# Saving Lake Chad: An analysis of the Oubangui-Chari water transfer proposal

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## INTRODUCTION

Imagine a plan to divert water from the Canadian Rockies to the Great Salt Lake in Utah, and you'll have some idea of what Sanusi Imran Abdullahi is proposing. Abdullahi, the Nigerian-born executive secretary of the Lake Chad Basin Commission, is in charge of saving one of the world's most endangered water bodies, central Africa's Lake Chad. Threatened by a perfect storm of climate change, overwithdrawals, and a rapidly growing population, the people who rely on Lake Chad for their livelihood have watched it shrink to $1/10^{th}$ of its size over the last 50 years.

With some scientists predicting the lake will disappear entirely by 2030, Abdullahi is now banking on a dramatic last-ditch effort to rehabilitate the basin: a massive diversion of water from the Congo River watershed, 1000 km away, into the Chari River which feeds the lake. Since 2003, the LCBC has been trying to lure international investors to help fund a dam, pumpworks, and canal that are together estimated to cost $14.5B (Chimtom, 2013).

As expensive as that may sound, the cost of doing nothing may be greater. 30 million people rely on the lake and its source rivers for drinking water, irrigation, and fish. The lake supports a valuable marshland ecosystem that provides a home to migratory birds, hippos, and crocodiles. And by moderating the weather, some of the hottest on earth, it acts as a bulwark to keep the encroaching Sahara Desert at bay.

Any solution must deal with the complicated geography of the region. Lake Chad is the ultimate transboundary water body. The borders of four nations meet up in the middle of its waters, while the basin itself, the second largest in Africa, includes portions of eight nations. Aside from these, the

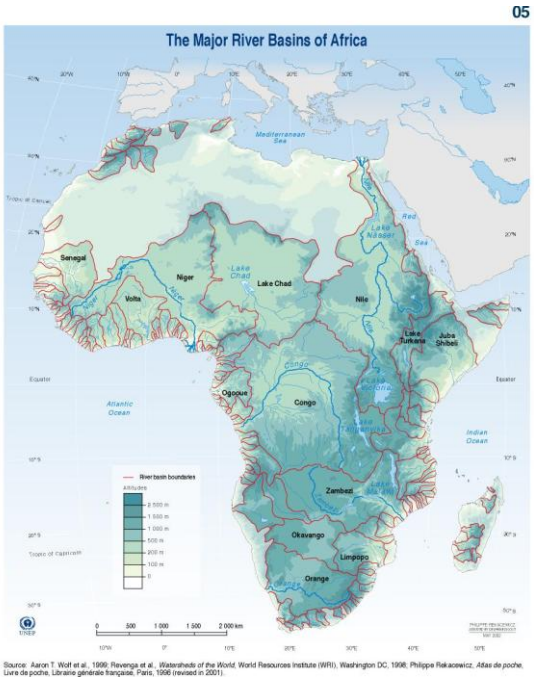
water transfer project would affect still more nations in the Congo Basin. The number of stakeholders is truly immense.

Then there are the socioeconomic and political dimensions. The nations involved are some of the poorest and least developed in the world – Niger ranks dead last in the 2013 Human Development Index, while Chad is at #4. The Central African Republic, where most of the infrastructure would be built, has had no stable government since the March 2013 armed coup by the Séléka Coalition, and the fighting is ongoing. Central Africa has long been a crossroads of cultures, and tensions between Islamic and Christian groups and between farmers, pastoralists and fishermen persist. Famine spread across the Sahel in 2012, affecting 18.7 million people (FAO 2012).

Such challenges demand a holistic, systems thinking approach. Beyond water, we must consider energy, economics, people, politics, and the environment. Some African leaders have come to see Lake Chad as a key that will unlock the solutions to multiple interrelated problems across huge parts of landlocked central Africa. However it is done, replenishing the lake would directly address the food security, water needs, and economic livelihood of the 30 million people living close to the lake. Beyond that, the Oubangui River transfer has the potential to affect millions more by bringing hydropower to central Africa, driving economic development in northern Central African Republic and southern Chad, and creating a navigable route to the sea that will allow the entire region more opportunities for trade.

