29/10/02 - DD

OFFICE INTERNATIONAL DE L'EAU

Développer les Compétences pour mieux Gérer l'Eau

FLEUVES TRANSFRONTALIERS AFRICAINS
- BILAN GLOBAL -


AFRICA
North Atlantic Ocean
South Atlantic Ocean
Indian Ocean
Indian Ocean
RUSSIA
KAZAKHSTAN
ALGERIA
LIBYA
EGYPT
SAHARA DESERT
MAURITANIA
MALI
NIGER
CHAD
SUDAN
NIGERIA
CONGO
BASIN
DEM. REP. OF THE CONGO
ANGOLA
ZAMBIA
MOZAMBIQUE
TANZANIA
KENYA
SOMALIA
ETHIOPIA
SAUDI ARABIA
IRAN
IRAQ
TURKEY
GREECE
SPAIN
PORTUGAL
FRANCE
MOROCCO
TUNISIA
BOTSWANA
NAMIBIA
SOUTH AFRICA
MADAGASCAR
Scale 1:51,400,000
Azimuthal Equal-Area Projection

International River Basins of

AFRICA

AFRICA: International River Basin register *(updated August 2002)*

Basin Name	Total area of basin (sq. km) (1)	Country name	Area of country in basin (sq. km)	Percent area of country in basin (%)
Akpa (2)	4,900	Cameroon	3,000	61.65
		Nigeria	1,900	38.17
Atui (3)	32,600	Mauritania	20,500	62.91
		Western Sahara	11,200	34.24
Awash	154,900	Ethiopia	143,700	92.74
		Djibouti	11,000	7.09
		Somalia	300	0.16
Baraka	66,200	Eritrea	41,500	62.57
		Sudan	24,800	37.43
Benito/Ntem	45,100	Cameroon	18,900	41.87
		Equatorial Guinea	15,400	34.11
		Gabon	10,800	23.86
Bia	11,100	Ghana	6,400	57.58
		Ivory Coast	4,500	40.28
Buzi	27,700	Mozambique	24,500	88.35
		Zimbabwe	3,200	11.65
Cavally	30,600	Ivory Coast	16,600	54.12
		Liberia	12,700	41.66
		Guinea	1,300	4.22
Cestos	15,000	Liberia	12,800	84.99
		Ivory Coast	2,200	14.91
		Guinea	20	0.11
Chiloango	11,600	Congo, Democratic Republic of (Kinshasa)	7,500	64.60
		Angola	3,800	32.71
		Congo, Republic of the (Brazzaville)	300	2.69

Congo/Zaire (4, 5)	3,691,000	Congo, Democratic Republic of (Kinshasa)	2,302,800	62.39
		Central African Republic	400,800	10.86
		Angola	290,600	7.87
		Congo, Republic of the (Brazzaville)	248,100	6.72
		Zambia	176,000	4.77
		Tanzania, United Republic of	166,300	4.51
		Cameroon	85,200	2.31
		Burundi	14,400	0.39
		Rwanda	4,500	0.12
		Sudan	1,400	0.04
		Gabon	500	0.01
		Malawi	100	0.00
		Uganda	70	0.00
Corubal	24,000	Guinea	17,500	72.71
		Guinea-Bissau	6,500	27.02
Cross	52,800	Nigeria	40,300	76.34
		Cameroon	12,500	23.66
Cuvelai/Etosha	167,400	Namibia	114,100	68.15
		Angola	53,300	31.85
Daoura	34,500	Morocco	18,200	52.72
		Algeria	16,300	47.28
Dra	96,400	Morocco	75,800	78.65
		Algeria	20,600	21.33
Gambia	69,900	Senegal	50,700	72.48
		Guinea	13,200	18.92
		Gambia	5,900	8.51
Gash	40,000	Eritrea	21,400	53.39
		Sudan	9,600	24.09
		Ethiopia	9,000	22.52
Geba	12,800	Guinea-Bissau	8,700	67.69
		Senegal	4,100	31.88
		Guinea	50	0.42
Great Scarcies	12,100	Guinea	9,000	74.96

		Sierra Leone	3,000	25.04
Guir	78,900	Algeria	61,200	77.53
		Morocco	17,700	22.47
Incomati (6)	46,700	South Africa	29,200	62.47
		Mozambique	14,600	31.20
		Swaziland	3,000	6.33
Juba-Shibeli	803,500	Ethiopia	367,400	45.72
		Somalia	220,900	27.49
		Kenya	215,300	26.79
Komoe	78,100	Ivory Coast	58,300	74.67
		Burkina Faso	16,900	21.66
		Ghana	2,200	2.85
		Mali	600	0.82
Kunene	110,000	Angola	95,300	86.68
		Namibia	14,700	13.32
Lake Chad (7)	2,388,700	Chad	1,079,200	45.18
		Niger	674,200	28.23
		Central African Republic	218,600	9.15
		Nigeria	180,200	7.54
		Algeria	90,000	3.77
		Sudan	82,800	3.47
		Cameroon	46,800	1.96
		Chad, claimed by Libya	12,300	0.51
		Libya	4,600	0.19
Lake Natron	55,400	Tanzania, United Republic of	37,100	67.00
		Kenya	18,300	33.00
Lake Turkana (8)	206,900	Ethiopia	113,200	54.69
		Kenya	89,700	43.36
		Uganda	2,500	1.21
		Sudan	1,500	0.70
		Sudan, administered by Kenya	70	0.03

Limpopo	414,800	South Africa	183,500	44.25
		Mozambique	87,200	21.02
		Botswana	81,500	19.65
		Zimbabwe	62,600	15.08
Little Scarcies	18,900	Sierra Leone	13,000	69.12
		Guinea	5,800	30.88
Loffa	11,400	Liberia	10,100	88.56
		Guinea	1,300	11.38
Lotagipi Swamp (8)	38,700	Kenya	20,300	52.33
		Sudan	9,900	25.54
		Sudan, administered by Kenya	3,300	8.52
		Ethiopia	3,200	8.32
		Uganda	2,100	5.29
Mana-Morro	6,800	Liberia	5,700	82.84
		Sierra Leone	1,200	17.16
Maputo (6)	30,700	South Africa	18,500	60.31
		Swaziland	10,600	34.71
		Mozambique	1,500	4.98
Mbe	7,000	Gabon	6,500	92.97
		Equatorial Guinea	500	7.02
Medjerda	23,100	Tunisia	15,600	67.53
		Algeria	7,600	32.90
Moa	22,500	Sierra Leone	10,800	47.79
		Guinea	8,800	39.20
		Liberia	2,900	13.01
Mono	23,400	Togo	22,300	95.19
		Benin	1,100	4.81
Niger	2,113,200	Nigeria	561,900	26.59
		Mali	540,700	25.58
		Niger	497,900	23.56
		Algeria	161,300	7.63
		Guinea	95,900	4.54
		Cameroon	88,100	4.17
		Burkina Faso	82,900	3.93

		Benin	45,300	2.14
		Ivory Coast	22,900	1.08
		Chad	16,400	0.78
		Sierra Leone	50	0.00
Nile (9)	3,031,700	Sudan	1,927,300	63.57
		Ethiopia	356,000	11.74
		Egypt	272,600	8.99
		Uganda	238,500	7.87
		Tanzania, United Republic of	120,200	3.96
		Kenya	50,900	1.68
		Congo, Democratic Republic of (Kinshasa)	21,400	0.71
		Rwanda	20,700	0.68
		Burundi	12,900	0.43
		Egypt, administered by Sudan	4,400	0.15
		Eritrea	3,500	0.12
		Sudan, administered by Egypt	2,000	0.07
		Central African Republic	1,200	0.04
Nyanga	12,300	Gabon	11,500	93.56
		Congo, Republic of the (Brazzaville)	800	6.44
Ogooue	223,000	Gabon	189,500	84.98
		Congo, Republic of the (Brazzaville)	26,300	11.79
		Cameroon	5,200	2.34
		Equatorial Guinea	2,000	0.89
Okavango	706,900	Botswana	358,000	50.65
		Namibia	176,200	24.93
		Angola	150,100	21.23

		Zimbabwe	22,600	3.19
Orange (6, 10, 11)	945,500	South Africa	563,900	59.65
		Namibia	240,200	25.40
		Botswana	121,400	12.85
		Lesotho	19,900	2.10
Oued Bon Naima	500	Morocco	300	65.08
		Algeria	200	34.92
Oueme	59,500	Benin	49,400	82.98
		Nigeria	9,700	16.29
		Togo	400	0.73
Ruvuma (12)	151,700	Mozambique	99,000	65.27
		Tanzania, United Republic of	52,200	34.43
		Malawi	400	0.30
Sabi	115,700	Zimbabwe	85,400	73.85
		Mozambique	30,300	26.15
Sassandra	68,200	Ivory Coast	59,800	87.64
		Guinea	8,400	12.36
Senegal	436,000	Mauritania	219,100	50.25
		Mali	150,800	34.59
		Senegal	35,200	8.08
		Guinea	30,800	7.07
St. John (Africa)	15,600	Liberia	12,900	83.04
		Guinea	2,600	16.96
St. Paul	21,200	Liberia	11,800	55.75
		Guinea	9,400	44.25
Tafna	9,500	Algeria	7,000	74.39
		Morocco	2,400	25.60
Tano	15,600	Ghana	13,700	87.96
		Ivory Coast	1,700	11.21
Umba	8,200	Tanzania, United Republic of	6,800	83.58
		Kenya	1,300	16.41
Umbeluzi (6)	10,900	Mozambique	7,200	65.87

		Swaziland	3,500	32.44
		South Africa	30	0.27
Utamboni	7,700	Gabon	4,500	58.65
		Equatorial Guinea	3,100	40.40
Volta	412,800	Burkina Faso	173,500	42.04
		Ghana	166,000	40.21
		Togo	25,800	6.26
		Mali	18,800	4.56
		Benin	15,000	3.63
		Ivory Coast	13,500	3.27
Zambezi (13, 14)	1,385,300	Zambia	576,900	41.64
		Angola	254,600	18.38
		Zimbabwe	215,500	15.55
		Mozambique	163,500	11.81
		Malawi	110,400	7.97
		Tanzania, United Republic of	27,200	1.97
		Botswana	18,900	1.37
		Namibia	17,200	1.24
		Congo, Democratic Republic of (Kinshasa)	1,100	0.08

1 The numbers referring to basin areas have been rounded to significant digits and, as a result, the numbers for area within each basin do not necessarily add up to the total area for that basin. Also, the percentages were calculated based on raw data, and therefore do not reflect the rounding of the areas.

2 The dispute between Nigeria and Cameroon, over land and maritime boundaries in the vicinity of the oil rich Bakasi Peninsula, was referred to the International Court of Justice, which gave a ruling in 1998. Nigeria has filed an appeal on the ruling and the dispute has yet to be resolved. The Bakasi Peninsula, in the southwest province of Cameroon, is divided by the Akpa Yafi river and lies to the west of Cameroon's Rio del Ray. (CIA World Factbook, 1998; Columbia Gazetteer, 1998).

3 Morocco claims and administers Western Sahara, but the region's sovereignty is unresolved and the UN is attempting to hold a referendum on the issue. A UN-administered cease-fire remains in effect since September 1991. (Encyclopedia of International Boundaries, 1995; CIA World Factbook, 1998).

4 It has been informally reported that the indefinite segment of the Democratic Republic of the Congo (Kinshasa)-Zambia boundary has been settled. Therefore, the Democratic Republic of the Congo (Kinshasa)-Tanzania-Zambia tripoint in Lake Tanganyika also may no longer be indefinite. (CIA World Factbook, 1998).

5 A long segment of the boundary between the Democratic Republic of the Congo (Kinshasa) and the Republic of the Congo (Brazzaville) along the Congo River remains indefinite, as no division of the river or its islands has been made. (CIA World Factbook, 1998).

6 Swaziland has asked South Africa to open negotiations on reincorporating some nearby South African territories that are populated by ethnic Swazis or that were long ago part of the Swazi Kingdom. (CIA World Factbook, 1998).

7 Lake Chad varies in extent between rainy and dry seasons - from 50,000 to 20,000 km2. Demarcation of international boundaries in the vicinity of Lake Chad is complete and awaits ratification by Cameroon, Chad, Niger, and Nigeria. Determining the boundaries of sectors involving rivers draining into Lake Chad is complicated by flooding and the uncovering or covering of islands. The lack of demarcated boundaries has led to border incidents in the past. (Encyclopedia of International Boundaries, 1995; The CIA World Factbook, 1998).

8 The administrative boundary between Kenya and Sudan does not coincide with the international boundary. (CIA World Factbook, 1998).

9 Egypt's administrative boundary with Sudan does not coincide with the international boundary and creates the "Hala'ib Triangle," a barren area of 20,580 km2 north of the 22nd parallel. (CIA World Factbook, 1998).

10 Although topographically Botswana is riparian to the Orange River basin, it is unknown whether Botswana territory contributes water to the Orange River. Botswana's political status as riparian to the Orange River basin remains to be clarified among the basin states. (Conley and van Niekerk, 1998).

11 Namibia and South Africa are undergoing negotiations to confirm the exact positions of their boundary along the Orange River. (Conley and van Niekerk, 1998).

12 Malawi is in dispute with Tanzania over the boundary in Lake Nyasa (Lake Malawi). (CIA World Factbook, 1998).

13 The quadripoint between Botswana, Namibia, Zambia and Zimbabwe is in disagreement. (CIA World Factbook, 1998).

14 The dispute between Botswana and Namibia over the uninhabited Kasikili (Sidudu) Island in the Linyanti (Chobe) River is presently before the International Court of Justice. Botswana and Namibia are also contesting at least one other island in Linyanti River. (CIA World Factbook, 1998).

15 Two disputed sections of the boundary between China and Russia remain to be settled. China holds that the main channel of the Amur River is followed northeast to a point opposite the city of Khabarovsk. Russia claims that the line follows the Kazakevicheva channel southeastward to the Ussuri River. The two countries dispute control of islands in the Amur and Ussuri Rivers, despite a 1987 agreement that established the line as running through the median lines of the main navigable and unnavigable channels. The five disputed islands in the Amur – Popov, Savelyev, Evrasikha, Nizhne-Petrovskiy and Lugovskoy – amount to 3,000 km2 of territory. Also in dispute are the Tarbarov and Bolshoy Ussuriyskiy islands, located in a 30 km section of the boundary at the confluence of the Amur and Ussuri rivers, and the Bolshoy Island, located in the upper reaches of the Argun river. (Encyclopedia of International Boundaries, 1995; CIA World Factbook, 1998; IBRU, 1999).

16 Most of the boundary shared between China and Tajikistan is in dispute, including in the Pamir mountain region. (CIA World Factbook, 1998; IBRU, 1999).

17 Kyrgyzstan and Tajikistan have a territorial dispute regarding their boundary in the Isfara Valley area. (CIA World Factbook, 1998).

18 The boundaries of the Caspian Sea remain to be determined among Azerbaijan, Iran, Kazakhstan, Russia, and Turkmenistan. (CIA World Factbook, 1998).

19 Brunei may wish to purchase the Malaysian salient that divides the country. (CIA World Factbook, 1998).

20 Sections of the land boundary between China and Vietnam are indefinite. (CIA World Factbook, 1998).

21 India and China dispute approximately 83,000 km2, including three of the four political divisions of the Northeast Frontier Agency – the Sumdurong Cho sector. This region falls in the Ganges-Brahmaputra basin. (Conflict and Border Disputes, 1993; Columbia Gazetteer, 1998; IBRU 1999)

22 Portions of the boundary between Bangladesh and India are indefinite. Much of the boundary between the two countries is based on administrative units that do not shift with the rivers as they change course or level over time. Alluvial or "char" land that is exposed as a river shifts often leads to dispute, as the land is highly valued for agriculture. (CIA World Factbook, 1998; IBRU, 1999).

23 A 33-km section of the boundary between China and North Korea in the Paektu-san (mountain) area is indefinite. North Korea claims territorial rights to two thirds of Chonji, the crater lake on Mount Paektu. (CIA World Factbook, 1998; IBRU, 1999).

24 The Demarcation Line between North Korea and South Korea is in dispute. (CIA World Factbook, 1998).

25 Disputed boundaries between China and India include approximately 25,900 km2 in the regions of Sang, Demchok, and Aksai, China. (Encyclopedia of International Boundaries, 1995; Columbia Gazetteer, 1998).

26 India and Pakistan dispute the status of the Jammu and Kashmir region, an area of approximately 220,000 km2. (Encyclopedia of International Boundaries, 1995; CIA World Factbook, 1998).

27 The West Bank and Gaza Strip are Israeli-occupied with the exception of territories under control of the Palestinian Authority, as delineated in the 1995 "Israeli-Palestinian Interim Agreement on the West Bank and the Gaza Strip," commonly referred to as "Oslo II", and in the 1998 agreement signed at Wye. Permanent status is to be determined during further negotiation. (CIA World Factbook, 1998).

28 Israel and Syria dispute the Golan Heights, which is currently administered by Israel. (CIA World Factbook, 1998). 29 Topographically, Egypt is riparian to the Jordan River basin, however Egyptian territory does not contribute water to the basin, except for the possibility of intermittent, seasonal wadis.

30 Parts of the boundary between Cambodia and Thailand are indefinite, including overlapping claims in the Gulf of Thailand, an area potentially containing oil and gas deposits, and an island located near the boundary between Cambodian Koh Kong and the Thai province of Trat. (CIA World Factbook, 1998; IBRU, 1999).

31 Parts of the boundary between People's Democratic Republic of Laos and Thailand are indefinite. The two countries have an agreement to demarcate their boundary, but demarcation was suspended in February, 1998. (CIA World Factbook, 1998; IBRU, 1999).

32 Iran and Iraq restored diplomatic relations in 1990, but work continues on developing written agreements to settle outstanding disputes from their eight-year war, including boundary demarcation, prisoners-of-war, and freedom of navigation and sovereignty over the Shatt al Arab waterway. (CIA World Factbook, 1998).

33 Disputes are ongoing between Bosnia-Herzegovina and Serbia, over Serbian populated areas. According to the Serbian Republic of Bosnia-Herzegovina (SRBH), the external boundaries are marked by the Una river in the west, the Sava river in the north, the state boundary with the Federal Republic of Yugoslavia in the east, and Croatia and the Serbian Republic Krajina in the south. (CIA World Factbook, 1998; IBRU, 1999).

34 Eastern Slavonia, which was held by Serbs during the ethnic conflict in the former Yugoslavia, was returned to Croatian control by the UN Transitional Administration for Eastern Slavonia on January 15, 1998. (CIA World Factbook, 1998).

35 Under an International Court of Justice (ICJ) ruling, Hungary and Slovakia were to agree on the future of the Gabcikovo Dam complex by March 1998. The dispute, however, has yet to be resolved. Completion of the dam system would alter the boundaries between Hungary and Slovakia established under the 1920 Treaty of Trianon. (CIA World Factbook, 1998; IBRU, 1999).

36 The boundary commission formed by Serbia and Montenegro, and the Former Yugoslav Republic of Macedonia in April 1996 to resolve differences in delineation of their mutual boundary has made no progress so far. (CIA World Factbook, 1998).

37 Romania considers certain territories of Moldova and Ukraine-including Bessarabia (45,600 km2) and Northern Bukovina-as historically part of Romania. This territory was incorporated into the former Soviet Union following the Molotov-Ribbentrop Pact in 1940. (CIA World Factbook, 1998; Columbia Gazetteer, 1998).

38 Border problems between Byelarus and Lithuania in part lie in the fact that the new boundary is different from the old Soviet administrative division between the two republics. Areas of dispute include the land around the Adutiskis railway station and the Druskininkai resort claimed by Byelarus. Demarcation of the boundary between Byelarus and Lithuania is underway. (CIA World Factbook, 1998; IBRU 1999).

39 The 1997 boundary agreement Lithuania and Russia remains to be ratified. (CIA World Factbook, 1998).

40 The December 1996 technical boundary agreement reached between Estonian and Russian negotiators remains to be ratified. Estonia claimed over 2,000 km2 of territory in the Narva and Pechory regions of Russia-based on the boundary established under the 1920 Peace Treaty of Tartu. (CIA World Factbook, 1998).

