

Hydrogeology of Ghana

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Farmers are known to be living in the area of present day Ghana were farmers by the 5th century BC, and by the 9th century AD the then Ghana Empire was a major power, and included parts of modern Senegal, Mauritania and Mali. After the 10th century, the empire came under Almoravid rule, and was later incorporated into Sahelian empires such as the Mali Empire. From the 16th century much of the area was brought under the governance of the Ashanti Empire. Many European powers contested the area for trading rights from the 15th century, and modern-day Ghana fell under British colonial rule from the late 19th century. After Ghana gained independence in 1957, the country saw a series of alternating military and civilian governments, and was often affected by economic instability. Since 1992, when multi-party system politics was restored, Ghana has enjoyed relative political stability, and has seen growing economic prosperity.

Ghana is a middle income country, with services accounting for around half of GDP, followed by manufacturing, extractive industries (including oil, discovered offshore in 2007; and gold, diamonds and a wide range of precious and industrial minerals). Agriculture is also important, particularly cocoa, of which Ghana is one of the world's largest producers.

Ghana has major surface water resources in Lake Volta and its tributary rivers, but away from these groundwater is a key resource, particularly in dry seasons and in the drier north. Overall some 40% of households depend on groundwater, and this rises to 60% in rural areas. In the drier north, urban areas also depend primarily on groundwater. Rural areas, particularly in the north of the country, still lag behind in water supply infrastructure.

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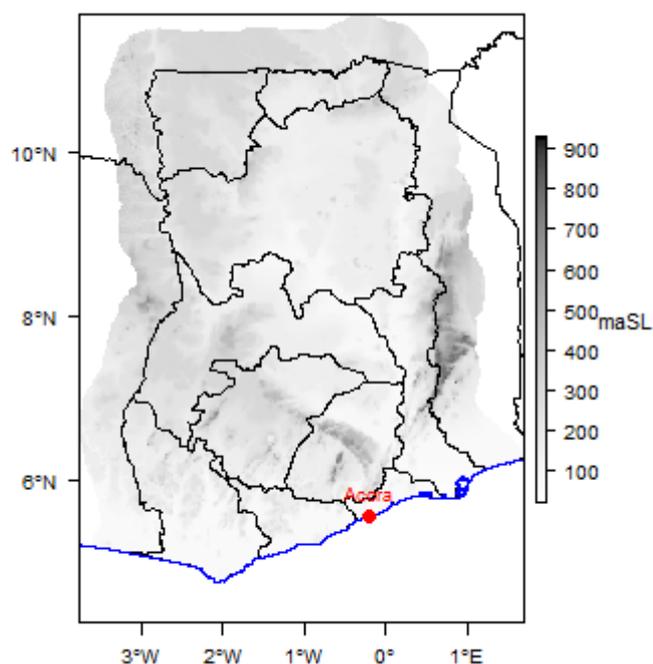
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Geographical Setting



Ghana. 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

Ghana's land area extends from the Atlantic Ocean (Gulf of Guinea) in the south, to its border with Burkina Faso in the north. In the west of the country a forest belt extends northward from the coast for over 300 km. The area to the north of the forest belt is largely flat or gently undulating savannah. The highest point is Mount Afadjato, which sits at an elevation of 880m in the eastern part of the country.

Capital city	Accra
Region	West Africa
Border countries	Cote d'Ivoire, Burkina Faso, Togo
Total surface area*	238,540 km ² (23,854,000 ha)
Total population (2015)*	27,410,000
Rural population (2015)*	12,827,000 (47%)
Urban population (2015)*	14,583,000 (53%)
UN Human Development Index (HDI) [highest = 1] (2014)*	0.5791

