Kerri formations	Cretaceous	Marine arkosic, gravelly, poorly sorted cross-bedded sandstones and sandy limestones (Adelana et al. 2008).	The sedimentary rocks lie unconformably on the Precambrian Basement Complex

Lower Benue Basin - Sedimentary

Ezeaku, Makurdi, Keana, Awe and Asu River formations	Cretaceous	The Lower Benue Basin consists of shales, silts and silty shales with subordinate sandstones and limestones, intruded by dolerite dykes (Adelana et al. 2008).	The sedimentary rocks lie unconformably on the Precambrian Basement Complex
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Igneous - younger granites

Younger granites	Jurassic	An-orogenic volcanic and hypabyssal rocks emplaced within the Precambrian Basement Complex.	Arcuate to circular intrusions forming ring-like complexes.
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Precambrian Basement Complex

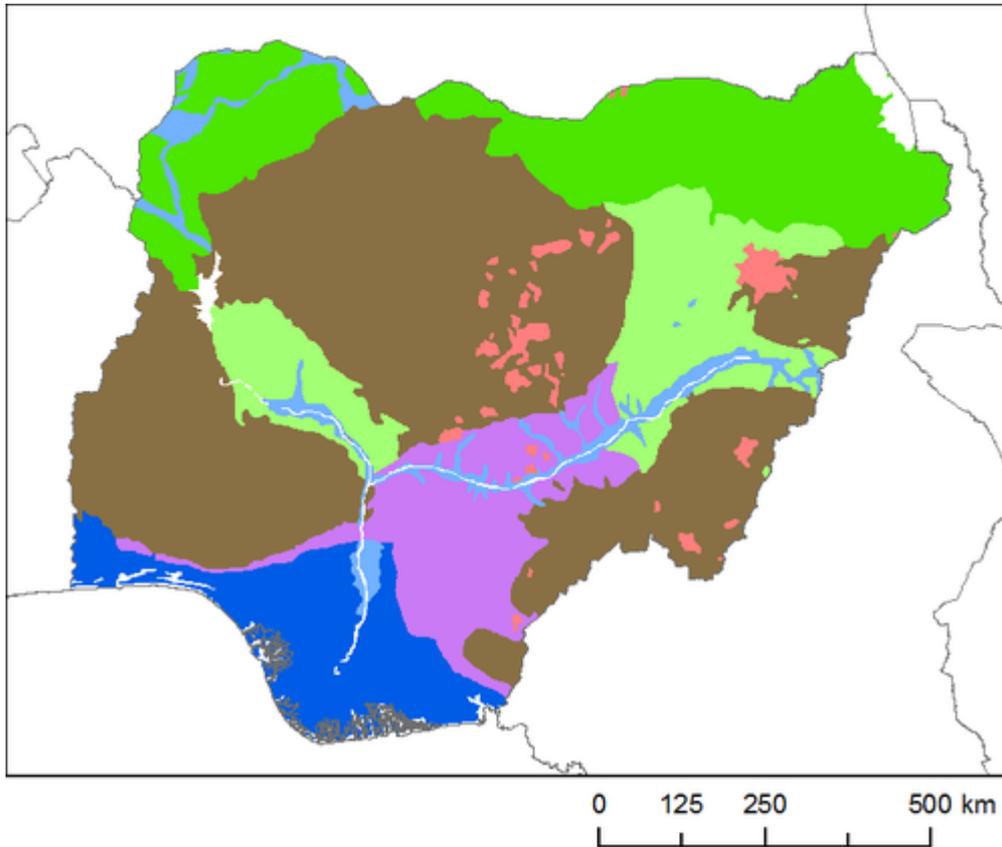
Migmatite-Gneiss Complex (quartzites, amphibolites, marble)	Liberian (ca 2800 Ma) to Pan African (ca 600 Ma)	These rocks are found in the north-central area of Nigeria, including the Jos Plateau, and in the southwest of Nigeria. They comprise gneisses, migmatites, granites, schists, phyllites and quartzites (Adelana et al. 2008). Metamorphism is in the amphibolites facies range.	
Schist belt	Precambrian	Schist belts, comprising phyllites, schists, quartzites and banded iron formations, found in northwestern Nigeria.	Folds
Older Granites	Upper Proterozoic	Intruded into the migmatite-gneiss complex and the schist belts.	