41 Latvia claimed the Abrene/Pytalovo section of the border ceded by the Latvian Soviet Socialist Republic to Russia in 1944, based on the 1920 Treaty of Riga. A draft treaty delimiting the boundary between Latvia and Russia has not been signed. The Abrene/Pytalovo region is crossed by the Utroya River, a tributary of the Vclikaya river. (CIA World Factbook, 1998; Columbia Gazetteer, 1998).

42 While the Meuse basin is topographically part of the Rhine basin, European nations treat it as a politically separate basin. (Huisman, de Jong, and Wieriks, 1998).

43 The boundary between Belize and Guatemala is in dispute. Talks to resolve the dispute are ongoing. Changes in the boundary between Guatemala and Belize could impact the Hondo, Belize, Grijalva, and/or Sarstun basins. (Until 1991, Guatemala claimed all of Belize). (CIA World Factbook, 1998; Columbia Gazetteer, 1998; IBRU, 1999).

44 Three sections of the boundary between Ecuador and Peru have been in dispute. The areas cover over 324,000 km2 and include portions of the Amazon and Maranon rivers. The districts of Tumbes, Jaen, and Maynas are claimed by Ecuador and administered by Peru. In December 1998, Peru and Ecuador signed a joint agreement on the implementation of a permanent development policy for the border region. A joint commission was created to determine their common land boundary. (Encyclopedia of International Boundaries, 1995; CIA World Factbook, 1998; Columbia Gazetteer, 1998; BBC Summary of World Broadcasts, 12/3/98; Xinhua News Agency, 12/11/1998).

45 The boundary upstream from the confluence of the Courantyne/Koetari (Kutari) River with the New (Upper Courantyne) River remains unsettled. Guyana administers the triangle formed by the two rivers, while Brazil and Suriname continue to claim the area. Suriname also claims the west bank of the Courantyne River below the New River as the boundary, but de facto the boundary continues to follow the thalweg. (Encyclopedia of International Boundaries, 1995; CIA World Factbook, 1998).

46 Talks are ongoing between Guyana and Venezuela regarding their boundary dispute. Venezuela claims all of the area west of the Essequibo River. (CIA World Factbook, 1998; IBRU, 1999).

47 A short section of the boundary between Brazil and Paraguay, just west of Salto das Sete Quedas (Guaira Falls) on the Rio Parana, has yet to be precisely delimited. (CIA World Factbook, 1998).

48 Two short sections of the boundary between Brazil and Uruguay are in dispute - the Arroio Invernada (Arroyo de la Invernada) area of the Rio Quarai (Rio Cuareim) and the islands at the confluence of the Rio Quarai and the Uruguay River. (CIA World Factbook, 1998).

49 A short section of the southeastern boundary of Chile with Argentina, in the area of the Beagle Channel, remains unclear. The 1991 Aylwin-Menem Treaty delineates the boundary between Argentina and Chile in the continental glaciers area. As of March 1999, the treaty has not been ratified by the Congresses of either country. (CIA World Factbook, 1998; IBRU, 1999).

50 Suriname and French Guiana are in dispute over which of the upper tributaries of the Maroni River was originally intended to carry the boundaries down to the Brazilian boundary. The disputed area is administered by France as a region of the overseas department of French Guiana and claimed by Suriname. The area lies between the Riviere Litani and the Riviere Marouini, both headwaters of the Lawa. (Encyclopedia of International Boundaries, 1995; CIA World Factbook, 1998).

51 Bolivia has desired a sovereign corridor to the South Pacific Ocean, since the Atacama desert area was lost to Chile in 1884. The creation of such a corridor could impact territory in the Zapaleri basin or create a new international basin. (CIA World Factbook, 1998; IBRU, 1999).

Percentage of area within international basins

Continent	1999 Update	1978 Register
Africa	62%	60%

Number of International Basins

Continent	1999 Update	1978 Register
Africa	60	57

1 - The Nile Basin

The Nile River, with an estimated length of over 6800 km, is the longest river flowing from south to north over 35 degrees of latitude. It is fed by two main river systems: the White Nile, with its sources on the Equatorial Lake Plateau (Burundi, Rwanda, Tanzania, Kenya, Zaire and Uganda), and the Blue Nile, with its sources in the Ethiopian highlands. The sources are located in humid regions, with an average rainfall of over 1000 mm per year. The arid region starts in Sudan, the largest country of Africa, which can be divided into three rainfall zones: the extreme south of the country where rainfall ranges from 1200 to 1500 mm per year; the fertile clay-plains where 400 to 800 mm of rain falls annually; and the desert northern third of the country where rainfall averages only 20 mm per year. Further north, in Egypt, precipitation falls to less than 20 mm per year.

The total area of the Nile basin represents 10.3% of the area of the continent and spreads over ten countries (Map 4 and Table 20).

For some countries, like Zaire, the Nile basin forms only a very small part of their territory. Other countries, like Burundi, Rwanda, Uganda, Sudan and Egypt, are almost completely integrated into the Nile basin.' However, all the waters in Burundi and Rwanda and more than half the waters in Uganda are produced internally, while most of the water resources of Sudan and Egypt originate outside their borders: 77% of Sudan's and more than 97% of Egypt's water resources as shown in Table 6. Moreover, these latter two countries already use nearly all of the water currently allocated to them, as shown below.

Table 20: Nile basin: areas and rainfall by country

Country	Total area of the country	Area of the country within the basin	As % of total area of basin	As % of total area of country	Average annual rainfall in the basin area (mm)		
	(km^2)	(km^2)	(%)	(%)	min.	max.	mean
Burundi	27 834	13 260	0.4	47.6	895	1 570	1 110
Rwanda	26 340	19 876	0.6	75.5	840	1 935	1 105
Tanzania	945 090	84 200	2.7	8.9	625	1 630	1 015
Kenya	580 370	46 229	1.5	8.0	505	1 790	1 260
Zaire	2 344 860	22 143	0.7	0.9	875	1 915	1 245
Uganda	235 880	231 366	7.4	98.1	395	2 060	1 140
Ethiopia	1 100 010	365 117	11.7	33.2	205	2 010	1 125
Eritrea	121 890	24 921	0.8	20.4	240	665	520
Sudan	2 505 810	1 978 506	63.6	79.0	0	1 610	500
Egypt	1 001 450	326 751	10.5	32.6	0	120	15
For Nile basin		3 112 369	100.0		0	2 060	615

Rivers and discharges

The most distant source from the sea is the Luvinzora River in Burundi, a tributary of the Kagera River. The Kagera River forms the border between Rwanda and Tanzania, then between Uganda and Tanzania and then flows into Lake Victora, the second-largest freshwater lake in the world with an area of about 67000 km^2. Total flow into the lake is about 20 km^3/year, of which 7.5 km^3 from the Kagera River, 8.4 km^3/year from the forest slopes in the north-east (Kenya), 3.2 km^3/year from the drier Serengeti Plains in the south-east (Tanzania) and from 1 to 2 km^3/year from the swamps in the north-west (Uganda).

The level of Lake Victoria is extremely sensitive to moderate changes in rainfall over the lake and its tributaries. Average lake rainfall and evaporation are the main factors affecting the lake balance and are more or less equal. As evaporation varies little from year to year, high rainfall gives rise to a disproportionate surplus and also greatly increases the tributary flows which are themselves relatively more variable than the rainfall. The rise in lake level during 1961-64 of about 2 metres seems to be the result of a higher rainfall during that period over the lake and its basin. This surplus then influences the outflow which declines only gradually over a longer period of years [41].

The only outlet of Lake Victoria is at Ripon Falls (Owen Falls Dam) in Uganda. Then begins the Victoria Nile which flows through Lake Kyoga into Lake Albert, also called Lake Mobutu Sesse Seko. This lake also receives water from the Semliki River, which originates in the Mufumbiru mountains in Zaire and flows through Lake Edward to Lake Albert. The combined waters of the Semliki and the Victoria Nile leave Lake Albert at the northern end and become the Albert Nile, which then flows into Sudan.

Uganda is a humid country with numerous lakes and wetlands and with internal renewable water resources globally estimated at 39 km^3/year. However, the total annual flow into the country (at Ripon Falls and from Zaire) is about equal to the total annual outflow to Sudan, which means that a lot of water disappears within the country through evaporation and evapotranspiration from the lakes and wetland.

Entering Sudan, the Albert Nile becomes the Bahr el Jebel. It flows into the Sudd region, the great wetlands which are a maze of channels, lakes and swamps in southern Sudan, and which also receive water from the Bahr el Gazal River, originating in south-west Sudan.

The most remarkable topographic feature of the Sudd area is its flatness: for 400 km, from south to north, the slope is a mere 0.01 % and much of it is even flatter. The soils of the whole area are generally clayish and poor in nutrients. Rain falls in a single season, lasting from April to November and varying in the Sudd area from about 900 mm in the south to 800 mm in the north. As the rainy season coincides with, though is slightly shorter than, the flood seasons of the rivers, there is land of water and mud for half of the year and, away from the rivers, land of desert-like dryness for the other half. The main natural channels flow through a swamp area waterlogged throughout the year, and are then flanked by grasslands flooded at high river and exposed when the river level drops. Because of the important rainfall in the Equatorial Lake Plateau during the 1960s and 1970s the permanent swamp area increased from 2700 km^2 in 1952 to 16200 km in 1980 [42].

Less than half of the water entering the Sudd region flows out of it into the White Nile. The rest disappears through evaporation and evapotranspiration. The quantity entering the Sudd region varies greatly over the years, mainly depending on the rainfall in the upper catchment area, and hydrological measurements have shown that the greater the flow of water into the Sudd, the greater the percentage of water 'lost' in evaporation (Table 21 [42]).

Table 21: Average annual discharges at different locations in the Sudd region

Period	Discharge at Mongalla (km/year)	Discharge at tail of swamps (km^3/year)	Quantity disappeared (km^3/year)	% disappeared
1905-1960	26.8	14.2	12.6	47.0
1961-1980	50.3	21.4	28.9	57.5
1905-1980	33.0	16.1	16.9	51.2

In order to bypass the Sudd region and to direct downstream a proportion of the water considered lost each year by spill from the river and evaporation in the swamps, the construction of the Jonglei Canal

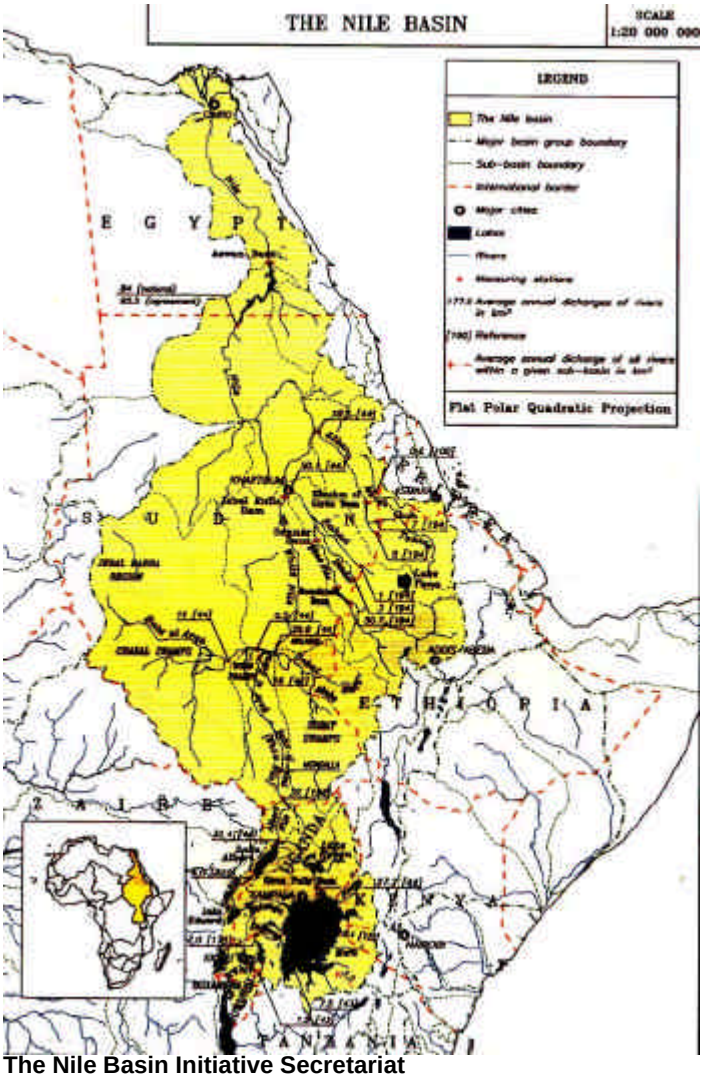
had been planned. This water could then have become available for irrigation and other uses downstream in Sudan and Egypt. Construction of the canal began in 1978 for a planned total length of 360 km, but work stopped in November 1983 after 240 km because of the civil war. By that time it had also become clear that these 'losses' create resources in pasture and fisheries and that the canal causes enormous human and environmental problems in the area. The issue is now how much water can be drained from the Sudd through the construction of the Jonglei Canal without serious and irreparable damage to the local environment and economy and its potential expansion [195].
The Sobat River, that flows into the White Nile just upstream of Malakal, is fed by the Baro and Akobo Rivers and others with catchment areas situated mainly in the southern Ethiopian foothills.
The Blue Nile and its main tributaries, the Dinder and the Rahad, rise in the Ethiopian mountains and around Lake Tana. The confluence of the White Nile and the Blue Nile is at Khartoum. Further downstream is the Atbara tributary, the last important tributary of the Nile system, again deriving from the Ethiopian plateau north-east of Lake Tana and forming the border between Ethiopia and Eritrea before entering Sudan. There are no important tributaries further downstream in Egypt.
The contribution of the rivers of the Ethiopian catchment area (Blue Nile system) to the Nile is about twice the contribution of the rivers of the Equatorial Lake Plateau catchment area (White Nile system), but it is characterized by the extreme range in discharges between the peak and low periods, while the flow from the Equatorial Lake Plateau is more uniform. At its peak the former provides nearly 90% of all water reaching Egypt, the latter only 5%. During the months with low flow the contributions are nearer 30% and 70% respectively [29].

As already mentioned, variations in rainfall over the years can cause quite considerable variations in discharges and lake levels. This seems to be more explicitly the case for the White Nile River system. For this reason, average discharge figures might vary greatly depending on the period under consideration, as shown in Table 22 [29, 210, 44].

Table 22: Variations in discharges at different locations on the Nile

Location	Average annual discharges in km^3		
	period 1961-1970	period 1948-1970	period 1912-1982
Lake Victoria exit	41.6	29.4	27.2
Lake Kyoga exit	44.1	30.1	26.4
Lake Albert exit	48.8	33.7	31.4
Mongalla (White Nile)	52.6	36.8	33.1
Malakal (White Nile)	37.8	31.6	29.6
Khartoum (Blue Nile)	45.9	49.8	50.1
Mouth of the Atbara	10.9	12.1	10.6
Dongola (Nile)	86.2	86.2	82.7

In addition to variations due to rainfall, the discharges might vary also due to water abstractions, mainly for irrigation purposes



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2 - The Lake Chad basin

The Lake Chad basin, located in Northern Central Africa, covers almost 8% of the continent and spreads over **seven countries** (Map 3 and Table 16).

Table 16: Lake Chad basin: areas and rainfall by country

Country	Total area of the country (km^2)	Area of the country within the basin (km^2)	As % of total area of basin (%)	As % of total area of country (%)	Average annual rainfall in the basin area		
						(mm)	
					min.	max.	mean
Nigeria	923770	179282	7.5	19.4	285	1330	670
Niger	1267000	691473	29.0	54.6	0	635	105

Algeria	2381740	93451	3.9	3.9	0	135	20
Sudan	2505810	101048	4.2	4.0	70	1155	585
Central Africa	622980	219410	9.2	35.2	760	1535	1215
Chad	1284000	1046196	43.9	81.5	0	1350	400
Cameroon	475440	50775	2.1	10.7	365	1590	1010
For Lake Chad basin		2381635	100.0		0	1590	415

About 20% of the total area of the Lake Chad basin, or 427500 km^2, is called the Conventional Basin (42% in Chad, 28% in Niger, 21% in Nigeria and 9% in Cameroon), which is under the mandate of the Lake Chad Basin Commission. This commission was created in 1964 by the four member states with the objective of ensuring the most rational use of water, land and other natural resources and to coordinate regional development.

Rivers and discharges

Lake Chad is a terminal depression with the seven basin countries grouped around it, of which four are in direct contact with the lake: Nigeria, Niger, Chad and Cameroon.

In Nigeria, two sub-basins drain into the lake:

- the Yedseram/Ngadda sub-basin to the south;
- the Hadejia/Jama'are-Komadougou/Yobe sub-basin to the north.

The Yedseram River and its tributaries rise in the Mandara hills and it 'loses' most of its water while flowing northwards through a 7-km-wide flood plain. Further downstream, together with the Ngadda River it forms an 80-km^2 swamp and does not maintain a definable water course to the lake.

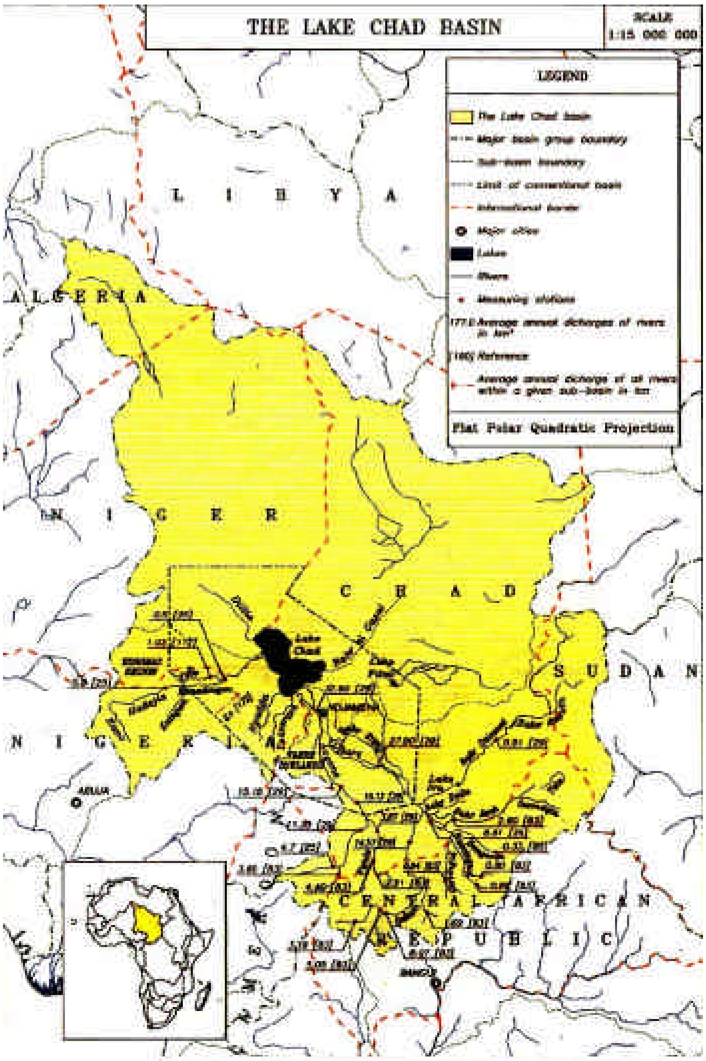
The Komadougou/Yobe River is the border between Nigeria and Niger over the last 300 km. Upstream of the confluence of the Hadejia and Jama'are rivers the Hadejia-Nguru wetlands (fadamas) start. These cover a total area of about 6000 km^2 and a water surface area of about 2000 km^2, but dam construction and increasing water abstraction for irrigation purposes upstream since the 1980s contribute to the fact that large areas of the floodplains are becoming increasingly drier [172]. All rivers crossing this area lose flow as a result of evaporation and evapotranspiration and infiltration to recharge the groundwater. The inflow varies between 1 and 1.8 km /year, the outflow between 0.6 and 0.7 km /year. When the inflow is more than 2 km^3/year, the outflow gradually increases to 1.2 km^3/year. Upstream the peak flow is at the end of August and rises and falls rapidly reflecting the sporadic nature of heavy rainfalls and the largely impermeable strata. Downstream the peak flow is in January. The flow into Lake Chad is about 0.5 km^3/year. In Niger, in addition to the border Komadougou/Yobe River, there are the Koramas in the south of the country close to the border with Nigeria. These are seasonal rivers and their flow does not reach Lake Chad.

