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OF AFRICAN GREAT LAKES
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CONSERVATION OF THE RESOURCES OF THE AFRICAN GREAT LAKES: WHY?

An Overview

by

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The purpose of our Symposium is to analyse the nature of the resources of the Great African lakes, their utilisation and the need to conserve them, and to determine ways to convince policy makers and economists dealing with their management.

As an introduction to the Symposium which has just been officially opened, I propose to present you now with an overview to illustrate the relation between the different subjects to be discussed during the next few days.

1. The first question is: Which African Great Lakes are to be covered by the symposium?

The African Continent has been subject to a very long period of tectonic inactivity, until the second half of the Tertiary. During the Miocene (20 million years ago), it was stirred by vast tectonic and volcanic activity which caused multiple fractures, created mountain chains as well as rift valleys, the latter being mostly oriented North-South in the East African region. In the Pliocene (over 1,5 million years ago), these deep rifts already existed in the form of two more or less parallel branches.

These profound changes in the relief of Africa led to important modifications in the hydrological system which had been established during the millions of years of tectonic inactivity. Rivers which flowed from East of West were interrupted by tectonic trenches gradually filling with water, thus creating a series of lakes. The numbers and size of these first lakes were probably different from the present lakes. These present lakes are:

- in the Western branch, Lake Mobutu (ex Albert, 6,800 km^2), Lake Idi Amin (ex Edward, 2,325 km^2), Lake Kivu (2,700 km^2), Lake Tanganyika (33,000 km^2) and Lake Malawi/Nyasa (30,000 km^2);

- in the Eastern branch, the only Great Lake is Lake Turkana (ex Rudolph, 7200 km^2), with a great number of smaller lakes like Stefanie, Baringo, Nakuru, Naivasha, Manyara etc., of which some are presently filling with sediment.

Although, in their present form, they did not exist when the rifts formed, these lakes are of great geological age. It is thought that Tanganyika, the deepest and largest lake, has existed 5-20 million years, during most of which time it has been isolated from other hydrographic basins.
Only Lake Kivu in its present form can be considered very recent as it formed after the Virunga volcanoes emerged and about 10,000 years ago blocked the outflow which then existed between a former lake and Lake Idi Amin.

Between the two Rift Valleys other lakes were formed in different circumstances. Of these, the most important are Victoria, the largest lake in Africa (68,000 km^2) and Lake Kyoga (2,700 km^2).

Lake Victoria occupies an enormous, shallow basin (average depth 20m), formerly drained by a large network of rivers flowing towards the Western rift, and probably also of smaller lakes. Since the mid Pleistocene (some 500,000 years ago), tectonic movements would have gradually uplifted the Western part of the basin, thus creating a barrage and even a reversal of the flow of the rivers. This led to the creation of a lake having as many branches as there were inundated river valleys, probably swampy and fragmented, and later, when the uplifting of the western rim continued, to a single shallow basin.

During a relatively long transition period, this lake could occasionally have overflowed in westerly direction, into the old valleys of the Akagera and Katonga rivers.

The present situation dates back only about 35,000 years, when the level rose a further 100 m. Lake Victoria then overflowed towards the North, filling the valley of another river which originally also flowed westward thus forming Lake Kyoga. The latter overflowed in its turn via the Murchison Falls, and joined the Nile below Lake Mobutu (Albert). Lakes Victoria and Kyoga are therefore considerably younger than the Rift Valley lakes.

The East African Great Lakes thus comprise the Rift Valley lakes Mobutu, Idi Amin, Kivu, Tanganyika, Malawi and Turkana as well as the shallow lakes Victoria and Kyoga.

Victoria is the largest of these lakes (68,000 km^2) and Tanganyika the deepest (1,470 m). To these can be added the reservoirs Lake Kariba (5,250 km^2) and Cabora Bassa (1,739 km^2), created on the Zambezi River some 30 and 15 years ago, respectively.

2. What resources do the African Great Lakes contain?

These are manifold: water reservoirs, fish stocks, biological diversity, touristic attractions, transport opportunities and sources of energy.

2.1 Water reservoirs

These lakes constitute above all irreplaceable reservoirs of drinking water for the inhabitants of the area, and of course also for an important wild and domestic terrestrial fauna.