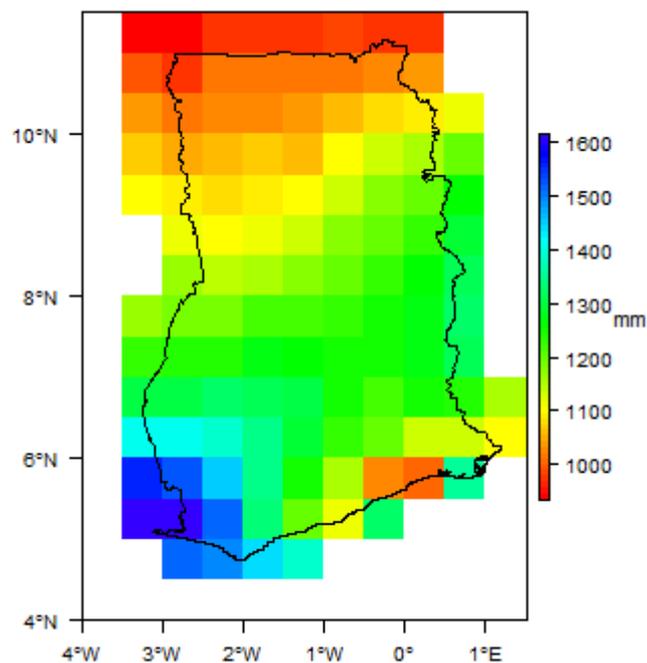
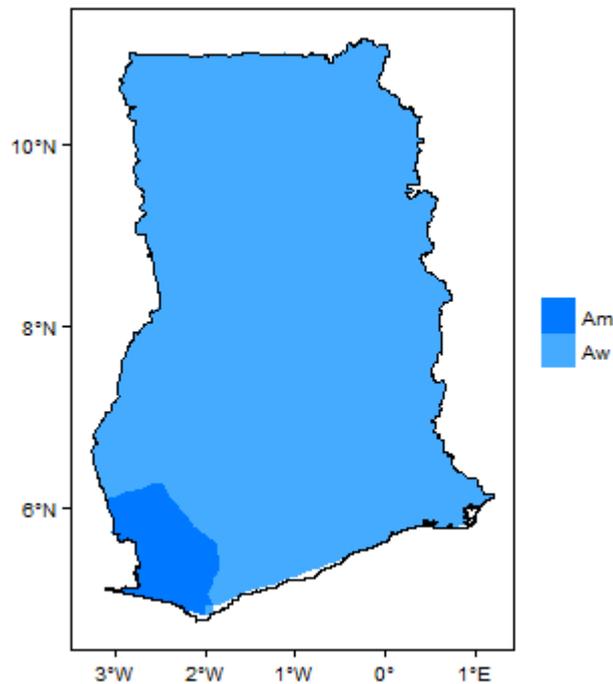
* Source: [FAO Aquastat](#)

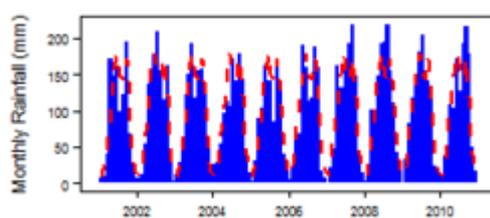
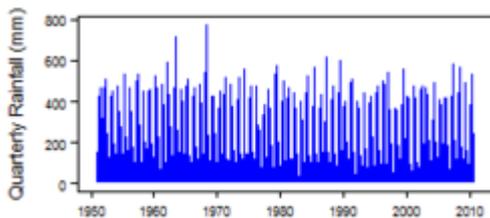
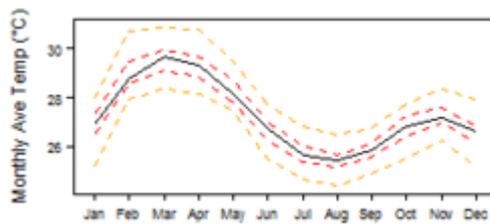
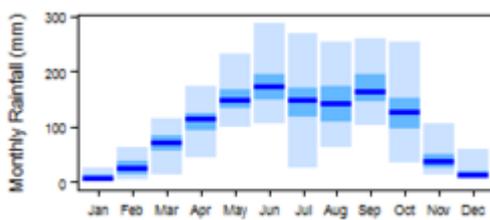
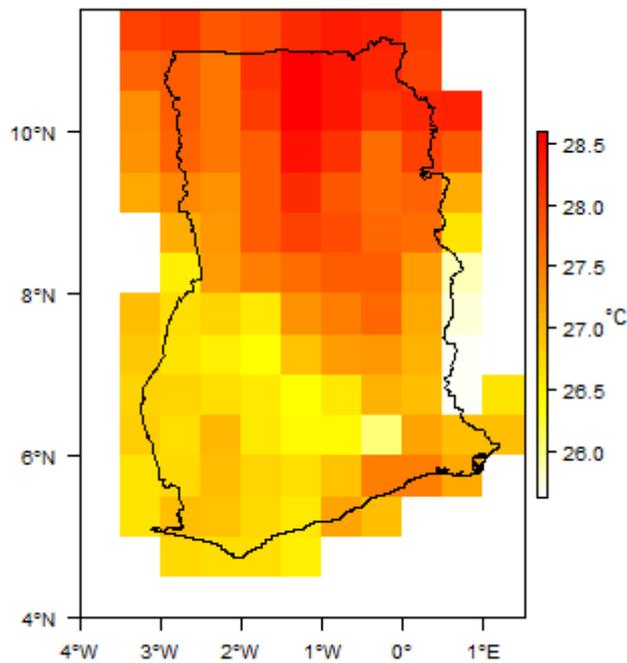
Climate

The majority of Ghana is classified as a tropical savannah climate, apart from the south western corner which is designated tropical monsoon. Average annual precipitation is higher in the tropical

monsoon region and generally decreases from south to north across the tropical savannah region. Average temperatures are slightly lower in the southwest of Ghana and increase towards the north.

Precipitation varies throughout the year and is generally higher between April and October. In the south of the country this is more distinctly split into two wet seasons during April-June and September-October. Temperatures are generally highest in March and lowest in August.