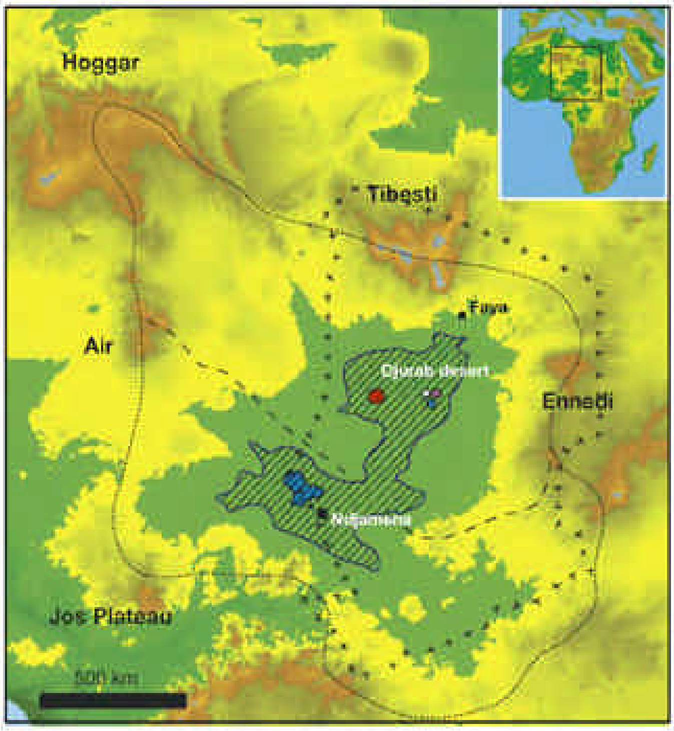
In the north, far away from Lake Chad, is Algeria. The country possesses few renewable water resources. To the east is Sudan with Wadi Kaya and Wadi Azum, both seasonal wadis with spate flows that originate on the western slopes of the Jebel Marra. Their alluvial aquifers could deliver about 0.08 km /year of water of excellent quality [30].

To the south is the Central African Republic, a humid country with enormous water resources. The sources of the Chari-Logone Rivers are located in the Central African Republic and the quantity of water leaving the country to Chad was about 33 km^3/year in the period before the 1970s, but fell to 17 km^3/year during the 1980s [29].

The amount of water crossing the border from Cameroon to Chad varies between 3 and 7 km/year. More to the north, the Logone River forms the border between Cameroon and Chad until N'Djamena where it flows together with the Chari River which then continues north to the lake. These rivers have a tropical regime with a single flood occurring at the end of the rainy season, which lasts from August to November. They are characterized by irregular inter-annual flows and by their large water 'losses', estimated at about 5 km^3/year, due to flooding of the adjacent Yaéré lowlands in Chad and Cameroon. The largest area flooded covers about 8000 km^2 and is used for pasture, fishing, flooded rice production and flood recession cropping. In order to expand the Yaéré area, two sites for regulatory dams have been identified on upstream branches of the Logone in Cameroon and Chad.

However, this would be to the detriment of water uses for hydro-electric power generation and for irrigation outside these Yaéré lowlands [86].
The rivers outside the Chari-Logone basin in Chad have flash floods during heavy rains and negligible flows the rest of the time, like the Batha River. This regime seriously limits irrigation development.
The Chari-Logone rivers, with 38.5 km^3/year, contribute for about 95% of the total inflow into Lake Chad. In recent history the area of Lake Chad has varied between 3000 and 25000 km^2, with a variation in its level of over 8 metres and a variation in volume of between 20 and 100 km^3. The total inflow in recent times has varied between 7 km^3/year (1984/85) and 54 km^3/year (1955/56) [40]. Due to the lowering of the lake level, ideas have been put forward to replenish the lake with water from the Congo/Zaire basin through the construction of a 2400 km-long canal, but for the time being this is impractical on technical, economic and political grounds [86].





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3 - The Niger River basin

The Niger River basin, located in western Africa, covers 7.5% of the continent and spreads over **ten countries** (Map 2 and Table 12).

Table 12: Niger River basin: areas and rainfall by country

Country	Total area of the country (km^2)	Area of the country within the basin (km^2)	As % of total area of basin (%)	As % of total area of country (%)	Average annual rainfall in the basin area		
						(mm)	
					min.	max.	mean
Guinea	245857	96880	4.3	39.4	1240	2180	1635
Côte d'Ivoire	322462	23770	1.0	7.4	1316	1615	1466
Mali	1240190	578850	25.5	46.7	45	1500	440
Burkina Faso	274000	76621	3.4	28.0	370	1280	655
Algeria	2381740	193449	8.5	8.1	0	140	20
Benin	112620	46384	2.0	41.2	735	1255	1055
Niger	1267000	564211	24.8	44.5	0	880	280
Chad	284000	20339	0.9	1.6	865	1195	975
Cameroon	440	89249	3.9	18.8	830	2365	1330
Nigeria	770	584193	25.7	63.2	535	2845	1185
For Niger basin		2273946	100.0		0	2845	690

Algeria and Chad together cover about 9% of the total Niger River basin, but there are almost no renewable water resources in these areas.

The area of the Niger River basin in Guinea is only 4% of the total area of the basin, but the sources of the Niger River are located in this country. The quantity of water entering Mali from Guinea (40 km^3/yr) is greater than the quantity of water entering Nigeria from Niger (36 km^3/yr), about 1800 hen further downstream. This is due among other reasons to the enormous reduction in runoff in the inner delta in Mali through seepage and evaporation combined with almost no runoff from the whole of the left bank in Mali and Niger.

The most important areas of the Niger basin are located in Mali, Niger and Nigeria (25 % in each of these three countries). Mali and Niger are almost entirely dependent on the Niger River for their water resources. In the case of Niger nearly 90% of its total water resources originates outside its borders (the Niger River and other tributaries from Burkina Faso and Benin).

Rivers and discharges

The Niger River, with a total length of about 4100 km, is the third-longest river in Africa, after the Nile and the Congo/Zaire Rivers, and the longest and largest river in West Africa.

The upper Niger River system

The source of the Niger River farthest away from the mouth is in the mountains of Guinea near the border with Sierra Leone. Together with several tributaries it traverses the interior plateau of Guinea flowing north-east towards the border with Mali. Just after the border it is joined by another tributary which also originates in Guinea. The total annual flow entering Mali from Guinea is estimated at 40 km^3.

The river then proceeds north-east towards the inner delta in Mali, where it is joined at Mopti by an important tributary, the Bani River, which is about 1100 km long and has its sources in Côte d'Ivoire and Burkina Faso.

The inner delta

The total area covered by the inner delta, which is a network of tributaries, channels, swamps and lakes, can reach about 30000 km^2 in flood season. The delta area is swampy and the soil sandy. Consequently, the river 'loses' nearly two-thirds of its potential flow between Ségou (at 900 km from its source) and Timbuktu (at 1500 km) due to seepage and evaporation, the latter being aggravated by the fact that the river here touches the southern flanks of the Sahara desert. All the water from the Bani tributary, which flows into the Niger River at Mopti (at 1150 km), does not compensate for the 'losses' in the inner delta, as the total flow further downstream still decreases rather than increases (Figure 13). The average 'loss' is estimated at 31 km^3/year, but varies considerably according to the years: it was 46 km^3 during the wet year of 1969 and about 17 km^3 during the dry year of 1973 [29].

The middle Niger River system

From the inner delta the river continues to flow north-eastwards before turning south-east to form a great bend, the Niger Loop. After meandering through arid areas it enters Niger. In the Niger Loop another 4 hen /year of water disappear between Dire and Ansongo. Like in the inner delta, these losses are mainly caused by evaporation, but they are much less because of the smaller area inundated during and after the floods. 'Losses' by infiltration are limited.

Within Niger the river receives water from six tributaries originating in Burkina Faso (Gouroual, Dargol, Sirba, Gouroubi, Diamangou, Tapoa). The total annual discharge leaving Burkina Faso is estimated at about 1.4 km^3.

Further downstream the river becomes the border between Niger and Benin, from where three main tributaries enter the river (Mekrou, Alibori, Sota) with a total annual discharge of about 3 km^3.

At Gaya in Niger or Malanville in Benin, just upstream of the border with Nigeria, the average annual discharge has been estimated at about 36 km^3 [35], but only about 18 km was measured in 1986 [29].

The lower Niger River system

Leaving the border between Niger and Benin the river enters Nigeria, where it is joined by numerous tributaries. The most important tributary of the Niger is the Benue which merges with the river at Lokoja in Nigeria. The Benue itself rises in Chad although there are almost no surface water resources in its uppermost part. In Cameroon it receives water from several tributaries. The slope in Cameroon is considerable and the discharge there has important seasonal variations. The quantity of water entering Nigeria was estimated at 25 km^3/year before the 1980s [25] and at 13.5 km^3/year during the 1980s [172]. In Nigeria itself the Benue is joined by several tributaries, of which the ones at the left side originate mainly in Cameroon. The Benue reaches its flood level in September. It begins to fall in October and falls rapidly in November, continuing slowly over the next three months to reach its lowest level in March and April.

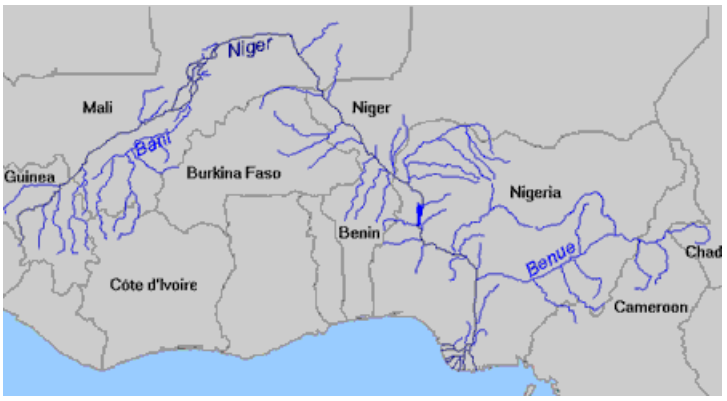
From the confluence with the Benue, the Niger heads southwards and empties in the Gulf of Guinea through a network of outlets that constitute its maritime delta.

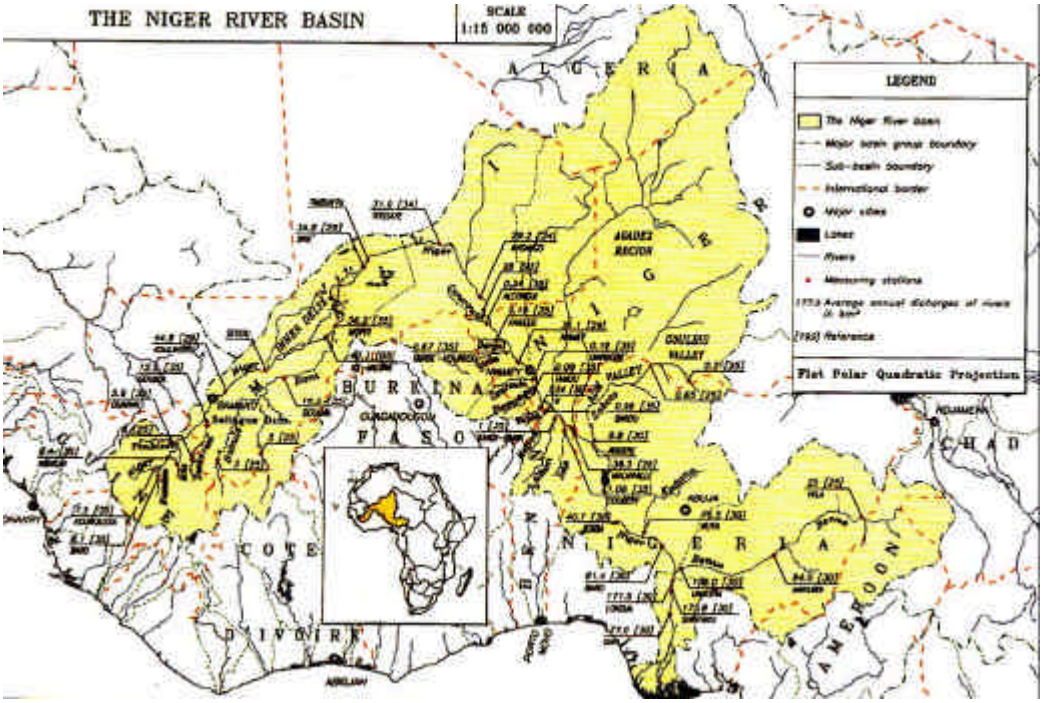
Table 13 shows the difference between the long term annual flows in Nigeria before the 1980s [30] and the annual flows during the 1980s [172], which was a much drier period.

Table 13: Average annual discharges of the Niger River and its main tributaries in Nigeria over different periods

River	Measuring station	Average flow before 1980 (km^3/year)	Average flow in the 1980s (km^3/year)	Difference (%)
Kaduna	Wuya	16.5	14.8	-10
Benue	Yola	25.0	13.5	-46
Benue	Makurdi	94.0	74.9	-20
Benue	Umaisha	108.0	76.7	-29
Niger	Jebba	40.7	24.3	-40
Niger	Baro	61.4	43.3	-29
Niger	Lokoja	171.5	137.9	-20
Niger	Shintaku	173.8	139.0	-20

Niger	Idah	177.0	147.3	-17





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4 - The Senegal River basin

The Senegal River basin, located in West Africa, covers 1.6% of the continent and spreads over **four countries** (Map 1 and Table 10).

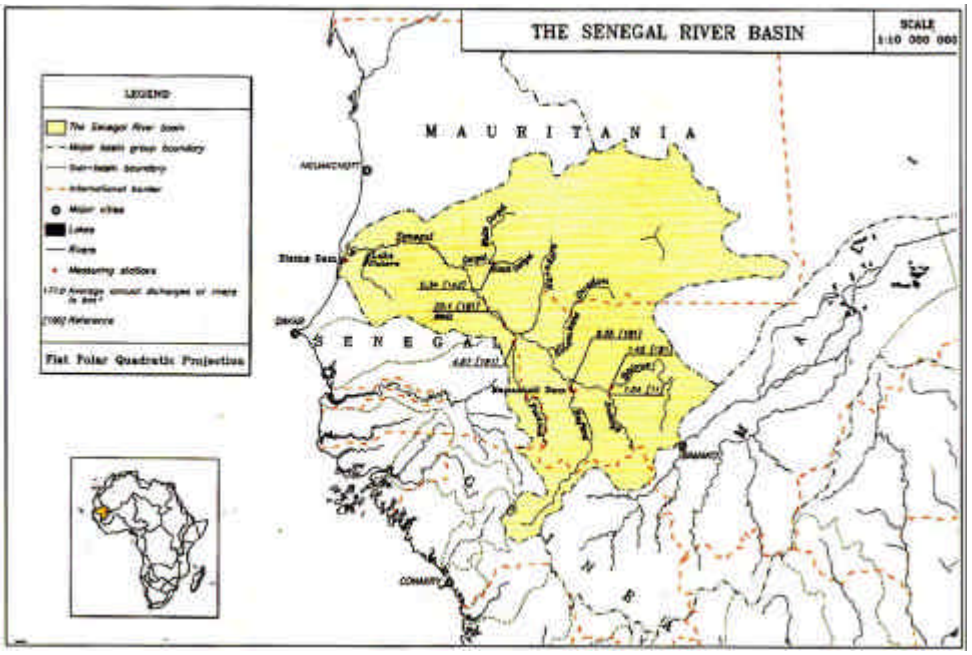
TABLE 10: Senegal River basin: areas and rainfall by country

Country	Total area of the country (km^2)	Area of the country within the basin (km^2)	As % Of total area of basin (%)	As % of total area of country (%)	Average annual rainfall in the basin area (mm)		
					min.	max.	mean
Guinea	245857	29475	6.1	12.0	1120	2100	1475
Mali	1240190	139098	28.8	11.2	455	1410	855
Maurita	1025520	242742	50.2	23.7	55	600	270

nia							
Senegal	196720	71866_	14.9	36.5	270	1340	520
For Senegal basin		483181	100.0		55	2100	550

Rivers and discharges

The sources of the Senegal River are located in Guinea and in the wetter south-western part of Mali. Total annual discharge leaving Guinea is estimated at about 8 km^3, but during the dry season the rivers frequently run dry. The Falémé River forms the border between Senegal and Mali over most of its distance. By the time they reach the border point between Mali, Mauritania and Senegal, the different tributaries have become one river, the Senegal River, which then continues to form the border between Senegal and Mauritania. The Karakoro River, flowing into the Senegal River at more or less the same point, originates in Mauritania. The annual discharge of the Senegal River at Bakel is 20 km . The Gorgol River, originating in Mauritania, joins it about 200 km downstream. Further downstream there are no other important tributaries.



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5 - The Rift Valley

The Rift Valley, located in Eastern Africa, covers just over 2% of the continent and spreads over **seven countries** (Map 5 and Table 29).

Table 29: The Rift Valley: areas and rainfall by country

Country	Total area of the country	Area of the country within the basin	As % of total area of basin	As % of total area of country	Average annual rainfall in the basin area
					(mm)

	(km^2)	(km^2)	(%)	(%)	min.	max.	mean
Djibouti	23 200	12 800	2.0	55.2	110	345	155
Eritrea	121 890	8 605	1.3	7.1	95	545	230
Ethiopia	1 100 010	310 981	48.8	28.3	90	1 990	725
Sudan	2 505 810	16 441	2.6	0.7	360	1 320	515
Uganda	235 880	4 514	0.7	1.9	385	1 540	710
Kenya	580 370	130 452	20.5	22.5	155	1 545	480
Tanzania	945 090	153 800	24.1	16.3	370	2 210	690
For Rift Valley		637 593	100.0		90	2 210	650

The Rift Valley consists of a group of independent interior basins, extending from Djibouti in the north to Tanzania in the south, nearly half being located in Ethiopia.

Rivers and discharges

The **Danakil basin** is a very dry basin and only rainfall of more than 10 mm results in rapid floods lasting not more than a few hours. Annual runoff is less than 1 km^3.

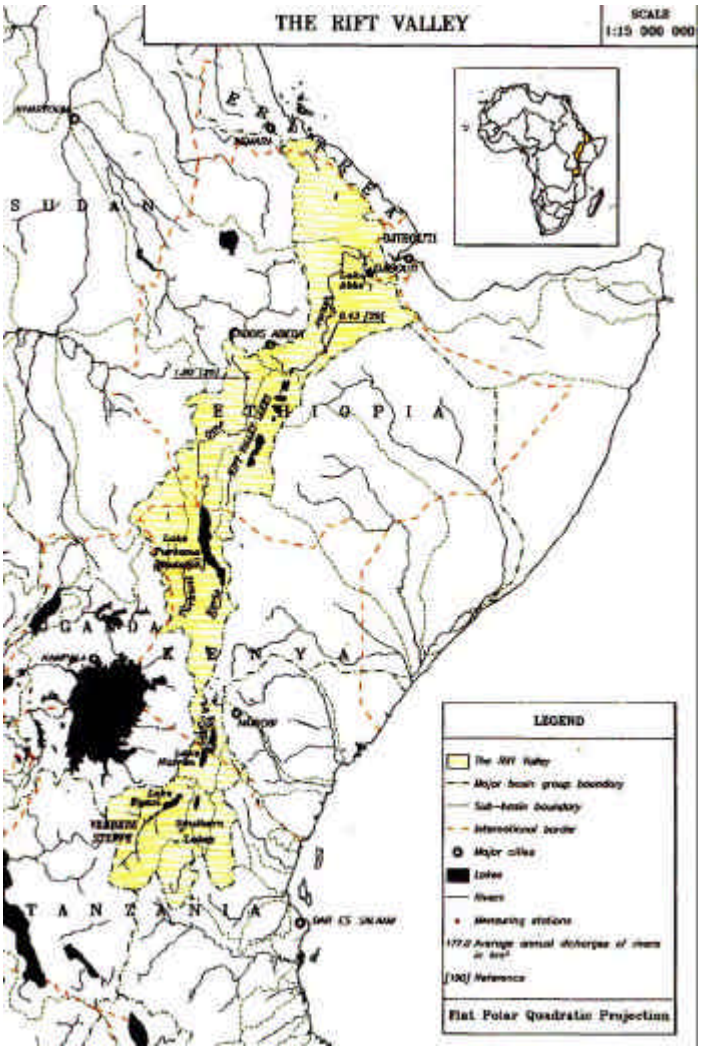
Lake Abbé, a salt lake on the border between Djibouti and Ethiopia, is in the **Awash basin**. The main part of the Awash basin is in Ethiopia, with annual rainfall ranging from 200 mm in the north to over 1900 mm in the south. The annual runoff in this basin is estimated at 4.6 km^3 [108].

