

International research collaboration as a tool for water resource management in the Lake Chad Basin

B. Ngounou Ngatcha¹, G. Favreau², J.C. Doumnang³, I.B. Goni⁴, Y. Nazoumou⁵, D. Sebag⁶, B. Laignel⁶, Ch. Leduc⁷, J. Mudry⁸ and A. Durand⁶

(1) Department of Earth Sciences, Faculty of Science, University of Ngaoundéré, PO Box 454 Ngaoundéré, Cameroon, E-mail: ngatchangou@yahoo.fr

(2) UMR Hydrosociétés, Université de Montpellier II, CC MSE, 34095 Montpellier cedex 5, France

(3) Department of Geology, Faculty of Exact and Applied Science, University of N'Djamena, PO Box 1027, N'Djamena, Chad

(4) Department of Geology, Faculty of Science, University of Maiduguri, Nigeria

(5) Department of Geology, Faculty of Science, University of Abdou Moumouni, PO Box 10099 Niamey, Niger

(6) UMR 6143 CNRS, University of Rouen, 76821 Mont-Saint-Aignan, France

(7) IRD, UMR G-EAU, Université de Montpellier II, CC MSE, Montpellier, France

(8) UMR Chrono-Environnement, University of Besançon, F-25030 Besançon, France

ABSTRACT

There is a large community of researchers in resource management in Africa, but they are currently partly disconnected, even in a single country. Most researchers engaged in the Lake Chad Basin are involved in studies motivated nationally or in their own institutions. Groundwater or streams do not stop at political borders. This means that investigation must also cross national borders. As a consequence and considering that no country or region is independent of the rest of the world, international research collaboration stands out as the major challenge in addressing excellence and sustainability of scientific activities in the future? A multi and interdisciplinary approach and international cooperation are absolutely essential for positive realization of the objectives of water resource management in the Lake Chad basin.

In 2002 the UNESCO project "Virtual laboratories for drying lakes in Africa, Middle East and Central Asia" was a joint effort to mobilizing researchers of the sub region promoting sustainable development of the Lake Chad basin.

CORUS and FSP-RIPIECSA have successfully supported joint research in the Lake Chad basin on climate and water resource.

IRD has initiated major's programmes as LMI (Laboratoire Mixte International) that offer opportunities to examine interactions between science, environment and society.

Despite the substantial body of research that exists on the Lake Chad basin, it remains inadequate to address the serious challenges facing the sub region. The sharing of experience and knowledge among researchers from South to South and from South to North can better be viewed to ensure knowledge transfer to where it is needed, and in the form in which it can be used.

Keywords: Lake Chad basin, International research collaboration, LMI (Laboratoire Mixte International), water resource management, transboundary aquifer

1. INTRODUCTION AND MOTIVATION

The Lake Chad Basin (Fig. 1), with ~ 2.5 M km², is the largest transboundary endoreic basin at a global scale (Burke, 1976). Whenever talking of the Lake Chad Basin, people generally refer to surface water; the Lake Chad itself. The Lake Chad is unique as its water remains fresh while being submitted to intense evaporation in the semiarid Sahel (E ~ 2000 mm/yr, rainfall of $\sim 200 - 600$ mm/yr). Between 1963 and 1976, Lake Chad had lost nearly 90% of its water volume. Its surface area had shrunk from 25,000 km² to less than 3000 km², and its water level had fallen by ~ 4 m. The Lake Chad Basin is also characterized by rainfall deficits, southwards shift of the isohyets (Ngounou Ngatcha *et al.*, 2005; Niel *et al.*, 2005), reduced runoff of the (Komadougou and Chari) rivers discharge into the Lake Chad (Olivry *et al.*, 1996).

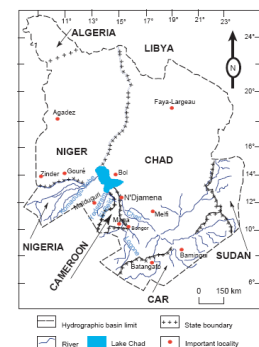


Figure 1 The Lake Chad watershed

Population in the Lake Chad basin has grown rapidly for the last decades, at a rate of about +2.5% year⁻¹ and was estimated of ~35 M inhabitants in 2007 (World Bank, 2010). Regarding water uses (water supplies for drinking, industry and agriculture), demand in the Lake Chad Basin is satisfied mainly with groundwater. However, extraction rates are rarely measured and, therefore, it is impossible to estimate the level of use of the aquifers. The need to improve social conditions and reduce poverty for the inhabitants will lead to an increase in water supply and sanitation services. In addition, higher water demands are expected in the basin for economic activities such as tourism, intense cultivation within the lake (polders), fishing and herding. Questions remains on how pumping would affect groundwater reserves at the whole aquifer scale (500,000 km²). As a consequence of the diverse and competing uses for water, the Chad basin faces a challenge for integrated water resources management.

Collaboration between scientists is a strong recommendation for improving research programs outcomes and formation. The LMI project is bound by strong links between researchers from different universities in Africa (Cameroon, Chad, Niger, Nigeria), Europe (Montpellier, Rouen and Aix-Marseille in France), Australia (University of « James Cook », Cairns), America (University of Texas, Jackson School of Geosciences, Austin), and other institutions of higher learning or research (IRD). The aim of this LMI is to bring together the global experience in an accessible and helpful compendium of optimal approaches, to support the practical and effective development of IWRM in the Lake Chad basin, to provide adequate formation to students and updated key information to stakeholders.