As the quality of the water is still generally good, water is used directly by rural populations, or is pumped up and distributed in many towns after mere filtration and bacteriological deactivation. The town of Bujumbura depends on this technique for part of its water supply.

We dare not think of the problems which would arise when these reservoirs for one reason or another would become unsuitable as sources of drinking water.

2.2 Fish stocks

The next resource which immediately comes to mind are the fish stocks for human consumption, which abound in the Great African Lakes. Since these lakes are located in developing countries where the production of animal protein is well below nutritional requirements, these stocks are of great importance.

From an economic point of view, fisheries and related activities constitute a source of income for an important part of the population.

On Lake Tanganyika, of which the annual fisheries potential is estimated at 300,000 tonnes, the fishery is largely based on the pelagic clupeids Stolothrissa tanganicae (Ndagala) and Limnothrissa miodon (Lumpu) and their predators (Lates species). The clupeids constitute more than 80% of the catches, and Lates stappersi a little over 10%.

One of the pelagic Tanganyika Clupeids - Limnothrissa miodon - has been introduced into lakes Kivu and Kariba and presently forms the basis of a developing artisanal fishery. For various reasons, the stock in Lake Kivu, however, remains smaller than in Lake Tanganyika.

Until the 1970's the fishery in Lake Victoria was based mostly on cichlids, particularly Haplochromis and Tilapia, but these stocks have drastically declined after the explosive increase of Nile perch (Lates niloticus), which was introduced in 1957. At present, this species constitutes most of the catch in this lake. We shall come back to this a little later.

The resource "fish" is thus a very important source of protein around Lake Victoria, and even further away since these Victoria Lates can now also be found in the market of Bujumbura.

Lake Malawi is believed to be less productive than Tanganyika, though showing large fluctuations in productivity. With an estimated annual yield of 30,000 - 40,000 tonnes, it forms an important source of protein as well as employment in its riparian countries.

There is no need to go into further details here concerning the Great East African lakes, which are irreplaceable reservoirs of fish for the local populations, even those living further away from the lakes, particularly in landlocked countries like Burundi, Rwanda, Uganda and Zambia.

The morphological variability of the fishes in these lakes, particularly in cichlids, makes many of them are very popular as ornamental fishes. Trade in these fishes is already more or less developed as in Tanganyika, but could be further expanded and thus contribute to the foreign exchange earnings of the countries in the region.

2.3 Species diversity

These lakes not only contain fishable stocks, but are also sanctuaries of a fauna and flora which are so diversified as to have an immense scientific value.

The very long isolation of these lakes, the variation in their biotopes and the ecological characteristics of each individual lake has led to an unprecendented speciation of aquatic organisms, particularly fish, molluscs and crustaceans.

In fishes, species diversity particularly occurs in the cichlid family, with over 250 species in Lakes Malawi and Victoria, close to 200 in Lake Tanganyika and over 50 in Lake Mobutu (Albert). In all these lakes the degree of endemism within this family is close to 99%.

The African Great Lakes and for that matter most of the smaller lakes too are life-size laboratories in which mechanisms of speciation and evolutionary stages can be studied together with the correlation between biotopes and biocenoses. These lakes have in no way given away all of their secrets.

The biotopes need to be better explored, and the fluctuations in physical and chemical composition of the different water masses better understood as well as the mechanisms of biological production at different trophic levels. The systematic inventory is by no means complete. The biology of most of the coastal species is not yet known. All the more reason to leave them intact.

2.4 Tourism

The African Great Lakes are also known for their beauty and variety of coastal landscapes, their untouched beaches, their vegetation and wildlife, their clear waters, their opportunities for sports fishing and hiking. Tourism is yet to be developed in this region, and can bring considerable revenue for the riparian countries.

At present, tourism is mostly developed in parks and nature reserves as in Kenya, Tanzania, Rwanda, Malawi and Zaïre. It could be extended to the lake areas when infrastructures for water tourism are developed (waterskiing, canoeing, hiking) on the lakes.

2.5 Lake transport

Because of their great size and international character, the African Great Lakes offer excellent possibilities for trade as well as for opening up isolated regions of East Africa. In Burundi, everyone knows the importance of Lake Tanganyika in this respect.

