

Final Report

Overall Assessment of Efforts Related to Water Resources in Lake Chad Basin

By

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MAJOR ABBREVIATIONS AND ACRONYMS¹

BGR	German Federal Institute for Geosciences and Natural Resources (Bundesanstalt für Geowissenschaften und Rohstoffe)
COM	Council of Ministers
DEC	Delegation of the European Commission
EC	European Commission
EPA	Environmental Protection Agency
EU	European Union
EUWI	European Union Water Initiative
FAO	Food and Agriculture Organisation of the UN
GEF	Global Environmental Facility
GIS	Geographic Information System
GTZ	German Technical Cooperation (Gesellschaft für Technische Zusammenarbeit)
IWRM	Integrated Water Resources Management
LCB	Lake Chad Basin
LCBC	Lake Chad Basin Commission
MDG	Millennium Development Goals
PMU	Project Management Unit
SAP	Strategic Action Plan
TDA	Trans-boundary Diagnostic Analysis
UN	United Nations
UNDP	United Nations Development Program
UNOPS	United Nations Office of Project Services
USAID	United States Agency for International Development
WB	World Bank

¹ Acronyms dominant in Appendixes and Annexes are not listed. Other unlisted acronyms are identified in the specific sections where they appear for convenience.

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PREFACE

The Environmental Protection Agency has been asked by the U.S. Department of State to participate in the seventh year of its Embassy Science Fellows Program. This specific assignment was intended for three-month duration in Chad. The program emphasis was on studying the development challenges and degradation of Lake Chad, which concurs with US EPA ORD Goal 4 for integrating environmental science and technology to solve environmental problems.

Situated on the southern edge of the Sahara desert Lake Chad is one of Africa's largest fresh water resources. Over the past four decades the lake level has continuously fallen with its surface area shrinking dramatically. The drying up of the lake is caused by combined effects of climate change and unsustainable uses of water, which has drawn the attention of the international community. In 1964 the Lake Chad Basin Commission was established by the riparian countries with the overall objective to protect the water resources of the basin. However, achievements remain limited due to political, institutional and financial constraints. Many international institutions have stepped in to help mitigate the situation and to combat degradation of the lake and its ecosystem.

To promote bilateral US-Chadian scientific cooperation, the US Embassy in N'djamena requested the Embassy Science Fellow (referred to as Science Advisor, or simply "*author*", hereafter) to provide advice and assistance on issues related to Lake Chad and to participate in embassy public outreach and public diplomacy efforts through meetings and building relationships with scientists at Lake Chad Basin Commission, as well as public officials, academics, and journalists engaged in sustainable development challenges and/or combating degradation of the ecosystem in Lake Chad². In addition to the bilateral cooperation, the regional benefits of a Science Advisor covering Lake Chad are obvious given that the lake is the center-point of four adjoining countries (Chad, Niger, Nigeria, and Cameroon) and that its basin extends to another four neighboring countries (Central African Republic, Sudan, Libya, and Algeria). The Science Advisor assignment was planned for a period of three months; however, unrest due to intense rebel activities in Chad caused abrupt separation of the Science Advisor from the embassy work station after only three weeks.

While this effort is intended to promote US-Chadian scientific cooperation on areas related to water resources in Lake Chad Basin and to provide the Department of State with assessment and scientific insights useful for relevant foreign policy development in this region, extrapolation of this assessment for decision making or policy development is beyond the scope of this work.

² ANNEX 1 presents specifics relevant to Science Advisor's assignment

EXECUTIVE SUMMARY

The US Government supports the United Nations Millennium Development Goal (MDG) No. 7 “Ensure environmental sustainability” which was adopted after the World Summit on Sustainable Development in Johannesburg in 2000. This goal aims at reversing loss of environmental resources and reducing by half the proportion of people without sustainable access to safe drinking water by the year 2015. The US Water for the Poor Act of 2005 was initiated to further the government’s foreign assistance objective of providing affordable and equitable access to safe drinking water and sanitation in developing countries. This Act calls for promoting programs that develop river basin, aquifer, and other watershed-wide mechanisms for governance and cooperation. The Sub-Saharan Africa, with its 300 million inhabitants, was identified as the most in need region and stepped up assistance to this region was encouraged. The main objective of the current effort was to promote US-Chadian scientific cooperation on issues related to water resources in Lake Chad Basin and to provide assessment and scientific insights useful for foreign policy development in this region. More specifically, this effort addresses the needs³ of the US Government to understand the current status and gaps of ongoing activities in water resources in Lake Chad Basin in order to implement the Water for the Poor Act. The four chapters in this report cover such needs by addressing the following specific areas: A) Assess the status of existing and anticipated water resources projects presented by the various national and international organizations and donors in the region; B) Assess the overall capacity and effectiveness of the local recipient organization, the Lake Chad Basin Commission (LCBC); C) Identify some of the gaps in the existing efforts where future research and funding is needed; D) Recommend areas for assistance from US Government. In each chapter, the *author* presented relevant information from available sources and references, analyzed the information as needed, and concluded with remarks that highlight the salient assessment issues.

Lake Chad is situated in central Africa on the southern edge of the Sahara desert. This lake is one of Africa’s largest fresh water resources. The entire Lake Chad Basin covers an area of 2,434,000 km² shared between the countries of Algeria, Cameroon, Central African Republic, Chad, Libya, Niger, Nigeria and Sudan and supports a growing population of 37 million inhabitants. The bulk of water resources in the Basin are used in agriculture, followed by domestic use. Access to safe drinking water for domestic use in the Basin is very limited and water is mainly obtained using traditional methods. Sanitary conditions for rural dwellers are poor with severely limited waste disposal facilities. There are very prominent indicators of freshwater shortage, including the shrinkage of the Lake Chad by 90% in the past four decades and reduced river discharges by 55%. **Freshwater shortage** is due to both **climatic variability** and stream flow modification by **water diversion**. Freshwater shortage has impacted heavily on the Basin’s **economic activities** including the fisheries, agriculture, animal husbandry, fuel wood provision and wetland economic services. There has been consequential food insecurity in the region and this, combined with a lack of potable water, has had negative implications on the

³ The stated needs were requested by the Deputy Chief of Mission at the US Embassy in Chad, the coordinator of the Embassy Science Fellow Program at the US Department of State, and a member of the Senate Appropriations Committee for Africa Development.

health status of the Basin's population. **Social impacts** of freshwater shortage have included upstream/downstream **conflicts** over who has the right to use the diminishing water resources. Social tensions have also been further provoked by the increased pressure on resources due to the **migration** of people from the drought stricken northern regions of the Basin into areas surrounding the Lake and associated river basins. International support to mitigate these problems has been growing during the last five years through multilateral and bilateral projects in the region. Most projects concentrate on enhancing Integrated Water Resources Management in the region and building capacities within local organizations and institutions to conserve and better manage this vital resource. Meanwhile, feasibility of diverting water from a neighboring watershed is being considered.

A) Status of water resources projects sponsored by various national and international organizations and donors

1. GLOBAL ENVIRONMENTAL FACILITY INITIATIVE

The project "Reversal of Land and Water Degradation Trends in the Lake Chad Basin Ecosystem" is funded by the Global Environmental Facility (GEF) through World Bank (WB) and the United Nations Development Program (UNDP). The first phase of project term is four years. It started in January 21, 2003 and is expected to end in June 2008. The project development objective is to contribute to the sustainable management of land and water resources in Lake Chad Basin, and enhance policy initiatives and transboundary institutional mechanisms to ensure that countries sharing the basin jointly develop and manage the basin's resources. The specific objective is to build capacity within Lake Chad Basin Commission and its national committees so that it can better achieve its mandate of managing land and water resources in the basin. The total project funding from the GEF was US\$ 9.6 million (US\$ 6.7 million from UNDP and US\$ 2.9 million from WB) with Co-finance from other donors of US\$ 9.3 million for a grand total of US\$ 18.9 million (12 million €).

The first stage of the project (ending June, 2008) aims to: 1) overcome barriers to the concerted management of the basin through enhanced collaboration and capacity building among riparian countries and stakeholders; 2) complete a Transboundary Diagnostic Analysis and prepare a descriptive framework for the concerted water management across the basin; and 3) prepare a Strategic Action Plan for long term actions to address transboundary issues related to water resources and mobilization of donor support for implementation of the plan. A follow up stage of the GEF support will cover full-scale implementation of the Strategic Action Plan.

The project has a total of six components: three are implemented by the UNDP, two are implemented by the WB, and one is implemented jointly by the WB and UNDP. The current status of the GEF initiative is compiled in Table 4 which presents the six identified components of the project together with their respective activities and the relevant performance indicators. The current status of the project indicates that only 28% of the activities are finished; 60% are ongoing; 6% are just starting; and 6% are stalled.

2. EUROPEAN UNION PROGRAM

The European Union (EU) has a unique continent to continent strategic partnership with Africa with the purpose of making a more effective joint contribution to the achievement of the water and sanitation related Millennium Development Goal. This partnership provides a platform for strategic and political dialogue on water issues through bilateral and multilateral initiatives between EU member states and African nations. The EU has earmarked 10 million € to finance Integrated Water Resources Management in five pilot basins (including Lake Chad Basin) through EU Water Initiative. To the date of this report, there are no active EU projects related to water resources in Lake Chad Basin except for one through bilateral cooperation with Germany. The German project “Sustainable Water Resources Management of Lake Chad” consists of three phases each extending for a period of 3 years and costing one million € (US\$ 1.6 million): the first (ended in 2007) concentrated on surface water; the second (starting in 2008) deals with groundwater, and the third will follow in 2010 (focus is not known to the *author*). Future allocation of 2.5 million € (US\$ 3.9 million) is expected in 2008 by EU towards projects carried by the UN Global Environmental Facility’s initiative in LCB.

3. INTER-BASIN WATER TRANSFER PROPOSAL

The project aim is to replenish Lake Chad through transfer of water from Oubangui River/Congo River Basin into Lake Chad Basin. A dam would be constructed on the Oubangui River and a connecting channel would transfer the water at a rate of $900 \text{ m}^3 \text{ s}^{-1}$ throughout the year between the two watersheds. A 1350-km channel from the Chari River system would carry the transferred water to Lake Chad. The objectives and prospects of the project include:

- refilling the Lake Chad and other wetlands in Lake Chad Basin for sustainable development of navigation, agriculture, forestry, tourism, and industries;
- poverty alleviation through increased agricultural production, fisheries, and employment opportunities;
- drought mitigation and control of desertification and land erosion;
- generation and distribution of hydroelectric power in the region to promote a sustainable socioeconomic development;
- reduction of refugees’ problems in the basin; and
- promote regional economic integration, cooperation, and security.

The call for international bids for a **feasibility study** of the project was released in July, 2007. Only two companies responded and presented their bids in January 2008. The Council of Ministers indicated that two respondents were not enough and requested rewriting of the international call for bids and reopening the offer again. Rough estimate of the expected cost of this project is 15 billion € (US\$ 23 billion). Opinions of the international donor community seem to reflect a lack of support to the project for the following reasons:

- Environmental effects of IBWT and the effects of the changed environment on socio-economy of each country cannot be determined in advance.
- Institutional weakness of LCBC is a major impediment to execute the IBWT.
- Institutions at member states are weak and have to be strengthened to execute IBWT and to develop transboundary mechanisms.

- There is lack of an overall water management strategy and absence of coordinating mechanism.
- The economic viability of IBWT is undetermined. Initial cost as well as operational and maintenance costs are high. Highly qualified engineers and technicians are required to plan, design, implement, and operate the scheme.

However, the current trend in climate change causes lack of rain and increased evaporation. In addition, population growth increases demand on the already overstressed water resources. The *author* thinks that augmenting the amount of water in Lake Chad Basin becomes an inevitable solution to counteract such adverse effects and restore the basin and its ecosystem. The viability of this project, however, will be confirmed after the feasibility study has been carried out.

B) Assessment of the overall capacity and effectiveness of the local recipient organization

The Lake Chad Basin Commission, an Inter Governmental Agency, is responsible for: the regulation and control of the utilization of water and other natural resources in the Basin using Integrated Water Resources Management; following up on natural resources development projects and research; and examining complaints and promoting settlement of disputes. There are now five member countries in LCBC: Chad, Niger, Nigeria, Cameroon, and Central African Republic. Sudan was admitted in 2000 but has yet to ratify the convention establishing the commission. The LCBC organizational structure includes: **The Summit of the Heads of State and Government** (the highest authority, which ratifies legislations and decisions); **The Council of Ministers**, (the highest legislative authority); and **The Executive Secretariat** with five **Departments** to execute the main functions.

The assessment of the overall capacity of the Commission is based on four recent sources of information: (1) consultancy appraisal for German Government intervention, (2) assessment of the capacity-strengthening needs of the commission conducted during September-December 2005, (3) validation workshop for the key findings in No. 2, and (4) most recent remarks by the executive secretary and by the Transboundary Diagnostic Analysis. The first source highlights the fact that LCBC is the main player in shared (transboundary) water resources management in the region and that it needs to be reformed and updated to meet present and future demands and challenges. In addition, it encourages technical cooperation and support be provided through the transformation process.