# LAKE CHAD

## *GEOGRAPHY*


Lake Chad lies at the intersection of four national borders: Chad, Cameroon, Niger, and Nigeria (Niger and Nigeria are considered traditional riparian nations even though the lake has shrunk beyond their national borders). It is currently the 4th largest lake in Africa and the largest *endorheic* basin in the world, meaning that it is a closed basin with no surface outflow, though unlike most endorheic lakes it contains freshwater. Although there is no outfall from the lake, evaporation from the surface and infiltration into the ground play a significant role in the loss of water from the basin.

Lake Chad sits at the southern end of the *Sahel*, a semi-arid bioregion that stretches across Africa, representing a transition from the Sahara Desert to the north and to the Sudanian savannahs to the south. The Sahel has been drifting southward as climate change and desertification cause the Sahara to encroach on its northern front.

## *WATER BUDGET*

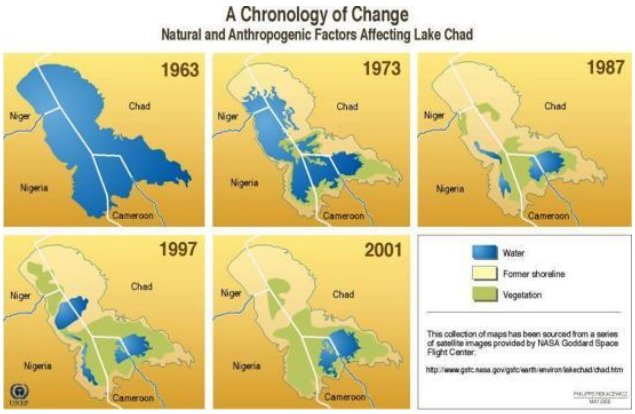
Water enters Lake Chad either by direct precipitation, or via three rivers that discharge into it. The lake receives ~80% of its inflow from the Chari-Logone river system which flows north along the

boundary of Chad and Cameroon (Boubakari 2009). The Chari-Logone is the Tigris-Euphrates of Central Africa. In the floodplain between these rivers lies a zone of fertile agricultural land, where farmers have created many diversions for irrigation. Farther south, the Chari river runs through the Chadean capital of N'Djamena where it is used for municipal drinking water.


3% of Lake Chad's input comes from the Komadugu-Yobe river system on the Nigerian side. The remaining 17% comes from precipitation, which falls during the west season of June-September (Doeden 2009).

Water leaves the lake via evaporation, human withdrawals, and infiltration into the ground (the water table is far below the floor of the lake, so this water is effectively removed from the basin).

### *SHRINKAGE*




At one time the sixth largest lake in the world, Lake Chad shrunk by 95% between 1963 and 1998 (imagine a water body the area of Lake Ontario shrinking to about twice the area of Lake Tahoe over just 35 years). This dramatic shrinkage is because of the shallowness of the lake – 11 meters at most – meaning that small changes in the lake's volume have large impacts on its areal extent.

Although there are officially four "riparian" nations according to the Fort Lamy Convention, only Chad and Cameroon are truly riparian since the lake waters no longer reach Niger or Nigeria.

Where the lake has disappeared it has left behind a fertile area of vegetation that thrives on the remaining soil moisture.

The causes are several – overgrazing and desertification of the surrounding land, water extraction for agriculture, and the ongoing Sahel drought that began in the 1970s. The water shortage has resulted in conflicts between farmers and herders, who divert water from the lake and source rivers to irrigate fields and raise animals, and fishermen, who are seeing their fish stocks depleted as the lake dries up. It has also put a strain on the bird and game communities around the lake. These problems are compounded by the transboundary nature of the lake system, and by historical disputes over national borders, which cannot be easily demarcated or enforced as they run through the middle of the lake. The drying of the lake has also resulted in increased dust storms.

