

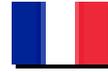
Hydrogeology of Senegal

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The area of present-day Senegal has been inhabited since prehistoric times. Recorded history shows kingdoms in this area from the 7th century; and parts of Senegal lay within the ancient empires of Ghana and Jolof at times between the 8th and 16th centuries. Islam has been an important influence since the Almoravid era of the 11th century. Various European colonial powers competed for trade in the area from the 15th century, including Portugal, the Netherlands and Britain. From the 17th century France dominated the area as part of French West Africa. In 1960 Senegal gained independence, initially as part of the short-lived Mali Federation with French Sudan (later Mali) and then a few months later as independent Senegal. Between 1982 and 1989, Senegal federated with Gambia as Senegambia. There were sporadic episodes of unrest in the 1980s and 90s, but since 2000 the country has seen relative political and civil stability, although there has been a long-running, albeit relatively low key separatist conflict in the southern Casamance region.

In the colonial period the economy was dominated by export of groundnuts and other agricultural products. After independence, commercial agriculture was run by government parastatal organisations. From the 1980s there have been moves to privatise and diversify the economy. Senegal's manufacturing industry is better developed than that of other West African countries, with petrochemicals now playing a significant role in the economy, and Dakar an important international port. Current key exports include fish, chemicals, cotton, groundnuts and calcium phosphate. Tourism is of growing importance, in part due to Senegal's diverse ecology and culture, its relatively high level of development in comparison with other West African countries, and its reputation as a fairly stable democracy within the region. Information technology based services are another key contributor to the economy.

Senegal has relatively abundant water resources averaged across the country, but there are strong regional and seasonal variations. The north of the country is semi-arid; the south humid-tropical. The largest surface water resource is the shared Senegal River, which forms the country's northern boundary. Many smaller perennial rivers and some lakes are also important resources. Groundwater is relatively abundant and provides much of the country's water supplies. Overabstraction of

groundwater is a growing problem in some areas.

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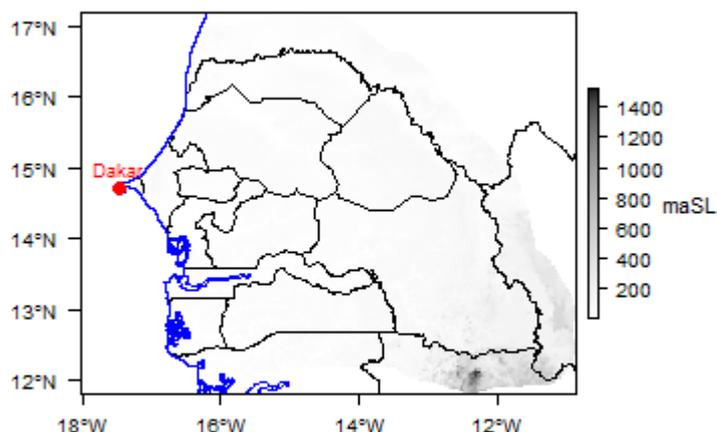
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Geographical Setting



Senegal. 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](#).

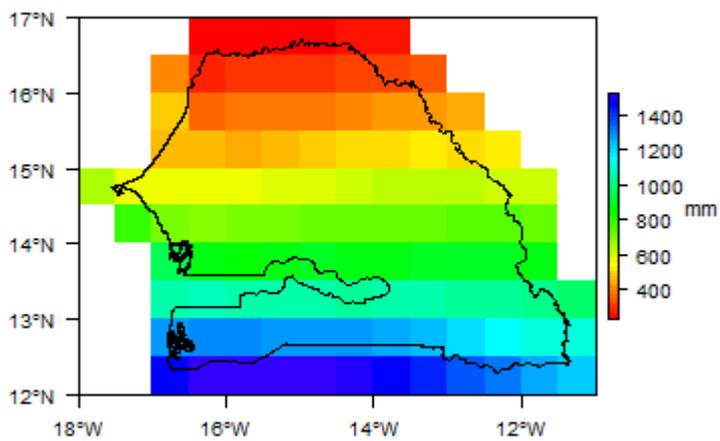
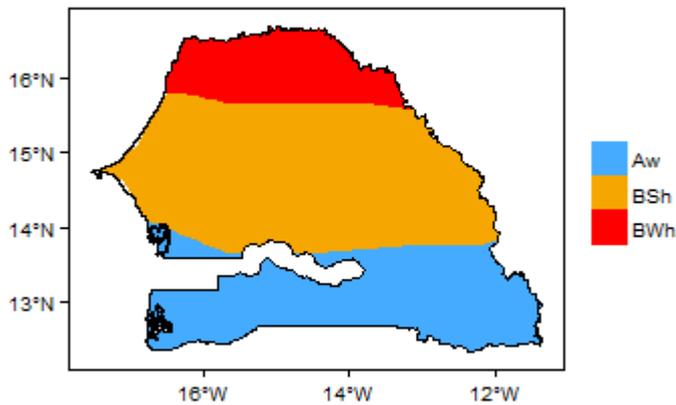
General