The validation workshop for the key findings of the capacity strengthening needs was conducted by two international consultants in June, 2006. The objectives of the workshop were to discuss and validate the Institutional Assessment Report (No. 2 above); and to prepare an action program. Participants in the workshop agreed on the need to address the following seven main issues that were highlighted in the report:

- Fiduciary capacity
- Organizational improvement
- Management capacity

- Enabling legal and policy environment
- Communications and knowledge networking
- Knowledge base improvement
- Common vision for future governance and management

The action program document was prepared for the attention of the subsequent meeting of the Council of Ministers. Also, a draft of the resolution to improve LCBC performance was prepared for the ministers' consent. The action program called for short-term/immediate actions (within one year); medium-term actions (by the end of GEF initiative); and long-term actions (post GEF initiative). However, the most recent remarks (in 2007) by the executive secretary and by the Transboundary Diagnostic Analysis indicated lack of actions toward the identified issues.

In the *author's* opinion, the lack of a prompt response to the assessment of the capacity needs of LCBC resulted from a delay in the decision by the Council of Ministers and the ratifications at higher levels (i.e., Heads of States and Governments). It is clear that the size of the weaknesses extend beyond the Executive Secretariat into the legislative and ratifying bodies that control the Commission. Improvement may require a more sophisticated mechanism to not only follow progress within the Commission, but also within the involved governments. This mechanism should be actively involved until the Commission reaches the expected level of performance.

C) Gaps in the existing efforts where future research and funding is needed

In order to identify gaps, ongoing water resources initiatives and their outcomes were related to a global frame of reference that is founded on the MDGs and built within an Integrated Water Resources Management framework. More specifically, activities in Lake Chad Basin are identified based on their contributions to: 1) advancing the enabling environment through strengthening of political, legal, and financial frameworks; 2) strengthening the LCBC as the main regional institution; and 3) improving management instruments for developing Integrated Water Resources Plans, managing conflicts, and devising social change.

During the period 2002 – 2007, the number of international donors increased from one to five and the amount of donations increased from 1 million € to 5 million €. All initiatives were directed towards support of the Integrated Water Resources Management to build the basis for a sustainable development of water resources in Lake Chad Basin.

Nevertheless, the *author* believes that most of the MDGs are not met yet due to gaps in:

- **Infrastructures to:** store surface water; further develop groundwater resources; provide safe drinking water; provide appropriate environmental flows to maintain wetlands goods and services; protect rural poor populations and urban slum dwellers against flood risks; expand sanitation; treat discharges of human waste waters.
- **Technologies to:** monitor and collect water resources data (including geomorphological changes and sedimentation in rivers, various ecosystems, and invasive species); control toxic emission from industrial enterprises; control of pesticide release to groundwater as well as wetlands and surface water; optimize and protect health and productivity of aquatic ecosystems including fish productivity.

D) Conclusions and recommendations for US involvement

US programs in 47 African countries cover a number of the identified priorities under the MDGs that include economic development and growth as one of the priorities. Currently, the US Agency for International Development (USAID) has 23 bilateral and 3 regional missions in Africa to help improve health, education, economic growth, agriculture, and environment programs. Except for some USAID humanitarian activities, however, the *author* detects that there is no noticeable examples of US-Chad projects in many needed fields, especially water resources and the environment.

In the *author's* opinion, the following water resources areas are the top most in need for further attention by the international community in general and the US Government in particular. The population benefiting from such interventions and projects can embrace all 37 million inhabitants living in Lake Chad Basin.

- Provide updated technology for **conservation of surface water** through: 1) improving irrigation systems to reduce evaporation and infiltration losses; 2) lining irrigation channels and enhancing anti-erosion banks; 3) reducing sedimentation in rivers and water bodies; 4) reducing bank overtopping, spilling, and controlling and managing flow to wetlands; 5) using underground pipes; 6) using drip and sprinkler systems; 7) applying efficient cropping patterns; and 8) reducing water blockage by invasive plant species.
- Assist in utilization of **sustainable exploitation of groundwater resources** through: 1) providing a basin-wide monitoring network to analyze variations in water surface elevation, gradient, and water movement; 2) improving storage capacity, natural recharge, potential induced natural recharge, artificial recharge of aquifers through infiltration basins, canals, water traps, drainage wells, and sinkholes; and 3) providing technology to eliminate contamination from wastewater and improve sanitation conditions of rural populations.
- Provide technology for **rainwater harvesting** through: 1) surface storage in topographic depressions; 2) underground storage through aquifer recharge; and 3) reducing evaporation losses.
- Upgrade the **monitoring and information technology** system for water resources support and management including: 1) strengthening networks for monitoring surface water, groundwater, and rainwater; 2) providing upgrades of infrastructure hardware, software; and 3) training of technical staff. The World Meteorological Organization presented a proposal (WMO, 2005) to execute this need for an estimated cost of US\$ 2 billion.
- Assist in **water quality and pollution monitoring** of surface and ground water by providing: 1) sampling technology and equipment; 2) laboratory equipment for sample analysis; 3) training and capacity building for technical staff; 4) technology for identifying critical contaminants and hotspots; and 5) strengthening the water quality monitoring network.
- Positively support the **inter-basin water transfer** project throughout its phases of realization: feasibility study, design, construction, operation, and maintenance. Based on very rough estimates from similar projects around the world, the construction cost of this project could reach 15 billion € (23 billion US\$).

- Support **model development** for prediction and assessment of best management practices by: 1) providing model software; 2) assisting in data gathering for model implementation including satellite and GIS data; and 3) providing technical expertise and support.
- Improve road **infrastructure** and communication networks to facilitate execution of various water resources projects.
- Assist in building and maintaining LCBC's **technology** by: 1) providing information technology hardware (computers, printers, plotters, networks); 2) developing centralized regional **databases** (including GIS) for environmental planning and monitoring trends in desertification and deforestation; and 3) developing a modern library and archival system for hard copies as well as electronic files.
- Promote environmental **education** in the Lake Chad Basin through: 1) encouraging the development of academic curricula and materials focusing on Lake Chad Basin environmental issues; 2) supporting academic partnerships at school and university levels; and 3) assisting universities to develop programs featuring Lake Chad Basin issues in ecology and environmental science.
- Foster the development of **research collaboration** partnership with the regional institutions and centers of expertise.

The *author* believes that the US support should be offered within a local mechanism that continuously oversees progress and releases funds as progress indicators are achieved. This mechanism should follow up on the various stages of a project from its inception during the prefeasibility study, feasibility study, planning, design, execution, maintenance, and the fulfillment of expected short- and long-term benefits.

INTRODUCTION

Objective

The main objective of the current effort is to promote US-Chadian scientific cooperation on issues related to water resources in Lake Chad Basin and to provide assessment and scientific insights useful for foreign policy development in this region. More specifically, this effort addresses the needs of the US Government (see footnote 3, page 10) to understand the current status and gaps of ongoing activities in water resources in Lake Chad Basin in order to implement the Water for the Poor Act of 2005. This Act was initiated to further the government's foreign assistance objective of providing affordable and equitable access to safe drinking water and sanitation in developing countries. The Act calls for promoting programs that develop river basin, aquifer, and other watershed-wide mechanisms for governance and cooperation. The Sub-Saharan Africa with its 300 million inhabitants was identified as the most in need region and stepped up assistance to this region was encouraged⁴.

Lake Chad Basin facts

The following facts about LCB (Fig. 1) are presented in many publications and are modified here from UNESCO (2007). Lake Chad is situated in central Africa on the southern edge of the Sahara desert. This lake is one of Africa's largest fresh water resources. The entire Lake Chad Basin covers an area of 2,434,000 km² shared between the countries of Algeria, Cameroon, Central African Republic, Chad, Libya, Niger, Nigeria and Sudan and supports a growing population (at 3% y⁻¹) of 37 million inhabitants. The climate in most of the basin is hot and dry with rainfall varying between 1,500 mm y⁻¹ in the southern parts to less than 100 mm y⁻¹ in the northern parts. The bulk of water resources in the Basin are used in agriculture, followed by domestic use. Access to safe drinking water for domestic use in the Basin is very limited and water is mainly obtained using traditional methods. Sanitary conditions for rural dwellers are poor with severely limited waste disposal facilities. There are very prominent indicators of freshwater shortage, including the shrinkage of the Lake Chad by 90% in the past four decades and reduced river discharges by 55%. **Freshwater shortage** is due to both **climatic variability** and stream flow modification by **water diversion**. Freshwater shortage has impacted heavily on the Basin's **economic activities** including fisheries, agriculture, animal husbandry, fuel wood provision and wetland economic services. There has been consequential food insecurity in the region and this, combined with a lack of potable water, has had negative implications on the **health status** of the Basin's population. **Social impacts** of freshwater shortage have included upstream/downstream **conflicts** over who has the right to use the diminishing water resources. Social tensions have also been further provoked by the increased pressure on resources due to the **migration** of people from the drought stricken northern regions of the Basin into areas surrounding the Lake and associated river basins. International support to mitigate these problems has been growing during the last five years through multilateral and bilateral projects in the region. Most projects concentrate on enhancing Integrated Water Resources Management in the region and building capacities within local organizations

⁴ International and US assistance in Sub-Saharan Africa are listed in Appendix 4.

and institutions to conserve and better manage this vital resource. Meanwhile, the feasibility of diverting water from a neighboring watershed is being considered.

Comprehensive assessment of water resources in the LCB is presented in the Global International Waters Assessment report (UNEP 2004). It indicates that the basin contains a number of transboundary waters that include three main aquifers in addition to the networks of the Chari-Logon and Komadugu-Yobe rivers. The assessment ranks freshwater shortage as severe and as the priority concern in the region. Freshwater shortage is due to both climatic variability and stream flow modification by water diversion. Several studies have demonstrated that rainfall events in particular have reduced and in turn have led to drought (Nicholson 1988 in Le Barbé & Lebel 1997). A comparison of isohyets (contour of equal rain fall intensity) of the wettest decade of the 1950s with the driest in the 1980s shows considerable shift towards the south. The bulk of water usage is for agriculture followed by domestic use. Unsustainable use of water is recognized through a number of indicators including the shrinkage of the Lake Chad and reduced river discharges. Freshwater shortage causes habitat modification, reduction in the extent of wetlands, and reduction in fish stocks. In addition, the study indicates that water pollution may become a future concern due to increased application of agro-chemicals, oil industry, and mining activities. The assessment recommends priority actions to mitigate the current conditions including development of an agreement on the equitable and reasonable allocation of water resources by member states, and study of water conservation techniques suitable for LCB.

The rainy season in LCB extends from April to October with a peak in August. Beauvilain (1996) indicated that the intensity of rainfall exceeds $1,500 \text{ mm yr}^{-1}$ in the southern part of LCB and drops by 100 mm every 100 km yr^{-1} northward. This study showed that the intensity of rainfall distribution has shifted tens to hundreds of kilometers southward exposing northern areas to dryer conditions and reducing the total amount of rain on LCB. River inflows that come to Lake Chad through Chari-Logone (96%) and Komadugu-Yobe (2%) have shown a 47% decrease during 1970 – 1990 (Odada et al. 2005). Table 1 shows the change in the overall water balance of Lake Chad during that same period. Comparing the total input with the total output indicates a drop of the surplus in surface water from $2,890$ to $180 \text{ million m}^3 \text{ yr}^{-1}$ from 1970 to 1990. The reduction in rain and river flow affects the amount of water reaching the lake or recharged to the groundwater reservoir. The increase in population demand for water puts additional stress on this limited resource (see population distribution in Fig. 2 and Table 3). Table 2 presents the annual consumption of water in the conventional LCB. Comparing the total consumption ($280 \text{ million m}^3 \text{ yr}^{-1}$) to the surplus of surface water in 1990 ($180 \text{ million m}^3 \text{ yr}^{-1}$) indicates shortage and a need to augment from the already stressed groundwater reservoir.

Water accessibility

Water is the main resource for all the various types of life in any basin. The primary source of water is rain. Upon reaching the ground surface rain water can move in the form of streams, accumulate in lakes, or penetrate the surface to join the subsurface/ground water. These various components are interconnected and a water parcel can reside in one or more of these components until it returns back to the

atmosphere (evaporates) or reaches the receiving sea before evaporation. The level of difficulty to obtain water for various uses (domestic, agriculture, industry, etc.) is highly dependant on the proximity of the water source (i.e., its location and depth) relative to the locality in need. In order from easiest to hardest comes surface water, ground water, then rain water. For example, when surface water is distant or scarce, availability of groundwater can be explored. (The World Health Organization (WHO 2000) suggests that reasonable accessibility to water is 20 liter/capita within 1 km from the user's dwelling.)

Loss of water at a locality can be due to evaporation, consumption, or seepage (for surface water). Evaporation from surface water, groundwater, and plants (i.e., transpiration) is affected mainly by climatic variables (e.g., temperature, wind, humidity) which are hard to control. Nevertheless, methods to reduce evaporation losses can be devised to minimize this loss. In addition, water consumption for domestic and agriculture uses can be regulated and conserved. Exchange between surface and ground water can be considered loss to one (surface water) and gain to another (groundwater) with a different level of accessibility.