Hydrogeology

This section provides a summary of the hydrogeology of the main aquifers in Nigeria. More information is available in the references listed at the bottom of this page. Many of these references can be accessed through the [Africa Groundwater Literature Archive](#).

The hydrogeology map on this page 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).

[Download a GIS shapefile of the Nigeria geology and hydrogeology map.](#)



Nigeria - Aquifer Type and Productivity

- Unconsolidated - High to Very High
- Unconsolidated - High
- Igneous - Low to Moderate
- Sedimentary Intergranular/Fracture - Moderate (locally High)
- Sedimentary Intergranular - Moderate to High
- Sedimentary Intergranular - Low to Moderate
- Basement - Low to Moderate

Hydrogeology of Nigeria at 1:5 million scale. For more information on how the map was developed see the [Hydrogeology map](#) resource page. [Download a GIS shapefile of the Nigeria geology and hydrogeology map.](#)

Dominantly Unconsolidated

Named Aquifers	Aquifer Productivity	General Description	Water quantity issues	Water quality issues
Alluvium	High Productivity	Alluvial aquifers occur along major river valleys, and are thickest (15 - 30 m thick) along the rivers Niger and Benue. Largely unconfined, with shallow water tables. Recharge is directly from rainfall and by infiltration from rivers.	None	

Niger Delta Basin: Deltaic Formation, Benin Formation	High to Very High Productivity	<p>The unconsolidated aquifers of the Niger Delta Basin are extensive and high yielding. The upper Deltaic Formation is unconsolidated and largely unconfined with shallow water table (0-10 m below ground level) (Offodile 2002).</p> <p>The older Benin Formation is partly consolidated. It is largely unconfined, but locally confined by lower permeability beds. Water table is typically between 3 and 15 m below ground level (Offodile 2002), but can be as much as 55 m deep.</p> <p>The aquifers can provide yields from 3 to 60 l/s. Borehole depths range from 10 to 800 m. Recharge is mostly directly from rainfall.</p>	None	Salinity problems arising from sea water intrusion; iron problems; pollution problems.
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Igneous - Volcanic

Named Aquifers	Aquifer Productivity	General Description	Water quantity issues	Water quality issues
Volcanic rocks, including basalts	Low to Moderate Productivity	<p>Igneous volcanic aquifers provide low to moderate yields, usually below 3 l/s. These aquifers are typically unconfined, with typical variations in water table depth of less than 5 m. Aquifer thickness varies substantially, and borehole depths of 15 to 50 m are common. Direct rainfall recharge.</p>	None	Water quality is generally good.

Chad Basin - Sedimentary - Intergranular

Named Aquifers	Aquifer Productivity	General Description	Water quantity issues	Water quality issues
Chad, Kerri-Kerri and Gombe formations	Moderate to High Productivity	<p>The Chad Formation can be unconfined or confined depending on local conditions. Deeper sandstone layers are often confined and can be artesian. Yields of between 2.5 and 30 l/s are quoted. The water table depth is often between 10 and 15 m (Offodile 2002).</p> <p>The Gombe Sandstone has relatively low permeability, usually providing yields of about 1 to 5 l/s.</p> <p>Relatively little is known about the Kerri-Kerri Formation at depth. Recharge is usually directly from rainfall.</p>	None	Water quality is generally good.