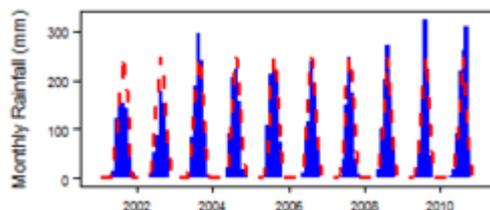
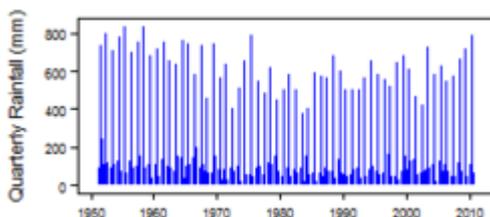
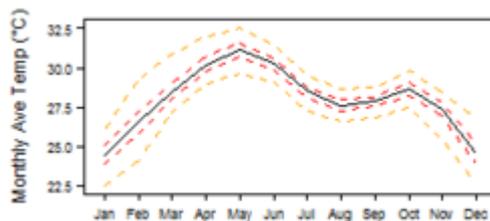
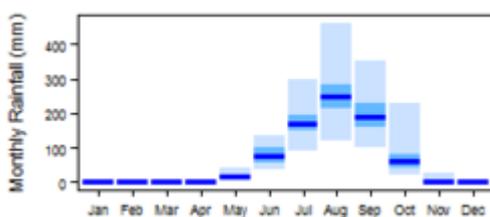
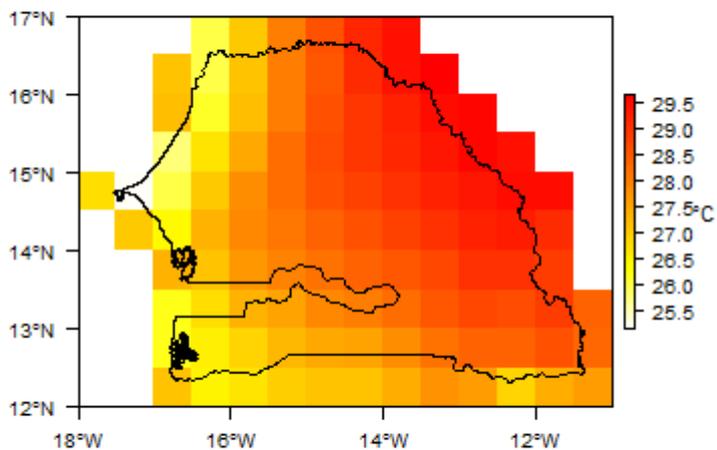
Capital city	Dakar
Region	Western Africa
Border countries	Gambia, Guinea-Bissau, Guinea, Mali, Mauritania
Total surface area*	196,710 km ² (19,671,000 ha)
Total population (2015)*	15,129,000

Rural population (2015)*	8,585,000 (57%)
Urban population (2015)*	6,544,000 (43%)
UN Human Development Index (HDI) [highest = 1] (2014)*	0.4659

* Source: [FAO Aquastat](#)

Climate





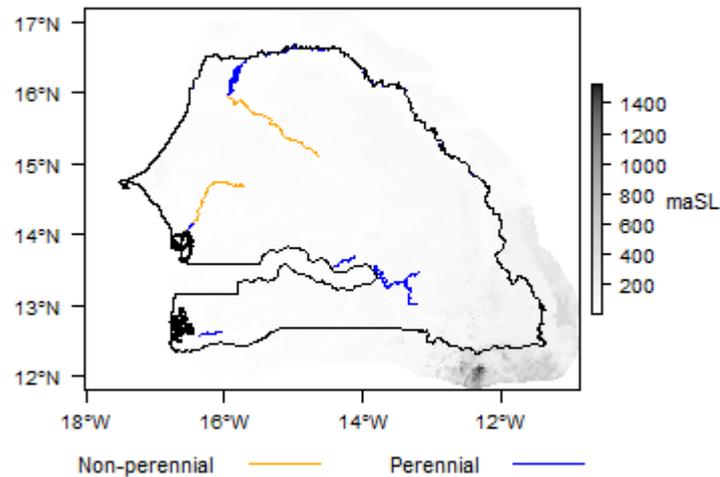
More information on average rainfall and temperature for each of the climate zones in Senegal can be seen at the [Senegal climate page](#).

