

THE RIVER NILE

The River Nile represents a unique geographic phenomenon in North Africa; it is the only river that managed to open its way through the Sub-Saharan Desert in North Africa carrying portion of Africa's tropical water to the Mediterranean Sea.



The River Nile

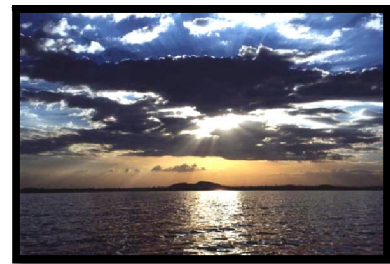
Geography of the Nile:

- The Nile River, the world's longest river, is 6670 kilometers long. In its journey from its remotest southern sources, the Ruvyironza River, in Burundi to its mouth north in the Mediterranean, the Nile passes through different types of religions, natures, languages, cultures and races.
- Unlike other world rivers, the Nile is marked by the following characteristics:
 - It passes from south to north;
 - The Nile covers more than 34 latitudes stretching between its sources at the Equatorial Lakes and its mouth in the Mediterranean Sea;
 - The Nile water flows into a distance of 2700 kilometers between Al-Atbara River and the Mediterranean Sea without receiving any tributaries;
 - The River Nile yield fluctuates from one year to another; the lowest recorded yield reached 42 billion cubic meters, while the highest amounted to nearly 150 billion cubic meters. The Nile's average annual yield throughout the twentieth century is nearly 84 billion cubic meters at Aswan.

Discovering the Nile's Sources:

Explorers followed each others' tracks in their endeavors to discover the Nile's sources. Discovery of the Nile's sources is summarized in the following lines.

- In 460 B.C., **Herodotus**, the Greek historian, visited Aswan where he made the conclusion that part of the Nile water comes from Ethiopia and that the Nile's original sources might have existed in the west.
- In the middle of the first century, Emperor **Nero** dispatched two expeditions to the Nuba; but the expeditions did not manage to achieve any progress due to swamps.
- In the middle of the second century, **Ptolemy**, the scientist, drew his famous map of the Nile in which the Nile is shown to originate from two lakes south of the Equator that gather water resultant from the snowmelt over Mountains of the Moon(The Rwenzori Mountains).
- In the middle of the eighteenth century, **James Bruce**, a Scottish Orientalist, found out that the Nile's primary origin is the Blue Nile. He expressed his extensive description of a trip he made to the Blue Nile and Lake Tana in an- eight-volume compilation.
- From 1839 to 1842, **Mohamed Ali Pasha** sent a series of expeditions under the supervision of Captain **Saleem Bek** to the White Nile. These missions were able to refute the idea that prevailed during that time to the effect that the White Nile's sources lie in the west.



Lake Tana

- From 1853 to 1857, engineer **John Patrick** discovered Bahr Al Ghazal. He was appointed in the Egyptian government to explore the coal mines in Egypt and Sudan.
- From 1860 to 1862, the British Geographic Association sent a delegation headed by the British explorer **John Speke** to east Africa where Lake Victoria was discovered.



Lake Victoria

- From 1864 to 1866, **Samuel Baker**, the English explorer, discovered Lake Albert and wrote a book titled “Albert Nyanza”.
- In 1874, **Chalet Long**, an American Colonel discovered Kioga Lake.
- In 1888, **Henry Stanley**, the British explorer discovered Lake Edward.

A General Description of the Nile River:

Kagera River is the true source of the Nile; it consists of the confluence of two tributaries: Ruvuvu and Nyabarongo where it runs northwards then eastwards to empty in Lake Victoria. The Nile branches from Lake Victoria bearing the name “Victoria Nile”; slopes northwards penetrating a group of swamps before entering Lake Albert, then it goes northwards where it is called “Albert Nile”. When the Nile enters the Sudanese territories, it is called “Bahr Al-Jebel” till it is joined by Bahr Al-Gazal at Lake No forming what is known as “the White Nile” that is stretching till Al-Khartum city where it merges with the Blue Nile coming from the Ethiopian Highlands.