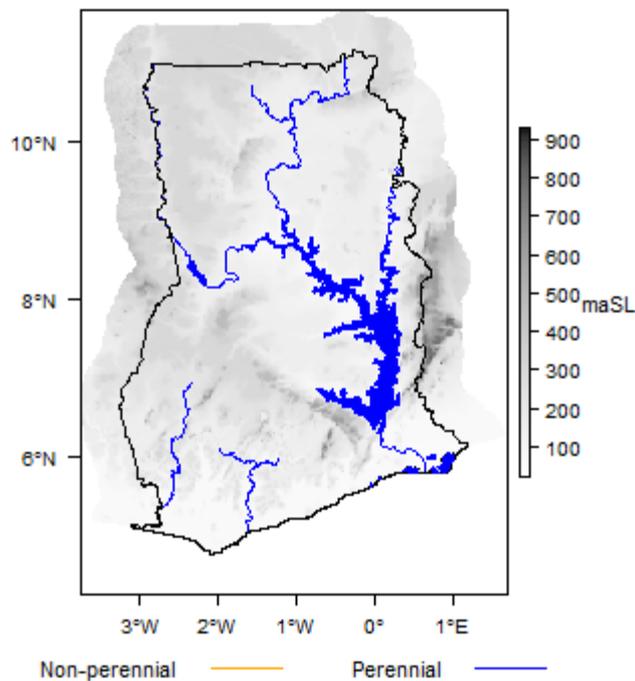


More information on average rainfall and temperature for each climate zone in Ghana can be found on the [Ghana Climate Page](#).

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](#).

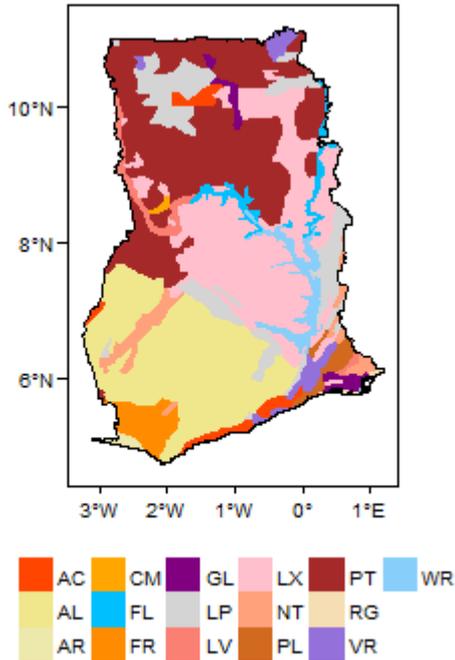
Surface water

The most significant surface water feature in Ghana is Lake Volta, which extends roughly north-south over a distance of around 500 km. The Black Volta and White Volta Rivers flow perennially into the northern end of Lake Volta. The White Volta originates to the north in Burkina Faso. The Black Volta also originates in Burkina Faso but flows along the border with Cote d'Ivoire to the west before turning and flowing into the lake. Lake Volta is drained to the south by the perennial Volta River, which discharges into the Gulf of Guinea in the east of Ghana. Several other perennial rivers discharge into the Gulf of Guinea, draining the forest belt in the west of Ghana. The two main rivers are the Tano, in the west, and Ankobra, in the east. The Hydrological Services Department (HSD) of the Ministry of Water Resources, Works and Housing is responsible for all river flow gauging in Ghana, and all river gauging data are stored at the HSD. Generally, daily data exists from the 1960s onwards, but some stations also have data from before 1960. Some river flow data have been collected by research organisations working on individual projects. The German funded GLOWA Volta project, which ended in 2012, collected some river flow data that are currently held with the Volta Basin Authority (VBA) in Ouagadougou, Burkina Faso. The VBA has also been collecting river flow data through the VBA observatory, in collaboration with the Volta Basin riparian countries. Presently, the German funded West Africa Science Service Centre on Climate Change and Adapted Land Use (WASCAL) is recording river flow measurements at some locations in the Volta Basin, and has installed a number of automatic water level /discharge readers at selected points on the White Volta River and its major tributaries. The data are held by WASCAL at its offices in Ghana and Burkina Faso.



Major surface water features of Ghana. 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 Ghana, from the European Commission Joint Research Centre: European Soil Portal. For more information on the map see the [soil resource page](#)

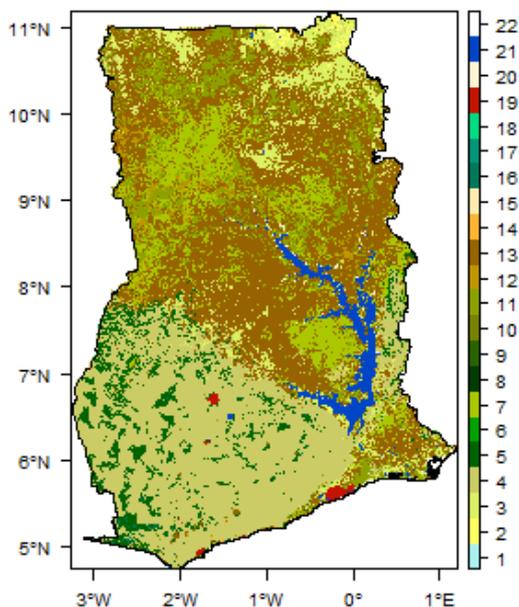
The southwest of Ghana is dominated by Alisols. These highly acidic soils are typical of hot and wet climates and often form due to the weathering of minerals with a high aluminium content. This area corresponds with the dense forest belt in southwest Ghana.