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

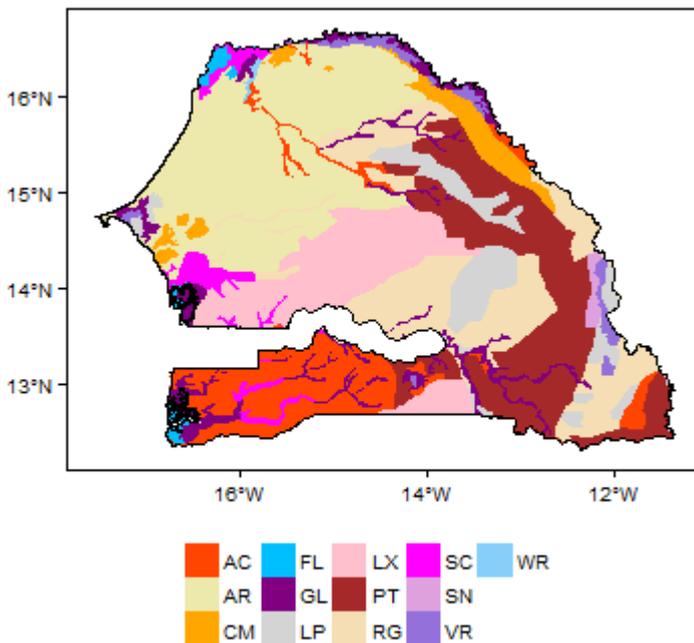
The following institutions have responsibilities for surface water in Senegal:

- Organisation pour la Mise en Valeur du Fleuve Sénégal (OMVS)
- Organisation pour la Mise en Valeur du Fleuve Gambie (OMVG)
- Direction de la Gestion et de la Planification des Ressources en Eau (DGPRE)



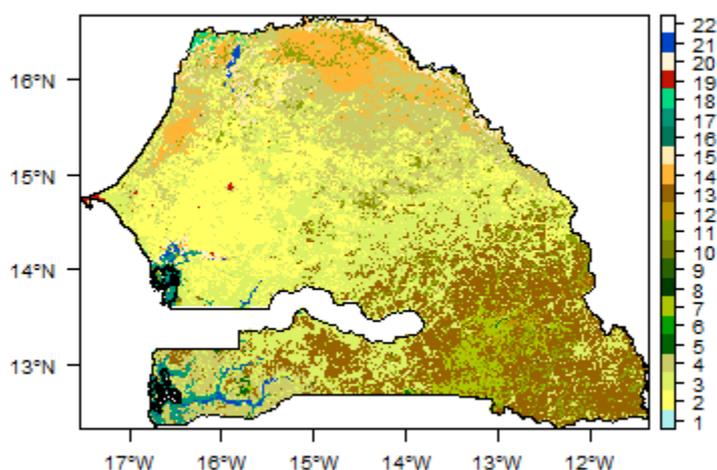
Major surface water features of Senegal. Map developed from World Wildlife Fund HydroSHEDS; Digital Chart of the World drainage; and FAO Inland Water Bodies. For more information on the map development and datasets see the [surface water resource page](#).

Soil



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

Water statistics

	2002	2014	2015
Rural population with access to safe drinking water (%)			67.3
Urban population with access to safe drinking water (%)			92.9
Population affected by water related disease	No data	No data	No data
Total internal renewable water resources (cubic metres/inhabitant/year)		1,705	
Total exploitable water resources (Million cubic metres/year)	No data	No data	No data
Freshwater withdrawal as % of total renewable water resources	5.70		
Total renewable groundwater (Million cubic metres/year)		3,500	
Exploitable: Regular renewable groundwater (Million cubic metres/year)	No data	No data	No data
Groundwater produced internally (Million cubic metres/year)		3,500	
Fresh groundwater withdrawal (primary and secondary) (Million cubic metres/year)	No data	No data	No data
Groundwater: entering the country (total) (Million cubic metres/year)	No data	No data	No data
Groundwater: leaving the country to other countries (total) (Million cubic metres/year)	No data	No data	No data
Industrial water withdrawal (all water sources) (Million cubic metres/year)	58		
Municipal water withdrawal (all water sources) (Million cubic metres/year)	98		
Agricultural water withdrawal (all water sources) (Million cubic metres/year)	2,065		
Irrigation water withdrawal (all water sources) ¹ (Million cubic metres/year)	No data	No data	No data

Irrigation water requirement (all water sources) ¹ (Million cubic metres/year)	949.4		
Area of permanent crops (ha)		68,000	
Cultivated land (arable and permanent crops) (ha)		3,268,000	
Total area of country cultivated (%)		16.61	
Area equipped for irrigation by groundwater (ha)	10,000		
Area equipped for irrigation by mixed surface water and groundwater (ha)	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](#).