Table 30: The different basins within the Rift Valley

Name of basin	Total area of basin	Area in the country
	(km^2)	(km^2)
Danakil:	92 741	
Djibouti		11 800
Eritrea		8 605
Ethiopia		72 336
Awash:	112 030	
Djibouti		1 000
Ethiopia		111 030
Central lakes:	54 070	
Ethiopia		51 070
Kenya		3 000
Omo-Gibe:	199 952	
Ethiopia		76 545
Sudan		16 441
Uganda		4 514

Kenya		102 452
Southern lakes:	178 800	
Kenya		25 000
Tanzania		153 800
Total	637 593	637 593

The **Central lakes basin**, which groups several lakes, is also mainly located in Ethiopia, with a small part continuing into Kenya. Total annual runoff is estimated at 5.64 km^3 [108].
The **Omo-Gibe basin**, with rivers flowing into Lake Turkana (also called Lake Rudolph) is mainly located in Ethiopia and Kenya, with small parts in Sudan and Uganda. From Ethiopia the Omo and Gibe Rivers flow into the lake, while from Kenya the Turkwel and Kerio Rivers flow into the lake. Annual runoff in this basin is estimated at 16.1 km^3 [108].
In the southern part of Kenya and the northern part of Tanzania the **Southern Lakes** basins are grouped, of which Lake Natron and Lake Eyasi are the most important ones.



6 - The Shebelli - Juba basin

This basin occupies about one-third of **Ethiopia**, one-third of **Kenya** and one-third of **Somalia** and covers about 2.7 % of the continent (Map 6 and Table 33).
Table 33: Shebelli - Juba basin: areas and rainfall by country

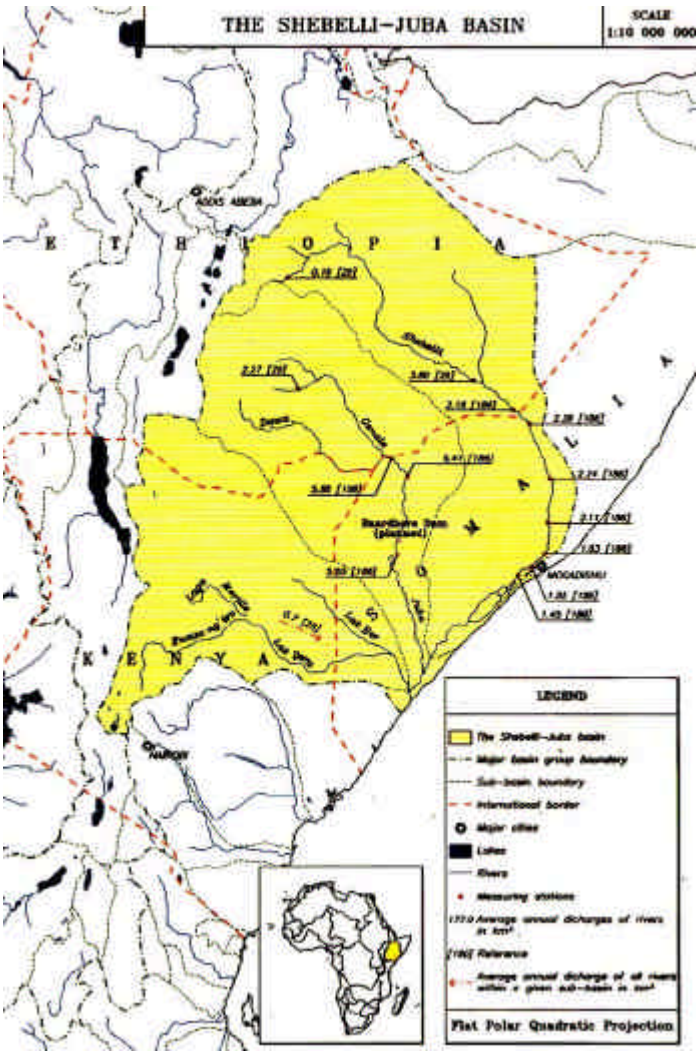
Country	Total area of the country (km^2)	Area of the country within the basin (km^2)	As % of total area of basin (%)	As % of total area of country (%)	Average annual rainfall in the basin area(mm)		
					min.	max.	mean
Ethiopia	1100010	373739	46.1	34.0	220	1470	490
Kenya	580370	210226	25.9	36.2	205	1795	395
Somalia	637660	226462	27.9	35.5	250	585	375
For She-Jub basin		810427	100.0		205	1795	435

Rivers and discharges

The Shebelli and Juba Rivers originate in Ethiopia and flow together just before the mouth in Somalia. Over 90% of the discharge of the Shebelli River originates from runoff in the Ethiopian highlands and there are large inter-annual variations in discharge. The surface water resources in Ethiopia are estimated at 3.2 km^3/year. Within Somalia the discharge decreases rapidly as it flows to its confluence with the Juba River, as a result of losses by seepage, evaporation and overbank spillage due to a low channel capacity [186]. Often the river ceases to flow in the lower reaches during the early part of the year.

The water resources of the Juba River in Ethiopia are estimated at 5.9 km^3/year. The river crosses Somalia for a distance of 875 km and is one of the important rivers of east Africa. Within Somalia its discharge decreases significantly for the same reasons as the Shebelli River. This river can also cease to flow in the early part of the year. While the basin area of the Juba River at the border with Ethiopia is smaller than that of the Shebelli River, its discharge is almost three times as much due to geological conditions.

The part of the basin in Kenya collects drainage from the northern side of Mount Kenya and the Aberdares, and from smaller mountains or uplands in the north and north-east. Except for the Ewaso Ng'iro River itself, streams flow only in direct response to rainfall. The water reaches the border with Somalia only in very wet years.



7 - The Congo/Zaire River basin

This basin is the largest river basin of Africa, covering over 12% of the continent. It extends over **nine countries** and the largest area is in Zaire (Map 7 and Table 35). It is one of the most humid basins of Africa.

Rivers and discharges

Its sources farthest away from the mouth are located in Zambia, one draining to Lake Tanganyika, estimated at 2 km^3/year, and one to Lake Mweru, where the flow at the outlet is estimated at over 41 km^3/year. No information is available about the sources originating in Tanzania and flowing into Lake Tanganyika. The flows in Burundi drain mainly into Lake

Table 35: The Congo/Zaire River basin: areas and rainfall by country

Country	Total area of the country (km²)	Area of the country within the basis (km²)	As % of total area of the basin (%)	As % of total area of the country (%)	Average annual rainfall in the basin area (mm)		
					min.	max.	mean
Zambia	752610	177735	4.7	23.6	985	1420	1195
Tanzania	945090	244593	6.5	25.9	720	1385	970
Burundi	27834	14574	0.4	52.4	920	1565	1155
Rwanda	26340	6464	0.2	24.5	1135	1580	1365
Central	622980	403570	10.7	64.8	1065	1680	1465

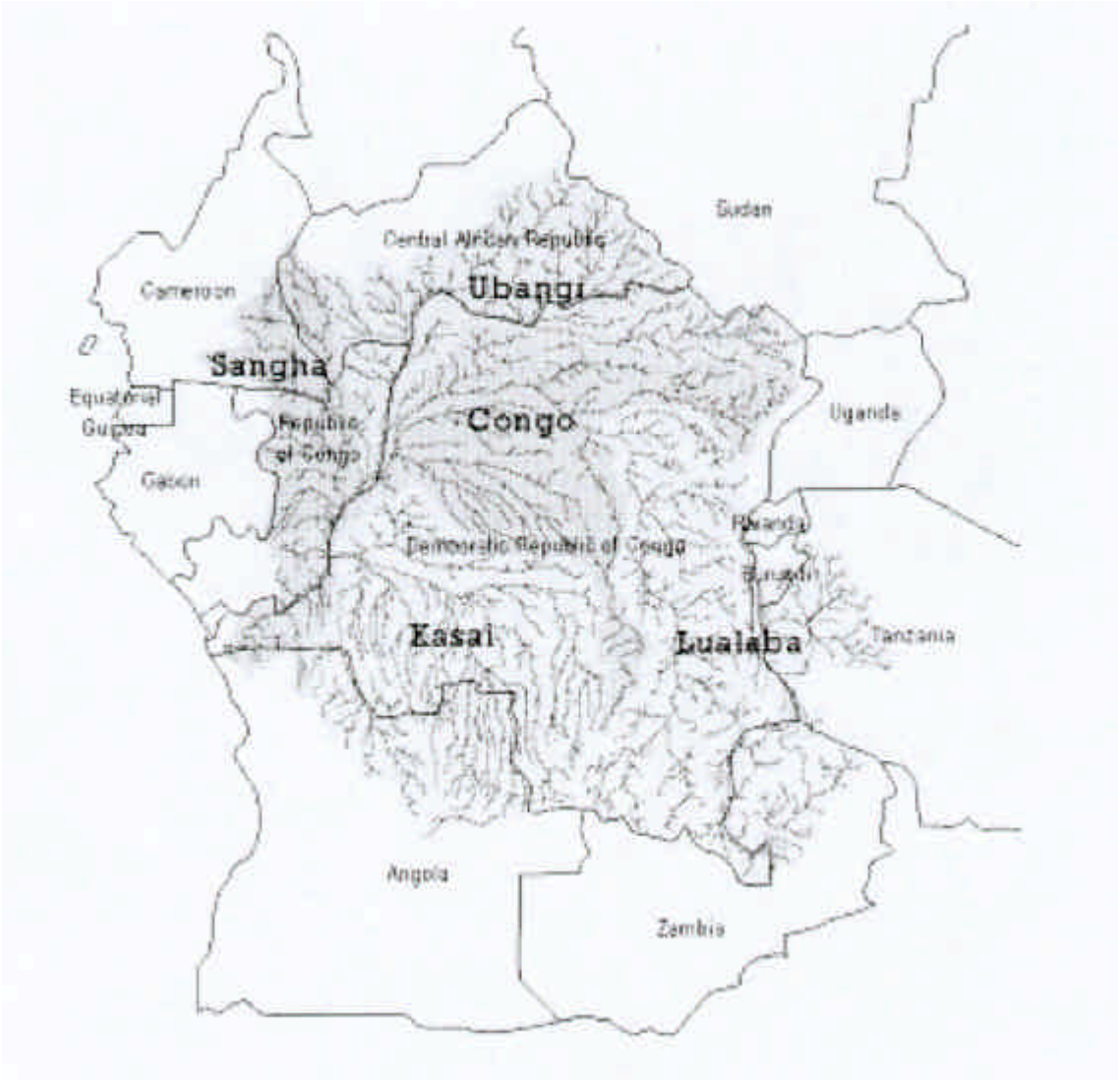
Africa							
Cameroon	475440	96395	2.5	20.3	1440	1670	1545
Congo	342000	246977	6.5	72.2	1190	1990	1660
Angola	1246700	285395	7.5	22.9	785	1635	1375
Zaire	2344860	2313350	61.1	98.7	775	2115	1540
For Congo/Zaire basin		3789053	100.0		720	2115	1470

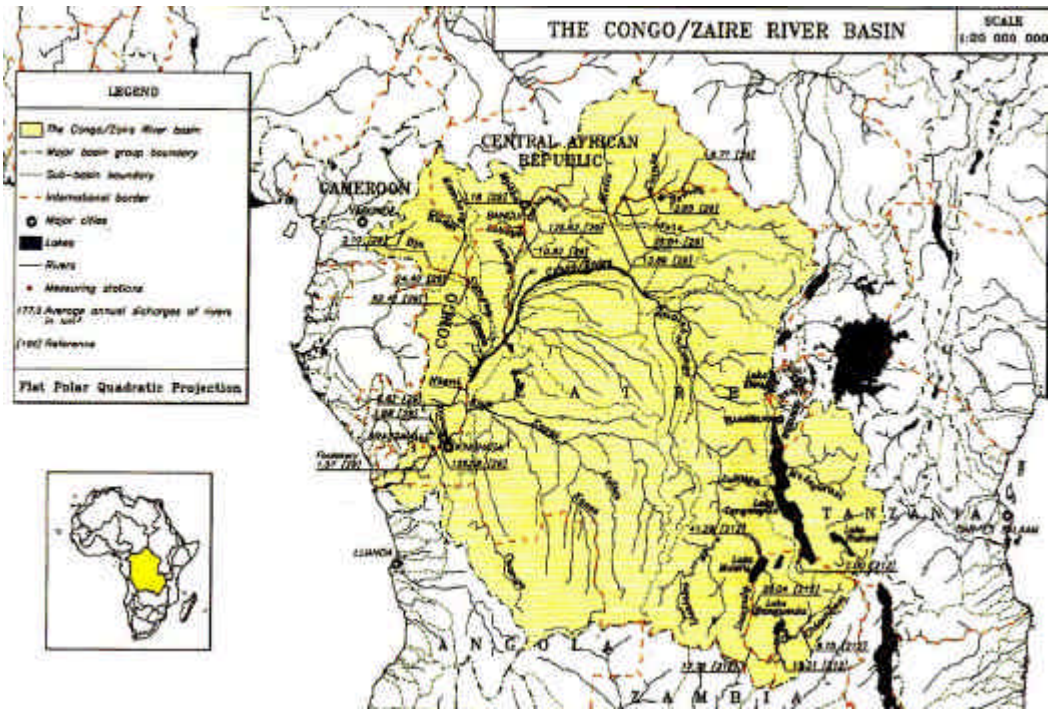
Tanganyika and those in Rwanda into Lake Kivu, which is connected with Lake Tanganyika through the Rusizi border river between Zaire, Rwanda and Burundi.

In the north about two-thirds of the Central African Republic lie within the Congo/Zaire basin. It is a humid country, with many sources flowing into the Oubangui River, a major tributary of the Congo/Zaire River and forming the border between the Central African Republic and Zaire. At Bangui, its discharge is estimated at over 126 km^3/year. The tributaries originating within Cameroon flow either to the Central African Republic in the east or to Congo in the south, where the discharge of the Sangha River at the border is over 52 km^3/year. The Oubangui tributary forms the border between Congo and Zaire, then flows into the Congo/Zaire River which continues to be the border until the far south-west where it enters Zaire. Many other tributaries originate in Congo.

To the south is Angola, where the Kasai River, another major tributary, originates together with many other smaller tributaries.

Zaire has a very dense hydrographic system (Figure 6). The discharge of the Congo/Zaire River reaching Kinshasa and Brazzaville is about 1269 km^3/year, which is equal to 32% of the renewable water resources for the whole of Africa. The river then continues to the south-west and forms the border between Angola and Zaire before flowing into the sea.


Sudan
Central African Republic
Cameroon
Ubangi
Sangha
Equatorial Guinea
Republic of Congo
Congo
Uganda
Gabon
Rwanda
Democratic Republic of Congo
Kasai
Lualaba
Tanzania
Angola
Zambia


THE CONGO/ZAIRE RIVER BASIN
SCALE
LEGEND
The Congo/Zaire River basin
Major basin group boundary
Sub-basin boundary
International border
Major cities
Lakes
Rivers
Measuring stations
Average annual discharges of rivers
Reference
Flat Polar Quadratic Projection
CENTRAL AFRICAN REPUBLIC
CAMEROON
CONGO
ZAIRE
TANZANIA
ANGOLA
ZAMBIA

8 - The Zambezi basin

The Zambezi basin is the fourth-largest river basin of Africa, after the Congo/Zaire, Nile and Niger basins. Its total area represents about 4.5% of the area of the continent and spreads over **eight countries** (Map 8 and Table 38). The Zambezi River flows eastwards for about 3000 km from its sources to the Indian Ocean.

Table 38: The Zambezi basin: areas and rainfall by country

	Total area of the country (km²)	Area of the country within the basis (km²)	As % of total area of the basin (%)	As % of total area of the country (%)	Average annual rainfall in the basin area (mm)		
					min.	max.	mean
Angola	1246700	235423	17.4	18.9	550	1475	1050
Namibia	824900	17426	1.3	2.1	545	690	630
Botswana	581730	12401	0.9	2.1	555	665	595
Zimbabwe	390760	213036	15.8	54.5	525	1590	710
Zambia	752610	574875	42.5	76.4	600	1435	955
Tanzania	945090	27840	2.1	2.9	1015	1785	1240
Malawi	118480	108360	8.0	91.5	745	2220	990
Mozambique	801590	162004	12.0	20.2	555	1790	905
For Zambezi basin		1351365	100.0		535	2220	930

Rivers and discharges

The Zambezi River rises in the Kalene hills in north-western Zambia and flows northwards for about 30 km. It then turns west and south to run over about 280 km through Angola and reenters Zambia with an annual discharge of nearly 18 km^3. It then flows southwards through marshy plains. In the south-west of Zambia the river becomes the border between Zambia and the eastern Caprivi Strip of Namibia for about 130 km.

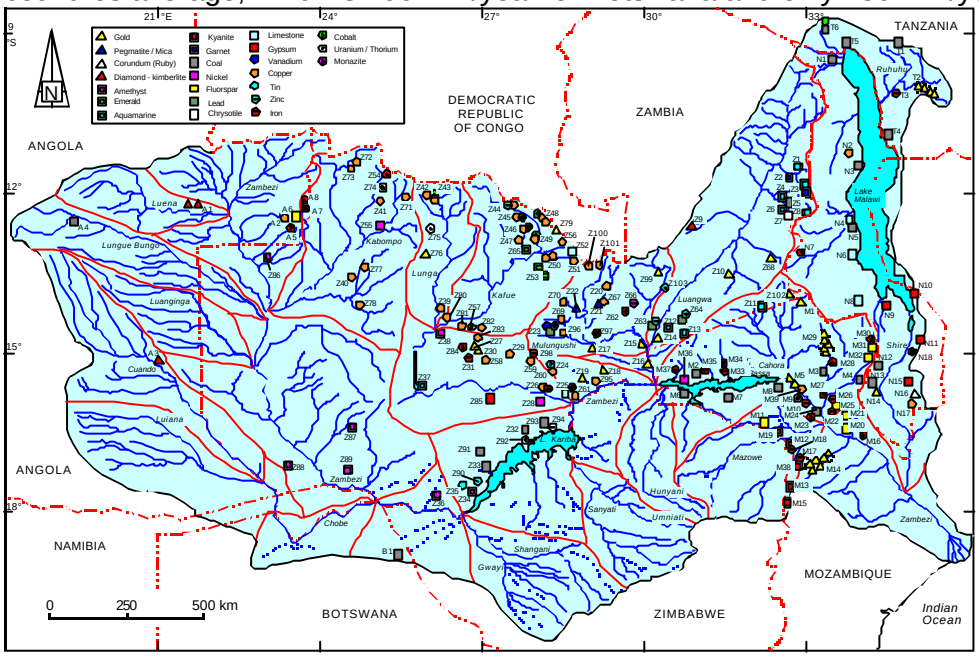
The Chobe tributary originates in Angola, crosses the Caprivi Strip with an annual discharge of about 1.3 km^3, then forms the border between Namibia and Botswana and enters Botswana to flow southwards for about 75 km until it meets the Selinda spillway along which spillage from the Okavango occurs in high flood years (see section The Okavango basin). It then turns east, again forming the border between Namibia and Botswana as it flows through a swampy area and flows into the Zambezi River at the border point between Namibia, Botswana, Zimbabwe and Zambia with an annual discharge of about 4.1 km^3. The discharge of the Zambezi River at this point is 33.5 km^3/year.