In the north and east, the dominant soil types are Lixisols and Plinthosols. Lixisols are generally clay-rich, while Plinthosols contain high levels of iron. These soils often occur on plateaus or plains and reflect the weathering of predominantly basic rocks.

Fluvisols are found along the valleys of the Black and White Volta Rivers, while Acrisols and Gleysols are more common in the eastern coastal region.

The mountainous area along the eastern border with Togo is denoted by Leptosols - these are generally very shallow soils that commonly form over hard rock.

Land cover



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

Water statistics

	2000	2010	2013	2014	2015
Rural population with access to safe drinking water (%)					84
Urban population with access to safe drinking water (%)					92.6
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)				1105	
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	1.747				
Total renewable groundwater (Million cubic metres/year)				26,300	
Exploitable: Regular renewable groundwater (Million cubic metres/year)	No data	No data	No data	No data	No data
Groundwater produced internally (Million cubic metres/year)				26,300	
Fresh groundwater withdrawal (primary and secondary) (Million cubic metres/year)	No data	No data	No data	No data	No data
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)	950				
Municipal water withdrawal (all water sources) (Million cubic metres/year)			251		
Agricultural water withdrawal (all water sources) (Million cubic metres/year)	652				
Irrigation water withdrawal (all water sources) (Million cubic metres/year)	No data	No data	No data	No data	No data
Irrigation water requirement (all water sources) (Million cubic metres/year)		162			
Area of permanent crops (ha)				2,700,000	
Cultivated land (arable and permanent crops) (ha)				7,400,000	
Total area of country cultivated (%)				31.02	
Area equipped for irrigation by groundwater (ha)	No data	No data	No data	No data	No data
Area equipped for irrigation by mixed surface water and groundwater (ha)	No data	No data	No data	No data	No data

Source and more statistics at: [FAO Aquastat](#).

Geology

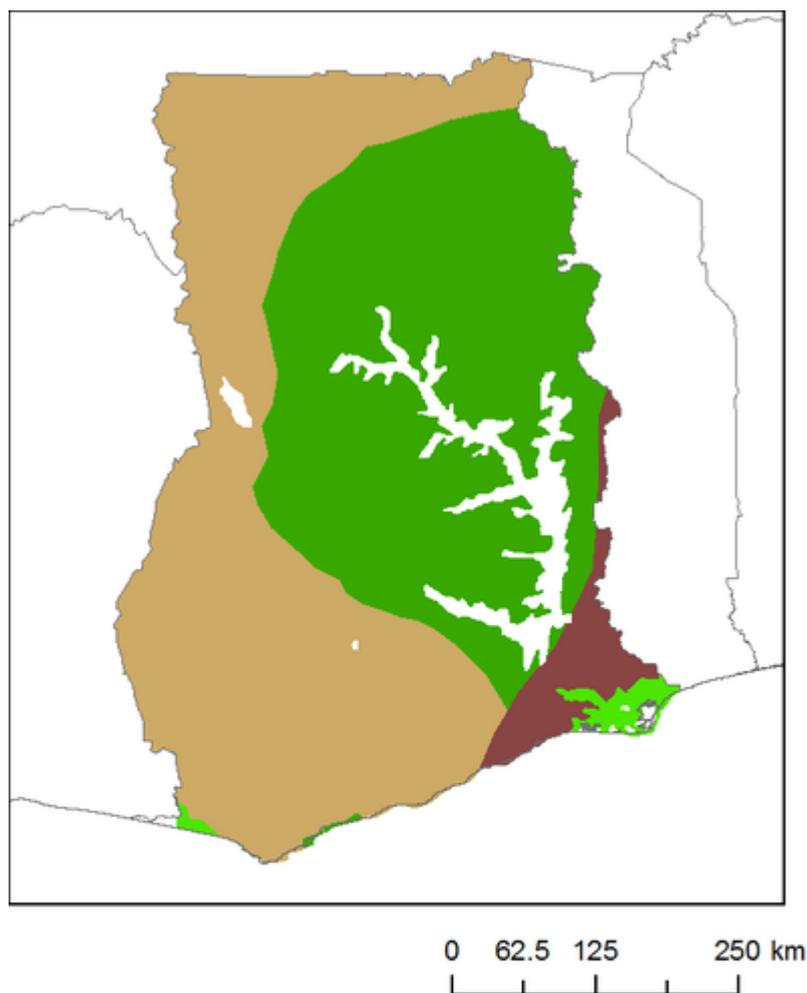
This section provides a summary of the geology of Ghana. More detail can be found in the references listed at the bottom of this page. Many of these references can be accessed through the [Africa Groundwater Literature Archive](#).