Sokoto Basin - Sedimentary - Intergranular

Named Aquifers	Aquifer Productivity	General Description	Water quantity issues	Water quality issues
Sokoto Group (Gwandu and Kalambaina formations); Rima Group (Wurno, Dukamage and Taloka formations); Ilo/Gundimi Formation	Moderate to High Productivity	<p>The lower sands of the Gwandu Formation are often confined; upper layers are unconfined. Water table can vary from 20 to 100 m depth. Storage is typically high. The Kalambaina Formation is locally permeable with perched aquifers in sandier layers (Offodile 2002).</p> <p>The sand layers of the Wurno Formation are moderately yielding, with a restricted recharge area. The Taloka Formation provides variable yields. It is sometimes confined by clay layers (Offodile 2002).</p> <p>The gritty, conglomeratic and gravel layers of the Ilo/Gundumi Formation act as aquifers, often confined by clayey layers at depth, when artesian conditions can occur. Shallower aquifer layers are usually unconfined. Typical yields are 2 to 8 l/s. Variable transmissivity values have been quoted, from less than 10 to nearly 1000 m²/day (Offodile 2002).</p>		

Nupe Basin - Sedimentary - Intergranular

Named Aquifers	Aquifer Productivity	General Description	Water quantity issues	Water quality issues
Nupe Sandstone, Patti & Lokoja Sandstone	Low to Moderate Productivity	<p>The Nupe Sandstone is slightly cemented, but the dominantly fine grained sandstones and interbedded clays, mudstones and siltstones through much of the sequence reduce groundwater potential. Overall, borehole yields are poor and highly variable, but where sandstones dominate, borehole yields of ~2 to 4 l/s are seen, and coarser conglomerate beds at the base of the sequence may support higher yields (Offodile 2002). The Patti and Lokoja sandstones are thought to have similar hydrogeological characteristics to the Nupe Sandstone. Recharge is directly from rainfall, through any overlying alluvial deposits</p>		

Upper Benue Basin - Sedimentary - Intergranular

Named Aquifers	Aquifer Productivity	General Description	Water quantity issues	Water quality issues

Bima Sandstone, Yolde Sandstone	Low to Moderate Productivity	These formations have relatively low permeability and usually provide poor to moderate yields of about 1 to 5 l/s. They vary substantially in thickness. The water table depth is usually between 60 and 165 m. Boreholes range in depth from 30 to 300 m. Recharge is usually directly from rainfall.	None	Water quality is generally good.
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Lower Benue Basin - Sedimentary - Intergranular & Fracture

Named Aquifers	Aquifer Productivity	General Description	Water quantity issues	Water quality issues
Makurdi, Keana, Ezeaku, Awe and Asu River Group formations	Moderate Productivity (locally High)	These formations tend to be indurated and dominated by fracture flow (although the Makurdi Sandstone is less so). Typical yields are around 2 to 8 l/s, but wide variations are seen, depending on the degree of fracturing and deep weathering. The aquifers therefore tend to be localised, and vary greatly in thickness. They are usually unconfined with the water table at about 10 - 40 m depth. Boreholes are typically 40 - 150 m deep. Recharge is usually directly from rainfall.	None	Water can be highly mineralised.

Basement

Named Aquifers	Aquifer Productivity	General Description	Water quantity issues	Water quality issues
Basement aquifers	Low to Moderate Productivity	Basement rocks can form local aquifers if the degree of weathering and/or fracturing is sufficient. Crystalline and coarse-grain rocks, such as gneiss and migmatite, become sandy on weathering, thus preferentially forming aquifers. Argillaceous meta-sedimentary rocks tend to be become clayey with low permeability when weathered, forming aquitards. Overall, basement aquifers tend not to be high yielding. They typically vary in thickness from 10 to 25 m, with water table depth varying from about 5 to 15 m. Boreholes tend to be drilled to depths between 10 and 70 m, depending on local conditions. Recharge is usually directly from rainfall.	None	Water quality is generally good.

Groundwater Status

Groundwater recharge

The total renewable groundwater resources potential in Nigeria is estimated at 155.8 billion cubic metres per year (BCM/year), derived from estimated total annual groundwater recharge (JICA 2014). Recharge is variable across Nigeria, controlled largely by climate. For example, in northern Nigeria, recharge is low, due to low rainfall and high evapotranspiration.