After junction between the White River and the Blue River, the Nile stream is called “the Nubian Nile” till Aswan town. Starting from Aswan, the river is known as “the main Nile River” and continues to bear the same name till north of Cairo city where it is ramified into two branches: Damietta and Rosetta.

The Nile River Basin:

The area of the River Nile Basin is estimated to be nearly 3.3 million km². Ten countries share this area from south to north:

Tanzania - Rwanda – Burundi – Democratic Republic of Congo - Kenya – Uganda – Ethiopia - Eritrea – Sudan – Egypt.



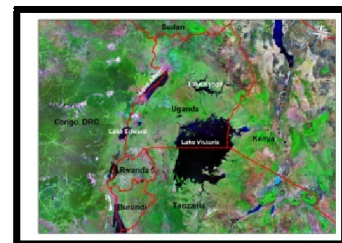
The Nile Basin countries

The Nile River Basin includes the following sub-basins:

First: the Equatorial Highland Lakes Basin

Precipitation falling on the freshwater Equatorial Lakes Highland throughout the whole year accumulates in the following basins:

- 1) ***Lake Victoria Basin*** that is considered the world's second largest freshwater lake in terms of area; its area is nearly 68, 000 km². The lake is not considered deep because its average depth is only 40 m and it is stretched in three countries: Uganda, Kenya and Tanzania.



Equatorial Highland Lakes

The basin's area embracing the rivers that feed the Lake with water is 194,000 km² shared by Tanzania, Kenya, Uganda, Rwanda and Burundi.

A number of tributaries, the most important of which is Kagera River that is 480 km long, flow into Lake Victoria. Kagera River is formed by the confluence of the following two rivers:

- Ruvuvu River originates near Mount Heha in Burundi and receives the income of Ruvyironza River, which is considered the remotest source of the River Nile.
- Nyabrongo River originates nearby the Mount Mfumbiro in Rwanda near Lake Kivu.

The two rivers meet near the Rusumu Falls to form Kagera River which runs northwards along the Rwandan Tanzanian Borders, then eastwards along the Ugandan Tanzanian Borders to discharge in Lake Victoria. The amount of water flowing from all the rivers to the Lake is estimated to be nearly 18 billion m³ annually. In addition, precipitation contributes to the Lake's yield with an annual 5.5 billion m³ only due to the enormous evaporation that occurs and which amounts to 94.5 billion m³ annually. Lake Victoria empties in a fast-flowing river named "Victoria Nile" which is 420 km long and discharges in the northeastern side of Lake Albert.

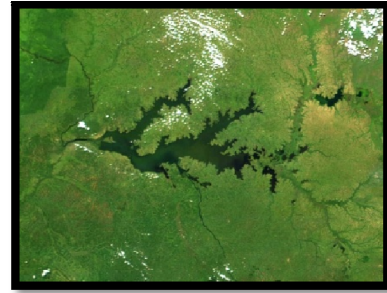
In the distance between Lake Victoria and Lake Albert, Victoria Nile comes out of a group of connected lakes forming a complex that bears the name "Lake Kyoga".

Victoria Nile is marked with a steep slope where the water current falls multiple times forming Ripon Falls and Owen Falls between Lake Victoria and Lake Kyoga and Murchison Falls between Lake Kyoga and Lake Albert. After building Owen Dam and Kera Dam on Victoria Nile, Ripon Falls and Owen Falls disappeared.



Murchison Falls

2) **Lake Kyoga Basin**, which is a huge swamp whose depth does not exceed six meters, is connected with and charged by a number of shallow swamps that are not more than three meters deep. The Lake is surrounded by sedge and covered by water-nymph. Precipitation falling on Lake Kyoga and its related swamps is about 8



Lake Kyoga

billion m^3 ; compared to 11 billion m^3 on its charging basin. In addition, Victoria Nile's yield amounting to 23.5 billion m^3 making the total yield of Lake Kyoga reach nearly 42.5 billion m^3 of which 20 billion m^3 are lost in evaporation due to the Lake's vast surface and its related swamps in an area of 6270 km^2 , leaving nearly 22.5 billion m^3 as the Lake's water supply.

3) **Lake George Basin**, a shallow lake whose area amounts to 250 km^2 in Uganda's remotest west, derives water from many tributaries streaming from the east and the south and discharges its water in Lake Edward via a 32 km watercourse named Kazinga.