The Zambezi River then forms the border between Zambia and Zimbabwe and reaches its greatest width, over 1.3 km, before its waters plunge over the Victoria Falls. It continues to form the border between Zambia and Zimbabwe until it enters Mozambique.

There are two major man-made lakes on the Zambezi River, Lake Kariba on the border between Zambia and Zimbabwe and Lake Cabora Bassa in Mozambique.

Downstream of Lake Kariba the Kafue River, a major tributary originating in the north of Zambia, flows into the Zambezi River with a discharge of about 10 km^3/year. Still further downstream, at the border with Mozambique, the Luangwa River flows into the Zambezi River with an annual discharge of over 22 km^3. This tributary originates in the north-east of Zambia. The total discharge entering Lake Cabora Bassa from Zambia is estimated at about 77.5 km^3 /year.

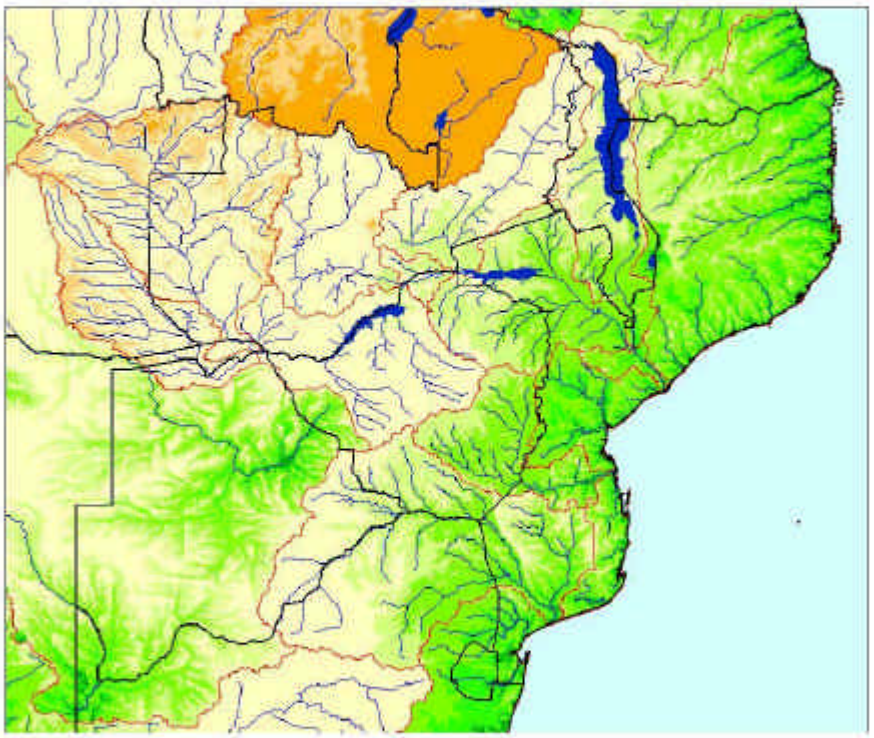
Leaving the lake the Zambezi River flows south-eastwards and receives water from its last great tributary, the Shire, with an annual discharge of nearly 16 km^3. The Shire drains Lake Malawi (also called Lake Nyasa) about 450 km to the north. The northern part of Lake Malawi forms the border between Tanzania and Malawi, the southern part the border between Mozambique anti Malawi. The total flow into the lake is estimated at about 29 km^3/year of which 53% from Tanzania, 43% from Malawi and 4% from Mozambique. Total outflow from the lake in the Shire River in the south is 12.5 km^3/year. The level of the lake has fluctuated 6 metres since the beginning of the century, with its lowest level in 1917 and its highest level in 1980.
At its mouth, the Zambezi River splits into a wide, flat and marshy delta. The annual discharge flowing to the sea is estimated at 106 km .
Annual rainfall in the basin decreases from almost 1800 mm in the north to less than 550 mm in the south. Both Botswana and Namibia are rather dry countries and only 2% of each of these countries is situated in the basin. However, rainfall in these parts, around 600 mm/year, is higher than the countries average, which is 400 mm/year for Botswana and only 280 mm/year for Namibia.



Southern Africa Region

Runoff Travel Time

Zambezi and Limpopo Basins

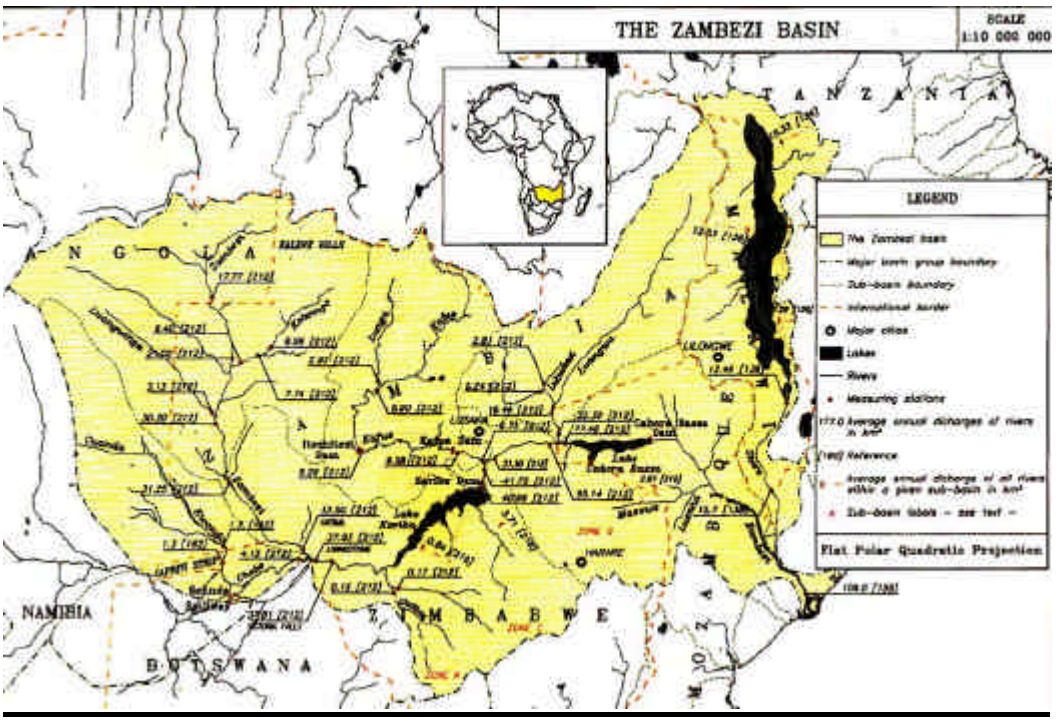


Time (days)

<.5	3-4	9-12
.5-1.0	4-5	12-15
1-2	5-7	15-20
2-3	7-9	>20

Basins - Pfafstetter level 2
Streams - Pfafstetter level 4
International Borders
water bodies

USGS



9 - The Okavango basin

The Okavango basin covers 1% of the continent. It is an endorheic basin, shared between **Angola**, **Namibia** and **Botswana** (Map 9 and Table 41).

Table 41: Okavango basin: areas and rainfall by country

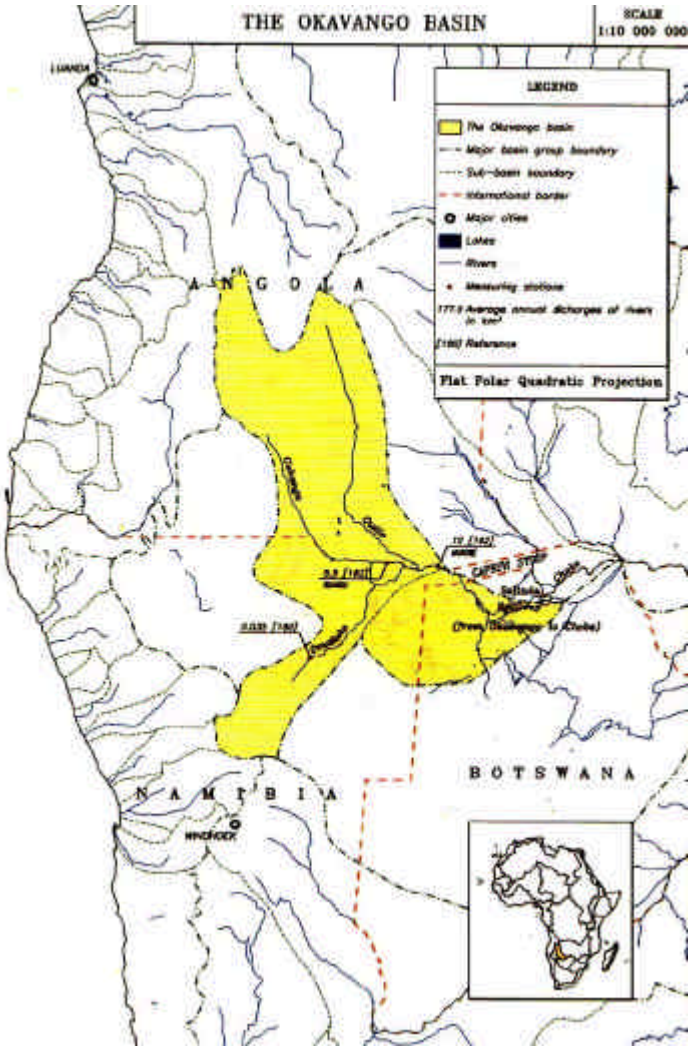
Country	Total area of the country (km^2)	Area of the country within the basin (km^2)	As % Of total area of basin (%)	As % of total area of country (%)	Average annual rainfall in the basin area (mm)		
					min.	max.	mean
Angola	1246700	166963	51.7	13.4	525	1320	865
Namibia	824900	106798	33.0	12.9	355	595	465
Botswana	581730	49431	15.3	8.5	415	570	495
For Okavango		323192	100.0		355	1320	680

Rivers and discharges

The two main rivers, the Cubango and Cuito, originate in Angola and flow to the south, where they become the border between Angola and Namibia. After flowing together they become the Okavango River that enters the Caprivi Strip in Namibia about 50 km further downstream. The average annual discharge leaving Angola at Mukwe is 10 km^3.

The Omatako tributary in Namibia is an ephemeral river, flowing north-east to enter the Cubango River at the border between Angola and Namibia.

After entering Botswana, the Okavango River flows into the Okavango Delta, a large swamp area. A spillway exists from this area to the Chobe River in the Zambezi basin in periods of high floods.



10 - The Orange basin

The Orange basin, located in Southern Africa, covers almost 3% of the continent and spreads over **four countries** (Map 11 and Table 46).

Table 46 :Orange basin: areas and rainfall by country

Country	Total area of the country (km^2)	Area of the country within the basin (km^2)	As % Of total area of basin (%)	As % of total area of country (%)	Average annual rainfall in the basin area (mm)		
					min.	max.	mean
Botswana	581730	71000	7.9	12.2	165	520	295
Namibia	824900	219249	24.5	26.6	35	415	185
Lesotho	30350	30350	3.4	100.0	575	1040	755
South Africa	1221040	575769	64.2	47.2	35	1035	365
For Orange basin		896368	100.0		35	1040	325

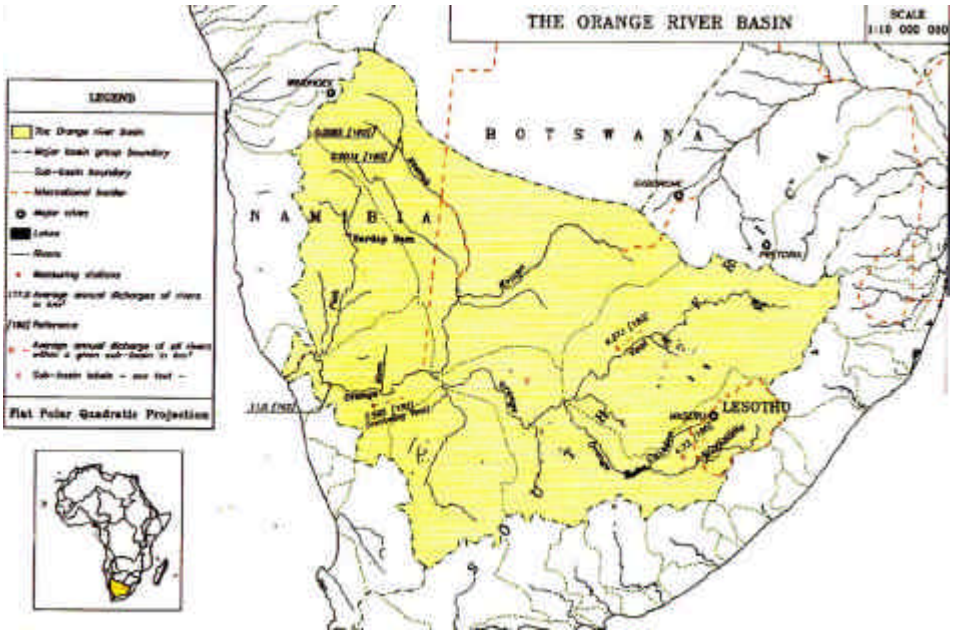
Rivers and discharges

The source of the Orange River is in Lesotho. The river receives water from the Makhaleng tributary just before entering South Africa. The Caledon tributary flows on the border between South Africa and the north of Lesotho and flows into the Orange River further downstream in South Africa. The average annual runoff from Lesotho to South Africa is estimated at 4.73 km^3/year, which is far in excess of the country's water requirements.

Almost the entire plateau of South Africa, representing over 48% of the area of the country, is drained by the Orange River and its tributaries, though they contribute only about 22% of the total runoff of South Africa. The Vaal is the major tributary of the Orange River and the average annual runoff in the Vaal basin area is about 4.27 km^3, of which 2.15 km^3 is exploitable. The average annual runoff of the Orange basin, excluding the Vaal, is estimated at 7.59 km^3, of which 5.76 km^3 is exploitable.

The Molopo, which forms the border between Botswana and South Africa, is a fossil river, which once flowed into the Orange River. Now it receives most of its very occasional flows from its tributaries in the northern Cape province of South Africa [61].

The Orange River forms the border between the south of Namibia and South Africa. The most important tributary entering from Namibia is the Fish River, on which the Hardap dam was constructed in 1972.



11 - The North Interior

The North Interior, which corresponds to the Sahara Desert, occupies almost 20% of the African continent. It extends from **Morocco** in the west to **Egypt** in the east. The largest part is occupied by **Algeria** (33%) and **Libya** (25%). More than 80% of the area of each of these two countries is located in this region (Map 13 and Table 51). The average annual rainfall is only 40 mm. It is even 0 mm in Niger.

Table 51: North Interior areas and rainfall by country

Country	Total area of the country (km^2)	Area of the country within the basin (km^2)	As % Of total area of basin (%)	As % of total area of country (%)	Average annual rainfall in the basin area (mm)		
Morocco + W. Sahara	712500	154682	2.7	21.7	0	455	95
Mauritania	1025520	578393	10.0	56.4	0	465	30
Mali	1240190	512746	8.8	41.3	0	700	70
Algeria	2381740	1944795	33.5	81.7	0	520	45

Tunisia	163610	78448	1.4	47.9	17	345	90
Niger	1267000	11316	0.2	0.9	0	0	0
Libya	1759540	1472372	25.4	83.7	0	390	10
Chad	1284000	217465	3.7	16.9	0	305	45
Sudan	2505810	313365	5.4	12.5	0	315	105
Egypt	1001450	520881	9.0	52.0	0	100	15
For North Interior		5804463	100.0		0	700	40

Rivers and discharges

The renewable water resources in the Rheris and Guir basins in Morocco are estimated at 0.82 km^3/year, of which 0.67 km^3/year is surface water and 0.15 km^3/year groundwater. No information is available about the Western Sahara. Average rainfall is 30 mm/year in Mauritania and 70 mm/year in Mali. No information is available on renewable water resources in these countries.

For Algeria water availability and needs for 2025 have been estimated by basin [50]. Table 52 summarizes the figures for the five basins of the North Interior part of Algeria.

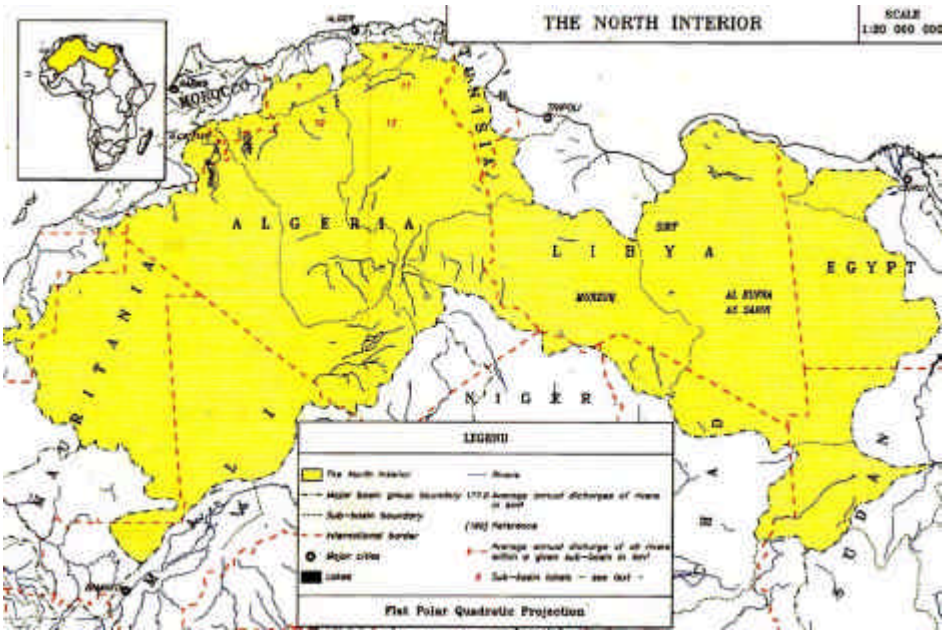
Table 52: Estimated water balance in the North Interior in Algeria in 2025 [50]

(in km^3 /year)	**2025**
Water availability:	
Total surface water	1.060
Available surface water	0.158
Groundwater (1)	2.051
Water re-use	0.678
Total available water	2.887
Water Demands:	
Irrigation	2.503
Other water uses	0.983
Total water use	3.486
Balance	0.599

(1) About 1.683 km^3 is considered to be fossil water

Available renewable water resources in the North Interior in Tunisia are estimated at 0.20 km^3/year, of which 0.15 km^3 is surface water and 0.05 km^3 groundwater. For the whole of Tunisia it is estimated at 2.8 km^3/year (of which 2.1 km^3 is surface water [206]), which is about 80 % of the total internal renewable water resources, estimated at 3.52 km^3/year.

Rainfall in the North Interior in Niger, occupying less than 1 % of the country, is negligible. Average annual rainfall is 10 mm in Libya, 45 mm in Chad, 105 mm in Sudan and 15 mm in Egypt. No information is available on renewable water resources in the North Interior for these countries.



12 - The Mediterranean coast

The Mediterranean Coast extends from Morocco in the west to Egypt in the east and is the aggregation of a large quantity of small, independent coastal basins draining to the sea. Its total area represents 2.2% of the area of the continent and spreads over **five countries** (Map 14 and Table 54).

TABLE 54 Mediterranean Coast: areas and rainfall by country

Country	Total area of the country (km²)	Area of the country within the basin (km²)	As % of total area of basin (%)	As % of total area of country (%)	Average annual rainfall in the basin area (mm)		
					min.	max.	mean
Morocco	446500	108300	15.9	24.3	185	740	350
Algeria	2381740	133327	19.6	5.6	270	895	495
Tunisia	163610	85162	12.5	52.1	60	735	300
Libya	1759540	287168	42.3	16.3	5	430	90
Egypt	1001450	65568	9.6	6.5	60	140	100
For Mediter. Coast		679525	100.0		5	895	235

Rivers and discharges

The total renewable water resources for the different basins and regions in the Mediterranean Coast in Morocco are summarized in Table 55.