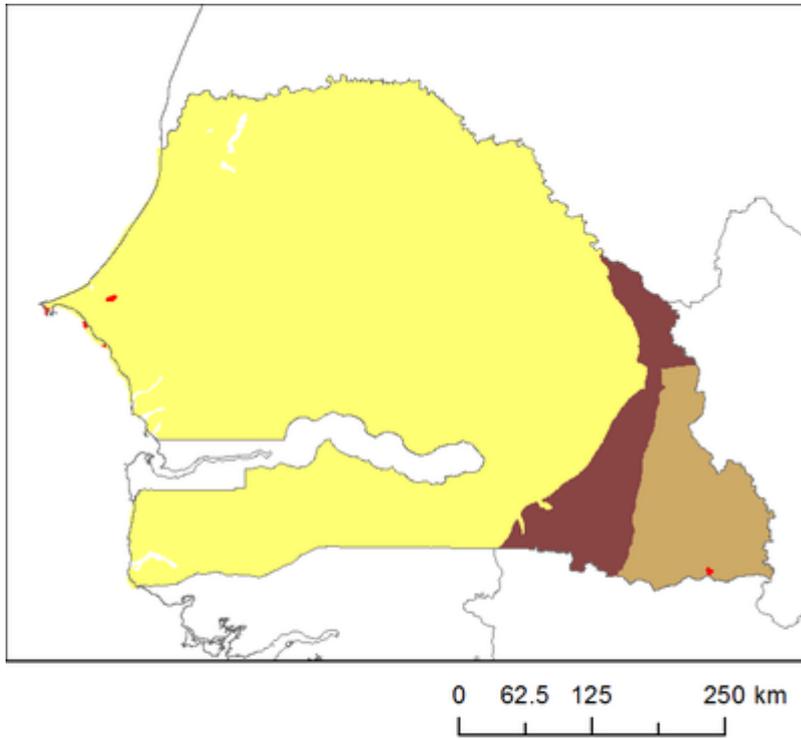
¹ More information on [irrigation water use and requirement statistics](#)

Geology

This section provides a summary of the geology of Senegal. 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 overview of the geology at a national scale (see the [Geology resource page](#) for more details).

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



Senegal - Geology

- Cretaceous - Quaternary Sedimentary (largely unconsolidated)
- Tertiary-Quaternary Igneous Volcanic
- Hercynian-Panafrican Mobile/Orogenic Belt
- Precambrian: Birimian

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

Geological Environments

Key Formations	Period	Lithology	Structure
Quaternary unconsolidated sediments			
	Quaternary	Quaternary sediments are not distinguished on the geology map above, but occur in places across the country. Variable deposits including alluvium in river valleys and coastal deposits. Including sand and clay.	Up to 42 m thick.
Tertiary - Cretaceous sedimentary rocks			
Continental Terminal	Neogene	Mainly laterite and sand with carbonates in some places.	Up to 92 m thick
Ypresian	Eocene	Marly calcareous and limestone deposits, clayey or sandy in places.	Up to 260 m thick
Thanetian	Palaeocene	Limestone	Up to 220 m thick
Montian	Palaeocene	Limestone	
Danian	Palaeocene	Marly calcareous	
Maastrichtian	Mesozoic	Sand, sandy clay, calcareous sandstone	Up to 488 m thick

Campanian	Mesozoic	Predominantly clayey	Up to 102 m thick
Lower Senonian	Mesozoic	Laterally variable; clayey in the western part of the basin	Up to 92.5 m thick
Turonian	Mesozoic	Black clay; a stratigraphic marker bed	

Tertiary-Quaternary volcanic rocks

Mamelles volcanics	Tertiary-Quaternary	Basalt, basanite, tuffs	Up to 25 m thick
Diack formations	Tertiary	Gabbro and basalt	

Hercynian-Panafrican Mobile/Orogenic belt

Mauritanides formations	Hercynian-Panafrican	Schists and quartzites	
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Precambrian: Birimian