Taking into account the investments needed for road or rail transport, lake transport is often preferable. These lakes therefore constitute an important resource for the development of trade between the countries in the region and with the world.

2.6 Energy resources

Most of the African Great Lakes are increasingly being explored for possible energy resources.

It has been known since Kufferath (1960) that methane has accumulated in the deeper water layers of Lake Kivu, the estimated quantity of which is 37 km^3, the caloric equivalent of 30 million tonnes of diesel oil. Financing has as yet to be found to develop adequate extracting techniques.

In the 1980's, explorations for oil have taken place in the bed rock of Lakes Tanganyika, Victoria, Mobutu, Turkana and their coastal plains. The fact that oil companies have accepted participation and are investing heavily means that they seriously believe in what they are doing. As yet we do not know their results and I believe that at least in Lake Tanganyika, exploration has not yet been finalised.

If these explorations lead to the discovery of exploitable deposits, this would mean that the countries concerned would be able to solve their most urgent economic problems. I want to add here that the exploitation of these oil deposits below lakes could easily lead to oil spills and thus to the destruction of all the other resources which I mentioned earlier, good drinking water, fish stocks of great nutritional and commercial value, a fauna of unique scientific value, the touristic value of the lakes etc.

The exploitation of oil resources is therefore not necessarily a good thing for the populations and countries concerned, even from an economic point of view.

The African Great Lakes constitute an important series of resource for the East African countries and for the world. All these resources could, however, threatened by human interventions.

3. Which are the main threats to these resources?

3.1 Risk of pollution

The main sources of pollution and their effects on freshwater can be classified as follows:

- chemical pollution, i.e. the accumulation of foreign chemical substances, either natural (heavy metals, minerals, hydrocarbons) or synthetic like detergents, pesticides, plastics, phenols;

- biological pollution resulting from the accumulation of biodegradable substances and the development of pathogenic micro-organisms;

- physical pollution, through the accumulation of suspended matter, modifications in temperature, radioactivity etc.

Chemical pollution results from urban and individual effluents, but also from leaching of fertilisers, pesticides or herbicides used in agriculture.

Biodegradable substances responsible for biological pollution reach freshwater with domestic effluents loaded with municipal detritus and fecal matter, or with discharge from various industries such as sugar plants, paper mills, distilleries, breweries, soap and oil factories, slaughter houses, milk and cheese plants, textile industries and many others.

Biological pollution leads to eutrophication, of which the final stage is the deoxygenation of water layers and the appearance of anaerobic fermentation, with production of methane, ammonia and hydrogen sulphide. Before this stage has been reached, the fauna, of course, has disappeared. This is presently happening in some of the Great Lakes in North America.

At present, this problem has not yet arisen in the Great African Lakes. However, urban populations and industrialisation are on the increase and agriculture is being modernised. These factors can lead to chemical or biological pollution, unnoticed at first, but serious and irreversible in the end.

A particularly serious risk of chemical pollution needs specific mention. It concerns pollution through hydrocarbon compounds. Let us look at the situation in Lake Tanganyika. A large part of the fuels and oils to be used by its riparian countries arrive by lake transport. Often, they are even stored near the lakeshore. The risk of an accidental spill of large quantities of fuel is always present, during transport or storage, e.g. in case of an accident involving a transport boat, failures in pipelines or storage reservoirs, or even in case of a fire. One tonne of hydrocarbon compound can spread into a monomolecular layer of 12 km^2.

Discarding used motor oils by garages directly into sewers should also be mentioned, particularly since these oils contain in addition highly toxic and even carcinogenic substances.

If oil exploration yields positive results and leads to the exploitation of oil in or near the lakes, the risks of contamination during extraction, storage, lake transport and refining are very high. This means that a catastrophic situation would arise where lake waters would become unsuitable as drinking water, that (even the surviving) fish would become inedible and that it would become impossible to bathe in the lake.

These disastrous effects would affect the human populations, as well as the terrestrial wildlife living near the lake, and also, of course, the total aquatic fauna constituting the great economic and scientific resources of the African Great Lakes. At the same time, all touristic attractions of the lakes would cease to exist.