There is some scientific dispute over the extent to which the recent depletion of the lake is due to human activities, anthropogenic climate change, or natural variations. The lake has fluctuated widely in geologic history, even drying up completely in the 1400s. But it is clear that all of these factors have had an impact (Gao 2011). In terms of human activity, agricultural and municipal withdrawals along the Chari-Logone diminish the amount of water that reaches the lake in the south, while two dams along the Komadugu-Yobe prevent all but a trickle from reaching the lake in the west. Yet human withdrawals from the lake itself represent less than 3% of the input into the lake, a tiny amount compared to the quantity of water that leaves by evaporation (Gao 2011).

Climate change, meanwhile, is affecting the lake in two ways: less rainfall, which leads to less recharge, and higher temperatures, which lead to more evaporation. The discharge from the Chari-Logone has been decreasing since the late 1960s. The dramatic shrinkage of the lake began in the early 1970s when the Sahel was gripped by a drought that is still ongoing.

### *ENVIRONMENT*

The lake is surrounded by marshland and is a biodiversity hotspot, home to 120 species of fish and 372 species of birds, as well as larger game like crocodiles and hippopotamus (Ladel 2009).

### *PEOPLE & ECONOMY*

An estimated 30 million people rely on water from Lake Chad (LCBC 2009). The main economic activities in the basin are agriculture (primary cotton, millet and sorghum), fishing, and animal husbandry. Agriculture is by far the largest consumptive use of water, followed by municipal use and a very small amount of industrial use (Ladel 2009).

Lake Chad used to support a thriving fishing industry. The traditional fishing villages along the lake became abandoned as the industry collapsed; many fisherman have turned to farming in the fertile soils left behind by the receding waters. Competition for water resources is intensified by social conflict. Many refugees from eastern Chad and Darfur have settled in the area, and the loosely controlled Cameroon-Niger border area has recently become the site of violence and kidnappings by militias (Al Jazeera 2012).

### *LEGAL FRAMEWORK*

Recognizing the importance of protecting the lake, the four surrounding nations signed the groundbreaking Fort Lamy Convention in 1964, which established the Lake Chad Basin Commission (LCBC), Africa's oldest basin organization. The convention provides for cooperation between the riparian nations in managing the lake's resources (LCBC 1964). In 1994 the convention was amended to expand the limits of the basin, at which point the Central African Republic (CAR), Libya, Algeria and Sudan joined the LCBC. This was also when the current efforts to save Lake Chad began.

The UN Convention on Transit Trade of Land-Locked States (1965) and the African Convention on the Conservation of Nature and Natural Resource (1968) also affected Lake Chad. The bilateral Moundou Agreement (1970) created a framework for allocating water on the Chari and Logone

Rivers that form the boundary between Cameroon and Chad. Niger and Nigeria signed a similar bilateral convention called the Maidugari Agreement (1990).

### *Previous Solutions*

In the late 1960s, the Nigerian government constructed a system of irrigation canals called the South Chad Irrigation Project. For a time, they diverted water from Lake Chad for agriculture. But since the 1990s, the canals have been operating at 1% of capacity – effectively dry ditches. Other more "soft path" solutions have been proposed: agricultural conservation, rainwater harvesting, and the injection of community greywater to artificially recharge groundwater.