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 Ghana geology and hydrogeology map.](#)

Other, larger scale, geological maps are available in printed format: see the Key Geology References section below for more details.

A regional project to update the geology map for the Volta and Keta basins, an area of approximately 100,000 km², included the production of a series of 48 new geological maps covering the area (Carney et al. 2010, Kalsbeek 2008).



Ghana - Geology

-  Sedimentary - Palaeozoic-Tertiary - Coastal Basins
-  Sedimentary - Proterozoic-Palaeozoic - Voltaian
-  Precambrian Mobile/Orogenic Belt
-  Precambrian Craton

Geology of Ghana 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 Ghana geology and hydrogeology map.](#)

This map shows four major bedrock lithostratigraphic regions in Ghana. From youngest to oldest, they are:

- Isolated and spatially restricted coastal sedimentary basin geological units of Ordovician to Tertiary age, comprising the Keta, Accraian, Ammissian, Sekondian and Apollonian formations.
- The Voltaian Supergroup - neo-Proterozoic to Palaeozoic (early Cambrian), comprising the Kwahu, Oti-Pendjari and Obusum groups;
- The Pan-African Dahomeyide Precambrian mobile/orogenic belt, comprising the Buem, Togo and Dahomeyan formations;
- The Birimian Supergroup - Precambrian (Paleoproterozoic) cratonic supracrustal and intrusive rocks, generally trending NE-SW;

These rocks are overlain in valley areas by generally minor alluvium and other unconsolidated deposits of Quaternary age.

The following section provides a summary of the geology of Ghana based on these lithostratigraphic divisions. Sub-divisions of the major lithostratigraphic units are shown in the table below, although they are not distinguished on the map on this page.

Key Formations	Period	Geological Environments	
		Lithology	Structure
Unconsolidated			
Tano Basin	Quaternary	Alluvium along river valleys.	
Sedimentary - Palaeozoic-Tertiary - Coastal Basins			
Keta Basin Series		Sand, gravel, siltstone, shale and clays with layers of fossiliferous limestone. Found in the extreme southeast of Ghana.	
Amissian Formation	Pliocene (Tertiary) to Recent	Interbedded soft pebbly grits, conglomerate, micaceous sandstone, arkose, shales and clays.	
Apollonian Formation	Cretaceous to Eocene (Tertiary)	Marine sedimentary sandstones, clays and occasionally fossiliferous limestones. Found in the extreme southwest of Ghana.	
Sekondian Series	Devonian to Cretaceous	Dominantly sandstones and shales with conglomerates, pebble beds, grits and mudstones resting with major unconformity on a Precambrian complex of granites, gneisses and schists. Six formations are recognised in this series, with some being fossiliferous, others not.	
Accraian Series	Devonian	Alternating shales and thin-bedded micaceous sandstone, overlain by massive cross-bedded sandstone, and a thick sequence of sometimes fossiliferous shale and mudstone.	
Sedimentary - Proterozoic-Palaeozoic - Voltaian			

Upper Voltaian: Obosum Group	Upper Ordovician to Upper Carboniferous	Massive, coarse-grained, feldspathic sandstones and thin-bedded quartzitic sandstones with siltstones and mudstones. The Tamale Sandstone and Sang Conglomerate formations are dominated by coarse-grained sandstones; the undivided Obosum Group in the Northern Region is dominated by mudstones and siltstones.	Gently folded
Middle Voltaian: Oti-Penjari Group	Proterozoic (Lower Vendian) to Lower Ordovician	Mainly well consolidated and closely compacted basal sandstone. Also includes shales and tillite-dolomite limestone. The Group includes the Bunya Sandstone (dominantly feldspathic sandstone) and Chereponi Sandstone (alternating sandstones and siltstones) members, and the Bimbila and Afram formations (dominantly micaceous mudstones and siltstones with rare limestones and sandstones).	Gently folded
Lower Voltaian: Kwahu/Bombouka groups	Proterozoic (Upper Rhiphaean)	Mudstone, claystone and siltstone interbedded with sandstone and conglomerate. The Kwahu Group includes the Anyaboni Sandstone and Panoboko Sandstone formations.	Gently folded

Precambrian Mobile/Orogenic Belt

Dahomeyan, Togo and Buem Formations	Proterozoic (Eburnean)	Mainly metamorphic rocks. The older Dahomeyan Formation comprises mafic gneiss, quartzite and mica schist. The Togo Formation comprises metamorphosed and folded sedimentary strata, including phyllite, quartzite and schist. The Buem Formation comprises a thick sequence of sandstone, shale and volcanic rocks.
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Precambrian Craton