When water sources are not adequate to sustain human development and ecosystem well being in a locality, better management measures are necessary for conservation, allocation, and even borrowing water from a neighboring system, if needed. These measures become more complicated when political boundaries intersect within drainage basins and water bodies, and necessitate transboundary management of water resources. In addition to the complexity of sustaining adequate water quantity, water quality and pollution are main concerns in managing and conserving this vital resource.

Integrated Water Resource Management

Integrated Water Resource Management (IWRM) is the process of promoting the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. IWRM encompasses the following eight principles (Rahaman & Varis, 2005):

1. Water **source** and catchment conservation and protection are essential.
2. Water **allocation** should be agreed upon between stakeholders within national and transnational frameworks.
3. **Management** needs to be taken care of at the lowest appropriate level.
4. **Capacity** building is the key to sustainability.
5. Involvement of all **stakeholders** is required.
6. **Efficient** water use is essential and often an important “source” in itself.
7. Water should be treated as having an economic and social **value**.
8. Striking a **gender** balance is essential in management of water use.

More details about IWRM processes and success indicators are presented in Chapter 3 – Table 7. Many activities in the Lake Chad Basin support the development of an IWRM plan to mitigate adverse impacts from climate change and development needs of the growing populations of the basin.

Scope

The following specific areas are covered in sequence in the following four chapters of the report: A) assessment of the status of existing and anticipated water resources projects presented by the various national and international organizations and donors in the region; B) assessment of the overall capacity and effectiveness of the local recipient organization, the Lake Chad Basin Commission; C) identification of major gaps in the existing efforts where future research and funding is needed; D) recommendation of areas for future assistance from the US Government. In each chapter, the *author* presents relevant information from available sources and references, analyzes the information as needed, and concludes with remarks that highlight the salient assessment issues.

**Table 1 Water balance of Lake Chad
(modified from Odada et al. 2005)**

	Catchment Area (km ²)	Inflows & outflows (million m ³ yr ⁻¹)	
		Pre 1970 mean	1971-1990 mean
Inflows			
Chari-Logone	590,000	39,800	21,800
Komadugu-Yobe	147,840	1,000	450
Yedseram-Ngadda-Ebeji	53,720	890	120
Other Rivers		1,200	200
<i>Total River Inflows</i>		42,890	22,570
Rainfall on open water surface		6,000	2,100
<i>Total Input</i>		48,890	24,680
Outflows			
Evaporation		43,000	23,100
Infiltration		3,000	1,400
<i>Total Output</i>		46,000	24,500

**Table 2 Estimated annual water consumption in the conventional LCB
(Adenle, 2004).**

	Surface & groundwater consumption (million m ³ yr ⁻¹)		Groundwater consumption (million m ³ yr ⁻¹)				
	2000 ^a	1990 ^b	1990 ^b				
			Chad	Cameroon	Nigeria	Niger	Total
Drinking water	223.9	171.6	48.7	32.2	87.9	2.8	171.6
Irrigation	3,630	190	25.5	1	6	15	47.5
Stock	36.9	76.3	7.7	3	11	11.2	32.9
Total	3,890	437.9	81.9	36.2	104.9	29	252^c

^a UNDP

^b BRGM - LCBC

^c 28 million m³ yr⁻¹ should be added for losses from artesian sources.

Table 3 Population in LCBC's member states (Adamu 2007b)

Member State	Population	Area (km ²)
Cameroon	2,671,200	74,625
Niger	305,280	200,155
Nigeria	17,848,832	211,916
Central African Republic	890,400	217,536
Chad	6,428,056	439,481
Total	27,943,768	1,143,713

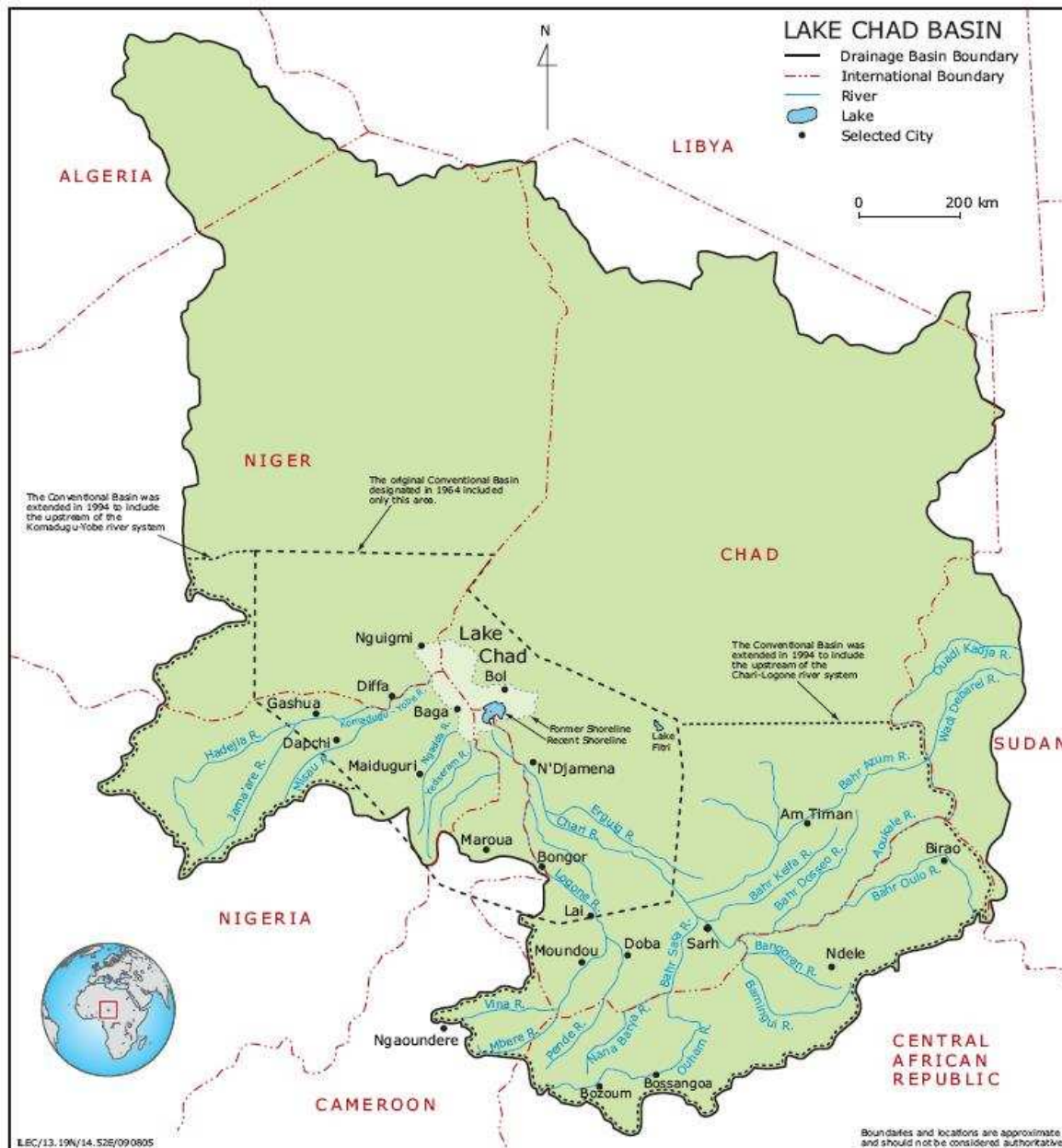
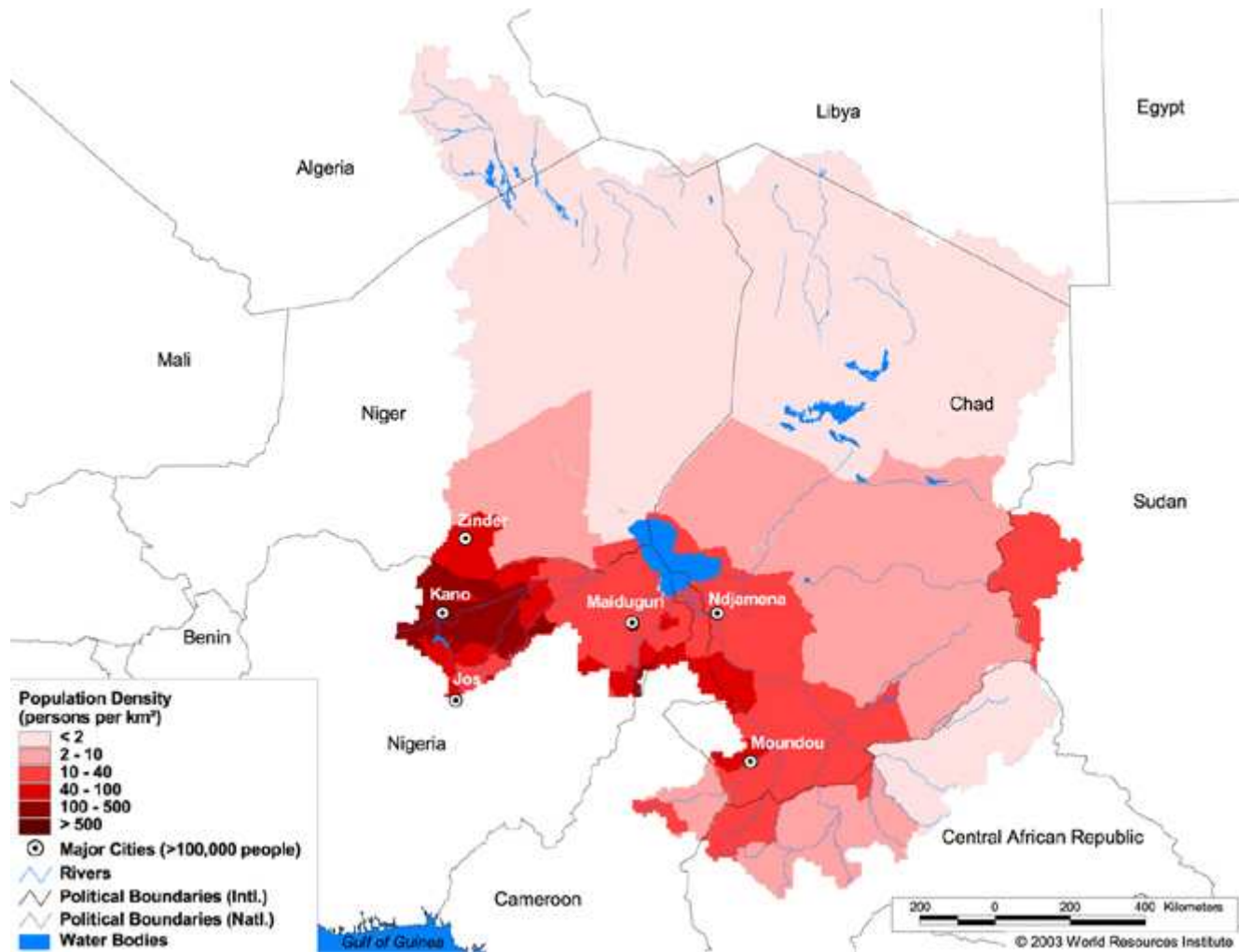


Figure 1 Lake Chad full and conventional basins (Odada et al. 2005)



**Figure 2 Population Density in LCB
(WRI, 2003)**

CHAPTER 1: Status of water resources projects sponsored by various national and international organizations and donors

To identify areas for implementing the Water for the Poor Act of 2005 and avoid duplicating efforts, it is pertinent to identify the status of existing and anticipated water resources projects presented by the various national and international organizations and donors in the region. In this chapter, the *author* lists old, recent, and present initiatives to illustrate national and international involvement as well as the ability of LCBC to carry out such activities. Nevertheless, emphasis is primarily given to the GEF initiative, the EU program, and the Inter-basin Water Transfer (IBWT) proposal which have direct impact on water resources in LCB, as their accomplishments were specifically requested by the US Government (see footnote 3, page 10). It is worth mentioning that both the EU program and the GEF initiative encompass many projects, and that some of the projects by EU member states act in response to activities set by the GEF initiative.

1.1. Old Initiatives

Many water resources initiatives have taken place since the inception of LCBC in May, 1964 (WMO, 2005). Older initiatives included:

- hydrological studies of the LCB with support from the FAO and UN Educational, Scientific, and Cultural Organization during 1965 - 1971;
- a series of studies concerning the basin's natural resources during 1968 – 1979;
- programs of action with support from FAO and UN Development Program during 1982-1986 and 1986-1991;
- master plan for the development and environmentally sound management of the natural resources of the conventional LCB with support from UN Environment Program, UN Sudano-Sahelian Office and FAO in 1992;
- Strategic Action Plan “for Sustainable Development of the Lake Chad Basin” with support from Global Environmental Facility -UN Development Program and UN Department for Economic and Social Affairs in 1998.

Readers interested in the accomplishments of these activities should consult final reports by the above-mentioned supporting agencies.

1.2. Recent Initiatives

The more recent (after 2000) and on-going projects in LCB are reported by Adamu (2007b) and are presented below.