We should also mention the physical pollution of the lakes. Agriculture on mountain slopes, deforestation and road construction considerably increase erosion in the catchment area. This increases the quantity of suspended matter carried by the river or flowing directly into the lake.

When looking at the littoral zone of lakes like Tanganyika during the rainy season, we always find a band of brown waters varying in width from ten to a couple of hundred metres, depending on the strength of the last rainstorms and the distance from the river mouth. These turbid waters contrast markedly with the blue to green water of the rest of the lake. The littoral fauna is certainly affected by the turbidity of the waters and the constant accumulation of sediment on the bottom.

The risks of pollution in the Great African lakes are therefore very real, even if they are not yet fully known. The effects of such pollution are exacerbated by the closed nature of some basins, resulting in particularly long water retention times, over a 1000 years for Lake Tanganyika. The evaporation rate of these lakes is also very high.

All these factors lead to an accumulation of pollutants in the deeper water. Surface layers are however also affected through periodic upwelling of deep water. Pollutants can thus accumulate in the food chain.

3.2 Reduction of fish stocks

All fish stocks subject to fisheries are potentially threatened. In stable ecosystems, exploitation of fish stocks necessarily has an impact on the composition, distribution and abundance of the resources.

Fishing gears and methods being generally selective, some species are more vulnerable than others. In Lake Tanganyika, where the fishery mostly addresses the pelagic stocks, the small clupeids seem to support fishing pressure relatively well, undoubtedly due to their resilience and high renewal rate. Catches of the larger predators (Lates) have, however, greatly decreased in the last decades, particularly in heavily exploited areas in Burundi and Zambia. The same phenomenon of decrease of larger species is found elsewhere, e.g. in Lake Malawi.

In Lake Victoria, larger Oreochromis became rare in gill net catches in the 1960's. Fisheries then turned to the small Haplochromines using bottom trawls. Stock composition has, however, changed again over the last five years after the sudden increase in Nile perch (Lates niloticus), which now dominates the catches. One may wonder how long this may last.

This leads us to mention the risks involved in introducing new species into lakes. While the introduction of Limnothrissa in Lakes Kivu and Kariba has led to an exploitation of the pelagic zones of these lakes, this should not make us forget that introduction of new species into stable ecosystems often leads to unforeseeable situations.

A recent example is again the case of Lates Niloticus which was introduced into Lake Victoria before the 1960's, in spite of several protests. This voracious species feeds on Haplochromis species endemic to the lake. Since its explosive increase in the lake and the subsequent decrease of a number of endemic species, fear has been expressed about the reduction of the biological diversity which made the lake unique. Valuable information on speciation in relation to biotopes is thus forever lost for science. It could also lead to economic loss since the total quantity of fish in the lake decreases; thus 8 - 10 kg of Haplochromis, which could have been consumed directly by man, now serve to produce one kg of Nile perch flesh. This is a wastage, even though a luxury product is thus obtained.

3.3 Changes in terrestrial and coastal biotopes

Modification of coastal biotopes and changes in catchment areas of lakes also have their impacts on the resources which we have identified.

Increases in human population density lead to increases in agriculture, in inhabited areas and transport networks at the expense of the natural vegetation, constituting biotypes indispensible to the terrestrial fauna living near the lakes. Thus hippopotamuses, crocodiles and water fowl which form the attraction of Lake Tanganyika are now disappearing; luckily, a small part, the Ruzizi delta, is now being protected.

Modifications in the catchment areas are also responsible for physical pollution of the waters which were mentioned above.

4. Conclusion

We have summarised the numerous resources of the African Great Lakes and their main threats. I have only mentioned them briefly, knowing that the presentations which will follow will illustrate them and present further detail.

I have not attempted to present solutions for the conservation of these resources. I am convinced that these will be identified as a result of the analysis of the different situations and the discussion that will follow them. If we work on this together, we shall have a greater chance that they will be more complete and hopefully more acceptable.

The effective conservation of the resources of the African Great Lakes will only be possible after consultations between all partners in development in the region leading to a consensus on the solutions to be adopted.

I hope that our present Symposium will actively contribute towards this goal.