Birimian Group , granitoids and basic intrusive rocks	Palaeoproterozoic	Metamorphosed sedimentary rocks (schist, quartzite, slate and phyllite) alternating with five parallel, generally evenly-spaced volcanic belts. The sequence is intruded by various igneous rocks including granite (porphyritic, sodic-rich hornblende biotite granite and potassium-rich muscovite granite), gabbro, dolerite and diabase.	Generally NE-SW trending, well fractured and isoclinally folded.
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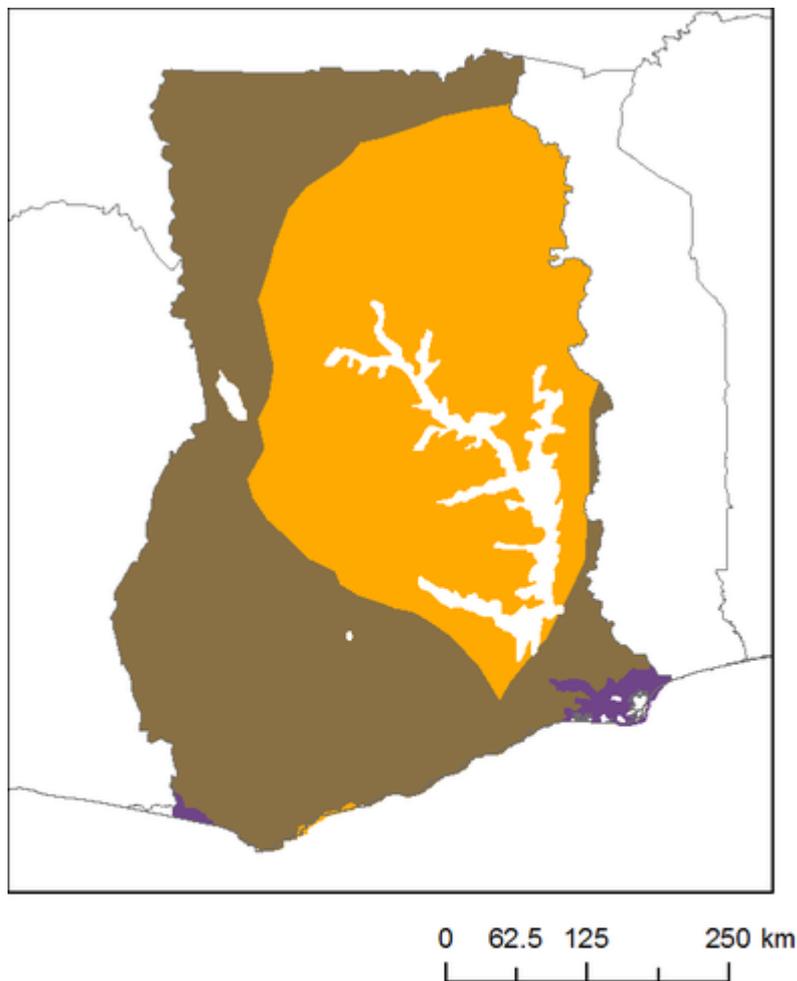
Hydrogeology

This section provides a summary of the hydrogeology of the main aquifers in Ghana, on the lithostratigraphic divisions described in the Geology section. The hydrogeology of some of the subdivisions of the major units is summarised, although the units are not distinguished on the map on this page. More information is available in the references listed at the bottom of this page.

The hydrogeology map on this page shows a simplified version 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 Ghana geology and hydrogeology map.](#)

Other hydrogeological maps at different scales and in different formats have been produced; some are listed in the key hydrogeology references section below.



Ghana - Aquifer Type and Productivity

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

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

Consolidated Sedimentary Aquifers with Fracture Flow

Named Aquifers	General Description	Water quality issues
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Upper Voltaian: Obosum Group	<p>Very low to zero intergranular permeability. Sandstone units can show variable development of joints, open planes and faults, creating secondary permeability. In thick sandstone units where secondary fracture permeability is well developed, high yielding boreholes have been developed, but in other areas, sandstones have proved to have low productivity. Mudstone and siltstone areas generally form a very low productivity aquifer, with little groundwater.</p>	<p>Groundwater from sandstones is often less mineralised than groundwater from mudstone and siltstones. However, there is some evidence that fluoride is more common in sandstones than in mudstones or siltstones. Groundwater from units dominated by mudstones and siltstones often has relatively high conductivity.</p>
Middle Voltaian: Oti/Pendjari Group	<p>Very low to zero intergranular permeability. Sandstone units show variably well-developed joints, open planes and faults, creating secondary permeability. Extensively fractured sandstone units can form moderately to highly productive aquifers, but there is wide variability in recorded yields, indicating that fractures are not well developed everywhere. Borehole yields range from less than 5 to 1000 l/min, but are often between 10 and 300 l/min. Units dominated by siltstones and mudstones tend to show lower yields, often between 20 and 40 l/min.</p>	<p>Groundwater from sandstones is often less mineralised than groundwater from mudstone and siltstones. However, there is some evidence that fluoride is more common in sandstones than in mudstones or siltstones.</p>
Lower Voltaian: Kwahu/Boumbaka groups	<p>Very low to zero intergranular permeability. Sandstone units such as the Anyaboni Sandstone and Panaboko Sandstone formations often form moderately to highly productive aquifers, dominated by secondary fracture permeability, often in thin zones, with borehole yields often between 150 and 250 l/min. There is evidence for groundwater inflows to boreholes to at least 100m depth.</p>	<p>Minor occurrences of saline groundwater have been noted in isolated boreholes, typically related to high sulphate concentrations. High iron is common, and high manganese in some areas. High fluoride concentrations occur rarely.</p>