The estimated groundwater recharge at a regional level is as follows (JICA 2014):

Region	Estimated Groundwater Recharge (BCM/year)
Niger North (Northwest Nigeria)	5.0
Niger Central (West-central Nigeria)	20.5
Upper Benue (East-central Nigeria)	19.3
Lower Benue (East Nigeria)	18.6
Niger South (South-central Nigeria)	31.9
Western Littoral (Southwest Nigeria)	23.4
Eastern Littoral (Southeast Nigeria)	32.8
Chad Basin (North-east Nigeria)	4.3
Total	155.8

Groundwater quantity

There are local issues of over-abstraction of groundwater, causing lowering of groundwater levels and, in some cases, land subsidence. These are mainly in unconsolidated aquifers in urban areas in the coastal plain in the south, including in Lagos and Port Harcourt (Ministry of Water Resources 2013).

There are issues with drought causing lowering of groundwater levels, both seasonally in dry seasons, and during longer term periods of low rainfall. This is particularly an issue for local, low storage basement aquifers, both in the north where rainfall is low and in the south, where rainfall is high (Ministry of Water Resources 2013). The potential impact of climate change on groundwater levels, with changing climate patterns combined with changing water demand, is recognised in the National Water Resources Master Plan (Ministry of Water Resources 2013).

Groundwater quality

Naturally highly mineralised groundwater occurs in the Awe Formation sedimentary aquifer in the Benue basin.

There are reports of sea water intrusion into southern coastal aquifers, due to lowering of groundwater levels following over-abstraction (Ministry of Water Resources 2013).

There are reports of local contamination of groundwater in the Lagos area by industrial chemicals. There are also reports of metals contamination of groundwater from mining activity (Ministry of Water 2013).

Groundwater-surface water interaction

There is interaction between the River Niger and sedimentary aquifers in the Sokoto Basin.

Groundwater use and management

Groundwater use

Groundwater is widely used in Nigeria for domestic, agricultural and industrial purposes. The cities of Calabar (coastal southeastern Nigeria) and Port Harcourt (capital of Rivers State, south Nigeria) are totally dependent on groundwater.

In 2013 there were around 65,000 boreholes or other groundwater points in Nigeria, extracting an estimated total of 6,340,000 m³/day (JICA 2014; Ministry of Water Resources 2013). Most are used for water supply in rural areas and for small towns (Ministry of Water Resources 2013). Rural water supply boreholes are usually installed with hand pumps, which have a maximum pumping capacity of 10 m³/day (Ministry of Water Resources 2013).

The groundwater access points identified were:

- Boreholes with motorised pump □19,758
- Boreholes with hand pump □44,736
- Shallow hand-dug wells □13,108

A 1996 survey by the Ministry of Water Resources found only 63% of Nigerian boreholes were in working order, with many out of action due to pump failure (JICA 2014). This is related to the management structure for boreholes: most are meant to be managed by communities, but only around one fifth of rural communities were identified as having borehole management organisations, so that actual management, including restoring non-operational boreholes, is not optimum (Ministry of Water Resources 2013).

Groundwater management

Groundwater management institutions

There are many bodies with responsibility for groundwater management in Nigeria. They include these government agencies:

1. Nigeria Hydrological Services Agency (NIHSA) whose mandate is water resources (groundwater and surface water) assessment of the country; its quantity, quality, availability and distribution in time and space
2. Nigeria Integrated Water Resources Management Commission (NIWRMC) that is responsible for regulation of water use and allocation
3. The state Ministries of Water Resources and their Rural Water Supply and Sanitation Agencies (RUWATSSAN), responsible for provision of water to their various States
4. The National Water Resources Institute, a parastatal of the Federal Ministry of Water Resources, has responsibility for training, research and data management relating to water in general.
5. All the River Basin Development Authorities, which are also parastatals of the Federal Ministry of Water Resources involved in the provision of water supply to rural environments within their catchments.