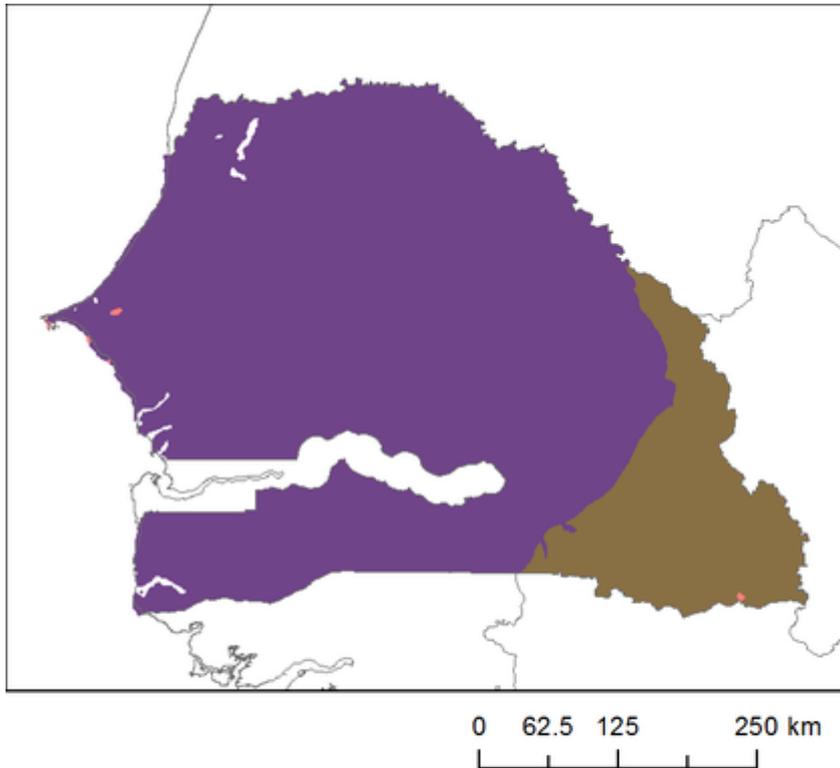
Birimian formations	Mesoproterozoic	Saraya Granite, complex granodiorite-granite of Sandikounda-Soukouta, Boboti Granite	
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Hydrogeology

This section provides a summary of the hydrogeology of the main aquifers in Senegal. 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 Senegal geology and hydrogeology map.](#)



Senegal - Aquifer Type and Productivity

- Sedimentary Unconsolidated and Consolidated Intergranular/Fracture Flow - High to Very High
- Volcanic - Moderate
- Basement - Low to Moderate

Hydrogeology of Senegal 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 Senegal geology and hydrogeology map.](#)

Unconsolidated Superficial Aquifers

Named Aquifers	General Description	Water quantity issues	Water quality issues	Recharge
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Superficial aquifer system
Unconsolidated Aquifer: High to Very High Productivity

The Superficial aquifer system includes Quaternary and Tertiary sediments. It covers the whole Senegal sedimentary basin. It is dominantly made of sand and sandy clay, which vary in proportion across its extent. The aquifers are intergranular, and the best groundwater potential occurs in sand layers. It comprises the following aquifers: infrabasaltic (occurs below basalts), Thiaroye, Littoral Nord, alluvial (Quaternary); and Continental Terminal and Oligo-Miocene aquifers (Tertiary). This aquifer system overlies more consolidated sediments of the Eocene, Palaeocene, and the Maastrichtian (Tertiary) - described below. The Superficial aquifer system ranges between 0 to 150 m thick, with a water table depth between a few metres to 72.5 metres depth. Typical borehole depth varies between 7.6 to 540 m. Typical values for aquifer parameters for the Superficial aquifer system are:

- Permeability = 1×10^{-5} to 8.9×10^{-4} m/s
- Transmissivity = 8.64 to 1728 m²/day
- Storage coefficient = 0.01-0.15
- Borehole yield = 50-183 m³/h

Nitrate contamination is known to occur in places.

Consolidated Sedimentary Aquifers: Cretaceous to Tertiary - Intergranular and Fracture Flow

Named Aquifers	General Description	Water quantity issues	Water quality issues	Recharge
----------------	---------------------	-----------------------	----------------------	----------

Intermediate
aquifer system
**Consolidated
Sedimentary
Aquifer: High
to Very High
Productivity**

The Intermediate aquifer system lies below the Superficial aquifer system. It includes Eocene and Palaeocene formations (Tertiary), and mainly comprises limestone, often karstic or affected by faults. The Eocene aquifer is exploited in the central western part of Senegal and along the Senegal river.

The Palaeocene aquifer occurs mainly in western Senegal, around Pout. These aquifers constitute one of the main sources of drinking water for Dakar. The Intermediate aquifer system ranges between 40 to 120 m thick, with a water table depth between a few metres to 102.5 metres depth. Typical borehole depth varies between 7.6 to 540 m.

Typical values for aquifer parameters for the Intermediate aquifer system:

- Permeability = 1×10^{-5} to 2.5×10^{-8} m/s
- Transmissivity = 1.728 - 9504 m²/day
- Storage coefficient = 0.05 - 0.10
- Borehole yield = 54 - 300 m³/h

High iron, fluoride and salinity seen in the central western part of Senegal. Saline intrusion in the coastal areas.

Groundwater recharge depends only on rainwater and rivers.