TABLE 55 Renewable water resources by basin of the Mediterranean Coast in Morocco

Basin/region	Renewable surface water (km³/year)	Renewable groundwater (km³/year)	Total renewable water (km³/year)
Moulouya	1.30	0.70	2.00
Loukkos	1.60	0.03	1.63
Other	2.85	0.40	3.25
Total	5.75	1.13	6.88

For Algeria a study has been done on the water availability and needs for 2025 by basin, as explained in the section *The North Interior*. Table 56 summarizes the figures for the eight basins of the Mediterranean coastal part of Algeria [50].

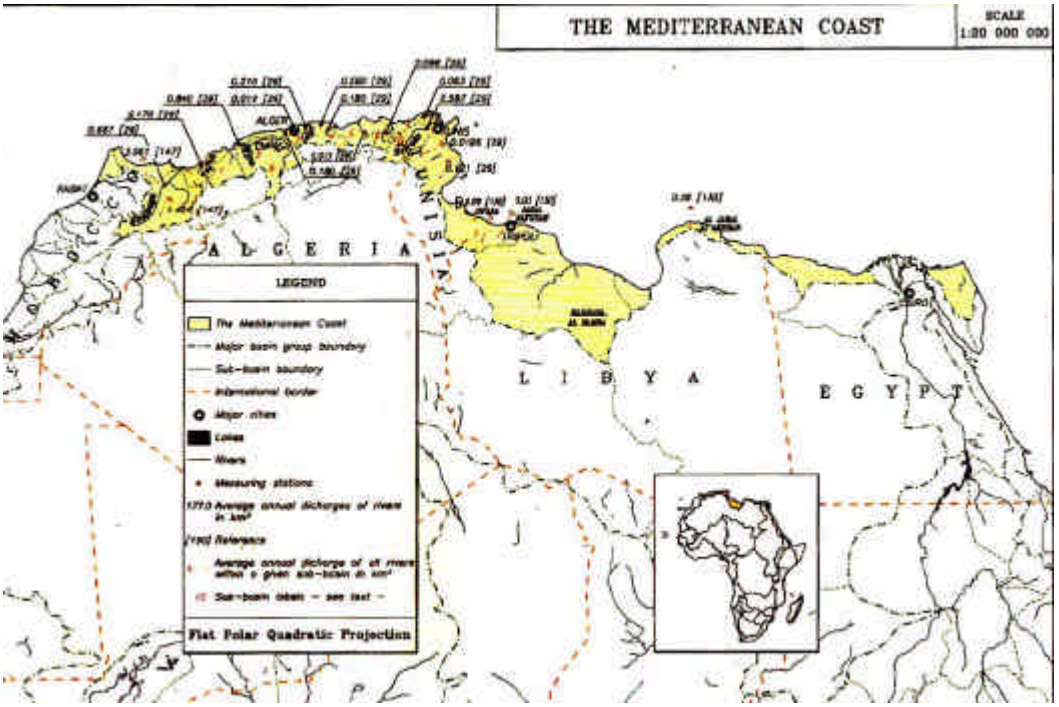
TABLE 56 Estimated water balance in the Mediterranean Coast in Algeria in 2025 [50]

(in km³/year)	2025

Water availability:	
Total surface water	12.050
Available surface water	4.454
Groundwater	1.391
Water re-use	1.616
Total available water	7.461
Water demands:	
Irrigation	2.695
Other water uses	3.691
Total water use	6.386
Balance	1.075

The Medjerda River in Tunisia is the country's major perennial stream. Flows fluctuate greatly with quantities in June and July amounting to less than one-twelfth of those in February. The available renewable water resources in the Mediterranean Coast in Tunisia are estimated at about 2.60 km³/year, of which 1.95 km³ is surface water and 0.65 km³ is groundwater (see also the section *The North Interior*).

The renewable water resources for Libya are estimated at 0.6 km³/year. Information on the renewable water resources of Egypt in this area is not available.



13 - The West Coast

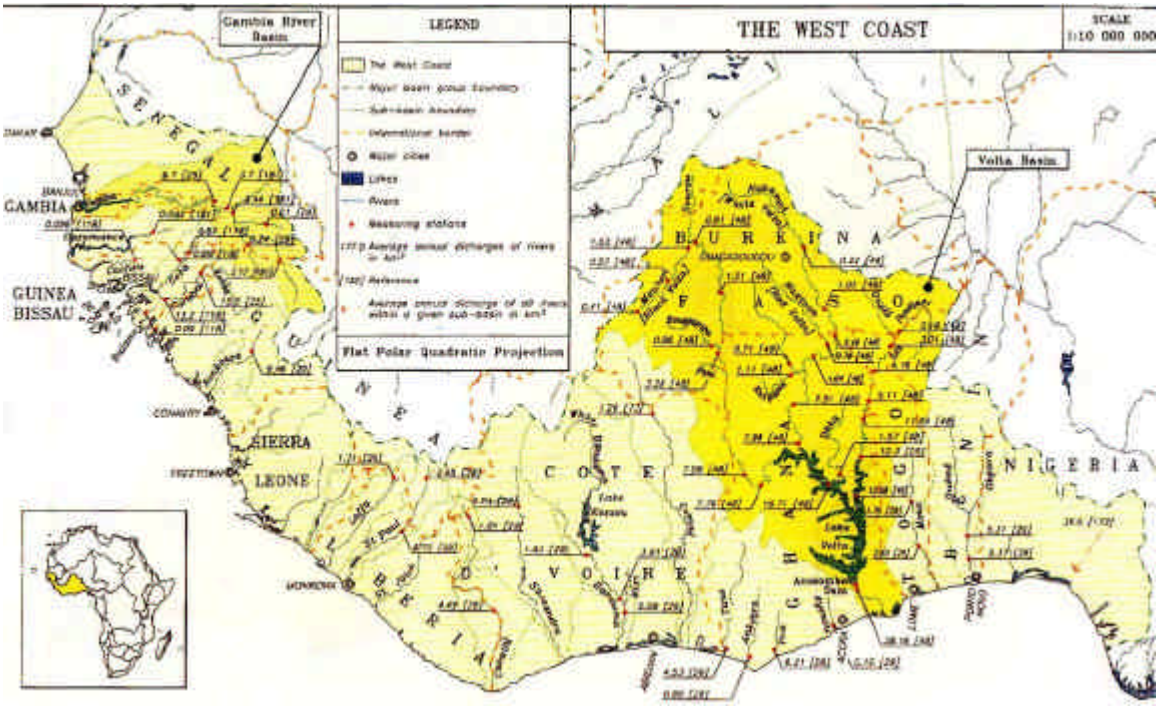
The West Coast is the region grouping all the basins draining to the sea from Senegal to Nigeria. It covers 4.7% of the continent and spreads over **13 countries** (Map 16 and Table 61).

Table 61: West Coast: areas and rainfall by country

Country	Total area	Area of the country	As % of total	As % of total	Average annual rainfal

	of the country (km²)	within the basin (km²)	area of basin (km²)	area of country (km²)	in the basin area (mm)		
					min.	max.	mean
Senegal	196720	124854	8.7	63.5	350	1630	870
Gambia	11300	11300	0.8	100.0	800	1115	955
Guinea Bissau	36120	36120	2.5	100.0	1260	2440	1700
Guinea	245857	119502	8.4	48.6	1300	3080	2085
Sierra Leone	71740	71740	5.0	100.0	1870	3395	2690
Liberia	97750	97750	6.8	100.0	1770	3300	2370
Mali	1240190	9496	0.7	0.8	545	1365	675
Burkina Faso	274000	197379	13.8	72.0	555	1310	920
Côte d'Ivoire	322462	298692	20.9	92.6	1050	2310	1370
Ghana	238540	238540	16.7	100.0	855	1785	1265
Togo	56785	56785	4.0	100.0	925	1550	1215
Benin	112620	66236	4.6	58.8	915	1345	1145
Nigeria	923770	101802	7.1	11.0	1090	2595	1505
For West Coast		1430196	100.0		350	3395	1435

In this section two international basins in this region have been treated separately, the Gambia River basin and the Volta basin. The other basins have been regrouped and called 'the West Coast, excluding the Gambia River and Volta basins'.



14 - The Gambia River Basin

The Gambia River basin occupies about 5.4% of the West Coast and is shared among **three countries** (Map 16 and Table 62).

Table 62: Gambia basin: areas by country

Country	Total area of the country (km²)	Area of the country within the basin (km²)	As % of total area of basin (%)	As % of total area of country (%)

Guinea	245 857	8 000	10.3	3.3
Senegal	196 720	68550	75.2	29.8
Gambia	11 300	11 300	14.5	100.0
For Gambia basin	77 850		100.0	

Rivers and discharges

The Gambia River has its sources in the high rainfall mountainous Fouta Djallon in the north of the Central Guinea region. The total quantity of water leaving Guinea for Senegal is estimated at 3 km³/year.

The river then flows northwards to enter The Gambia in the extreme east of the country. Contradictory information exists about the discharges entering The Gambia. According to different sources, they range from 4 km /year [181, average of 1951-1990] to nearly 10 km³/year, [25]. Its flow is highly seasonal: the peak discharge is about 2000 m³/s, but for six months the inflow at the Gambian border is less than 10 m³/s. In May it falls below 0.5 m³/s.

Because of the flat topography of The Gambia and the low river discharges during the dry season, salt water moves up to about 70 km upstream in the wet season and 250 km upstream in the dry season. The tidal variation at the mouth is about 1.6 m [48a].

15 - The Volta Basin

The Volta basin occupies almost 28% of the total West Coast and is shared between six countries (Map 16 and Table 64).

Rivers and discharges

The most upstream part of the Volta basin is located in Mali, where it occupies less than 1 % of the area of the country. One river, the Sourou, crosses the border from Mali to Burkina Faso, but there is almost no flow in this river.

Table 64: Volta basin areas by country

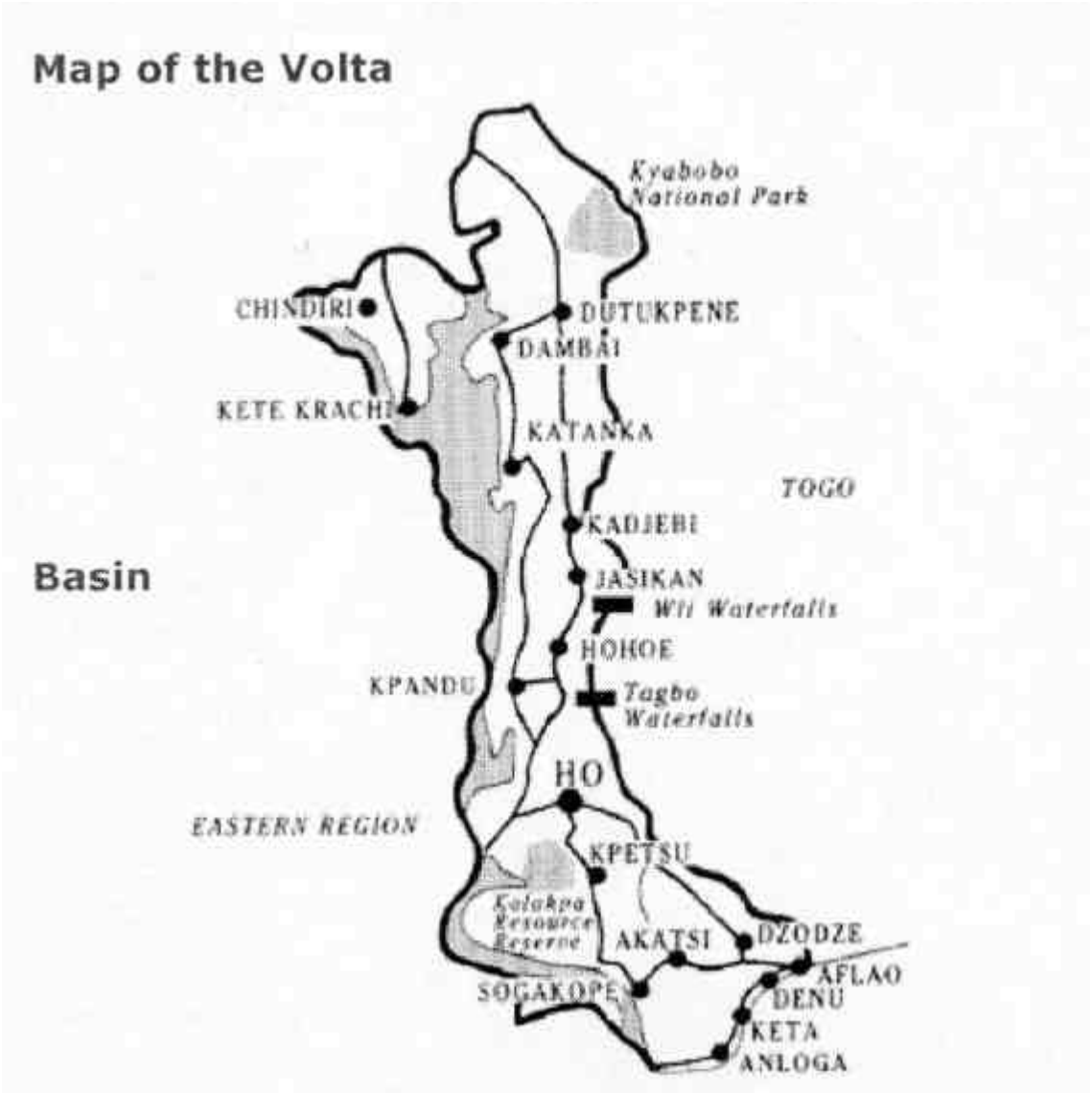
Country	Total area of the country (km^2)	Area of the country within the basin (km^2)	As % of total area of basin (%)	As % of total area of country (%)
Mali	1240190	9496	2.4	0.8
Burkina Faso	274000	183000	46.4	66.8
Benin	112620	16000	4.1	14.2
Togo	56785	26700	638	47.0
Côte d'Ivoire	322462	7000	1.8	2.2
Ghana	238540	152000	38.6	63.7
For Volta basin		394196	100.0	

Two-thirds of Burkina Faso are within the Volta basin. The Black Volta (Monhoun), Red Volta (Nazinon) and White Volta (Nakambé) all have their sources in Burkina Faso.

The *Black Volta* originates in the south-west of the country, flows north-eastwards and then turns south. In the south, it becomes the border, first between Ghana and Burkina Faso and then between Ghana and Côte d'Ivoire. When leaving Burkina Faso, its discharge is about 5 km³/year; when entering Ghana, it is about 6 km³/year. The *Red Volta* originates in the central part of Burkina Faso, near Ouagadougou, and flows south-eastwards to the border with Ghana. After crossing the border, it joins the *White Volta*. The White Volta originates in the north of Burkina Faso and also flows south-eastwards to the border with Ghana. The total annual discharge leaving Burkina Faso through the Red and White Volta Rivers is estimated at 3.7 km³/year.

The Pendjari River originates in the north-west of Benin. It flows north-east, then turns sharply to the west to become the border, first between Burkina Faso and Benin, then between Togo and Benin for just a short distance before entering Togo with a total annual discharge of 2.2 km³. In Togo, which it

crosses in the north, here called the Oti River. Further downstream it becomes the border between Togo and Ghana. Entering Ghana further south, its discharge is estimated at 11 km³/year.
Many other tributaries have their source within Ghana, but especially in the northern savannah part most of these water courses run almost dry after the rains. The groundwater here is low yielding and cannot be relied upon for extensive irrigation [113]. In the south a dam has been constructed at Akosombo for hydropower. Behind this dam, one of the world's largest artificial lakes has been created, Lake Volta, with a surface area of 8500 km² and a capacity of 148 km³. The average annual discharge flowing to the sea is estimated at about 38 km³.



16 - The West Coast, excluding the Gambia River and Volta basins

Except for The Gambia, which is entirely located in the Gambia River basin, all the other countries from Senegal in the west to Nigeria in the East are partly or wholly located within this remaining part of the West Coast (Map 16 and Table 67).

Rivers and discharges

The area of Senegal in the West Coast can be divided into two parts: the area south of the Gambia basin: Casamance and Kayanga basins; the area north of the Gambia basin and south of the Senegal basin: Ferlo, Car-Car, Sine and Saloum basins.

Table 67: West Coast, excluding Gambia River and Volta basins: areas by country

Country	Total area of the country (km^2)	Area of the country within the basin (km^2)	As % Of total area of basin (%)	As % of total area of country (%)

Senegal	196 720	66 304	6.9	33.7
Guinea Bissau	36120	36120	3.8	100.0
Guinea	245 857	111 502	11.6	45.4
Sierra Leone	71740	71740	7.5	100.0
Liberia	97 750	97 750	10.2	100.0
Burkina Faso	247000	14379	1.5	5.2
Côte d'Ivoire	322 462	291 692	30.4	90.5
Ghana	238540	86540	9.0	36.3
Togo	56 785	30085	3.1	53.0
Benin	112620	50236	5.2	44.6
Nigeria	923 770	101 802	10.6	11.0
For West Coast, without Gambia and Volta basins		958 150	100.0	

The annual discharge of the Casamance River, as measured between 1968 and 1983 was 0.07 km³. In the dry season (April-July) the river may run dry. Dams to protect the area against salt intrusion are necessary. The Kanyanga River is the upper part of the Gêba River in Guinea Bissau, but no discharge figures are available. Nor are there figures available for discharges in the northern part.
Guinea Bissau is wholly situated in the West Coast. The main rivers are the Cacheu originating within the country, the Gêba originating in Senegal and the Corubal originating in Guinea. The water resources in this small country are abundant, but they are badly distributed in space and in time: 90% of the flow occurs in 6 months. The annual discharge of the largest river, the Corubal, is estimated at 13.2 km³/year. In the coastal area, problems of salt intrusion exist in the dry season and many 'anti-salt' dams have been constructed.
Two separate parts of Guinea are located in this West Coast area:

- the eastern part of the Middle Region and the Lower Region, draining to the sea;
- the southern part of the Forest Region, draining to Liberia and Sierra Leone.

The water resources of Guinea are abundant.
Sierra Leone is one of the most humid countries of Africa. It can be divided into 12 major river basins, of which five are shared with Guinea and two with Liberia.
Like Sierra Leone, Liberia is one of the most humid countries of Africa. Two types of river exist: the major basins from north-east to south-west, with rivers originating in Guinea and Côte d'Ivoire and with an average entering discharge of 15 to 20 km³/year; numerous, short, coastal watercourses.
The source of the Comoé River is in the south-west of Burkina Faso, the most humid region of the country. It is one of the few permanent rivers of Burkina Faso, with an average annual discharge leaving the country to Côte d'Ivoire of about 1.29 km³. In Côte d'Ivoire many other rivers run parallel southwards to the sea. In the west is the Cavally River, which has its source in Guinea, then enters Côte d'Ivoire and further downstream becomes the border between Côte d'Ivoire and Liberia.
In Ghana many rivers run more or less parallel southwards to the sea. The most important are the Pra, with an annual discharge of about 6.2 km³, and the Tano, with 4.5 km³.
The Mono originates in Togo and at about 100 km from the sea it becomes the border between Benin and Togo, with an average annual discharge of about 2.9 km³. In the south-west of Togo is the Lake Togo basin, with an area of about 8000 km². The Couffo originates at the bower between Benin and Togo about 200 km north of the sea. In Benin, three main rivers flow southwards to the sea. The Ouémé originates in the centre. The Okpara tributary also originates in the centre but becomes the border between Nigeria and Benin before re-entering Benin to flow into the Ouémé. The discharge close to the sea is estimated at 5.4 km³/year.
About one-third of the basin area of Nigeria is covered by tropical rain forest. Many rivers flow from north to south to the sea. The annual potential surface water resources of the basin area are estimated at 36 km³. Peak outflows occur in September-October. Many dams have been built on the rivers of the western littoral, including the Oyan dam on the Oyan River. The runoff of the Osun River is regulated by the Asejire Dam.

17 - The West Central coast

The West Central Coast covers 2.3% of the continent and spreads over seven countries (Map 17 and Table 71).