Basement

Named Aquifers	General Description	Water quality issues	Recharge
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<p>Birimian, Granite, Dahomeyan, Togo and Buem Aquifers</p>	<p>The primary intergranular permeability of the basement rocks in Ghana is generally low. However, they form aquifers where secondary permeability is increased: where there is a significant weathered or regolith zone, and in highly fractured zones. The characteristics of the aquifers are very variable as a result of the varying intensity of weathering and the anisotropic nature of fractures. The most productive zone of these aquifers is usually the lower part of the regolith and upper part of the bedrock, otherwise known as the saprock. Yields from the basement aquifers are highly variable. Reported yields are from <0.1 to 10 l/s. Measured transmissivity varies between 0.2 and 119 m²/day. Storage is typically around 10-3.</p> <p>The basement aquifers are generally confined and vary in thickness from 2-20 m, depending on the thickness of the weathered zone. Borehole depths vary between 40-200 m, depending on the type of aquifer.</p>	<p>Water quality in the basement aquifers is fair to good. Groundwater is typically slightly acidic (pH<6.5) with low salinity and total hardness, but slightly higher salinity occurs in some areas. High fluoride (up to 4 mg/l) occurs in some areas in the Upper Regions, as does iodine deficiency. High arsenic (>0.01 mg/l) has been seen in some parts of southwest Ghana, linked to the abundance of arsenic-bearing minerals associated with gold in mineralised veins.</p>	<p>Recharge occurs mainly from rainfall.</p>
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Recharge

Few direct studies have been done on groundwater recharge in Ghana: those that have been done are largely for areas in the northern half of the country, using various methods including water balance, chloride mass balance, water table fluctuation and hydrological modelling. Groundwater hydrographs from more than 15 monitored wells in the northeast of the country suggest that the groundwater system in the country is active and it is affected by significant recharge and discharge.

Recharge to all the aquifer systems in Ghana is thought to be mainly by direct infiltration of precipitation through fractured and fault zones along the highland fronts, and also through the sandy portions of weathered zones. Some recharge also occurs indirectly as seepage from ephemeral stream channels and pools of accumulated runoff in the rainy seasons. Though there is some inflow contribution from regional (transboundary) aquifers in West Africa, the main source of recharge to the aquifers in Ghana, particularly in the north of the country, is precipitation. Estimated recharge values are generally low, varying from 1.5% to 19% of annual rainfall (Obuobie and Barry 2012), and there is high spatial and temporal variability.

Groundwater Status

Available data from past studies indicate that groundwater abstracted from boreholes in Ghana is generally of good chemical and microbiological quality and thus suitable for domestic (including drinking), agricultural and industrial uses. However, there are particular problems with the quality of groundwater in certain places. These problems include:

- low pH (3.5-6.0) waters, found mostly in the forest zones of southern Ghana;
- high concentrations of iron in many places throughout the country;
- high natural concentrations of manganese and fluoride, mostly in the north, including the Upper East and Northern regions; and
- high levels of mineralisation, with total dissolved solids (TDS) in the range of 2000 up to more than 14,000 mg/l in some coastal aquifers, largely due to high salt (sodium chloride) from sea water intrusion (Kortatsi 1994).

Many of these groundwater quality problems are natural in origin. A key process is geochemical weathering of the bedrock under particular hydrogeological and hydrochemical conditions, which can lead to high fluoride, iron and manganese, among other elements. Local hydrogeological conditions can also cause naturally low pH levels. Others are caused or worsened by human activity. Sea water intrusion is often related to over-abstraction of groundwater in coastal aquifers. There are also some isolated reports of high groundwater nitrate concentrations, thought to be linked to the increasing use of artificial fertiliser by farmers, although there may also be a link between increased nitrate concentrations and local contamination by human and/or animal waste.

Groundwater use and management

Groundwater use

The main uses of groundwater in Ghana are (Obuobie & Barry 2012):

- domestic water supply, including drinking water;
- small-scale irrigation of vegetables and watering of livestock; and
- industrial use for the commercial production of bottled and sachet water.

Over 95% of groundwater use in Ghana is for domestic water supply, mostly in rural areas and small towns (Gyau-Boakye et al. 2008). Overall, around 41% of households in Ghana depend on groundwater for their water supply (GSS-GLSS 5 2008) – this is generally much higher in rural areas (59%) than urban areas (16%). However, there are some urban areas, in the Upper East and Upper West regions, where 80% of the urban population depend on groundwater for their primary water supply.

Less than 5% of groundwater in Ghana is used for irrigation and watering of livestock and poultry (Laube et al. 2008, MOFA 2004, Agodzo et al. 2003).