## The Oubangui River Water Transfer

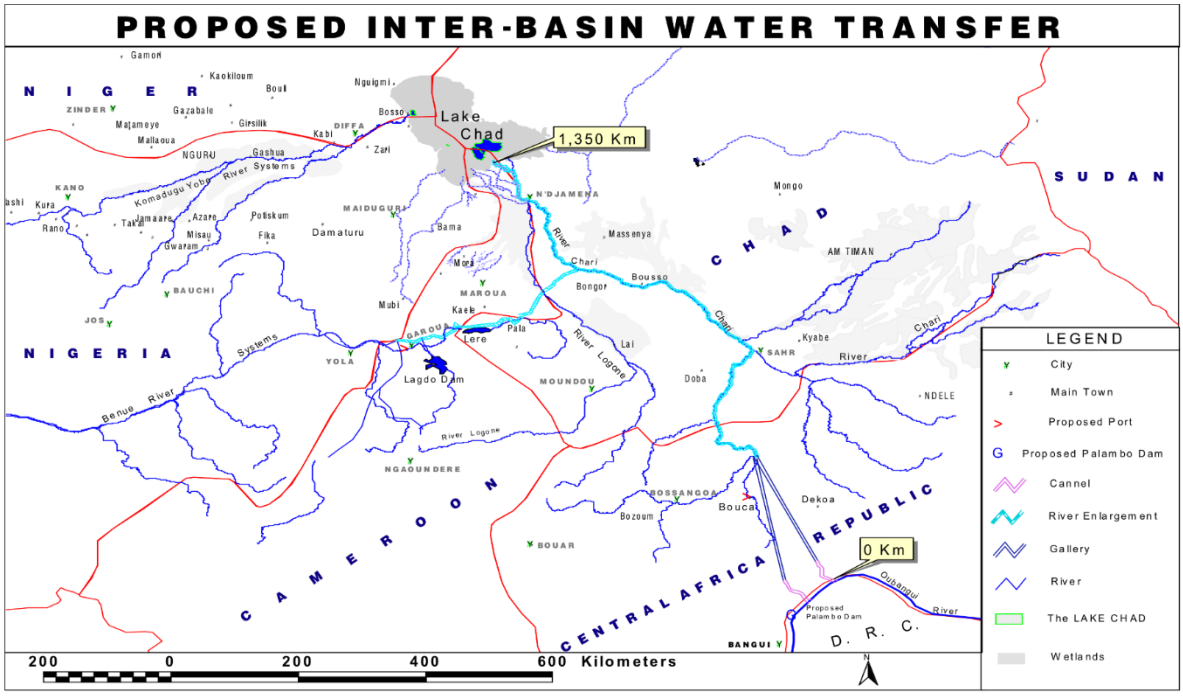
The most ambitious proposed solution is a massive infrastructure project to divert water from the Oubangi River, a tributary of the Congo that lies hundreds of kilometers to the south, to the Chari River and ultimately to Lake Chad. This project would require a dam on the Oubangi in the Central African Republic and infrastructure to pump water 277 km out of the Congo basin into a tributary of the Chari, where gravity would carry it another 1100 km to Lake Chad. In addition to replenishing the lake, the project would generate hydropower for the region and potentially provide a navigable route to the sea for landlocked central Africa. Such an ambitious project raises dozens of concerns: the effects of the reservoir behind the new dam, the effects on the downstream Oubangi-Congo system, the ethics and environmental effects of such a large inter-basin transfer.

The history of this proposal is a long one, originating with discussions as far back as the 1960s. In 1988, an Italian firm called Bonifica made the first concrete proposal for a much longer 2,500 km navigable channel connecting the watersheds. In 1990, a European Economic Commission study proposed a site for the dam at Palambo, about 100 km upstream of the CAR capital of Bangui. At the 1996 LCBC summit, the member nations committed to a feasibility study, and in 2002 they formed two committees to work on the plan. In 2008, the LCBC developed a Strategic Action Plan with both

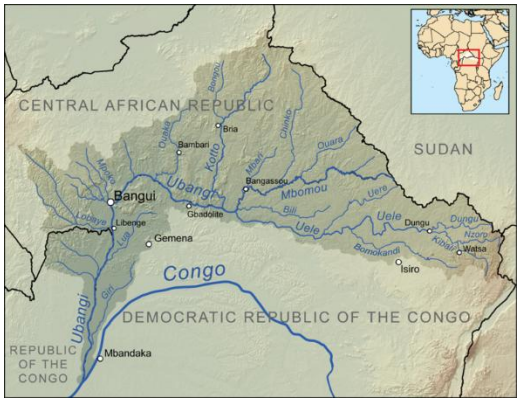
hard and soft proposals to improve water quantity and quality in Lake Chad. Soft proposals include aquifer recharge activities, agricultural water conservation projects, and adaptive management. The one hard proposal was a more fleshed out version of the water transfer plan.

The stated objectives of the plan are:

- To generate 700MW of electricity via Palambo Dam
- To increase the navigability of the Oubangui River upstream of Bangui
- To provide transportation of goods from central Africa to the sea, opening up the landlocked region to international commerce
- Improve the regional economic integration of central African nations
- Re-establish fisheries and agricultural irrigation
- Promote poverty alleviation through drought mitigation and control of desertification (LCBC 2008)



The epicenter of this plan is the Central African Republic, the extremely poor nation that straddles the divide between the Lake Chad and Congo basins. Geographically, it represents a transition between the dry savannahs of the Sahel to the north and the wet rainforests to the south. The capital city of Bangui lies downstream of the proposed dam site.