- **MEGA CHAD PROJECT:** “Promotion of the Use of Renewable Energy Resources and Conservation of Floral Species in the Dry Lands of Lake Chad Basin.” The First Phase of the project ended in 2004. It was funded by Belgium through the UN Environment Program, implemented by the University of Maiduguri (Nigeria), and coordinated by LCBC. The Objectives of the project were to: promote alternative renewable energy resources, promote appropriate water harvesting technologies, conserve the threatened flora species, and educate the local people on the sustainable management of natural resources. The degree of accomplishment of project goals is not known by the *author*.
- **INTEGRATED PEST MANAGEMENT PROJECT:** This is a research and development pilot project on integrated pest management for sustainable subsistence

farming in LCB. The project was funded US\$ 3.5 million by the African Development Bank and implemented by LCBC. The First Phase of the project ended in 2005. The objective of the project was to test and validate modern integrated pest management techniques in 20 selected villages of LCB with a goal of reducing millet and sorghum losses by 50% in two years. The degree of accomplishment of project goals is not known by the *author*.

- **HYDRO-CHAD PROJECT:** "Assessment, monitoring and forecasting water resources of Lake Chad Basin." The total cost of the project was US\$ 855,000. The project was partially supported by the Arab Bank for Economic Development in Africa (US\$ 250,000), which provided for the acquisition of hydrological and meteorological instruments and the training of 20 hydrological technicians. The objective of the project was to provide quick access to ready, accurate and reliable hydro-meteorological data of LCB for IWRM and socio-economic development of the region. A project update (Ladel & Roussel, 2007) indicates that the status and quality of data collected from the 76-station hydro-meteorological network are not known. Some stations are not operational and some devices are not functioning. Some new devices have been acquired by LCBC but only a subset of them has been installed. The collected data are intended for use in the Hydro-Chad model to predict flow in streams and flood plains. The model was not used or updated by LCBC since its development by Mott MacDonald (1993). This model is a one-dimensional hydrodynamic model in FORTRAN (under DOS) and is based on the conventional basin, not the full LCB (Fig. 1). Recently, researchers used the model to assess the restoration potential of the Logone floodplain in Cameroon under three climatic scenarios representing good, average, and poor conditions (Evans et al., 2003).
- **AFDB-AWF PROJECT:** African Bank for Development AFDB (Banque Africaine de Développement, BAD) and the African Water Facility AWF (Facilité Africaine de l'Eau, FAE) are contributing ~1 M€ for implementation of the legal and institutional framework as a central instrument for the LCBC to execute its Strategic Action Plan, apply the IWRM plan, and support the development and dissemination of a basin wide water charter (AFDB, 2007). The latter will enable a fair use of water resources among the different countries and users as well as minimize conflicts related to sharing water. The project objectives fall within the realm of Activity 2.6 of the GEF initiative (see Table 4 below). The project entered the pipeline for evaluation of funding in September 2006. The expected duration of this support is approximately 2 years with two-thirds of the funding dispersed in June 2007 and the remainder in April 2008. Achievements of the project have yet to be disseminated.

1.3. Present and Anticipated Initiatives

Emphasis is devoted below to the GEF initiative, EU program, and IBWT proposal which have direct impact on water resources in LCB. The *author* presents information about these specific initiatives from available references, analyzes the information as needed, and concludes each section with remarks to highlight the salient assessment issues.

1.3.1. Global Environmental Facility (GEF) Initiative

The following description of the GEF initiative was obtained and modified from WB (2003), UNDP (2002), UNDP (2008), and LCBC (2008).

The title of the GEF initiative is “Reversal of Land and Water Degradation Trends in the Lake Chad Basin Ecosystem.” This is the biggest initiative in the LCB region which absorbs most of the cooperation and involvement from international donors and organizations. The term of the initiative is four years which started in January 21, 2003 and is expected to end in June 2008. It is funded by the Global Environmental Facility (GEF) through the World Bank (WB) and the United Nations Development Program (UNDP). The total project funding from the GEF was US\$ 9.6 million (US\$ 6.7 million from UNDP and US\$ 2.9 million from WB) with co-finance⁵ from other donors of US\$ 9.3 million for a grand total of US\$ 18.9 million (12 million €).

The long-term objective of the GEF initiative is to achieve global environmental benefits through concerted management of the naturally integrated land and water resources of the LCB. The project development objective is to contribute to the sustainable management of land and water resources in LCBC, and enhance policy initiatives and transboundary institutional mechanisms to ensure that the member countries jointly develop and manage LCB’s resources. The specific objective is to build capacity within LCBC and its national committees so that the LCBC can better achieve its mandate of managing land and water resources in the basin. The specific purposes of the first stage of the project (end in June, 2008) are threefold: 1) to overcome barriers to the concerted management of the basin through enhanced collaboration and capacity building among riparians and other stakeholders; 2) to complete a Transboundary Diagnostic Analysis (TDA) and prepare a descriptive framework for the concerted water management across the basin; and 3) to prepare a Strategic Action Plan (SAP) for long term implementation of priority actions to address transboundary issues related to water resources and call for mobilization of increased donor interest and support for implementing the SAP. A later stage of GEF support will cover full-scale implementation of the GEF SAP, including investments. The project provides for a process of formal endorsement of the GEF SAP by the participating governments, support to the translation of SAP provisions into national and regional policy and legislation, and the mobilization of institutional and investment resources for its implementation (UNDP, 2002).

The “Reversal of Land and Water Degradation Trends in the Lake Chad Basin Ecosystem Project” is a regional GEF grant being implemented in the five countries that share the Lake Chad Basin (Cameroon, Central African Republic, Chad, Niger, and Nigeria). The project has a total of six components (Table 4): Components 1, 3, and 4 are implemented by the UNDP; Components 2 and 6 are implemented by the World Bank; and Component 5 is implemented jointly by the World Bank and UNDP. Component 5 includes five

⁵ Co-financing from: BMZ, DGIS (Directorate-General for International Cooperation), DFID (United Nations Department for International Development), WWF (World Wide Fund for Nature)

demonstration pilot projects to test methodologies, stakeholder involvement and implementation modalities. The following pilot projects are identified in Component 5:

UNDP-supported pilot projects:

- Land Use Impacts in the Head Waters of the Lake Chad Basin
- Lake Chad Shoreline and Northern Diagnostic Basin Pilot Projects

World Bank-supported pilot projects:

- Lake Fitri
- Komodougou-Yobe
- Chari-Logone (Waza-Logone)

This GEF grant is implemented by the WB and UNDP. The executing agency for the project is the United Nations Office for Project Services (UNOPS). Effective coordination of the project is the responsibility of the Project Management Unit (PMU) together with the Implementing Agency (LCBC), which work through the Project Steering Committee and the PMU to ensure the requisite level of coordination. The Project Steering Committee comprises of representatives from of the two implementing agencies (UNDP and WB), one member from UNOPS, a designated member from each of the participating countries, and two representatives of the LCBC. The Executive Secretary of the LCBC chairs the Project Steering Committee. The Project Manager serves as an ex-officio member of the Project Steering Committee. The PMU is situated in the headquarters of the LCBC in N’Djamena, Chad. The principal staff of the PMU comprises the Project Manager, Director of Administration and Finance, Information Technology and Scientific Officer, and the Remote Sensing Specialist. Each one of the participating countries has established an Inter-Ministerial Coordinating Committee, which coordinates country level activities necessary to the formulation of the TDA and the SAP. Each LCBC Member State has a National Coordinator, and each pilot project site has one or two Community Coordinators (depending on site requirements).

1.3.1.1. Selected results

The following information is quoted from the latest update on the project in February, 2008 (UNDP, 2008):

- Country reports on existing relevant data and information were collected and synthesized with the result being included in the TDA, completed in September 2006. Adoption of the Strategic Action Program is expected by March 2008.
- A GTZ (German Technical Cooperation) partner project is assisting LCBC in the collection, processing and exchange of data – including information on surface water and groundwater.
- All five Lake Chad Basin countries formed functional inter-ministerial committees in advance of the SAP being prepared. An assessment is being made of each country’s legal and institutional framework.
- A stakeholder strategy has been developed and approved by all LCBC countries. In Nigeria a stakeholder analysis was prepared by a DFID⁶-sponsored project in Nigeria,

⁶ DFID is the United Kingdom’s Department for International Development

which, together with a newly established Stakeholder Forum, are considered important tools for the project's implementation in Nigeria.

- The effective involvement of stakeholders has led to the establishment of a US\$ 13m trust fund in the Komadougou Yobe pilot site by the six riparian state governments and the Federal Government of Nigeria to finance the catchment management plan. A catchment water charter has also been approved.
- A total of thirty-one micro-grant projects have been supported at four pilot sites (Lake Chad Shoreline & Northern Diagnostic basin, Waza-Logone and Komadougou-Yobe). US\$ 800,000 has also been allocated to support local initiatives in the execution of pilot projects.
- An Integrated Water Resources Management (IWRM) study is expected to be completed by March 2008. Economic and financial assessments, as well as legal and institutional assessments have been completed. Experts and decision-makers have been trained in implementing IWRM in their respective countries while National Action Plan teams have been established in each of the member states and have commenced activities.
- A draft agreement on water use by the LCBC countries has been prepared for adoption once its annexes have been prepared by the LCBC Technical Committee on Water Resources.
- Institutional changes needed to strengthen the Lake Chad Basin Commission were identified by the GTZ project and have been incorporated into the LCBC Institutional Assessment sponsored by the GEF project. Adoption of the LCBC Institutional Assessment report, along with an action program to implement institutional reforms, is planned for March 2008.
- A trust fund, established by six Nigerian states and two provinces in Niger to manage a sub-basin of Lake Chad, has already received US\$16 million in pledges.

1.3.1.2. Current status

The current status of the GEF initiative is compiled in Table 4 which presents the six identified components of the project together with their respective activities and the relevant performance indicators (WB, 2003). The status of each activity is obtained through personal communication in April, 2008 (Mohammed Bila, Regional Coordinator, UNOPS) (See Bila (2006a) for earlier update of status.) The *author's* comments on the status of each activity are based on stated performance indicators and the expected date for completion of the first phase of the GEF initiative.

Table 4 Status of the GEF initiative

Project components are identified at the top of each set of relevant activities in the table where Column 1 shows activities and GEF allocations (UNDP, 2002); Column 2 presents participants/donors as compiled by the *author* (see specific project description above); Column 3 provides the current status (personal communication April, 2008: Mohammed Bila, Regional Coordinator, UNOPS⁷); Column 4 indicates the performance indicators (rearranged by the *author* from UNDP, 2002); and Column 5: lists the *author's* comments based on performance indicators (column 4) and judgments other than those in column 3.

Component 1: Project Mechanisms: An established Program Coordination Unit (PCU) and nominated lead agencies to drive and coordinate TDA completion, pilot projects, policy initiatives and institutional linkages (US\$2.338 million)⁸				
Activities	Participants	Status	Performance Indicators	Comments
Activity 1.1 Recruit the Project Manager, Public Participation and Communications Expertise, and requisite technical, administrative and secretarial support (\$945,000) ⁹	UNDP	Finished / Successful	<ul style="list-style-type: none"> • Project Manager employed/contract issued/terms of reference defined. 	
Activity 1.2 Create and organize the PMU to facilitate and coordinate the project work program (\$415,000)	UNDP	Finished / Successful	<ul style="list-style-type: none"> • PMU created • PMU staff employed / contracts issued / terms of reference defined. 	<ul style="list-style-type: none"> • Quarterly progress reports about the work program should be furnished by PMU to demonstrate adequate coordination of the project.
Activity 1.3 Create and make provision for Co-implementation Project Task Force meetings (\$115,000)	UNDP	Ongoing / Successful: Two Project Steering Committee meetings remaining. April and July, 2008	<ul style="list-style-type: none"> • Co-implementation Project Steering Committee created. 	<ul style="list-style-type: none"> • Agendas, minutes, and action points of meetings should reflect activities. Follow up on action points & results should be demonstrated.