Industrial use of groundwater in Ghana accounts for less than 1% of the total groundwater use. This includes large-scale commercial bottled water companies in the south of the country (Gyau-Boakye et al. 2008, Darko et al. 2003).

The main types of groundwater source in Ghana are:

- boreholes with hand pumps;
- boreholes with electric pumps; and
- hand dug wells.

There are no official national statistics of the numbers of each of these sources, but it is estimated that there are over 15,000 boreholes (hand pumps and electric pumps) and 45,000 hand dug wells across the country.

In the Volta Basin alone, Martin and van de Giesen (2005) estimated that 29.4 million cubic meters of groundwater was abstracted in 2001 from 7,285 boreholes fitted with hand pumps, 36 piped groundwater systems, and 3,960 modern hand dug wells.

Groundwater management

The key institutions responsible for groundwater management in Ghana are:

- The Water Directorate of the Ministry of Water Resources Works and Housing: this is the focal point for coordination of the water and water-related sanitation sector for policy harmonisation, sector-wide monitoring and evaluation of Ghana Poverty Reduction Strategy (GPRS) outcomes and Millennium Development Goal (MDG) targets, as well as coordination of foreign assistance (donor support/partnership) in the water sector.
- The Water Resources Commission (WRC): The WRC is mandated to regulate and manage the utilisation of water resources (both surface and groundwater) and to coordinate government policies in relation to them. The WRC also provides a focal point for fostering coordination and collaboration among the various actors in the water resources sector.
- The CSIR Water Research Institute (WRI): The WRI are responsible for conducting research into all aspects of water in Ghana, in order to provide scientific and technical information and services as well as strategies for the sustainable development, utilisation and management of such resources for the socio-economic advancement of the country.
- Community Water and Sanitation Agency (CWSA): The CWSA are responsible for facilitating the provision of safe drinking water and related sanitation services to rural communities and small towns in the country.
- Ghana Water Company Limited (GWCL): The GWCL are responsible for the provision of domestic water supply to cities and towns in the country.
- The Hydrological Services Department (HSD): This Department is under the auspices of the Ministry of Housing and Water Resources of Ghana. They are responsible for all river flow gauging stations in the country.

There is not yet a separate legal framework for groundwater management in Ghana. The current legal framework is for both surface and groundwater. There is no longer private ownership of water resources in Ghana. The ownership of water resources, including groundwater, is vested in the president per section 12 of the Water Resources Commission Act (1996): “the property in and the control of all water resources is vested in the President, or anyone authorized by the President, on behalf of and in trust for the people of Ghana”.

The Water Resources Commission has enacted legislative instrument (LI) under Act 522 of 1996 to guide the use and management of water resources in the country. These LI include:

- The Water Use Regulations (LI 1692 of 2001), which is for granting water permits for the regulation of surface and groundwater abstraction
- The Water Drilling Licence and Groundwater Development Regulations (LI 1827 of 2006) to regulate the development of groundwater resources.

All drilling companies are required to obtain permits from the Water Resources Commission before drilling. However, there is no legal framework regarding how much water can be abstracted.

The regulation of water disposal is a mandate of a separate entity, the Environmental Protection Agency (EPA). The EPA is represented on the WRC board and collaborates with the WRC in the

issuance of waste disposal licences to avoid pollution of water resources. However, the collaboration is weak leading to conflicting situations in some cases.

Transboundary aquifers

Ghana shares in two main transboundary aquifers, both of which are coastal:

- The Tano aquifer system, located in the extreme southwest of Ghana and shared between Ghana and Cote d'Ivoire. It covers an area of 806 square kilometres in Ghana and includes three aquifer units (Quaternary, continental terminal and Maastrichtian); and
- the Keta aquifer system, found in the extreme southeast of Ghana and shared among Ghana, Togo Benin, and Nigeria. It is a layered system covering an area of 2,721 square kilometres.

Each country currently manages its share of the aquifer systems independently. Ghana recognises the need for agreements and cooperation between countries that share in its transboundary aquifers (e.g. Togo and Cote d'Ivoire). However, such co-operations and the necessary frameworks have yet to be initiated.

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

Groundwater monitoring

Groundwater level monitoring in Ghana is managed at a national level. A limited number of monitoring wells have been established as part of previous groundwater projects implemented at river basin level. Between 2005 and 2012, a total of 70 monitoring wells were installed in Ghana in the Volta River, Tano, Ankobra and Densu river basins. These were funded by DANIDA, the European Union and CIDA.

Ghana's Water Resources Commission (WRC) mandated the CSIR Water Research Institute to undertake groundwater level monitoring. The collected data are currently stored in the WRC. Ghana also undertook a separate national groundwater monitoring project, in which monitoring is currently done by the Ghana Atomic Commission on behalf of the Water Resource Commission.

There are no groundwater quality monitoring programmes.

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Many of the references below, and others relating to the hydrogeology of Ghana, can be found in the [Africa Groundwater Literature Archive](#).

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