Many of the specifics of the proposal are still not clear, such as how large the reservoir will be and where water will be diverted from it. Somehow, the water must be pumped from the Palambo reservoir across the low divide that separates the basins – a distance of 277 km and 250 meters up. From there, it will discharge into the Fafa River, then the Ouham, and finally the Chari.

An even more ambitious part of the proposal involves dredging and possibly widening all of these rivers from the point where the water enters, in order to create a navigable channel that will open up northern CAR and southern Chad to international commerce. A new canal would then link the Chari River with the Benué River to the west, allowing access to the sea at Port Harcourt, Nigeria. This would effectively link the Congo, Lake Chad, and Niger River basins, providing a transcontinental waterway across Africa.

# ANALYSIS

### *TECHNICAL FEASIBILITY AND COST*

The LCBC estimates that the project will cost $14.5B (LCBC 2009). Given the huge price tag and the extreme poverty of the countries involved, the LCBC has been looking for foreign investors to finance the project. Chad, Cameroon and CAR were all former French colonies and maintain close ties with France. French businesses provide the bulk of foreign investment in these countries, so any water transfer project is likely to have significant French involvement.

Once built, the project would require energy from the dam to pump the water over the divide. Although the divide is only 250 meters above the Oubangui River level, the terrain in CAR is very hilly and so the total elevation gain would be large.

### *Legal Issues*

The Oubangui itself is a transboundary river, forming the border between CAR and the Democratic Republic of the Congo (DRC). Both of these countries are party to the International Commission of the Congo-Oubangui-Sangha Basin (CICOS), formed in 1999 to manage the Congo River basin, the second largest in the world. The support of DRC and Republic of the Congo, the two downstream nations, will be crucial for the transfer plan to go forward. CAR and Cameroon, as parties to both LCBC and CICOS, must play a pivotal role as liaisons between the two basin commissions.

One question is whether the downstream nations will be compensated for the loss of water in the Congo Basin. Because water in the basin is far from scarce – the Congo River is second to only the Amazon in terms of discharge to the ocean – there has thus far been no agreement between the CICOS nations in terms of allocation and withdrawals. The proposed diversion represents less than a tenth of a percent of the Congo River water discharged annually to the ocean. It seems unlikely, then, that there would be market-based compensation for DRC or Congo. More likely would be an agreement allowing DRC to benefit from the electricity generated by the Palambo dam.

### *Impacts on Human Populations*

The human impacts of the dam would be felt throughout the region. There are no figures for the number of people that would be displaced by the reservoir itself, but based on the population figures for CAR's prefectures and the very low population density in the region (7 people/km$^2$), I estimate that the number may be between 5,000 and 20,000 people in both CAR and DRC (Doeden 2009). The area covered by the reservoir is very rural with small villages and pastures. It is hard to

imagine the current CAR government organizing a relocation program until there is more political stability in the country.

Upstream of the dam, the reservoir would allow navigation farther up the Oubangui than is currently possible, connecting the remote eastern CAR to Bangui. In this region, iron ore deposits have been discovered near the Bangui River, but the distance to the sea and lack of infrastructure has so far made mining unfeasible. The opening of a new route to the ocean and a new supply of energy and water may make extraction of these ores profitable, bringing jobs but also environmental degradation.

Downstream of the dam, the only large population center is the capital city of Bangui, with a population of 734,000 people. The city would experience lower flows in the river, but a more stable water supply throughout the year.

In northern CAR the impacts would be more positive. This is the most populous part of the country, but it is very isolated, with few roads and rivers. The widening of the Chari tributaries would provide water for agriculture and domestic use, navigation, and a means of transporting goods to market at N'Djamena or even internationally.

