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LAKE OF GUIERS (SENEGAL, WEST AFRICA)

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Lake of Guiers is the only lake in Senegal. Located 50 km from the Atlantic coast (latitude 16°10' N ; longitude 16°08' W), it is a narrow cavity 50 km long and 7 km wide, situated at 2 meters below sea level. The lake constitutes an important fresh water reserve and is connected to the lower Senegal river in a straight line by the Taoué canal. A system of sluice gates allows control of water exchange between the lake and the river.

The configuration of the lake change considerably through time and space, under the effects of the river inflows, losses through evaporation and pumping. In its average state, the lake has a depth of 1.5 meters, an area of 225 km² and a volume of 350 millions m³.

The first modifications around lake of Guiers date from the 1950's. The damming up of the northern region and the closing of the southern and western outflows made it into the largest fresh water reserve in the country, before the building of the dams on the Senegal river. The lake water was first used for the irrigation of rice fields, then for irrigation of the 7500 ha of sugar cane cultivated nodaways. The lake supports several small agricultural installations, which are found all around its periphery. It also provides 10 to 15 % of the drinking water of Dakar, the capital city (population 2 million), through a 250 km water main. An open air canal project allowing the transfer of 450 million m³ of water per year to greater Dakar, is planned for 1996.

Since 1985, the Diama dam has modified the hydrology of lake of Guiers. This river dam, located 100 km downstream from the lake, was built to prevent sea water inflow in the lower valley of the Senegal river. The absence of relief previously allowed seawater intrusions up to 250 km inland. The river water would thus become brackish, limiting the development of irrigated cultivated land. A second dam (Manantali in Mali), built to regulate the floods, is situated 1200 km upstream; it has been in use since 1987.

The region has a sahelian climate : a rainy season lasting 2 to 3 months, irregular pluviometry of 200-250 mm per year, an average annual temperature of 28°C and a low relative humidity (40%).

The hydrology of the lake is complex and has been drastically modified since 1985 :

-before 1985, hydrology and lake's water level were dependent on the importance and duration of the annual river flood, which in turn was dependent on the pluviometry of the upper basin, itself largely deficitary since 1972. Under the combined effect of insufficient filling, increased pumping for irrigation, and evaporation (2.25 m per year), the level of the lake in certain years went below the threshold levels below which its exploitation is limited. Extreme conditions were reached in 1984 when the lake was almost completely dried up.

-since 1985, the effects of the Diama dam have been clearly discernible. Water is permanently available in the river, the lake can be filled several times per year, its water levels are more stable and higher, given a reduction of agricultural pumping.

The actual rate of use of river inflows to the lake (for irrigation and drinking water production) is low (about 7%). On the other hand, the losses are due mainly to evaporation (90%). The problem of the quantitative management of this sahelian ecosystem thus appears clearly.



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The physicochemical quality of the waters is characterized by yearly evolution of the mineralization of solutions and the establishment of a well defined salinity gradient from north to south. The current total mineralization is on average 270 mg/l (7.7 meq/l). Throughout the year, outside of water replenishing periods brought by the river floods, concentration of the waters occurs through evaporation. Chloride levels of 35 meq/l have been measured. Average annual water concentration gradient is 4.5 currently.

In extreme conditions observed during drought years, before 1985, chlorides reached levels of 230 meq/l. Average yearly concentration gradient of lake waters was of 6.5 then.

The pH is stable, varying from 7.5 to 8.0 (extreme conditions excepted). The average conductivity, year by year, is of 280 microS/cm at 25°C but the variation is important according to the station and the period of the year.

Nitrate levels are low, while phosphorus levels are in the order of 30 µgr/l. The study of nutrients has yet to be undertaken.

Since 1985, the more considerable renewing of lake water by river inflow has caused a spectacular decrease in mineralization of the lake water. Hydrobiological modifications have been discernible since that year :

-algal blooms have been observed since 1989, with high concentrations of Cyanophyceans (Anabaena and Mycrocystis).

-higher aquatic vegetation is developing, with an invasion of the southern lake region by Pistia stratiotes and rapid development Typha australis. Other species that were rare or absent before 1985 are now appearing and rapidly proliferating.

-fish fauna is diversifying and seems to be adapting to the new hydrological conditions. The annual fishing potential is estimated at 1600 tons.

We should also mention the appearance and rapid development of intestinal schistosomiasis upstream of the Diama dam since 1987. The spread of this disease towards lake of Guiers, where the mollusc that acts as intermediary host is present, is inevitable in the short term.

The Diama dam has had rapid and obvious effects on the hydrology, physico-chemistry and hydrobiology of lake of Guiers. The evolution observed is however too recent for a reliable diagnosis to be established.

The lake of Guiers is a sahelian ecosystem that is fragile and very sensitive to environmental modifications. Its importance as future source of water for the most populated region of the country makes it necessary to implement sound and concerted management practices starting now.

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