⁷ Earlier update of status is presented in Bila (2006a)

⁸ Total component cost to GEF

⁹ Activity cost to GEF

<p>Activity 1.4 Promote, in cooperation with participating countries and through the LCBC, country specific Inter-ministerial and local coordinating committees, as necessary, and a scientific advisory committee to assist in the work specified in Activity 2.3 and Component 3 (\$438,000)</p>	<p>UNDP, EU-future participation (500,000 €).</p>	<p>Finished / Successful</p>	<ul style="list-style-type: none"> • Country-specific Inter-ministerial Committees (IMCs) established. • Formalised (country-endorsed) TDA and SAP. • Project plan to effectively interact with related, regional GEF IW projects. • Increased country commitment for regional level participation in project related global fora. 	<ul style="list-style-type: none"> • IMC meeting agendas, minutes, and action points should reflect activities. Follow up on action points & results have to be furnished. • Project plan to effectively interact with related, regional GEF IW projects is lacking. • Increased country commitment for regional level participation in project related global functions is not demonstrated (activities 2.3 and 3.5 are stalled).
<p>Activity 1.5 Support a Lead Agency for each participating country and a senior official to assume leadership of project activities and represent the participating country at Project Steering Committee meetings (\$420,000)</p>	<p>UNDP, GTZ, BGR.</p>	<p>Finished / Successful</p>	<ul style="list-style-type: none"> • Country Lead Agencies and senior lead officials designated. 	<ul style="list-style-type: none"> • Attendance and active participation of senior officials in Project Steering Committee should be established from minutes of meetings, action points, follow up on action points, and actual results.
<p>Component 2 (WB): Enhanced regional policy initiatives and institutional mechanisms to address transboundary issues during and beyond the life of the project (US\$1.081 million)</p>				
<p>Activities</p>	<p>Participants</p>	<p>Status</p>	<p>Performance Indicators</p>	<p>Comments</p>
<p>Activity 2.1 Review current functions and responsibilities of the LCBC with a view to strengthening and improving its functional capabilities,</p>	<p>WB, GTZ.</p>	<p>Ongoing: LCBC Assessment completed; Assessment validated; Action Plan presented;</p>	<ul style="list-style-type: none"> • Specific, country-endorsed, and implemented proposals to create a more effective LCBC. • Increased capacity to create 	<ul style="list-style-type: none"> • Endorsement of Action Plan by COM is overdue. • Remedial actions are overdue (see Chapter 2 – Concluding remarks).

regional effectiveness, and ensuring a sufficient level of finance for its operations (\$86,000)		Remedial actions did not materialize.	national benefits through enhanced trans-boundary management regime.	
Activity 2.2 Identify actors in water resource and related land and environmental policy implementation in each country (\$226,000)	WB	Finished/Successful	As stated in Activity 2.2	<ul style="list-style-type: none"> • A list of actors should be furnished. • Active participation of these actors should be documented. • A feed-back mechanism for performance evaluation of these actors should be established.
Activity 2.3 Through the PCU and the LCBC coordinate activities with other related GEF projects, such as those in the Niger, Volta and Senegal River Basins, including technical exchanges and field visits as necessary (\$120,000)	WB	Stalled	As stated in Activity 2.3	<ul style="list-style-type: none"> • Activity is not executed.
Activity 2.4 Define and promote the integration of transboundary water and environmental policies into the National Development Plans (\$272,000)	WB	Ongoing	<ul style="list-style-type: none"> • New and updated national water policies in each country that take into account trans-boundary water issues and encourage environmental protection are incorporated into National Action Plans. • Country-agreed, regionally-based methodology for the 	<ul style="list-style-type: none"> • Incorporation of new and updated national water policies into National Action Plans is overdue. • Country-agreement on regionally-based methodology for the conduct of environmental impact studies is not yet demonstrated in national policies and National Action Plan.

			conduct of environmental impact studies.	
Activity 2.5 Undertake an assessment of current, relevant agreements, protocols, conventions statutes and other relevant legal frameworks in each country, including recommendations for incentives and harmonized legal frameworks to enable an integrated regional approach toward long-term management of the Basin's resources (\$175,000)	WB, GTZ, BGR, EU-future participation (10,000 €).	Ongoing	<ul style="list-style-type: none"> • Specific recommendations to affect changes in existing relevant legal frameworks to enhance prospects for an integrated regional approach to long-term, sustainable basin management. 	<ul style="list-style-type: none"> • This activity is overdue. • Success indicators for various phases of projects are not demonstrated (see GTZ-AHT project above). • Ongoing phases concentrate on a specific resource (e.g., groundwater, surface water) and not in an integrated approach.
Activity 2.6 Establish necessary structural arrangements for participating countries to review, harmonize and coordinate frameworks, regulations and approaches for the improved transboundary management of issues such as power generation, irrigation, downstream riparian considerations, fisheries, water quality and effluent standards, diversions and consumptive uses, and the creation and use of economic instruments	WB, AFDB-AWF (1 M€), GTZ, BGR, EU-future participation (50,000 €).	Ongoing	<ul style="list-style-type: none"> • Improved, regional agreements to improve trans-boundary management of power generation, irrigation, downstream riparian considerations, fisheries, water quality and effluent standards, diversions and consumptive uses, and creation of economic instruments. 	<ul style="list-style-type: none"> • This activity is overdue. • Success indicators for various phases of projects are not demonstrated (see GTZ-AHT project above).

(\$202,000)				
Component 3: Strengthened engagement of stakeholders (US\$1.227 million)				
Activities	Participants	Status	Performance Indicators	Comments
Activity 3.1 Create and provide resources for a Steering Committee for the engagement of stakeholders and key user groups at all levels (\$90,000)	UNDP	Finished / Successful	<ul style="list-style-type: none"> Steering Committee established. 	<ul style="list-style-type: none"> List of committee members should be furnished and maintained. Agendas, minutes, action points from the committee's meetings should reflect activity. Results of action points should be demonstrated and analyzed.
Activity 3.2 Formulate, plan and execute 15 stakeholder group exercises (3 in each participating country) (\$716,000)	UNDP	Finished / Successful	<ul style="list-style-type: none"> 15 pilot demonstration sites (3 in each participating country) selected. Terms of Reference, community based implementation groups, work plans, and timetable for completion for 15 sites. 	<ul style="list-style-type: none"> Stakeholder support for these local initiatives should be demonstrated. Results from monitoring and evaluation of these initiatives should be analyzed.
Activity 3.3 Support for 15 final workshop reports including recommendations for pilot projects in the SAP implementation phase of the GEF project (\$75,000)	UNDP	Ongoing	<ul style="list-style-type: none"> 15 final reports including recommendations for implementation and further activities in the next project phase. 	<ul style="list-style-type: none"> This activity is overdue.
Activity 3.4 Support for preparation of a final report, including recommendations, to	UNDP	Finished / Successful	<ul style="list-style-type: none"> Final report summarizing the overall exercise in developing mini-Agenda 	<ul style="list-style-type: none"> This activity is overdue as it depends on Activity 3.3.

assist governments and the LCBC to begin implementation of key results from user group exercises (\$15,000)			21's.	
Activity 3.5 Develop a regionally based methodology and mechanism for stakeholder participation at all levels, including provision for environmental impact studies (\$331,000)	UNDP	Stalled		<ul style="list-style-type: none"> • Activity is not executed. • Relevant success indicators are not stated in Project Appraisal.
Component 4: A completed TDA and a modeling framework for concerted management of the basin (US\$2.055 million)				
Activities	Participants	Status	Performance Indicators	Comments
Activity 4.1 Compile existing scientific, hydro-environmental and socio-economic data and information (including groundwater, aquatic ecosystems and water consumption). Prepare a descriptive basin framework and establish key processes and hot-spots. Data and descriptive models to be hosted by the LCBC (\$235,000)	UNDP, GTZ, BGR, EU-future participation (35,000 €).	Ongoing TDA report prepared; Problems prioritized; Awaiting approval by COM	<ul style="list-style-type: none"> • Country reports on existing, relevant data and information collected and stored within the PMU. • Key Lake Chad Basin water-resources processes and hot spots identified. 	<ul style="list-style-type: none"> • Country reports on existing, relevant data and information are not yet stored within the PMU. • Actions on prioritized problems are awaiting approval by COM. • Development of models is overdue.
Activity 4.2 Undertake a gap analysis of existing data to define a basin-wide monitoring network (\$100,000)	UNDP, GTZ, BGR, EU-future	Ongoing	<ul style="list-style-type: none"> • Gap analyses and program of action to meet further identified needs. 	<ul style="list-style-type: none"> • This activity is overdue. • Programs of action to meet further identified needs are

	participation (35,000 €).			<p>stalled.</p> <ul style="list-style-type: none"> Basin-wide monitoring system is inadequate.
<p>Activity 4.3 Support for the development of key water resource measures (e.g. hydrostratigraphy in the Chad Formation, updating of rating curves of existing hydrological stations to determine low flow, and flood conditions and specific water quality measurements) in order to refine the Lake and sub-basin water balances and complete the TDA (\$1004,000)</p>	UNDP, GTZ, BGR, EU-future participation (450,000 €).	Ongoing	<ul style="list-style-type: none"> Data and information synthesised in agreed basin framework. 	No comment due to lack of access to supporting data and results.
<p>Activity 4.4 Establish key environmental indicators in the Lake Chad Basin to verify compliance with existing and future management plans and, ultimately, to assist in evaluating GEF SAP implementation (\$50,000)</p>	UNDP, EU-future participation (35,000 €).	Finished / Successful	<ul style="list-style-type: none"> Key environmental indicators defined. Study and results of the extent of country compliance with existing management plans completed. 	<ul style="list-style-type: none"> The extent of country compliance with existing management plans should be established through adequate local policies and National Action Plans.
<p>Activity 4.5 Develop risk analysis capability within participating countries with the objective of, among other things, assessing regional-level hydro-environmental risk and identification of risk-</p>	UNDP, EU-future participation (35,000 €).	Ongoing	<ul style="list-style-type: none"> Report describing, evaluating and ranking regional-level hydro-environmental risks. Study and results of potential risk management 	<ul style="list-style-type: none"> This Activity is overdue.

management systems and approaches (\$175,000)			systems and approaches.	
Activity 4.6 Assemble a basin-wide simulation framework for surface/groundwater interaction within the Lake Chad Basin to pre-identify long-term consequences of development alternatives (\$491,000)	UNDP, EU-future participation (50,000 €).	Yet to take-off	<ul style="list-style-type: none"> Basin wide synthetic framework of surface-groundwater interactions completed. 	<ul style="list-style-type: none"> Late start of Activity.
Component 5: Creation of Regional Programs and initiation of demonstration projects to test and validate methodologies, secure stakeholder involvement and develop implementation modalities (US\$2.537 million)				
Activities	Participants	Status	Performance Indicators	Comments
Activity 5.1 Develop and begin implementation of a regional program to improve existing and define new protected areas, including the creation of corridors to link existing and new protected areas (\$300,000)	UNDP	Ongoing	<ul style="list-style-type: none"> Improved downstream protection for sensitive wetlands. Country-approved regional program developed to define new and improve existing protected areas. Newly established corridors connecting existing and new protected areas. 	<ul style="list-style-type: none"> Protection for sensitive wetlands has to be demonstrated. Country approvals for regional program for protected areas are overdue. Local policies should demonstrate active involvement in this program.
Activity 5.2 Develop and begin implementation of a regional program, including establishment of five pilot demonstration sites, to	WB	Ongoing	<ul style="list-style-type: none"> Regional program, including five pilot demonstration sites, developed to protect immediately threatened 	<ul style="list-style-type: none"> Komadougou-Yobe, Waza-Logone, Northern Diagnostic Basin and Lake Chad Shoreline pilot projects have commenced; Lake Fitr and Upper Chari

immediately protect threatened aquatic ecosystems (\$451,000)			<p>aquatic ecosystems.</p> <ul style="list-style-type: none"> Regional program, including five pilot demonstration sites, developed to create alternative livelihoods to those requiring intensive, unsustainable water uses. 	Watercourse Pilot projects are at the negotiation stage.
Activity 5.3 Develop a regional program aimed at reducing growing water demand with an emphasis on hot-spots identified in the LCB Strategic Plan (\$500,000)	UNDP, EU-future participation (380,000 €).		As stated in Activity 5.3	<ul style="list-style-type: none"> Program for reducing growing water demand is not clear, or does not exist.
Activity 5.4 Support development of a regional mechanism to create and implement a regional program to anticipate future pollution threats, including those that may derive from increased oil exploration, drilling, production and transport, and build capacity to prevent their occurrence (\$281,000)	UNDP	Yet to take-off	<ul style="list-style-type: none"> Anticipatory and preventative mechanisms developed by the countries to avoid future pollution related threats and problems. 	<ul style="list-style-type: none"> Late start of Activity.
Activity 5.5 Support a regional mechanism to develop integrated basin approaches (including flood plain management) in the	WB	Ongoing Komadougou-Yobe, Waza-Logone, Northern Diagnostic Basin and Lake Chad	<ul style="list-style-type: none"> Country-developed regional mechanism for flood plain management. 	<ul style="list-style-type: none"> This Activity is overdue.

Kamadagou-Yobe and Chari-Logone sub-basins. Using with full stakeholder participation, design and initiate basin development and management plans, with supporting decision aid tools, to maintain the integrity of sensitive wetlands systems downstream and promote sustainable development (\$945,000)		Shoreline pilot projects have commenced; Lake Fitr and Upper Chari Watercourse Pilot projects are at the negotiation stage		
Activity 5.6 Feedback of demonstration results into SAP design, through the PCU (\$60,000)	WB	Ongoing	<ul style="list-style-type: none"> All specified outputs as described in the separate log frames that are a part of each of the Demonstrations that appear later in this Project Document. 	<ul style="list-style-type: none"> This Activity is overdue due to the tardiness in some of the demonstration pilot projects.
Component 6: GEF SAP designed and endorsed with donor support mobilized (US\$0.362 million)				
Activities	Participants	Status	Performance Indicators	Comments
Activity 6.1 Develop and implement a plan for continuing donor contact (\$78,000)	WB	Ongoing SAP and National Action Plan are to be articulated in 2007 and implementation strategy through first half of 2008	<ul style="list-style-type: none"> Systematic procedure established to use the GEF project to leverage other donors for direct and indirect support to project activities. 	<ul style="list-style-type: none"> This Activity is overdue due to incomplete National Action Plans.
Activity 6.2 Plan and implement 2 donor	WB	Ongoing A donor conference	<ul style="list-style-type: none"> Donor conferences planned and executed. 	<ul style="list-style-type: none"> This Activity is overdue (Donor conference is postponed to the

conferences, one shortly after GEF project approval and one immediately prior to SAP implementation (\$60,000)		was planned for 2007		end of 2008).
Activity 6.3 Present the TDA and the GEF SAP to Interministerial Coordinating Committees and the LCBC; and formalize a regional agreement on the GEF SAP (\$161,000)	WB	Ongoing	As stated in Activity 6.3	<ul style="list-style-type: none"> This Activity is progressing (see latest developments in Section 2.7).
Activity 6.4 Develop of donor conference reports and prepare a strategy for ongoing project funds (\$63,000)	WB	Ongoing	<ul style="list-style-type: none"> Increased donor support for direct and indirect assistance to project related activities. 	<ul style="list-style-type: none"> This Activity is overdue as it depends on activity 6.2.