<p>Deeper aquifer system Consolidated Sedimentary Aquifer: High to Very High Productivity</p>	<p>The deeper aquifer system, of Maastrichtian (Cretaceous) age, extends across the whole of the Senegalo-Mauritanian basin and generally consists of sand, sandy-clay and calcareous sandstone. Groundwater storage and flow are largely intergranular. This aquifer constitutes the main source of groundwater supply in Senegal. It is a transboundary system. The deeper aquifer system is about 250 m thick, with a water table depth between a few metres to 140 metres depth. Typical borehole depth varies between 25 to 680 m. It is typically highly productive, although aquifer properties vary according to local characteristics (lithology, thickness, etc.). Where there are thick clay sequences, the aquifers can be semi-confined or confined. Typical values for aquifer parameters for the deeper aquifer system are:</p> <ul style="list-style-type: none"> • Permeability = 1×10^{-5} m/s • Transmissivity = 0.95 - 652,578 m²/day • Storage coefficient = 1×10^{-4} - 6×10^{-4} in the western central part • Borehole yield = 80 - 362 m³/h 	<p>Groundwater depletion occurs locally due to overabstraction</p>	<p>High iron, fluoride and salinity seen in the central western part of Senegal. Saline intrusion in the coastal areas.</p>	<p>Recharge occurs from direct rainfall and indirectly from rivers, and is estimated at about 103×10^6 m³/a to the Maastrichtian deeper aquifer system. This is mainly recharged in the western central part in Diass horst where formations outcrop, and at the contact with the basement formations and the unconsolidated formations in southeastern part of Senegal.</p>
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Key references for information on these aquifers:

Faye S, Faye SC, Ndoye S and Faye A. 2003. Hydrogeochemistry of the Saloum (Senegal) superficial coastal aquifer. *Env Geo* 44 (2):127-136

Diaw M, Faye S, Stichler W and Maloszewski P. 2012. Isotopic and geochemical characteristics of groundwater in the Senegal River delta aquifer: implication of recharge and flow regime. *Environ Earth Sci* DOI: 10.1007/s12665-010-0710-4.

Diaw M. 2008. Approches hydrochimique et isotopique de la relation eau de surface/nappe et du mode de recharge de la nappe alluviale dans l'estuaire et la basse vallée du fleuve Sénégal: Identification des zones inondées par Télédétection et par traçage isotopique; Thèse, Univ. C. A. Diop de Dakar. Dakar, Sénégal, pp. 210.

Re V Cissé, Faye S, Faye A, Faye S, Gaye CB, Sacchi E and Zuppi GM. 2010. Water quality decline in coastal aquifers under anthropic pressure: the case of a suburban area of Dakar (Senegal). *Environmental Monitoring Assessment*. DOI 10.1007/s10661-010-1359-s.

Sall M and Vanclooster M. 2009. Assessing the well water pollution problem by nitrates in the small scale farming systems of the Niayes region (Senegal). *Agricultural Water Management*, 96: 1360-1368.

Gueye-Girardet A. 2010. Evaluation des pratiques d'irrigation, de fertilisation et d'application de pesticides dans l'agriculture périurbaine de Dakar, Sénégal. Thèse de Doctorat, Université de Lausanne, 276p.

Tandia AA, Diop ES and Gaye CB. 1999. Nitrate groundwater pollution in suburban areas: example of groundwater from Yeumbeul, Senegal. *Journal of African Earth Sciences*, 29(4): 809-822.

Basement Aquifers (Hercynian-Panafrican and Birimian) - Low to Moderate Productivity

Named Aquifers	General Description	Water quantity issues	Water quality issues	Recharge
Metamorphic basement (of Hercynian-Panafrican Mobile/Orogenic belt)	<p>The lithologies within this group are extremely heterogeneous and have been subjected to significant metamorphism, so they also vary greatly in their aquifer properties. It is possible to define major aquifer groups comprising quartzite in the north, and schist and greywacke in the south. These aquifers are less productive than the Birimian volcanics (see below). Aquifer layers are typically between 18 and 94 m thick, with water table typically between 4 and 62 m depth. Boreholes are between 25 and 131 m deep. The mean borehole yield is 6.95 m³/hour, and the mean transmissivity is 1.42 m²/day.</p>	Abstracted yields are usually low, from handpumps (India Mark II)	Some anomalously highly mineralised water, with an electrical conductivity of over 2000 µS/cm, has been sampled in the north. Nitrate pollution is frequently identified in these aquifers, particularly in the north.	