4) **Lake Edward Basin**, which is located between Uganda and Democratic Congo, is 2150 km^2 . It draws water from tributaries originating in Mfumbiro mountains southwest of the Lake; of which the most important is Rutshuru River. The Lake empties into Lake Albert via Semliki River that is 230 km long.

Lake George and Lake Edward are connected by Kazinga Channel. The two lakes are almost at the same sea level; which makes the direction of the water current in Kazinga Channel varies in accordance with the difference in the water level between Lake Edward and Lake George. This leads to an increase in the volume of water lost via evaporation and leakage from Lake George and Kazinga Channel particularly when water moves in the direction of Lake George instead of moving towards one of the Nile tributaries, i.e. Semliki River.

The annual water yield that flows out from Lake Edward and Lake George via Semliki River amounts to almost 2.4 billion m³. Semliki River runs from south to north alongside of the western slopes of Rwenzori Mountains. After receiving water from Lake Edward and Lake George, Semliki River is fed by nearly 1.5 billion m³ of rain falling on its basin that is charged by torrents descending from the western slopes of Rwenzori Mountains (Mountains of the Moon).

5) **Lake Albert basin** which is nearly 6500 km². The lake itself is about 6000 km²; 58% is stretched in Uganda and 42% in the Democratic Congo.

The Lake receives 2.5 billion m³ from its basin tributaries that are formed by the torrents running on the northern slopes of Rwenzori Mountains; it also receives nearly 3.8 billion m³ annually from precipitation falling on its surface. Hence, the total water yield of this huge lake becomes 32.7 billion m³ of which 6.2 billion m³ evaporate annually leaving the annual net water yield at a range of 26.5 billion m³.

At its remotest northern part, Lake Albert pours in a watercourse named "Albert Nile" that runs for a distance of 225 km till a Sudanese town called Nimule that lies at the Ugandan Sudanese borders where the river loses approximately 5% of its water through evaporation and the water yield at Nimule reaches nearly 25.2 billion m³.

At Nimule, the river is called Bahr Al-Jebel; the river's course in its upper basin is obstructed by rocks and stones and it turns into a sweeping torrent. After 20 km, the river is intensified by combining with another river sloping from the east and known as "Aswa River" which originates from the Equatorial Highland in Uganda. At the point where the two rivers meet, Fula Falls are formed. Bahr Al-Jebel continues to flow in a regular stream to the Sudanese town of Mongla where it annually acquires approximately 4.8 billion m³ of water from the tributaries and precipitation. Its yield at Mongla town is nearly 30 billion m³.

Then, the river flow becomes slower due to its mild sloping. Water overflows on its banks forming swamps on which sedge and dense high savannah forests grow and form what is known as "The Sadd Region" that is stretched for a distance of 700 km from Mongla in the south to Malakal in the north, 250 km from Malakal in the east to the point connecting Bahr Al-Ghazal, Bahr Al-Arab and Al-Jur River in the west. Due to formation of these swamps and the evaporation of its heavy plant cover, Bahr Al-Jebel loses approximately half of its discharge, i.e. nearly 15 billion m³ annually.

On the eastern side of Bahr Al-Jebel, courses of some rivers are defined due to draining water of some swamps into them. One of these main rivers is Bahr Al-Zaraf that runs northwards and goes in a meandrous course for a distance of 280 km till it reaches its mouth that is 80 km away east of Lake No which receives water from Bahr Al-Gazal streaming from west of Sudan. Bahr Al-Jebel's course ends in a place nearby Lake No.

There are two rivers originating from South Sudan Heights; i.e. Al-Naam and Lao. Annual discharge of both rivers is almost 2.5 billion m³ that go completely to waste in Bahr Al-Jebel swamps south of the Sudanese town of Shambi.

The total water yield of Bahr Al-Jebel and Bahr Al-Zaraf at Malakal amounts to approximated 15 billion m³ per year.