1.3.1.3. Section concluding remarks

Based on the *author's* comments presented in the last column of Table 4 and the expected project end date in June of 2008, concrete results from the current phase of the GEF initiative in LCB are overdue for the majority of the identified activities. The reported status of the project (third column in Table 4) indicates that out of the 32 activities of the project 9 (28%) are finished, 19 (60%) are ongoing, 2 (6%) are just starting, and 2 (6%) are stalled. Component 1 (project mechanisms) is the highest in accomplishments with 4 activities (out of 5, i.e., 80%) reported as finished. Component 3 (engagement of stakeholders) comes next with 3 activities out of 5 (i.e., 60%) reported finished. The remaining components indicate lesser achievements. The overall level of accomplishments is less than expected at the conclusion of this phase of the GEF initiative. Moreover, actual results from the activities that are reported finished remain to be demonstrated (see last column in Table 4).

It is worth mentioning that the TDA identified three types of stakeholders in LCB:

- a. primary stakeholders, mostly resources users who tend to be supportive but lack the power to affect changes;
- b. secondary stakeholders, characterized mainly by regulatory and service providing government agencies, as well as the donor community that fund projects, who tend to be moderately supportive and powerful, but need to be motivated;
- c. key stakeholders, consisting mainly of powerful decision makers, who are not usually supportive, but whose support is needed if the interventions are to be successful.

Component 3 of the GEF initiative deals mainly with the first type of the stakeholders (primary stakeholders/resource users) whose motivation might explain the high achievement level for this component. The other two types of stakeholders are not direct users of the resource which may explain the low achievements in the other components (e.g., Component 2). This observation may call for proper adjustments to the GEF strategy in order to meet the contrasting participation level of the various stakeholder groups. The outcome of such adjustment would enhance policy initiatives and transboundary institutional mechanisms and ensures that the member countries jointly develop and manage their shared resources.

1.3.2. European Union Program

1.3.2.1. Context

The European Union (EU) comprises 25 Member States represented by their ministers in the European Council of Ministers (EUWI, 2003). The European Commission (EC) is the executive body of the EU with many Directorates-General for various fields (in this report, EU and EC refer to the same entity). The EU has a unique continent to continent strategic partnership with Africa with the purpose to make a more effective joint contribution to the achievement of the water and sanitation related MDG (see Preface – Context of Assignment). This partnership provides a platform for strategic and political dialogue on water issues through bilateral and multilateral initiatives between EU members and African nations.

The EU Water Initiative (EUWI) is represented by officials from Ministries of Development Co-operation and Ministries of the Environment from the EU Member States and by the EC Directorate-General for Development, Environment, Research, and EuropolAid (EUWI, 2003). The EUWI is not a financial institution, it is a facilitating mechanism. The EUWI established two working groups in Africa; one focuses on Water Supply and Sanitation and the other on IWRM. The EU has earmarked 10 million € to finance five pilot basins (including LCB) in IWRM. Leadership of the IWRM in Africa is shared by the EC and France. It is worth noting that, in the aim of seeking the closest contact to the African side of EUWI, an explicit link is made to the Technical Advisory Committee of the African Ministerial Council on Water. In addition to contributing to the MDG, the EUWI has two more development goals: development of IWRM plans (EUWI, 2003); and development of action programs (EUWI, 2004) with clearly defined targets, monitoring frameworks, and timeframes. The following main objectives of the action program are applied at both regional and country levels:

1. Increase demand for investment in water supply and sanitation for the poor
2. Strengthen underlying institutions, building capacity and making better use of existing human and institutional resources
3. Enhance funding for the supply, management and development of water resources and sanitation
4. Improve coordination between the actors involved in water resources management

In the course of achieving the above objectives, the EUWI analyzes major gaps in organizational, knowledge, and financial needs; prepares a coordinated action program with a long term financial strategy with concrete benchmarks and building blocks; establishes a monitoring and reporting mechanism to measure progress in implementation and to steer further action; and prepares a work program for the following years with specified targets and responsibilities.

The EU supports the GEF initiative in the LCB (see next section). To the date of this report, there are no active EU projects related to water resources in LCB except for one through bilateral cooperation with Germany which is executed by BMZ/GTZ-AHT¹⁰ and BMZ/GTZ-BGR¹¹ (see the following section and Table 4) (Personal communications January 10, 2008: Letizia Beltrame, Regional Programs Coordinator, DEC, N'Djamena, Chad). Future allocation of 2.5 M€ is expected in 2008 by the EU through GIRE (Gestion Intégrée des Ressources en Eau). This assistance is directed to the GEF areas shown in Table 4. Additional areas are introduced to Table 4 by the EC as follows (descriptions are modified from Ladel & Roussel (2007)):

¹⁰ AHT GROUP AG, Huysseallee 66-68, 45128 Essen, Germany
<http://www.aht-group.com/index.php?id=134>

¹¹ Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) [Federal Institute for Geosciences and Natural Resources], Geozentrum Hannover, Stilleweg 2, D-30655 Hannover
http://www.bgr.bund.de/cIn_030/nn_462814/EN/Home/homepage_node.html_nnn=true

Activities 4.4-4.5 (70,000€)¹²: “Identification of risk indicators and evaluation of risk.”

This activity includes

- Survey of risks related to water resources including climatic (droughts, floods), sanitary (malaria, cholera, etc.), and chemical pollution (hydrocarbons, pesticides)
- Present best practices for mitigation of the these risks
- Geochemical survey of transport of hydrocarbons in groundwater aquifers with modelling of a pilot site using MODFLOW model (USGS, 2008)

Activity 5.7 (300,000 €): “Strategies for River and Lake Transportation Systems.”

- Preparation of a strategy for the transportation on Lake Chad and the rivers in LCB in the perspective of the feasibility study of the IBWT from Ubangui to Chari rivers (see previous section) with techno-economical survey for Chari dredging. (The river beds are silted and enlarged, e.g., Chari river bed doubled in the last 30 years.)

Activity 5.8 (300,000 €): “Developing Management Strategies for Multipurpose sites.”

- Potential for hydropower generation in LCB or in Benoue basin with the possibility of interconnection areas with non self-sufficient energy
- Prefeasibility study of one or two sites for multiple purposes projects, in particular in Cameroon and/or Central African Republic

Other projects being investigated for additional support by the EU include research of LCB hydrology and hydrogeology, and the reuse of water produced by oil exploitation. The Dutch government (The Netherlands) is contributing 69 million Dutch marks towards the African Development Bank/LCBC project “Program for Sustainable Development of LCB” for the conservation and rehabilitation of the LCB ecosystem and its adaptation to climate change, with a project starting date in April, 2007.

1.3.2.2. German projects

Germany is the only EU member that has active water resources projects in LCB. Chad is a partner country of the Germany Federal Ministry for Economic Cooperation and Development (Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung, BMZ). The German Agency for Technical Cooperation (GTZ) has been active in Chad since 1986 (GTZ, 2008). The overall goal of the ongoing German initiative in water resources, “Sustainable Water Resources Management of Lake Chad,” is that the LCBC manages transboundary water resources sustainably. The GTZ support to LCBC focuses on: 1) organizational Development, 2) knowledge management, 3) information technology, and 4) integrated water resource management. The project is implemented by GTZ in three phases with an overall duration of nine years (2005 – 2013):

¹² It is assumed that activities have equal shares from the stated total amount.

- A. GTZ First Phase (2005-2007).** This phase was carried by the AHT Group for Management & Engineering for a total cost of 1,000,000 €. The specific objective of this phase is strengthening LCBC, as the authority for international cooperation among riparian countries, and providing the LCBC with a “knowledge management system” suited for its mandate (GTZ, 2005a).

The following summary of activities and progress during this phase is obtained from a presentation of the project progress (AHT, 2007) with more detailed information in AHT (2006, 2005a, and 2005b). The stated project activities include:

- Support of the LCBC in organizational development, knowledge management, information technology and IWRM;
- Drafting of inter-governmental protocols for the exchange of hydrological data between the member states;
- Harmonization of data collection, processing and evaluation with the member states;
- Installation of suitable information technologies for data storage and transfer;
- Development and implementation of a website for interactive visualization of hydro-meteorological information for Lake Chad Basin;
- Training of the Commission’s staff on various aspects of knowledge management, development and implementation of water resources management plans and institution building; and
- Organization of regular workshops for representatives of the member states.

The reported achievements since the inception of the project until April, 2007 include (AHT, 2006):

- Support of LCBC in procurement of hardware and software including: new notebooks, memory upgrades for existing desktop computers, file server, CD / DVD writers, anti virus software
- Implementation of Internet map and data server
- Drafting of a Data Exchange Agreement for member states
- Identification of data collecting institutions by member states
- Discussion of the two possible models for data flow between LCBC and member states: (1) from collecting institutions to LCBC data base, or (2) from collecting institutions to National Focal Points then from the Focal Points to LCBC database
- Discussion of the four possible alternatives for Focal Points: a) National Information Center for LCB to maintain independent information and forward regional relevant data to the LCBC, b) Data Verification Point to collect the information, verify (accuracy, formats and completeness), then forward to LCBC, c) Mailbox function to collect information and forward it as is to LCBC, or d) Contact Point to liaise between LCBC and national data collectors.
- Recovery of hydro-meteorological data previously available with LCBC
- Recalculation of catchment boundaries within LCB
- Identification of major existing water resources schemes
- Support in organization and interpretation of Remote Sensing Images

Other anticipated activities before the end of this phase in December 2007 include (AHT 2006):

- Support LCBC to submit a data exchange agreement to Council of Ministers
- Establish a “Communication and Knowledge-Management Unit” within LCBC
- Produce a monograph on variations of surface water resources availability in LCB
- Update information on existing and planned major water resources schemes
- Hold workshops on water resources simulation and remote sensing for land use classification
- Continue the ongoing activities related to procurement of IT equipment, data recovery, updating of web-based information systems, and support to Remote Sensing Unit

B. GTZ Second Phase (2008 – 2010) This phase commences in April, 2008 and is carried by the German Federal Institute for Geosciences and Natural Resources (BGR) (Bundesanstalt für Geowissenschaften und Rohstoffe) for the cost of 1,000,000 € (BGR, 2008). This phase is the first of two phases for BGR. The objective of this 3-year phase is to develop a GIS based knowledge management system at the LCBC and to formalize data exchange between member countries and the LCBC. The specific goal is that the LCBC coordinates the exchange of information on **groundwater resources** with its member states and integrates this information into its knowledge management system with the aim of developing a sustainable water resources strategy. The approach relies on capacity building through training of national water resources experts of the member countries in collecting, processing and analyzing groundwater data. A unit will be established within the LCBC to regionally assess and analyze the combined national data. This unit will provide information into the integrated water resources strategy that considers interaction with other relevant sectors. The main indicators for the success of BGR involvement include:

- a. The intergovernmental protocol on the exchange of hydrological data is produced and contains all essential groundwater issues required for integrated water management;
- b. Experts from the riparian states submit compatible groundwater data to the LCBC;
- c. Analysis of hydrological and hydrogeological data becomes possible at LCBC via the knowledge management system; and
- d. The LCBC has a special planning unit able to evaluate meteorological, hydrological and hydrogeological data to assess transboundary water availability and to plan on the use of the resources

C. GTZ Third Phase (2011 - 2013) is expected to be carried by BGR. This is the second of the two phases by BGR. Details about this phase are yet to be disseminated.

1.3.2.3. Section concluding remarks

In the *author's* opinion, real achievements from a project cannot be assessed from the executed activities and tasks; instead, status of the anticipated success indicators and results of the project have to be addressed. According to the terms of reference for GTZ (AHT, 2007), the expected project outcome would include developing and submitting an agreement on data exchange for water management to the COM; strengthening LCBC knowledge management capabilities; and implementing a system for IWRM.

Consequently, the following inquiries have to be addressed to assess the real progress on the ground: Has the data exchange protocol been submitted to the sector ministries of the member countries for their decision? Have the ministers approved it? Have data actually been exchanged between riparian countries and LCBC? Has LCBC set up a trans-boundary planning unit? Is this unit functioning and actively conducting its job? Has an analysis of the available hydrological data been conducted and furnished to the commissioners? Is the trained LCBC staff currently providing the operation and maintenance of the system for the collection, development, processing, presentation, and communication of the information? What is the current level of implementation of the operating system for integrated water management at LCBC and at the member states?