Volcaniclastic strata of the Birimian	<p>Groundwater can be obtained from various strata within the Birimian volcanoclastics found in the south east of the country. These rocks are highly heterogeneous, predominantly volcano-sedimentary rocks including sandstone and quartzite, rhyolitic to dacitic sediments, mudstones, siltstones, and greywacke. These formations are affected by a regional shear zone (the main transcurrent zone, MTZ), which is oriented NNE-SSW; boreholes are sometimes highly productive in affected formations.</p>	<p>Mainly low yields from handpumps. Water resource is impacted in some areas by mine dewatering and abstraction for ore processing.</p>	<p>Generally good quality. Some contamination results from artisanal gold mining (ASGM). Mercury and nitrate contamination has also been identified in places.</p>
	<p>These strata form aquifers where they are adequately weathered or fractured. The weathered zone varies in thickness from less than 6 m up to about 20 m, being typically thicker in the south due to climatic factors. The fractured zone is typically between 10 and 20 m thick. The volcanoclastic aquifers are unconfined. The water table is usually between 3 and 21 m depth; seasonal fluctuations in water level lead to some wells drying up periodically. Boreholes are typically between 20 and 70 m deep. The mean yield is 10.2 m³/hour, with a median of 6.5 m³/hour. Mean transmissivity is 17.3 m²/d.</p>		

Saraya granite and Sandikounda-Soukouta granite (Precambrian)	<p>These formations comprise leucogranite, monzogranite, granodiorite and tonalite granite lithologies. The upper weathered zone is predominantly sandy, providing a relatively permeable zone with storage capacity, forming an unconfined aquifer. The weathered profile ranges from about 5 to 15 m deep. The weathered aquifer is mainly tapped by hand dug wells that dry up at the end of the dry season (end of April). Beneath the weathered zone, secondary (fracture) permeability supports productive wells with average flows of about 6 m³/h. Boreholes are typically 20 - 70 m deep. Median yields are of the order of 3.8 m³/h. The transmissivity is about 12 m²/d. Numerous dykes intersect the Saraya granite and are probably a significant control on groundwater flow in this aquifer; they are oriented N030°.</p>	Borehole yields vary considerably, and are often very low. It is difficult to site boreholes successfully in these aquifers.	Generally good, but nitrate contamination has been detected in some boreholes.	Mainly recharged during rainy season and along the major rivers.

Key references for information on these aquifers:

COWI. 2000. Etude Hydrogéologique de la Nappe Profonde du Maastrichtien. Service de Gestion et de Planification des Ressources en Eau (SGPRE)

Diouf S. 1999. Hydrogéologie en zone de socle cristallin et cristallophyllien du Sénégal Oriental. Application de la méthode électrique 1D et 2D à la localisation et à la caractérisation des aquifères du batholite de Saraya et ses environs. Thèse de doctorat de 3e cycle. Université Cheikh Anta Diop de Dakar, 86 p. + annexes.

Mall I. 2009. Contribution à l'étude hydrogéochimique en zone de socle: cas du Sénégal Oriental. Mémoire de DEA de l'Université Cheikh Anta Diop, 81p.

Wuilleumier A, Théveniaut H, Mall I et Ndiaye PM. 2010. Notice explicative de la carte hydrogéologique à 1/500 000 du Sénégal oriental, Ministère des Mines, de l'Industrie, de l'Agro-Industrie et des PME, Direction des Mines et de la Géologie, Dakar.

Groundwater Status

Groundwater Quantity

Senegal has significant groundwater resources but the distribution of availability and demand do not match. This means that some groundwater systems are over exploited, leading to groundwater depletion: this has been observed in the Palaeocene and Maastrichtian in the Diass aquifer system.

Groundwater Quality

Saline intrusion

The shallow river delta aquifer and the Saloum superficial aquifer in Senegal have been affected by seawater intrusion as far as, respectively, 200 km and 100 km inland, with wells adjacent to the rivers reporting salt concentrations as high as 10 g/L in the Senegal delta (Diaw et al. 2012) and 3 g/L in Saloum (Faye et al. 2003). The whole coastline (1,700 km) of Senegal and the deep Maastrichtian aquifer have been also highly affected by seawater intrusion. In the western part, the deep Maastrichtian aquifer is characterized by the presence of salt water depth or true "brine" with concentrations above 100 g/l. The interface limit of fresh and salt waters is very variable, which makes it difficult to estimate the volume and water flow direction.

Soil and shallow groundwater salinity Large-scale irrigation in alluvial valleys (Senegal, Saloum and Casamance) may also act to gradually increase the salinity levels in soil water, surface water systems and/or aquifers. This is because the crops transpire almost pure water, which means that applied irrigation leaves a residue of dissolved substances. The effects are most pronounced under arid conditions but also with the use various anthropogenic pollutants (fertilizers, domestic, industrial and agricultural effluents etc). In addition, the using brackish water or treated waste waters for irrigation in Niayes area (north coastline) may promote salinization of the underlying groundwater system in particularly around of large cities like Dakar. It is assumed that the groundwater salinization because of irrigation is restricted to the first meters to tens of meters below the groundwater table in sands dunes (Niayes area). Groundwater salinization effects of these processes will be rather localised.