Professional bodies

The [Nigerian Association of Hydrogeologists](#) (NAH) is the professional body concerned with due process and best practices in the exploration, development and management of Nigeria's water

resources. The NAH disseminates information on the state of the nation's water resources through annual conferences and a journal, *Water Resources*. Through membership of the Hydrology and Hydrogeology Subcommittee of the National Technical Committee on Water Resources (NTCWR), the technical arm of the National Council of Water Resources (NCWR), the NAH contributes to the development of water resources policies and legislation, including the Water Resources Act 100 and the Nigerian Standard for Drinking Water Quality, and is currently involved in their review and/or implementation.

Legal framework for groundwater management

Legislation has been developed, including the Water Resources Decree 101 promulgated in 1993 (now referred to as Water Resources Act 100), but is under review and awaiting enactment.

The 2004 National Water Policy aimed to decentralise management of water to the most local government unit possible and to maximise user participation in planning and management, with central government retaining overall control of water governance.

Groundwater monitoring

The Nigeria Hydrological Services Agency (NIHSA), an agency of the Federal Ministry of Water Resources, has responsibility for groundwater monitoring. There is a national groundwater level monitoring programme with 43 monitoring points, 32 of which are equipped with data loggers. These are sited in basement and sedimentary aquifers. The frequency of monitoring at sites with data loggers is daily, and sometimes twice daily.

NIHSA has implemented a programme of drilling new monitoring boreholes for monitoring groundwater level. The new boreholes so far are focussed on sedimentary aquifers used for urban water supply; with borehole depths of 80 to 100 m (Ministry of Water Resources 2013). The groundwater level monitoring data are stored at NIHSA headquarters in Abuja.

The NIHSA is also responsible for water quality monitoring, but as yet a full programme is not in place due to lack of equipment.

The National Water Resources Master Plan recognises current problems in the effective acquisition and management of groundwater data, and recommends strategies for improving this situation (Ministry of Water Resources 2013).

Groundwater for the future

Groundwater could contribute to increasing future water demand by upgrading existing borehole infrastructure, switching from hand pumps to motorised pumps (JICA 2014).

During their project to update Nigeria's Water Resources Masterplan, JICA (2014) identified issues that were affecting both yield and quality of groundwater in Nigeria:

- overabstraction leading to water level decline and boreholes drying up
- contamination of groundwater resulting from sea water intrusion and infiltration of domestic and industrial contaminants.

Modelling by JICA (2014) suggested that climate change would lead to an overall decline in groundwater recharge in Nigeria, with the impact most likely greatest in the North Niger and Chad basins. This modelling suggested declining groundwater levels would occur, leading to previously productive boreholes becoming dry. The study suggested the following measures to increase

resilience to climate change in Nigeria's groundwater supply:

- drill future boreholes 20 m deeper
- position pumps at greater depth (20 m deeper than present)

Transboundary aquifers

Nigeria has a number of transboundary aquifers:

1. The Iullemeden, Taoudeni/Tanezrout Aquifer Systems (ITAS), shared by Algeria, Benin, Burkina Faso, Mali, Mauritania, Niger and Nigeria.
2. The Chad Basin Aquifer, shared by Cameroon, Central African Republic, Chad, Niger and Nigeria.
3. The Keta Basin Aquifers, shared by Ghana, Togo, Benin and Nigeria.
4. The Benue Trough, shared by Cameroon and Nigeria
5. The Rio Del Rey Basin, shared by Cameroon and Nigeria along the coast.

A mechanism for the management of the Iullemeden aquifer is in development, as Nigeria has just ratified an Agreement. The Lake Chad Basin Commission manages issues on the Chad Basin. Groundwater management activities on other Basins are yet to commence.

For links to further information about transboundary aquifers, please see the [Transboundary aquifers resources page](#)

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Many of the references below, and others relating to the hydrogeology of Nigeria, can be accessed through the [African Groundwater Literature Archive](#).

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