TABLE 71 West central Coast: areas and rainfall by country

Country	Total area of the country (km²)	Area of the country within the basin (km²)	As % of total area of basin (%)	As % of total area of country (%)	Average annual rainfall in the basin area		
						(mm)	
					min.	max.	mean
Nigeria	923770	58493	8.3	6.3	1420	2740	2 070
Cameroon	475440	239021	33.9	50.3	1365	2830	1835
Gabon	267670	267670	38.0	100.0	1320	2595	1800
Equat. Guinea	28050	28050	4.0	100.0	1695	2585	2050
Congo	342000	95023	13.5	27.8	1125	1940	1475
Angola	1246700	7150	1.0	0.6	775	1280	1110
Zaire	2344860	9367	1.3	0.4	785	1290	1190
For West Central Coast		704774	100.0		775	2830	1785

Rivers and discharges

Rising in the Cameroon highlands, an area of dense rain forest, the Cross river, enters Nigeria with an annual discharge estimated at 17 km³. Annual runoff to the sea is estimated at almost 52 km³. Another important river in Nigeria is the Imo River, with an average annual discharge of 4 km³. The total surface water resources in the basin area are estimated at 69 km³/year. About 85 % of the annual runoff of the Cross River and 70 % of the annual runoff of the Imo River are concentrated in five months, from June to October with the peak in September.

In Cameroon many rivers flow directly to the sea. The most important one is the Sanaga River, with an average annual discharge of almost 63 km³. Other important rivers are the Nyong, the Wouri and the Ntem Rivers, with a total annual discharge of over 32 km³.

Also in Gabon many rivers flow directly to the sea. The most important one is the Ogooué with an annual discharge of more than 148 km³/year. Its basin occupies about 75% of the country. Another important river is the Nyanga to the south, with an annual discharge estimated at 17.1 km³.

In the mainland part of Equatorial Guinea several watercourses, most of which originate within the country, cross the country while flowing to the sea. The renewable water resources are estimated at 30 km³/year for the mainland and the island together.

Of the many rivers flowing to the sea in Congo, the most important one is the Kouilou-Niari River. Its basin covers nearly 60% of the area of Congo in the West Central Coast. Its annual flow to the sea is estimated at about 28 km³.

Cabinda, the part of Angola lying in the West Central Coast, is separated from the rest of Angola by the Congo/Zaire River and a strip of land to the north of the river belonging to Zaire. Its area corresponds to only 0.6% of the total area of Angola. The most important river is the Chiloango, the upstream part of which forms the border between Zaire and Angola. The part of Zaire lying in the West Central Coast, only 0.4% of the total area of Zaire, corresponds to the basin of the Chiloango River.

18 - The Indian Ocean coast

The southern and south-western part of the Indian Ocean Coast is wholly situated in South Africa. The eastern part is shared between Swaziland, South Africa and Mozambique. The north-eastern part is shared between Zimbabwe and Mozambique (Map 20 and Table 77). Its total area represents 2.2% of the area of the continent.

TABLE 77 Indian Ocean Coast: Areas and rainfall by country

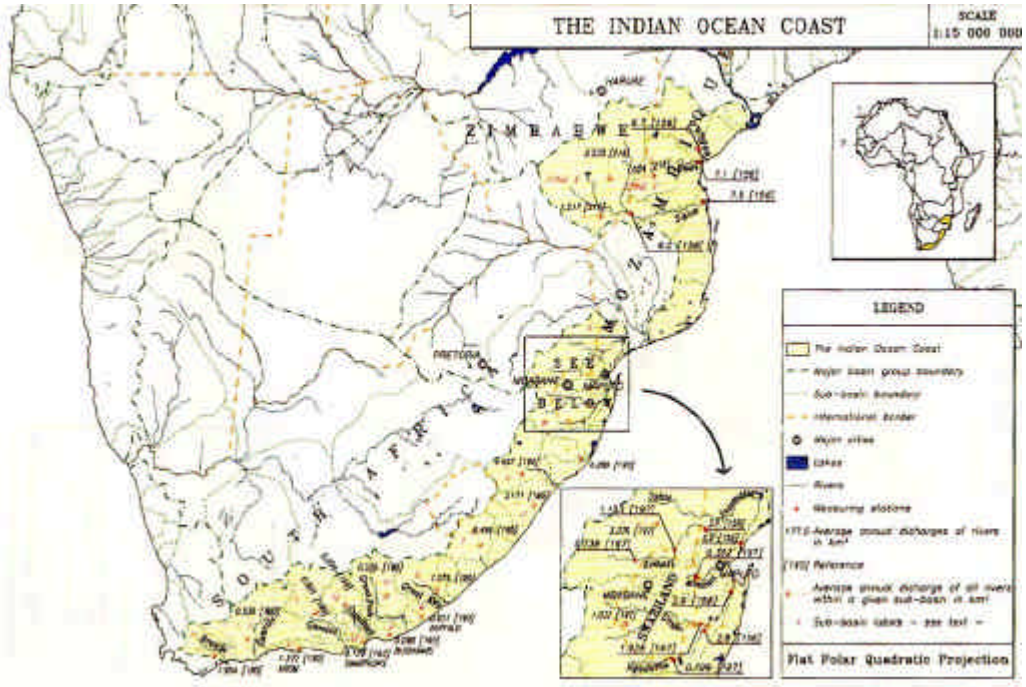
Country	Total area of the country (km²)	Area of the country within the basin (km²)	As % of total area of basin (%)	As % of total area of country (%)	Average annual rainfall in the basin area (mm)		
					min.	max.	mean
Swaziland	17364	17364	2.6	100.0	600	1020	780
South Africa	1221040	358648	54.0	29.4	125	1270	585
Zimbabwe	390760	102047	15.4	26.1	375	1685	650
Mozambique	801590	185726	28.0	23.2	470	1770	885
Total Ind. Oc. Coast		663785	100.0		125	1770	680

Rivers and discharges

Of the four major rivers in Swaziland, two originate inside the country, the Mbuluzi and Ngwavuma rivers, and two in South Africa, the Komati and Usutu rivers. Total inflow from South Africa to Swaziland is 1.8 km³/year. Total outflow from Swaziland is 3.5 km³/year, of which 2.3 km³ flow directly into Mozambique to the Umbulezi and the Maputo rivers. The remaining 1.2 km³ first enter South Africa before flowing into Mozambique, in the south towards the Maputo River and in the north towards the Incomati River. The Sabie River is another tributary of the Incomati River originating in South Africa.

Within South Africa, perennial rivers occur over only one quarter of the area and mainly in the southern and south-western Cape province and on the eastern plateau slopes. However, even the perennial rivers are very irregular and have important seasonal variations. The surface water resources in the Indian Ocean part are estimated at 31 km³/year, of which about 21 km³/year are exploitable. Less than 10 km³/year are available for agricultural purposes.

The Save, Buzi and Pungoé rivers originate in Zimbabwe and all flow to Mozambique. Although the catchment area of the Pungoé River in Zimbabwe is only 5 % of the total catchment area, about 26% of the annual runoff originates from this area [155].



19 - The East Central coast

The East Central Coast extends from Mozambique in the south to Somalia in the north. It spreads over five countries and covers 3.4% of the continent (Map 21 and Table 81).

TABLE 81 East Central Coast: areas and rainfall by country

Country	Total area of the country (km^2)	Area of the country within the basin (km^2)	As % Of total area of basin (%)	As % of total area of country (%)	Average annual rainfall in the basin area (mm)		
					min.	max.	mean
Malawi	118480	10120	1.0	8.5	845	2305	1160
Mozambique	801590	368879	35.9	46.0	780	1935	1140
Tanzania	945090	434657	42.4	46.0	395	1780	965
Kenya	580370	193463	18.9	33.3	275	1615	655

Somalia	637660	19133	1.9	3.0	290	435	345
For East Central Coast		1026252	100.0			2305	960

Rivers and discharges

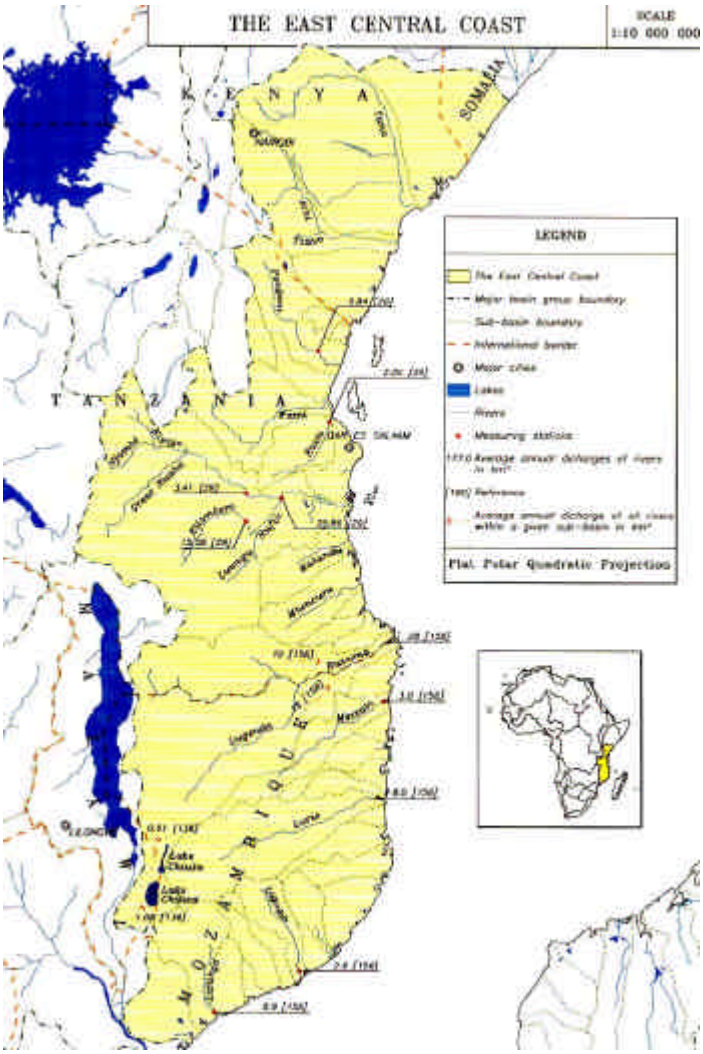
The area of Malawi located in the East Central Coast region corresponds to the Lake Chilwa and the Lake Chiuta basins. Both lakes are on the border between Malawi and Mozambique. The average annual runoff in the Lake Chilwa basin is estimated at 1.06 km³, in the Lake Chiuta basin at 0.61 km³

In Mozambique the rivers, except for the Ruvuma, which is the border river between Mozambique and Tanzania, originate from the plateau and mountains within the country, and are usually not perennial. Some of them have important waterfalls and steep slopes. The contribution of the Lugenda River to the Ruvuma River is estimated at about 18 km³/year. Other important rivers flowing to the sea are the Messalo (3.0 km³/year at mouth), the Lurio (8.0 km³/year at mouth), the Ligonha (2.6 km³/year) and the Licungo (8.9 km³/year at mouth). This gives a total of 22.5 km³/year from these rivers alone, which means that the water resources are abundant.

In Tanzania many rivers drain to the coast, the most important being, from the south to the north: Ruvuma, Mbenkuru. Matandu, Rufiji, Ruvu, Wami, Sigi, Msangasi and Pangani. The water resources of Tanzania are quite abundant, but not many figures are available on river discharges. The most important rivers are the Ruvuma on the border between Mozambique and Tanzania with an annual flow to the sea of about 28 km³, of which the contribution of Tanzania is estimated at 10 km³, and the Rufiji with an annual runoff of nearly 26 km³ as measured between 1955 and 1978.

In Kenya two main rivers originate in the East Central Coast. The Tana River originates in the mountains in central Kenya and flows through a semi-arid plain to the sea. It has two seasons of high flooding corresponding to the two rainy seasons. The mean annual runoff is 4.95 km³, but with a high inter-annual variability The Athi River is a strongly seasonal river with high flows in April-June and November-December and very low flows in the two intervening seasons. The average annual flow is about 1.80 km³. The river is characterized by important losses; under low flow conditions. losses of 0.14 km /year have been measured over the middle and lower reaches. Ejjluent discharges from Nairobi make a large contribution to the river flow. Most of the water supply to Nairobi comes from the Tana basin and returns to the Athi basin.

The Lag Badana basin in Somalia is part of the East Central Coast. Surface water resources are rather scarce. Some localized runoff occurs during heavy rainfall, but little water reaches the coast.



20 - The South Interior

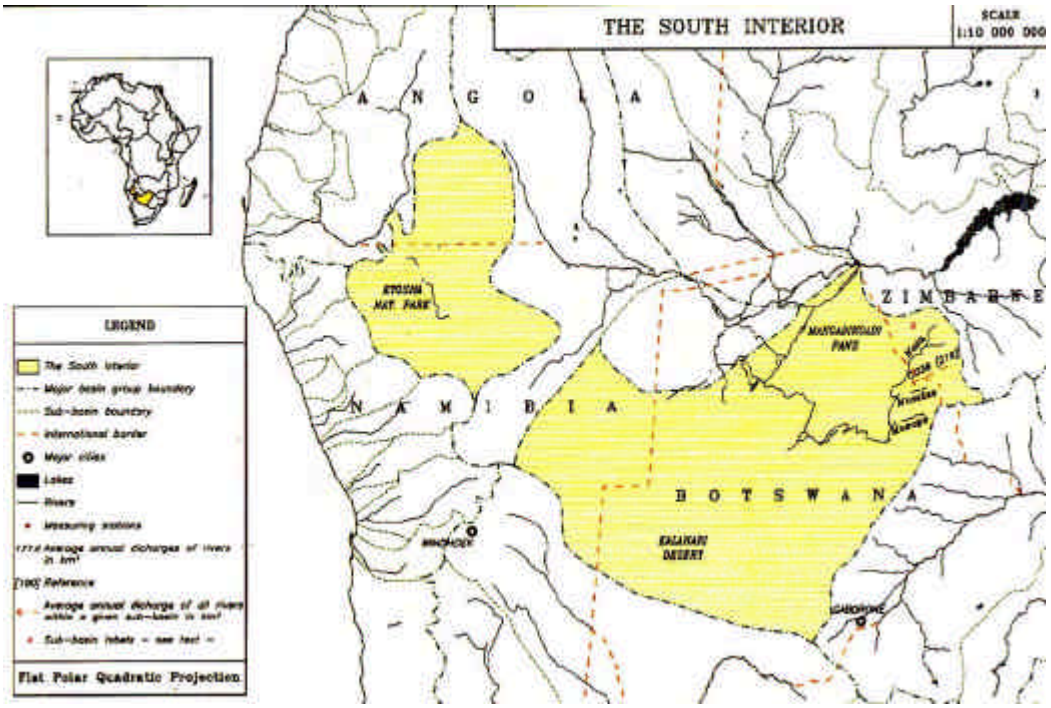
The South Interior is divided into two separate basins, as shown in Figure 2. One is shared by **Zimbabwe**, **Botswana** and **Namibia**. A major part of the Kalahari Desert is located in this basin. The other one is shared by Angola and Namibia. Its total area represents 2.1% of the area of the continent (Map 12 and Table 49).

Table 49: South Interior: areas and rainfall by country

Country	Total area of the country (km^2)	Area of the country within the basin (km^2)	As % Of total area of basin (%)	As % of total area of country (%)	Average annual rainfall in the basin area (mm)		
					min.	max.	mean
Zimbabwe	760	24210	3.7	6.2	465	660	550
Botswana	581760	368780	57.1	63.4	270	670	405
Angola	1246700	53118	8.2	4.3	500	905	680
Namibia	824900	199718	30.9	24.4	275	580	410
For South Interior		645826	100.0		270	905	435

Rivers and discharges

The surface water resources of Zimbabwe are estimated at 0.038 km^3/year, of which 0.008 km^3 is still available for irrigation development after deducting quantities already used or committed [216]. The annual runoff of the Mosupe and Mosetse rivers, located in Botswana, is estimated at 0.055 km^3. Most of the rivers are ephemeral. In Angola the South Interior occupies 4% of the area of the country, but no information is available on water resources. In the Namibian part of the basin there are only ephemeral rivers.



21 - The Limpopo basin

The Limpopo basin, located in South-eastern Africa, covers 1.3% of the continent and spreads over **four countries** (Map 10 and Table 43).

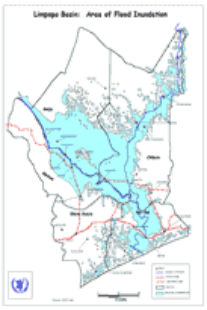
Table 43: Limpopo basin: areas and rainfall by country

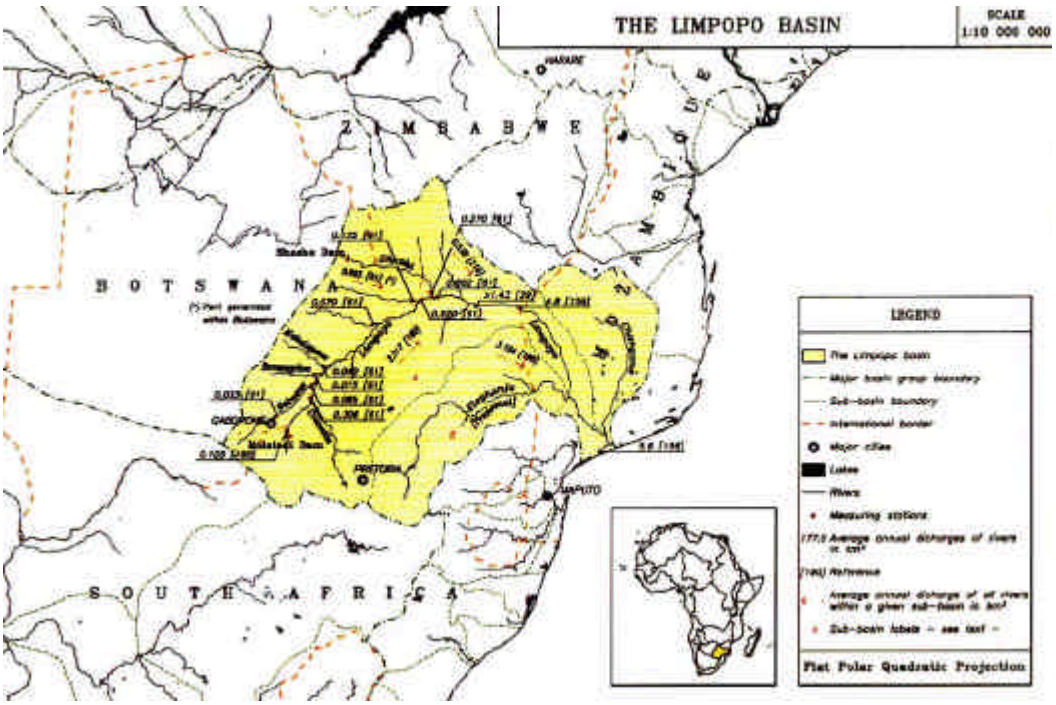
Country	Total area of the country (km^2)	Area of the country within the basin (km^2)	As % Of total area of basin (%)	As % of total area of country (%)	Average annual rainfall in the basin area (mm)		
					min.	max.	mean
Botswana	581730	80118	19.9	13.8	290	555	425
Zimbabwe	390760	51467	1238	13.2	300	635	465
South Africa	11221040	185298	4631	15.2	290	1040	590
Mozambique	801590	84981	21.1	10.6	355	865	535
For Limpopo		401864	100.0		290	1040	530

Rivers and discharges

The Crocodile River, which is the upper part of the Limpopo River, originates in South Africa near Johannesburg. It flows north-westwards to the border with Botswana and then turns to flow northeastwards, first on the border between South Africa and Botswana and then on the border

between South Africa and Zimbabwe. Several tributaries originate in Botswana, the most important being the Shashi, which forms the border between Botswana and Zimbabwe before flowing into the Limpopo River. Entering Mozambique, the river has an average annual discharge of 4.8 km^3. Another important tributary, the Elephants River (also called the Transvaal River), originates in South Africa not far from Johannesburg and flows in north-eastwards. It flows into the Limpopo River in Mozambique.
The Mozambican part of the basin area is estimated to contribute only 10% of the total mean annual runoff of the river [155]. The Limpopo River, which was initially a perennial river in Mozambique, can actually fall dry for up to a period of eight months per year, mainly due to abstractions in the upper catchment area [155].





22 - The south west coast

The South West Coast covers 1.7% of the continent and spreads over **two countries** (Map 18 and Table 73).