Agricultural and industrial contaminants In Senegal, agricultural and industrial activities affect the quality of surface water and groundwater that undergo also strong alteration due to chemical pollution from industrials effluents and used products in agriculture including pesticides and fertilizers. This depends on several factors: soil characteristics, irrigation, crops performed, regulation deficiencies, illiteracy of farm operators and funding facility of chemical inputs. These are sensitive problems in areas such as Senegal River Delta, Dakar, Mbour and Fatick etc. The studies carried out in the Senegal delta showed that the river and distributaries channels are affected by mineral pollution from private irrigation discharges in the alluvial plain of Djeuss, pumping stations discharges of Ndong and Gaela on the Gorom channel and high mineralized drainage water discharge of sugar company in Guiers Lake (Diaw 2008).

The presence of dangerous herbicides or insecticide residues were detected in the analysis carried at several locations in Guiers Lake and in the alluvial aquifer.

Other anthropogenic contaminants In addition to these phenomena mentioned above, other factors may cause water quality degradation, especially in alluvial and coastal unconfined aquifers that are most vulnerable. These shallow groundwaters have been contaminated by anthropogenic pollution in Dakar city and suburbs, most likely a consequence of high population growth,

uncontrolled land use and poor hygiene and lack sanitation of the people. Pollution is shown by the presence of nitrates and organic micro-pollutants and bacteriological contamination. Groundwater pollution by nitrates in Dakar region, is important particularly at Mbeubeuss discharge in the Pikine-Thiaroye area, but also occurs in outcropping groundwaters in the Dakar slums (Dalifor, Medina-Gounass). The nitrogen concentrations are increasing in shallow groundwater (sometime to over 400 mg/L) and several studies have been carried out to characterize the problem of nitrate pollution in groundwater in the Dakar Region (Cisse Faye 2013, Diédhiou et al. 2011; Re et al. 2010; Sall & Vanclooster 2009; Gueye-Girardet 2010; Tandia et al. 1999).

Groundwater Dependent Ecosystems

Senegal has areas known as 'niayes', which are depressions between dunes which have a very shallow groundwater level. These are common in the Niayes region of northwest Senegal. These areas are prone to groundwater depletion.

Mangrove forests occur in the Saloum and Casamance estuaries.

Groundwater use and management

Groundwater use

About 60% of Dakar's drinking water is supplied from groundwater, obtained from the Cretaceous-Tertiary Intermediate and Deeper aquifers.

Groundwater is also used elsewhere for drinking water, industry and agriculture, abstracted largely from basement aquifers.

Abstraction from the Intermediate and Deeper aquifer systems is from boreholes with electric pumps, while hand pumps are more common in the basement areas.

Groundwater management

Groundwater and surface water management in Senegal, including water policy, are the responsibility of the Direction de la Gestion et de la Planification des Ressources en Eau (DGPRE). Permits are required for drilling and water abstraction.

Currently, there is no legislative protection for groundwater in vulnerable areas, and water disposal is not controlled.

Data show that in 2008 there were at least 7000 recorded groundwater sources in Senegal, both boreholes and large diameter (hand dug) wells, with geological log information for about 1400 of the boreholes.

Groundwater monitoring

Groundwater levels

Groundwater levels are monitored twice a year: before and after the rainy season. This work is funded through the Ministry of Hydraulics and Sanitation.

Groundwater quality Groundwater quality is measured twice per year, before and after the rainy season, funded by the Ministry of Hydraulics and Sanitation. This work is sometimes extended by

NGOs, researchers or others who want to better understand water quality.

These data are collected and stored by the Direction de la Gestion et de la Planification des Ressources en Eau (DGPRES) and the Société Nationale des Eaux du Sénégal (SONES).

Transboundary aquifers

The Deeper aquifer system of the Maastrichtian is a transboundary aquifer, which is shared by Senegal, Gambia, Mauritania and Guinea-Bissau but there is no specific management issue.

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

References

Many of the references below, and others relating to the hydrogeology of Senegal, can be seen in the [African Groundwater Literature Archive](#).

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Roger J, Noël BJ, Barusseau JP, Serrano O, Nehlig P and Duvail C. 2009. Notice explicative de la carte géologique du Sénégal à 1/500 000, feuilles nord-ouest, nord-est et sud-ouest. Ministère des Mines, de l'Industrie et des PME, Direction des Mines et de la Géologie, Dakar, 61 pages.

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