To put the BGR activities (Second Phase of GTZ project) in groundwater into context, one should review the relevant past and present efforts related to groundwater management, which include the following (Adamu, 2007a):

1. **Survey of groundwater resources in the Lake Chad Basin.** This work was funded by UNDP and FAO and carried out between May 1967 and 1972. The objective of the project was to survey and explore various known or assumed aquifers. The project identified the limits of artesian activity and the extent of the lower Pliocene aquifer, existence and extent of a deeper artesian aquifer, general characteristics of a phreatic aquifer, and chemical composition of the groundwater and its unsuitability for irrigation. Two main documents were produced by the project one for hydro-geological study (Gear & Schroeter 1973a) and the other for drilling investigations and data (Gear & Schroeter 1973b).
2. **Monitoring and management of groundwater resources in the Lake Chad Basin.** This project was funded by France (through the Fonds d'Aide et de Coopération de la République Française) between 1991-1993. The studies were carried out by the Bureau of Mines and Geology¹³ (BRGM), France. The objective of the project was to provide tools for management of groundwater resources. The first stage included design of a piezometric network, updating of data and implementation of an aquifer surveillance system. The second stage included modeling of the aquifer, evaluation of the resources, and simulation of groundwater exploitation.
3. **Management of groundwater resources for the sustainable development of the LCB.** This project was funded by BMZ (within the framework of UNESCO/LCBC) during the period from July 1997 to December 2007. The

¹³ Bureau of Mines and Geology (BRGM), 3 Avenue Claude Guillemin, B.P. 6009, 45060 Orléans Cedex 2, France.
<http://www.brgm.fr/brgm//ANGLAIS/default.html>

objectives of the project were to: quantify water resources and recharge in the upper aquifer under three climatic scenarios (medium, dry, and humid) as well as its water quality for various uses (water supply and irrigation); evaluate the aquifer recharge from floodplains and surface water; provide software for chemical analyses interpretation (AQUACHEM¹⁴) and from hydro-geological modeling (MODFLOW). The project provided an inventory of control points for piezometer head values, two surveys of head values during wet and dry seasons, two water samples collection for chemical analyses during wet and dry seasons, definition of the various aquifers (upper, middle, and lower), and definition of hydraulic parameters (i.e., transmissivity and storage coefficients).

It is expected that the BGR project would utilize the above-mentioned knowledge and information from the previous work and augment it with efficient mechanisms for IWRM, data exchange, and capacity building in groundwater.

1.3.3. Inter-basin Water Transfer Proposal

This ambitious project aims to replenish Lake Chad through transfer of water from Oubangui River/Congo River Basin into LCB. The history of this project is presented in Table 5. The objectives and prospects of the project include:

- Refilling Lake Chad and other wetlands in LCB for sustainable development of navigation, agriculture (irrigation), forestry, tourism, and industries
- Poverty alleviation through increased agricultural production, fisheries, and employment opportunities
- Drought mitigation and control of desertification and land erosion
- Generation and distribution of hydroelectric power in the region to promote socioeconomic development at sustainable level
- Reduction (elimination) of refugees' problems in the basin
- Promotion of regional economic integration, cooperation, and security

Table 5 Brief history of the IBWT proposal

Date	IBWT Event
Late 80's	First proposal by BONIFICA, Italy (BONIFICA 1991): 2400 km long canal, 3200 m ³ s ⁻¹ discharge, irrigate 7 million ha, improve river transportation, generate hydroelectric power (35 GWh/year)
1989	Second proposal by Nigerian National Power Authority, NEPA (Mott MacDonald, 1991): construct dam at Bungui, pump water to LCB, generate hydroelectric power. Preferred proposal by LCBC.
February 1990	Pre-feasibility study by Central African Republic (SOGREAH, 1990): construct dam at Palambo, IBWT, improve navigability, and produce hydroelectric power.
1992	LCBC Master Plan (LCBC 1992): identify IBWT as a priority
1994	LCBC 8 th session: member states commitment to IBWT (LCBC 2005a)

¹⁴ **Data Base and Analysis of Geochemical Data.**
<http://www.groundwatersoftware.com/aquachem.htm>

1998	LCBC SAP (LCBC1998): request to initiate pre-feasibility studies for IBWT
March 1998	Visit of LCBC experts to Bangui LCBC (2005b): examine IBWT options
February 2000	Consultant report and a workshop (LCBC 2000): discuss feasibility and pre-project for IBWT
2001	1 st meeting of LCBC-IBWT technical committee (LCBC 2005b): 1 st version of Terms of Reference adopted by member states
September 2001	Tender for Feasibility Study published (LCBC 2005a): 5 firms presented bids, process was suspended for lack of funds
January 2002	49 th session of COM: Obtain non-objection to IBWT feasibility study from all (except DRC), requests for funds submitted, LCBC committed one million from the 6 million US\$ needed
June 2004	51 st session of COM: Nigeria's willingness to pay the total sum for IBWT feasibility study and called for donor conference
August 2004	Meeting of experts from LCBC and DRC (LCBC 2005a,b): address reservations about technical aspects of IBWT feasibility study
February 2005	2 nd meeting of LCBC-IBWT technical committee (LCBC2005c): address different aspects of IBWT project.
6 June 2005	12 th session of Heads of State (CEEAC, 2005): stated non objection of IBWT donor states and permitted LCBC to execute necessary studies
16 June 2005	52 nd session of COM (LCBC 2005d): called for donor conference to finance the remaining 5 million US\$ for the IBWT feasibility study
30 June 2005	Donor conference held with all heads of state (CBF 2005): Supported LCBC to fundraise for IBWT studies; Nigeria committed the remaining 5 million US\$ for the feasibility study
August 2005	Terms of Reference for IBWT feasibility study (2005b): prepared
July 2007	International Competitive Bidding (ICB) for IBWT feasibility study launched (LCBC 2007)

1.3.3.1. Current status

After analyzing the two approaches presented by BONIFICA and NEPA (Table 5), LCBC decided to choose NEPA's approach. The proposal would entail damming the Oubangui River, a tributary of the Congo River, at Palambo (65km upstream of Bangui) in Central African Republic and channeling some of its excess water through a 150 km canal/tunnel that connects the donor and receiving basins. A system of 1,350-km navigable canals would carry the transferred water through the Chari River to end in Lake Chad with possible navigable connections between Chari, Logone, and Benue rivers (Figure 3). It is estimated that the annual flow rate for the IBWT would be $900 \text{ m}^3 \text{ s}^{-1}$.

The LCBC member states agreed to conduct a feasibility study for IBWT (Table 5). The international call for bids was launched in July, 2007 (LCBC, 2007) with the main objectives to prepare feasibility studies, detailed engineering designs, cost estimates, and tender documents to address: (1) constructing a reservoir dam situated in Palambo region to ensure enough flow that would enable water to be transferred, energy to be produced,

and make navigation possible during the low water period; (2) water transfer by gravity from the Oubangui to the Lake Chad basins to stop the Lake from drying up and to gradually restore its normal level and make navigation between Lake Chad to Oubangui possible during all seasons; and (3) concerns (economic, social, and environmental) of riparian countries of Oubangui tributaries. Specific details of the issues to be covered in the feasibility study (LCBC, 2007) are presented in Appendix 1. Two companies responded to the international call for bids and presented their bids in January 2008:

(1) National Engineering Services Pakistan (NESPAK) associated with Société de Canal de Provence (SCP), France; Société Générale d'Etudes et de Conseil (SOGEC), Chad; and Etablissement de Service de Consultants (ESC) (see company profile on:

<http://www.nespak.com.pk>

(2) Coyne et Bellier (France) associated with Studio Pietrangeli (Italy) De Crown (Nigeria), EnPlan (Nigeria), and WadscO (Nigeria) (see company profile on:

<http://www.coyne-et-bellier.fr/en/index.html>).

The bids were evaluated by a four-member evaluation committee who were amongst the technical experts from the Republics of Chad, Central African, Cameroon, Niger, and Nigeria. A representative of Oubangui-Sangha International Basin Commission (CICOS) also participated. The process of evaluation included both technical and financial evaluation of the submitted bids. The evaluation criteria were the same as those employed by the World Bank Guidelines Index for procurement in projects financed by the International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA) (see WB 2006). In the technical evaluation, Coyne et Bellier scored 90.28 while NESPAK scored 77.61. Coyne et Bellier scored better because it had partnered with five experienced consulting firms and had more experience of projects in the donor and receiver basins. Since both companies scored more than 75 in the technical evaluation, their financial bids were then opened. Coyne et Bellier bid amount was 3,447,000 € while NESPAK amount was 2,700,516 €. In the final combined score, Coyne et Bellier scored 85.504 while NESPAK scored 86.566. The final decision of the award would be made by the Council of Ministers (COM) during the meeting of the 25th March, 2008 in Abuja, Nigeria. The COM thought that only 2 offers for the feasibility study were not enough and decided to rewrite the international call for bids and to reopen the offer again.

1.3.3.2. Project cost

The following very rough estimates of the cost of the IBWT project were presented by SOGREAH (1990) and adjusted for inflation until 2005 (GTZ, 2005b):

- Dam at Palambo: 110 M€
- Feeder canal from Palambo dam to Fafa River (100 to 150 km): 0.65 to 2 billion €
- Widening and excavation of Fafa, Ouham, and Chari riverbeds (total of 1350 km) and stabilization of Chari riverbed (740 km): yet to be estimated as it depends on current excavation rates for various soil types (including rocks); rental rates for bulldozers, excavators, trucks; and foremen salaries. At a very rough estimate of

- 10 M€ km⁻¹ (based on average cost per kilometer from similar projects worldwide), the cost for the channel system would be 12.5 billion €.
- The approximate total cost would be 15 billion € (~23 billion US\$) exclusive of hydraulic structures for irrigation (e.g., barrages, pump stations, etc.) and navigation (e.g., locks, ports, etc.).

1.3.3.3. Opinion of potential donors

The following opinions of international donors are summarized from interviews by a consultant to representatives from donor organizations (GTZ, 2005b). The **UNDP** representatives indicated that IBWT appears to be very risky from the environmental point of view and that the present institutional situation seemed to be not adequate for such a project. The **WB** representatives expressed willingness to participate in the ongoing dialogue regarding the IBWT, but could not commit to its implementation prior to completion of a full analysis of options to meet the water demands in the region. The **French Development Agency** did not possess enough information about the status of IBWT and did not see the possibility of support for the project. The **EU** representatives reiterated the concerns expressed by UNDP and added that the institutions included in the project at the member state level were still weak and had to be strengthened. The Delegation of the European Commission (DEC) in Chad indicated that the **EU** did not adopt the project, but expressed willingness to provide technical help if needed (Personal communications January 10, 2008: Letizia Beltrame, Regional Programs Coordinator, DEC, N'Djamena, Chad).

1.3.3.4. Section concluding remarks

The major concerns of the international donor community seem to reflect a lack of support to the IBWT. However, with the current trend in climate change, lack of rain, increased evaporation, and increased demand, augmenting the amount of water in LCB may become an inevitable solution. The *author's* responses to donors' concerns are as follows:

Environmental effects of IBWT and the effects of the changed environment on socio-economy of each country cannot be determined in advance. When water availability within a basin cannot meet the needs for agriculture, people and nature, it is often transferred from another surplus basin. Such water transfer has been carried out throughout the world for centuries as presented in the following information from a recent review of existing and proposed water transfer schemes by the International Commission on Irrigation and Drainage (ICID 2006). The existing global total water transfer capacity is about 490 billion m³ yr⁻¹ realized by about 155 schemes in 26 countries. Almost half of the number of the existing schemes (82) is located in the Americas. Most of these schemes have been developed for hydropower and irrigation. Other uses include municipal and industrial water supply, flood control, navigation, dilution of sewage water, transport, stabilization of lake water levels, estuary improvement, and supply of reservoirs. Lessons learned from existing water transfer schemes could alleviate the fears associated with such a solution. In addition, a good feasibility study can address the specific concerns related to the proposed IBWT (see

Appendix 1). Fear that the project impacts cannot be determined in advance is legitimate; however, this risk exists with any new initiative of such scale and magnitude. Consequences from the no solution alternative have to be considered in a cost-benefit framework for these alternatives (see below). Nevertheless, degradation of LCB will continue until a remedial action is agreed on.

A. Institutional weakness of LCBC is a major impediment to execute the IBWT.

This concern undermines the promised results of most of the ongoing activities by the GEF initiative that was designed to address and alleviate such weaknesses (see below). What may be needed is an intervention to reduce the degradation in LCB (e.g., IBWT) with simultaneous building of the capacity of LCBC. Neither can wait for the other, otherwise unfavorable consequences may occur. The action program for strengthening LCBC (Chapter 2) should be implemented. Augmenting LCBC with international experts through this transition phase is highly recommended.

B. The institutions at member states are weak and have to be strengthened to execute IBWT and to develop transboundary mechanisms. Similar to the response in A, what may be needed is an intervention to reduce the degradation with simultaneous building of the capacity of such state institutions and augmenting them with international experts.

C. There is lack of an overall water management strategy and absence of coordinating mechanism. Again, this concern undermines the success of the GEF initiative in meeting its goals of developing integrated water resource management plan, TDA, and SAP as well as strengthening the institutional capacity of LCBC. The GEF should make sure that its stated success indicators (e.g., Table 4) are met. Nonetheless, it is realized that under the ongoing climatic trends and water demands, management of water resources in LCB cannot eliminate the ongoing degradation in the basin, but may reduce the severity of environmental impacts. With IBWT in place, a water management strategy has to be well developed to ensure proper uses of the transferred water with minimal losses.