2. MAIN SCIENTIFIC ISSUES AND OUTCOMES

Most of the field-based scientific knowledge was gathered during the 1960-70s (Barber, 1965; PNUD/FAO, 1973). These results, conducted mainly using hydrological, geological and geochemical methods, helped to understand the basic functioning of the Lake Chad Basin. During the 1990s and 2000s, several PhD thesis of high quality were defended with various methods and approached developed, using complementary methods: unsaturated zone survey, surface water-groundwater modeling and remote sensing. Meanwhile, several key-questions remain fundamental for better predicting and managing surface water and groundwater resources.

- Understanding the role of climate (rainfall) variability and increasing water use on observed changes in water resources in the Lake Chad basin is the main goal of then LMI project. This question remains central for predicting changes in the Lake Chad Basin and managing water resources.
- Improving understanding and modelling of surface water – groundwater transfers. This question is central in every studies of large water bodies under tropical climates (eg., Okavongo basin, Inner Niger delta). Increase in knowledge in this domain requires improving lake level chronicles (using both on-ground and satellite surveys), long-term groundwater chronicles, better knowledge of groundwater use (pumping) and surface water use and management (dams).
- Understanding (eco-)hydrological functioning of large piezometric depressions. Natural piezometric depressions in the unconfined aquifer do exist all around the lake and their functioning remains challenging (eg., Dieng et al., 1990). Possible explanation includes role of deep rooting vegetation and low permeability of the aquifer. Understanding Piezometry of aquifers will help to quantify sustainable pumping in the unconfined aquifer.
- Understanding salt transfer from the lake to the aquifer. Groundwater below Lake Chad is salty and villages do struggle to find fresh lenses within the aquifer. Understanding variability in time and space of groundwater nearby Lake Chad will avoid villagers to use lake water,

often non-drinkable due to Cholera and other bacteria. Understanding salt transfer will also help to better quantify infiltration of water from the Lake to the aquifer.

- Understanding impact of climate and land use/land cover change (LUCC) on sediment, solute, and water transfer to rivers and/or aquifers. Past and present records of sediments and fluxes will help to estimate sustainability of water resources and rural development at a regional scale (damming, pollution from irrigation to the aquifer used for drinking water). These records will also help in constraining the sensitive response of the LCB system to environmental changes.

3. STRATEGY ON TECHNICAL CAPACITY BUILDING AND POST-GRADUATE EDUCATION

Following the worldwide recognition of the paramount importance of the human resources capital for sustainable and long term development, the LMI will help in:

- increased capacities in analytical capacities, modelling, access to a tool to deal with spatial processes (GIS) and application of data. Capacities will be expanded using commercial educational licenses in groundwater modeling and SIG;
- hydrogeological and hydrogeophysical tools will be acquired for both educational and research purposes; this will include the recent technique of MRS that has proved to be efficient in the LCB.

Researchers involved in the LMI have various background and capacities in different research specialities (geochemistry, sedimentology, geophysics, hydrodynamics, remote sensing). Cross-participation in Master's courses will strengthen each of these formations, enrich examples from neighbor countries sharing common issues and help to foster co-operation among nations and regional or international programmes for education and training facilities, for appropriate learning technologies, for the exchange of information and experts in the field of hydrology and water resources. In addition, the LMI project will:

- increase the multidisciplinary aspects of the contents of the courses, introduce the teaching of hydrology into regular school curricula or reinforce the teaching of the basic hydrological sciences at university level;
- promote a series of advanced study seminars, short courses, workshops or tutorials on national, regional or international scale for specific themes involving users, planners, policy-makers, women, postdoctoral researchers, hydrology teachers... at all levels;
- gain experience with distance learning techniques and encourage their use for greater efficiency.

4. PERFORMANCE INDICATORS

There is an ongoing project to restore lake Chad to its maximum 25,000 km² surface area of the 1950s by transfer of water from the Oubangui river (Congo basin) to the Chari river (World Bank, 2010). The feasibility of this project is under study and would involve huge socio-economic changes at a regional scale. The LMI team, by collecting data and building trans-national expertise, will help decision makers to obtain full benefit from significant and relevant investment.

The LMI will also help to: 1) product datasets and strengthen database for regional scale hydrological studies, 2) improve South/South co-operation, co-operation with NGO's and co-operation

between researchers and LCBC, 3) improve the quality of life of women by facilitating their access to water resources and their participation in training programmes, 4) improve community responses to climate change and land uses, 5) implement a regional working groups on water resources and environment, 6) reinforce teaching material on the specific hydrological problems on arid and semi-arid zones.

Water resource is a key component of development and there is an urgent and steady need in scientific expertise (Bassett, 2010). The execution of this ambitious project requires strong co-operation both intellectually and financially. The international component of the LMI project (9 Universities and Research Institute, 4 continents) will represent a proposition force that will help in developing high quality research, that aims to provide key quantitative analysis and perspective on the status of the water resources system and raising additional funds. The LMI team will work in close collaboration and cooperation with UN agencies, non-governmental organizations (NGOs), donor agencies, International networks of experts and co-operating intitutions (FRIEND, AMMA, IAH, IAHS, UNESCO, WMO, IGRAC, IAEA, ICSU,BAD, World Bank,).

The LMI Lake Chad is a major opportunity to develop joint studies and research programmes in order to strengthen the capacity for strategic and integrated water resources management in the Lake Chad basin and contibution to assist countries and LCBC in meeting the Millenium Development Goals (MDGs), and contributing to the UN International Decade for Action "Water for Life" (2005-15) and the UN Decade on Education for Sustainable Development (2005-15).

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