Second, Bahr Al-Ghazal Basin

Precipitation falling on west and south Sudan during the period from mid-July to September accumulates in Bahr Al-Ghazal Basin that is marked by its slight sloping. This basin embraces a number of rivers most of which originate from the mountains located at the water sharing line between the Congo River and the Nile River in the following order from the west to the east: Bahr Al-Arab, Lol River, Jur River, Tonj River and Jil River. These rivers empty in Bahr Al-Ghazal that starts from the confluence of Bahr Al-Arab, Jur River southwest of Pantoio town in South Sudan.

Bahr Al-Ghazal Basin is about 526,000 km²; its annual rainfall yield is 12 billion m³. However, the nature of flow and decrease of the tributaries' sloping as they head to the north and northeast directions lead to a loss of almost 96 % of that amount via evaporation and leakage into swamps and plant evaporation (Sadd Region). Therefore, volume of the surplus from that huge basin hardly exceeds annually 0.5 billion m³ that end in Lake No.

Third, the Ethiopian Highland Basin

Seasonal rainfall water – from April to October - on the Ethiopian Plateau is accumulated in a large number of rivers that form three major basins:

1) Sobat River Basin:

Sobat River Basin is nearly 225,000 km². The Sobat River is formed by the junction of two main tributaries; Baro River and Pibor River. Baro River rises south of the Ethiopian Plateau, then stream westwards to Sudan. It is 306 km long; its main tributaries are: Birbir and Jokau. As for Pibor River, it is formed by the convergence of Loilla and Latoka Rivers descending from north of the Equatorial Lakes Plateau and runs in a northerly direction for a distance of 320 km. Its key Ethiopian affluents are Akobo and Jela rivers.

The Annual income of Baro River at the Ethiopian town of Gambela reaches nearly 13 billion m³. However, such a huge income does not go without losses till the end of the stream where maximal loss of running water in Baro River occurs after the mouth of Jokau River. Portion of the flowing stream springs from the right bank of the watercourse and spreads forming Mashar swamps in which Baro River loses nearly 4 billion m³ per year. On the other hand, the annual discharge of Pibor River at its junction with Baro River is 3 billion m³.

Thereby, the total water yield supplying the Sobat River from Baro and Pibor Rivers becomes 12 billion m³ annually upon their convergence 40 km before the Sudanese town of Al-Naser. The Sobat River streams in the Sudanese territories for a distance of 350 km with a mild sloping in a westerly direction to empty in the White Nile at 23 km south of Malakal town. Through its flow, the Sobat is connected to minor branches providing limited water amounts and making its annual water yield 13.5 billion m³ at its end in the White Nile.

The White Nile

All the aforementioned basins discharge into the White Nile that starts its journey from Lake No and ends in Al-Khartum town. The White Nile is 970 km long with an annual yield of 15.5 billion m³ at its upper course. Its yield is the resultant of yields of Bahr Al-Gazal Basin and Bahr Al-Jebel and Bahr Al-Zaraf basin. It takes a westerly direction for an approximated distance of 125 km passing in a slow sloping gorge with water overflowing its banks forming swamps throughout the distance from Lake No to the estuary of the Sobat River that supplies it with 13.5 billion m³ annually.

Then the White Nile goes north passing Malakal town. The White Nile's sloping decreases and its stream width gets wider regularly till it becomes nearly 2 km by the end of its course at Al-Khartum city.

Due to the vast surface of the White Nile and its increased evaporation rate, it loses almost 1.6 billion m³ on an annual basis within the distance between Malakal and Al-Khartum. It also loses nearly 1.9 billion m³ as a result of storing water in front of Jabal Al-Awliyaa Dam via evaporation and leakage in rocks layers in the bottom and sides of the Stream.

2) The Blue Nile Basin:

The Blue Nile Basin is 235,000 km²; the river originates from south east of Lake Tana that is located at 1800 m high above sea level. Owing to the heavy seasonal summer rainfall, the river has been carving a huge canyon through the Ethiopian Plateau, its depth increases gradually till it reaches 1500 m. The River also takes a steep sloping reaching 1:1000 particularly in the area from Lake Tana to the Roseires.