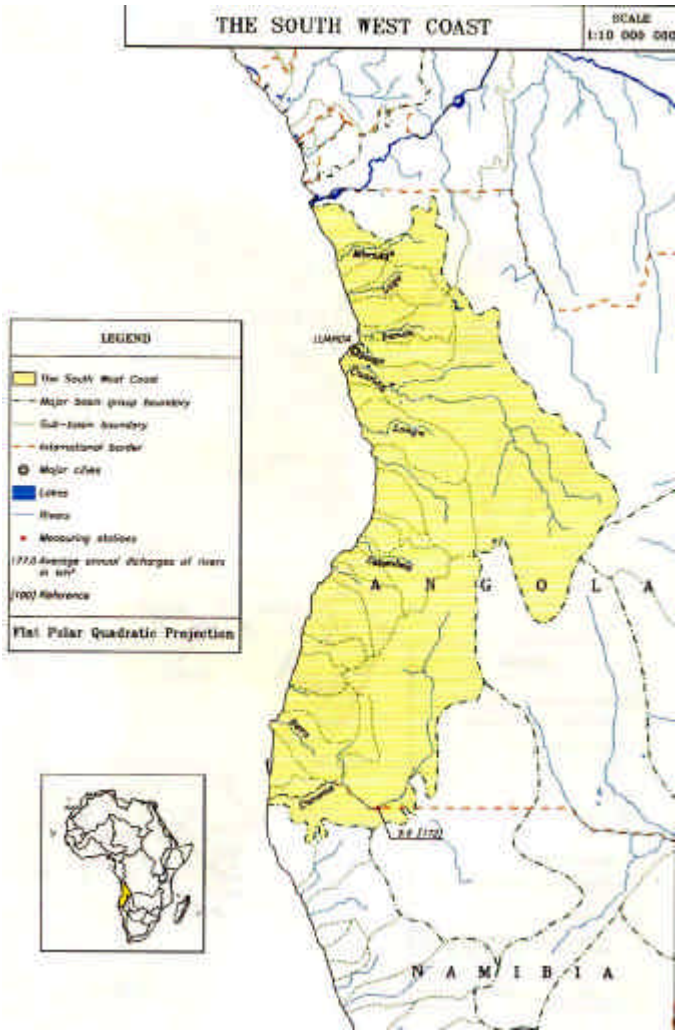
TABLE 73 South West Coast: areas and rainfall by country

Country	Total area of the country (km^2)	Area of the country within the basin (km^2)	As % of total area of basin (%)	As % of total area of country (%)	Average annual rainfall in the basin area (mm)		
					min.	max.	mean
Namibia	824 900	17 549	3.4	2.1	90	515	350
Angola	1246700	498651	96.6	40.0	10	1600	960
For S.		516 200	100.0		10	1600	940

West Coast							

Rivers and discharges

Almost 97% of the area of the South West Coast is covered by Angola, the remaining part by Namibia, that shares the border river, the Cunene, with Angola. This river originates in the central highlands of Angola and its annual discharge reaching the border is about 5 km³. Many other rivers originate within Angola. Annual rainfall in the South West Coast decreases considerably from the north-east to the south-west (from 1600 mm to 10 mm).



23 - The South Atlantic coast

The South Atlantic Coast, located in South-Western Africa, covers 1.2% of the continent and spreads over two countries (Map 19 and Table 75).

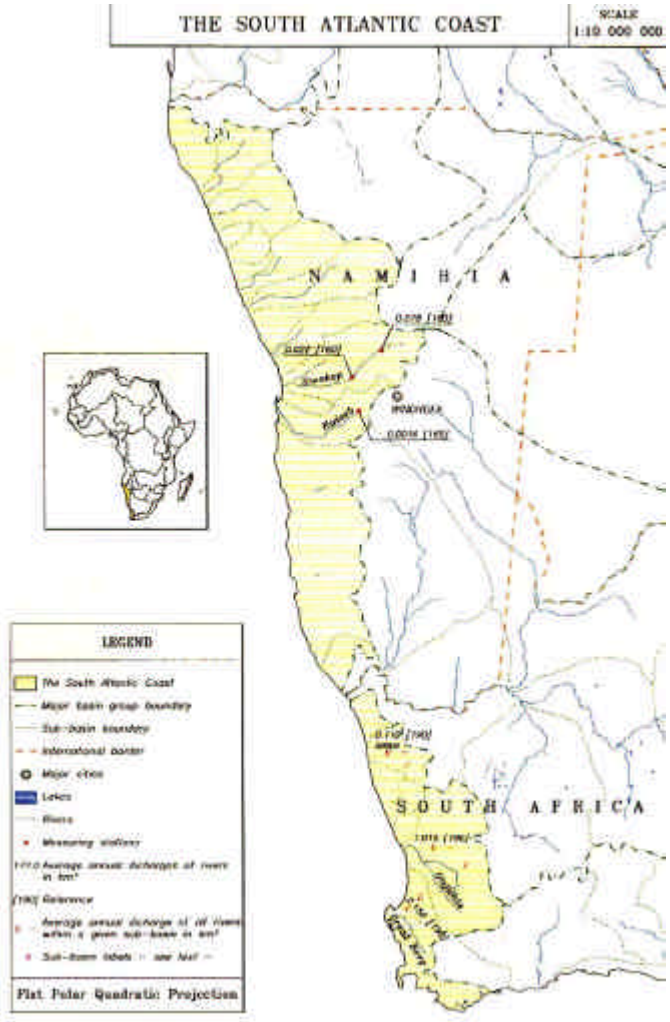
TABLE 75 South Atlantic Coast: areas and rainfall by country

Country	Total area of the country (km²)	Area of the country within the basin (km²)	As % of total area of basin (%)	As % of total area of country (%)	Average annual rainfall in the basin area (mm)		
					min.	max.	mean
South Africa	1221040	101325	27.7	8.3	45	555	200
Namibia	824900	264160	72.3	32.0	0	485	190
For S. Atl.		365485	100.0		0	555	190

Coast							

Rivers and discharges

The South Atlantic Coast is the driest region in southern Africa. In Namibia a few ephemeral rivers exist, on which dams have been constructed. In South Africa three main basins are located in this region and the total surface water resources are estimated at 3.37 km³/year, of which 1.62 km³/year is exploitable and less than 1.00 km³/year available for irrigation purposes [190].



24 - The North East coast

The North East Coast covers 2.4% of the continent and spreads over **six countries** (Map 22 and Table 83).

TABLE 83 North East Coast: areas and rainfall by country

Country	Total area of the country (km^2)	Area of the country within the basin (km^2)	As % Of total area of basin (%)	As % of total area of country (%)	Average annual rainfall in the basin area (mm)		
					min.	max.	mean
Somalia	637660	392065	54.0	61.5	0	650	180
Ethiopia	1100010	50173	6.9	4.6	95	725	235
Djibouti	23200	10400	1.4	44.8	40	465	145
Eritrea	121890	88364	12.2	72.5	40	570	275
Sudan	2505810	96450	13.3	3.8	16	310	80

Egypt	1001450	88250	12.2	8.8	0	135	20
For North East Coast		725702	100.0		0	725	165

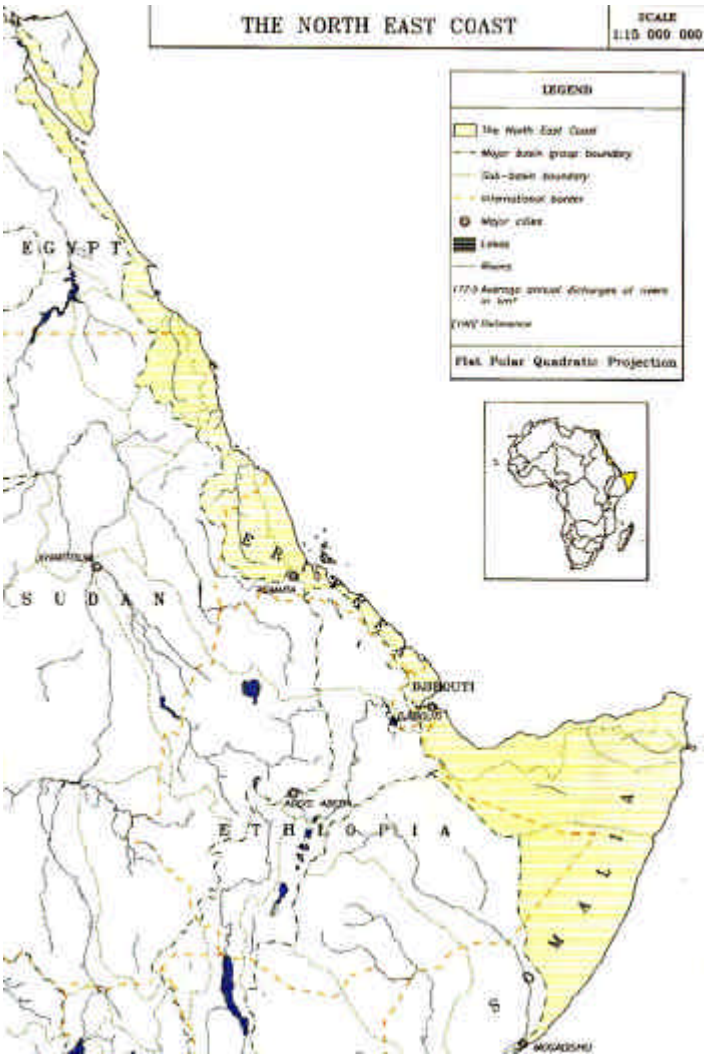
River system and discharges

Five basins can be distinguished in the North East Coast in Somalia:

- In the Gulf of Aden basin the annual upstream runoff is estimated at 0.48 km³. The quantity of water that disappears by infiltration in the upstream parts is estimated at 0.35 km³/year, the infiltration at the coastal area at 0.13 km³/year.
- In the Darror basin there are no significant surface water resources.
- In the Tug Der basin the average annual runoff is estimated at 0.03 km³. Water flows only after heavy rainfall, but it disappears quickly. Little water reaches the coast.
- In the Ogaden basin surface water resources are scarce due to lack of rainfall.
- The Indian Ocean basin is only a very narrow strip of land along the ocean. The surface drainage is insignificant.

The surface water resources in the Ogaden and Gulf of Aden basins in Ethiopia are considered to be negligible. About 55% of Djibouti drains to the sea to the east. Surface water resources are directly dependent on rainfall (> 10 mm), resulting in rapid floods lasting only a few hours. The internal renewable water resources for the whole of Djibouti are estimated at 0.3 km /year.

The Baraka and Anseba rivers rise on the north-western slopes of the central highlands in Eritrea and flow northwards to a confluence near the border with Sudan. Only high rainfall results in flows reaching the Sudanese border, with an average estimated at about 0.8 km³/year, The Red Sea drainage basin in Eritrea comprises numerous small rivers originating in the eastern escarpment. A global estimate of annual runoff of 0.88 km³ has been made for the littoral as a whole. The renewable water resources in Egypt are negligible.



25 - The North West Coast

The North West Coast covers 2.2% of the continent and spreads over **three countries** (Map 15 and Table 58).

Table 58: North West Coast: areas and rainfall by country

Country	Total area of the country (km^2)	Area of the country within the basin (km^2)	As % Of total area of basin (%)	As % of total area of country (%)	Average annual rainfall in the basin area (mm)		
					min.	max.	mean
Morocco + W.Sah.	712 500	449 518	67.0	63.1	6	680	150
Mauritania	1 025520	204 385	30.5	19.9	20	310	95
Algeria	2 381 740	16 718	2.5	0.7	0	110	60
For N.West Coast		670 621	100.0		0	680	145

Rivers and discharges

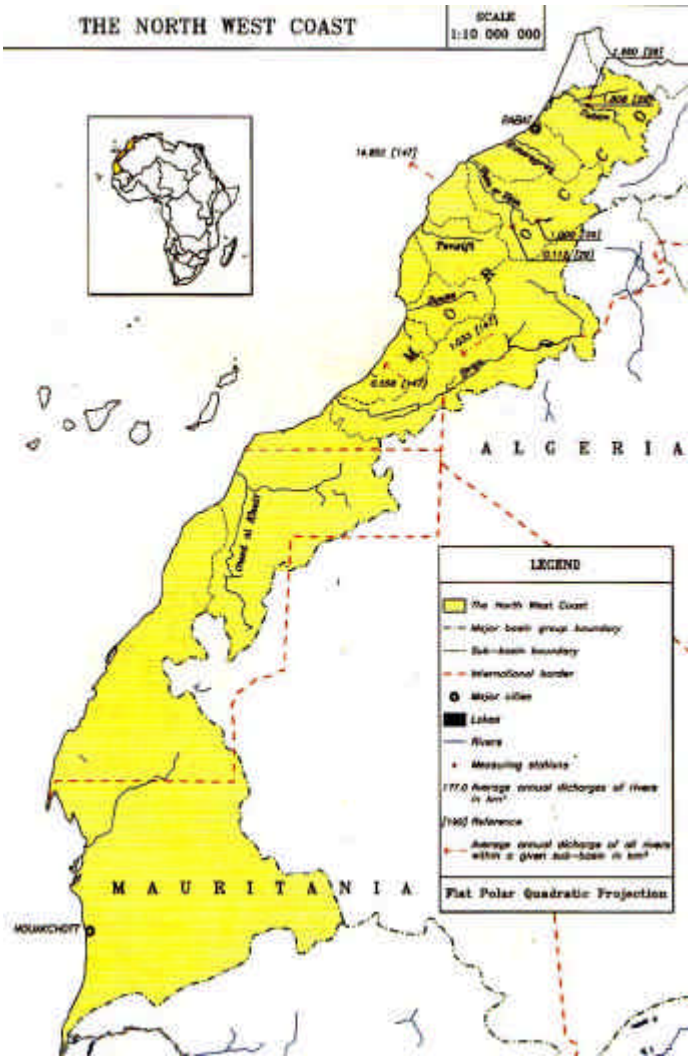
The total renewable water resources for the different basins and regions in the North West Coast in Morocco are summarized in Table 59.

No information on renewable water resources is available for the Western Sahara, Mauritania OR Algeria.

Table 59: Renewable water resources by basin of the North West Coast in Morocco

Basin/region	Renewable surface water (km³/year)	Renewable groundwater (km³/year)	Total renewable water (km³/year)
Sebou	6.60	2.90	9.50
Oum er Rbia	4.50	1.50	6.00
Souss-Massa	0.48	0.29	0.77
Draa	0.77	0.10	0.87
Other	3.59	1.43	5.02
Total	15.94	6.22	22.16

Irrigation potential and water requirements



26 - Madagascar

Two major basin groups can be distinguished in Madagascar: the one draining to the west to the Madagascar Channel and the one draining to the east to the Indian Ocean. Rainfall in Madagascar varies from that of tropical rain forest to near desert conditions. The types of irrigation vary according to the three main ecological regions of the country: the Highlands, the West and the narrow East Coast. Because of the high altitude, in the Highlands the dry season (June-October) is cool, which limits crop production. The West is hot and the dry season is very long, up to nine months in the far

south-west. Rainfall can be less than 400 mm/year. The East Coast is warm and humid with rainfall that can exceed 3000 mm/year and with almost no dry season. Irrigation potential has been estimated at 1.5 million hectares and over 70% of this area already benefits from irrigation, although large areas need rehabilitation.

TABLE 85 Madagascar: irrigation potential, water requirements and areas under irrigation

Country	Irrigation potential (ha)	Gross potential irrigation water requirement		Area under irrigation (ha)
		per ha (m^3/ha per year)	total (km^3/year)	
West	1000000	16000	16.000	700000
East	500000	14500	7.250	387000
For Madagascar	1500000		23.250	1087000

The renewable water resources are estimated at 337 km³/year, which is almost 15 times the total water required for the development of the irrigation potential.

27 - Islands

Five countries are grouped in this category, as shown in Table 86.

Cape Verde, an island group in the Atlantic Ocean to the west of northern Africa, is a very dry country. The islands of São Tome and Principe are situated in the Gulf of Guinea with very high rainfall. The three other countries are situated in the Indian Ocean to the east of southern Africa. Rainfall varies from an average of 900 in Comoros to almost 2200 mm/year in Mauritius. Table 87 summarizes the figures on irrigation and water requirements.

TABLE 86 Islands: areas and rainfall by country

Country	Total area of the country (km^2)	Average annual rainfall in the basin area (mm)		
		min.	max.	mean
Cape Verde	4030	60	500	230
Comoros	1861			900
Mauritius	2040	700	4000	2180
Sao Tome & Principe	960	900	7000	3200
Seychelles	455	1290	2370	1740
Total for islands	9346			

TABLE 87 Islands: irrigation potential, water requirements and areas under irrigation

Country	Irrigation potential (ha)	Gross potential irrigation water requirement		Area under irrigation (ha)
		per ha (m^3/ha per year)	total (km^3/year)	
Cape Verde	2990	25000	0.075	2779
Comoros	300	5000	0.002	130
Mauritius	20000	5000	0.100	17500
Sao Tome & Principe	10700	12500	0.134	9700
Seychelles	1000	5000	0.005	

Total for islands	34990		0.315	30109

Source: http://www.fao.org/docrep/W4347E/w4347e00.htm#Contents

SITES WEB UTILES

EAU EN AFRIQUE
http://www.thewaterpage.com/council.htm

FAO / Ressources en eau
http://www.fao.org/ag/agl/aglw/homeaglw.stm

BANQUE MONDIALE
Eaux transfrontalières:
http://lnweb18.worldbank.org/ESSD/essdext.nsf/18ByDocName/SectorsandThemesTransboundaryWaterManagement

INTERNATIONAL RIVERS NETWORK
http://www.irn.org/index.html

TRANSBOUNDARY WATERS
http://www.transboundarywaters.orst.edu/

RESEAU INTERNATIONAL DES ORGANISMES DE BASSINS - RIOB
http://www.riob.org/

INTERNATIONAL WATER MANAGEMENT INSTITUTE
http://www.cgiar.org/iwmi/

KeyWATER
http://keywater.vub.ac.be/

THE WORLD WATER COUNCIL
http://www.worldwatercouncil.org/

UNEP.Net Freshwater Portal
http://freshwater.unep.net/

African Water Issues Research Unit - AWIRU
http://www.up.ac.za/academic/libarts/polsci/awiru/

NILE BASIN INITIATIVE - NBI
http://www.nilebasin.org/

Water Utility Partnership for Capacity building in Africa - WUP
http://www.wupafrica.org/

AFRIQUE DU SUD

http://www.sadcwscu.org.ls/

BOSTWANA

MINISTERE DES AFFAIRES HYDRAULIQUES

http://www.gov.bw/government/ministry_of_minerals_energy_and_water_affairs.html

BURKINA FASO

MINISTERE DE L'ENVIRONNEMENT ET DE L'EAU

http://aochycos.ird.ne/HTMLF/PARTNAT/MEE/

TCHAD

DIRECTION DES RESSOURCES EN EAU ET DE LA METEOROLOGIE (DREM)

http://aochycos.ird.ne/HTMLF/PARTNAT/DREM/DREM.HTM

Mozambique

THE NATIONAL DIRECTORATE OF WATER

http://www.dna.mz/

AFRIQUE DU SUD

1-DEPARTMENT OF WATER AFFAIRS AND FORESTRY

http://www-dwaf.pwv.gov.za/

2-Umgeni Water (South Africa)

http://www.umgeni.co.za/services/index.html

3-Water Research Commission (WRC)

http://www.wrc.org.za/

OUGANDA

MINSITRY OF WATER LANDS AND ENVIRONMENT

http://www.mwle.go.ug/

MAROC

MINISTERE DE L'EQUIPEMENT

http://www.mtpnet.gov.ma/

OFFICE NATIONAL DE L'EAU POTABLE

http://www.onep.ma/

SENEGAL

MINISTERE DES RESSOURCES HYDRAULIQUES

http://www.sgpre.gouv.sn/

CAMEROUN

MINSTERE DES MINNES DE L'EAU ET DE L'ENERGIE

http://www.camnet.cm/investir/minmee/hydrauv.htm

CENTRE DE R**ECHERCHES HYDROLOGIQUES DU CAMEROUN**

http://aochycos.ird.ne/HTMLF/PARTNAT/CRHC/CRHC.HTM