In Lake Chad itself, the water from the Oubangui may not be enough to restore it to its pre-1960's shoreline, but it could at least be saved from disappearance and preserved in a smaller state. Nigeria would regain riparian access to the shoreline, and the fishing industry would return.

However, it is worth asking how much of the diverted water would actually reach Lake Chad, given the number of agricultural users along the Chari and its tributaries. The increased availability of water may in fact make things worse by encouraging more agriculture and land use changes along the river.

To avoid conflicts, CAR, Chad, Cameroon and Nigeria will have to come to a binding agreement about how to allocate the water in the Chari. They would need to align their domestic water law with the international agreement and empower the LCBC to arbitrate disputes at the basin level. In order to maintain a navigable channel, they would have to agree on a minimum in-stream flow, and these guaranteed flows could also serve to replenish Lake Chad.

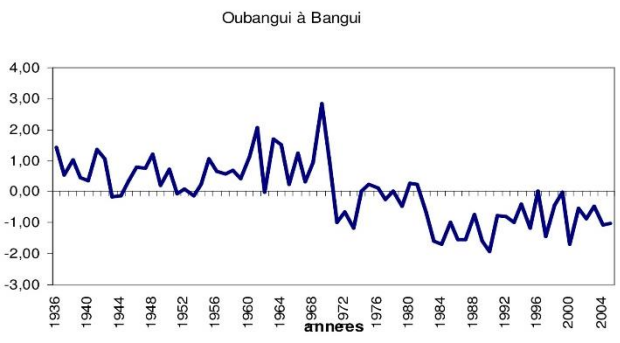
### *IMPACTS TO THE ENVIRONMENT*

The mixing of water from the Oubangui with autochthonous waters of the Chari-Logone watershed would alter the chemistry of the river and of Lake Chad, potentially altering the ecosystem as well. The amount of water to be diverted is massive – 920 $m^3/s$, about 42 times what has been proposed for the transfer of water from the Missouri River to Denver (Boubakari 2009). With this huge influx of water, the loss of indigenous species and migration of invasive species into the basin is very likely, especially considering the increased river traffic. Increased agriculture along the Chari will increase the nutrient loads to Lake Chad, which is already showing signs of eutrophication.

Nonetheless, the restoration of water levels in Lake Chad would go a long way towards rehabilitating the environment around the lake. The fishery would be restored and the marshes filled with birds once again. The enlarged lake would have a dramatic effect on the local weather, bringing more precipitation and reversing some of the effects of desertification.

### *DOWNSTREAM EFFECTS ON THE OUBANGI-CONGO SYSTEM*

The Sahel drought that began in the 1970s has affected the Oubangui River as well. Water levels have been decreasing, which has caused the number of days of navigation stoppage to increase from 4 in 1971 to 200 in 2002 (Ladel 2008). The Palambo dam



would provide more consistent flows throughout the year, though they would not be as high as usual during the rainy season.

Downstream of the CAR capital of Bangui, the Oubangui River turns south and enters the Cuvette region of DRC, an enormous area of swamp and tropical forest that is home to chimpanzees, gorillas, and elephants. The dam could disrupt the normal cycle of flooding that sustains the biodiversity in this area.

## CONCLUSION

It is tempting to write off this proposal as an overambitious pipe dream that will never get off the ground, or else a doomed-to-fail boondoggle full of unanticipated consequences. The extreme poverty of the nations involved and the ongoing violence in Chad and CAR make it very unlikely that the project will break ground anytime soon.

Yet the Oubangui-Chari transfer, if executed wisely, has the potential to change the fortune of this region, improving the lives of 30 million people in the Lake Chad basin and millions more across central Africa. It would bring much needed water to agricultural smallholders, provide power in a region where few people have it, and create a market for goods by providing a navigable route to the sea. It would also revitalize the Lake Chad environment, with its rich fisheries and marshes.

The main thing that is needed for the transfer to work is a new legal framework for inter-basin management. Currently, water resources management in Africa occurs at the national and basin levels. This project reveals the need for even broader coordination at the inter-basin level. The LCBC and CICOS will each need the full support of their member countries' legislatures, and they will need to be empowered to resolve extremely complex disputes, in which an action in one place may have consequences hundreds of kilometers away. By creating such a framework, Africa would be forging into uncharted territory, creating a template for inter-basin management on other continents.