The Blue Nile Basin

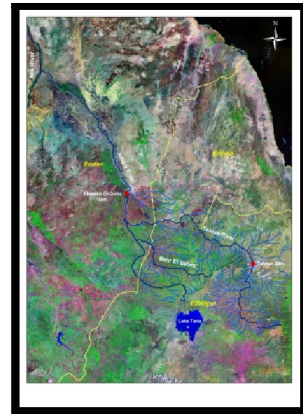
During the period of seasonal summer precipitation, the Blue Nile starts from Lake Tana with an annual water yield not exceeding 3.8 billion m³. At its upper course, the Blue Nile stream is blocked by rocks and cataracts forming Tis Issat Falls. The River then loops in a southeast direction, then south, south west, then west till it evades the high volcanic mount Shuk that is 4500 m above sea level, after a 980 km long journey, at the Roseires, its water yield amounts to nearly 50

billion m³ where the Blue Nile meets a large number of feeder streams including: Bashelo river, Gama river, Muger river, Guder river, Didessa river, Yabus river, beles river; all originating from the Ethiopian Plateau.

Within the distance from Roseires to the estuary of the Blue Nile at Al-Khartum city, which comes nearly to 640 km, the sloping decreases and the stream becomes wider. The river receives its water from two tributaries: Ad-Dindar and Ar-Rahad that start from northwest of the Ethiopian Highlands adding 4 billion m³ to make the Blue Nile's annual water yield 54 billion m³ upon its convergence with the White Nile.

3) The Atbarah River Basin:

The Atbara Basin is 112,000 km²; it starts 50 km north of Lake Tana passing 830 km till its mouth in the Main River Nile at the Sudanese town of Atbara that lies 310 km north of Al-Khartum town. Its major tributary is the Tekeze River, sometimes known as the Setit River, is 608 km long and starts north of the Ethiopian Plateau near Mount Qachen. The River has been excavating a great gorge whose depth is nearly 2000 m in some parts. Tekeze River is responsible for the largest part of sediment load carried by Atbarah River during the flood period.



Atbara is the last great tributaries feeding the Nile River till the end of its journey into the Mediterranean Sea. The Atbara makes a sever descent resultant from its swift flow and its massive capacity to carving leading to a remarkable decline of its water level in relation to the plane land area on both banks.

When precipitation ceases – from January to May- the River course turns into an arid and semi-arid space. The course bottom becomes exposed and apparent except in some scattered places in which some stagnant water remains.

During the period of precipitation on the Ethiopian Plateau - especially during July, August and September, the Atbara River turns to a totally different scene. At that time of the year, water flows abundantly like a sweep torrent carrying enormous amounts of sediment and suspended fragments that the river collects

from its tributaries and upper course. The Atbara's water yield at its estuary in the main Nile River is nearly 12 billion m³ annually.

The Nile River after Al-Khartum:

The White Nile converges with the Blue Nile at Al-Khartum town where a charming phenomenon signifying the difference between the natures of the two rivers occurs. During the Blue Nile's flood time – that starts from the Middle of July to September- its fierce boisterous water current rushes to occupy the main Nile's course north of Al-Kahrtum driving the



Confluence of White Nile and Blue Nile

White Nile flow tens of kilometers back till the flood period is over. Afterwards, the White Nile begins to flow once again to the Main Nile north of Al-Khartum. Within this period, the demarcating line separating the dark reddish Blue Nile (whose color is attributed to the sedimentations it carries) and the light-colored White Nile becomes apparent. The difference in color becomes visible, with the naked eye, between the point of convergence and Al-Mawrida area in Om Dorman in a general direction heading from the southeast to the northwest. The River Nile proceeds north of Al-Khartum with a sloping to the northeastern direction to join its final tributary, i.e. the Atbara.

After the convergence of the Atbara with the River Nile, the river streams to the north and northwestern. When it reaches the Sudanese town of Abu Hammad, the biggest fundamental change occurs in the general direction of the course of the River Nile; it converts its direction between the Abu Hamad and Ambikol towns from the northeastern to the southwestern, moving opposite to the flow in all sectors of the Main Nile course.

After Ambikol town, the River course turns back to continue its general direction heading to the north, drawing a great arch within latitudes 18 and 22. A short distance after Wadi Halfa, the Nile goes to its normal course heading to the northeast in its way to Aswan town.