# SOURCES


Boubakari, Mana. "Inter Basin Water Transfer Project from the Oubangui River to Lake Chad". Presented at World Water Week, Stockholm (2009).

> This presentation gives an overview of the transfer project and provides background hydrologic data on the Lake Chad basin.

Chimtom, Ngala Killian. "Saving a Shrinking Lake," Inter Press Service, 9 February 2013. http://www.ipsnews.net/2013/02/saving-a-shrinking-lake/

> The article discusses the effects the shrinking lake is having on local fishermen, the causes of the shrinkage, and the Oubangui diversion project.

Doeden, Matt. *Central African Republic in Pictures*. Twentyfirst Century Books (2009).

> This book provides background data on the history, geography, and demographics of CAR.

Foley, Jonathon and Michael Coe. "Human and natural impacts on the water resources of the Lake Chad basin." *Journal of Geophysical Research* **106** D4 3349-3356 (2001).

> Foley and Coe argue that human impacts – particularly withdrawals from the source rivers, are mostly to blame for Lake Chad's present condition. The biggest impacts are the damming of the Yobe River in Nigeria and agricultural water diversion on the Chari River in Chad/Cameroon.

Food and Agriculture Office (FAO). "FAO's Response to the 2012 Sahel Crisis." United Nations (2012).

> Provides data on the people and regions impacted by the 2012 drought in the Sahel.

Gao, H., T.J. Bohn, E. Podest, K.C. McDonald, and D.P. Lettenmaier. "On the causes of the shrinking of Lake Chad." *Environmental Research Letters* **6** (2011).

> This paper discusses the challenges of determining whether local human impacts, or global climate change, are mostly to blame for the lake's shrinkage. There is still scientific debate about this issue, but it is important to know which is having the largest effect in order to evaluate proposed solutions.

Ladel, Julie, *et. al.* Integrated Water Resources Management in the Congo Basin based on the development of the Earth Observation and Monitoring Systems in the framework of the AMESD Programme in Central Africa. 13th World Water Congress, Montpellier (2008).

> This describes a scientific initiative to acquire more data about the Congo Basin to facilitate IWRM of the basin. It gives data on historical flows in the Oubangui and Congo rivers.

Lake Chad Basin Commission (LCBC). Convention & Statues Relating to the Development of the Lake Chad Basin (aka Fort Lamy Convention). Fort Lamy, Chad. (1964).

This is the foundational document of the LCBC, providing for shared stewardship of the riparian portion of the Lake Chad basin. It was signed by Cameroon, Chad, Niger, and Nigeria.

Lake Chad Basin Commission (LCBC). Saving Lake Chad. Based on the proceedings of the Sirte Roundtable, Libya (2008).

This document gives a brief history of the interbasin transfer proposal and lists the alternative "soft path" options that have been considered.

Lake Chad Basin Commission. "Adaptive Water Management in the Lake Chad Basin: Addressing current challenges and adapting to future needs." World Water Week, Stockholm, August 16-22, 2009.

This document gives a good overview of the problems facing Lake Chad and their effects on the riparian inhabitants. It also discusses several solutions: the Oubangui River transfer, climate adaptation, aquifer recharge and storage, and up-scaling of small-scale agricultural conservation technologies.

Magrin, Géraud. "Le lac Tchad n'est pas la mer d'Aral." *Mouvements: des idées et des luttes*. 7 November 2007. http://www.mouvements.info/Le-lac-Tchad-n-est-pas-la-mer-d.html

Lake Chad is often compared to the Aral Sea, but there are important differences. This paper explains why Lake Chad has not become saline like the Aral Sea, and why it is likely that rehabilitation efforts will be successful.

Odada, E.O., L. Oyebande, J.A. Oguntola. "Lake Chad: Experience and Lessons Learned Brief." World Lakes, 2006.

There have been many previous attempts to rehabilitate Lake Chad. This paper gives several examples and explains what could have been done better. It also describes the international legal framework in which the riparian nations have coordinated their efforts, including both multiparty and bilateral agreements.