D. The economic viability of IBWT is undetermined. Initial cost as well as operational and maintenance costs are high. Highly qualified engineers and technicians are required to plan, design, implement, and operate the scheme. All these concerns are common to similar projects and are being successfully addressed in a large number of IBWT projects all over the world (see below). After the IBWT feasibility study, a precise cost-benefit analysis can take place to address these concerns.

The viability of the IBWT project will be evaluated after the feasibility study has been carried out to address the main concerns (Appendix 1). The following information both for the donor (providing water) and recipient (receiving water) basins is required at the various stages of planning, developing, implementation followed by operation and management of the IBWT project (ICID, 2006):

Socio economic issues: Identify those who benefit and those who are negatively affected; population size (present and future); rehabilitation and resettlement needs; land cover and land use patterns; trends in cultivation practice, cropping patterns, and irrigation practices; and need of stakeholders participation.

Environmental issues: Identify possible ecological impacts including introduction of non-indigenous organisms; changes in water quality; changes in hydrologic regimes; alteration of habitat; environmental impact on the existing hydrological regime; water availability and demand for the present and future scenarios; effect of climate conditions; nature of water bodies (rivers and lake); damage to existing natural systems; and pollution of air, soil, and water

The *author* believes that some of the sticking environmental issues associated with mixing of two different waters (i.e., different physical, chemical, and biological characters) are quite serious and could have severe consequences. The feasibility study should provide a thorough analysis of the effects on both the donor basin and the receiving basin. Physical effects include temperature, dilution, velocity, depth, clarity (turbidity), etc. Effects from chemicals dissolved, suspended, or adsorbed to particles should be considered. All biological constituents in the waters (e.g., larvae, plankton, fish) of the donor and receiving basins should be analyzed thoroughly to assess introduction of indigenous species and threat to existing species. Also, more water enhances sediment transport and a very thorough study of sediment erosion, transport, and deposition should be conducted for both the donor and receiver basins. Effects of sediment budget alteration in the donor basin before and after the proposed dam should be analyzed. It is always encouraged to develop and use models to cover all aspects of the study (physical, chemical, and biological) and all possible current and future scenarios for the IBWT.

Design and construction issues: A careful analysis should be made of other alternative options that are available for the project (including the case of no action); quantitative and qualitative water available at intake and delivery points; geological characteristics; river morphological information; and challenges and opportunities to be addressed.

Operation and maintenance issues: A clear agreement should be achieved on the tasks and responsibilities of those involved; the clear mode of financing for the required level of operation, maintenance, and management; the control measures and options for further improvement; and the cost – benefit analysis on each alternative option available.

Legal issues: A careful preparation from a legal point of view will be of utmost importance to develop a successful project, including the role of various levels of government with respect to land use, development plans, required legal frameworks, setting of standards concerning the functioning of systems and actual implementation. In addition, water allocation laws and existence of disputes should be addressed as well as the international dimension of the project.

Sustainability issues: IBWT schemes are generally developed for a long term. It is therefore of major importance that they contribute to the sustainable development of land

and water resources and are viable from a financial point of view. Financial analysis should cover specific costs and benefits from the IBWT, possibilities in finance assistantship cost recovery aspects, and present and possible future trends in development.

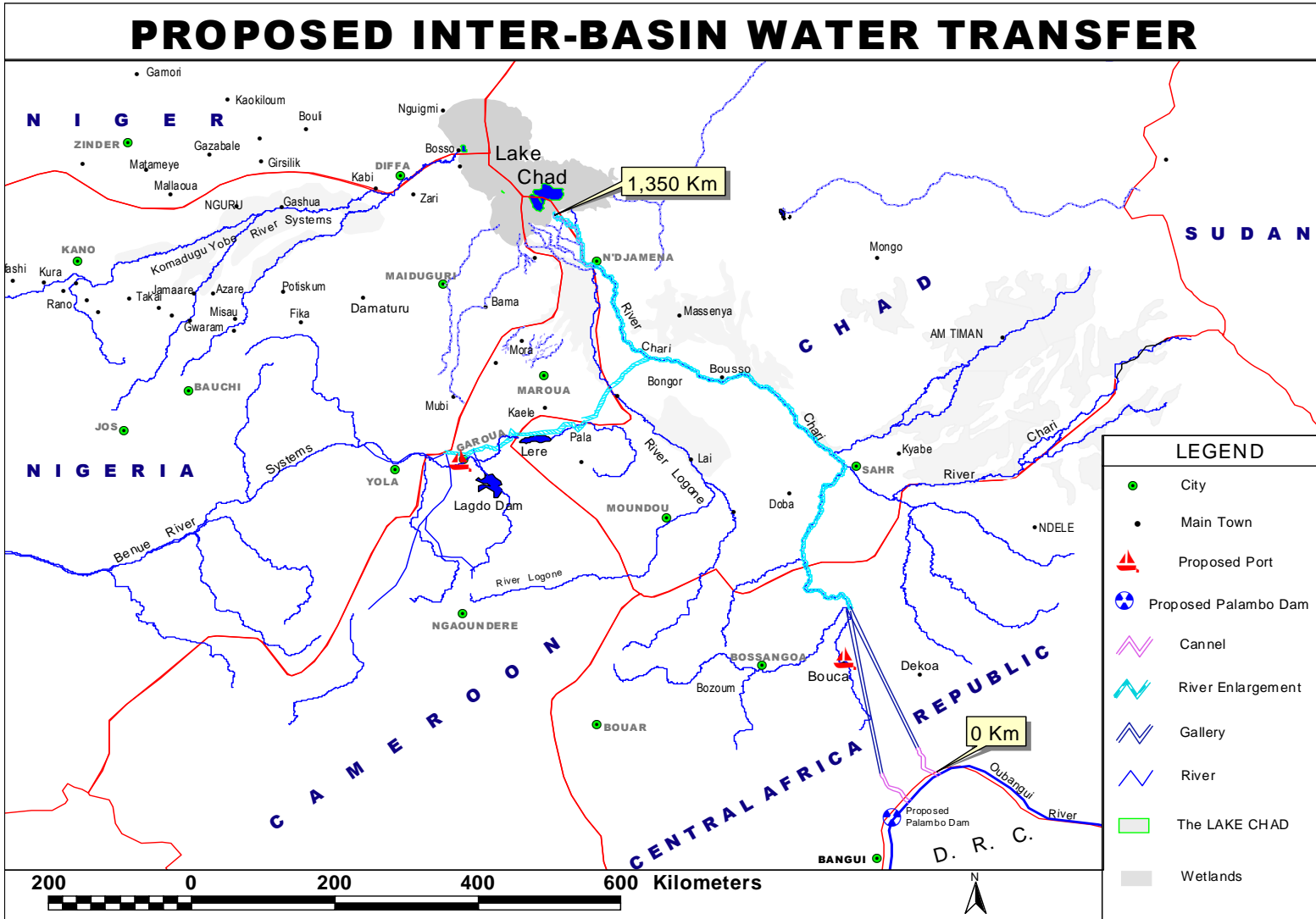


Figure 3 Proposed IBWT from Congo River Basin to Lake Chad Basin (Adamu 2004)

CHAPTER 2: Assessment of the overall capacity and effectiveness of the local recipient organization: Lake Chad Basin Commission (LCBC)

The US Water for the Poor Act calls for promoting programs that develop watershed-wide mechanisms for governance and cooperation. The Lake Chad Basin Commission is the main regional mechanism in charge of Lake Chad Basin. This chapter provides assessment of the overall capacity and effectiveness of the LCBC in managing its projects as well as national and international funds from the various donors. Such information is crucial for donors in order to develop proper policies for their funding.

Before presenting the assessment, the following section summarizes information from UNESCO (2003) that describes LCBC's scope of authority, internal structure, and decision making procedure.

2.1. Scope and structure of the Lake Chad Basin Commission

The LCBC is the key regional organization in charge of trans-boundary water resources management in LCB. There are now five member countries in LCBC: Chad, Niger, Nigeria, Cameroon, and Central African Republic. Sudan was admitted in 2000 but has yet to ratify the convention establishing the commission. The primary responsibilities of the LCBC are: to regulate and control the utilization of water and other natural resources; to initiate, promote, coordinate, and follow up on natural resources development projects and research; and to examine complaints and promote the settlement of disputes.

The LCBC is a term that applies to the whole organizational structure, which implicitly or explicitly includes the following legislative and executive bodies:

A) **The Summit of the Heads of State and Government** is the highest authority, which:

- Appoints and dismisses the Executive Secretary
- Appoints two ministers as commissioners in the LCBC's Council of Ministers (COM)
- Ratifies legislations and decisions by the COM
- Provides Finances to the organization
- Meets every two years

B) **The Council of Ministers (COM)**, the highest legislative authority, which is composed of two commissioners per member state. The commissioners are subject to appointment, instructions, and dismissal by the governments of the member states.

- The COM examines and approves the program of activities and corresponding budgets
- The COM draws up its own Rules of Procedure
- Decisions of the COM are made through unanimous agreement. To be binding, decisions have to be ratified by the governments of the member states
- The COM meets at least once a year in ordinary session, and meets exceptionally on the request of two member states.
- One commissioner from each member state being present forms a quorum
- Decisions by the COM are executed by the Executive Secretariat

C) **The Executive Secretariat** is the executive body of the LCBC:

- It is headed by an **Executive Secretary**, the administrative head of the Commission, in charge of the staff of the Commission and assisted by an **Assistant Executive Secretary**
- The Summit of the Heads of State and Government appoints and dismisses the Executive Secretary and the Assistant Executive Secretary
- The secretariat consists of **five executive departments**: (1) Department of Project Planning, Monitoring and Evaluation (responsible for technical aspects of projects: planning, programming, training; and remote sensing & surveying); (2) Department of Administration and Finance (Responsible for Finance Section and Administrative Service); (3) Department of Documentation, Information and Publications (responsible for documentation, information and publications); (4) Department of Water Resources and Environment (responsible for water resources and the environment); and (5) The Department of Agriculture, Live Stock and Fisheries (responsible for natural resources)
- A **Finance Controller** who reports directly to the COM and communicates with the Department of Administration and Finance

Various calls for restructuring the LCBC have been made through time to increase its efficiency in meeting its mandates. These calls include:

- The 35th session of the COM, held in N'Djamena in 1987, requested the Executive Secretary to establish contact with international organizations in order to study the restructuring of the Commission. A study was undertaken by UNDP in June-July 1988 which gave rise to a new institutional structure.
- In the 47th Session of the COM held in Abuja in March 2000, the Commissioners recommended that the LCBC staff rules and financial regulations be revised.
- In the 49th Session of the COM held in Yaounde in January 2002, the Commissioners recommended restructure of LCBC in order to review the mission of the Commission.
- In the 50th session of the COM held at Niamey on 27-28 February 2003, the Commissioners requested to employ a reputable independent consulting firm to carry out the institutional, financial and accounting audits of LCBC executive national environmental plans that exist in each country.

2.2. Assessment of overall capacity and effectiveness

The assessment of the overall capacity of LCBC is based on the following four main sources of the most recent information available to the *author* as of April, 2008: (1) consultancy appraisal for German Government intervention (Adenle, 2004), (2) assessment of the capacity-strengthening needs of the LCBC during September-December 2005 (Hodge, 2006), (3) validation workshop on 17-19 June 2006 for the key findings in No. 2, and (4) most recent remarks by the executive secretary of LCBC and by the TDA.

2.2.1. Consultancy appraisal for the German government

To appraise possibilities of future technical cooperation, the German Federal Ministry for Economic Co-operation and Development (BMZ) conducted a preparatory study in July, 2003, which pointed to the following major realizations: 1) LCBC is main player in the LCB region, 2) LCBC needs to be reformed and updated to meet present and future demands and challenges, 3) German technical cooperation should be provided to reform LCBC, and 4) an audit of the LCBC is essential for this reform.

In the beginning of 2004, the BMZ commissioned the German Technical Cooperation (GTZ) to evaluate the LCBC. A regional consultant from the LCB area (Aladepo Adenle) was hired to conduct the audit for LCBC. All important documents, literature, and reports were provided to the consultant. Interviews of selected key persons were arranged. In addition to this regional expert, a group of national experts included representatives from the five core states (Chad, Nigeria, Niger, Cameroon, and Central African Republic) to provide reports from their respective states, coordinated the evaluation work, and consolidate the findings. The regional consultant conducted a desk study for 15 working days and presented a draft report (Adenle 2004) on February 28, 2004.

The report indicated that LCBC's achievement could only possibly be measured, with respect to the projects listed in its Master Plan for the Development and Environmentally Sound Management of the Natural Resources of the Lake Chad Conventional Basin of 1992, against what has been done on these planned projects to the date of evaluation (February, 2004). The report evaluated 36 projects relating to water resources, agriculture, forestry, biodiversity management, and livestock and fishery development within the Lake Chad Basin. Information on the status of these projects was based on discussion with the Assistant Executive Secretary of LCBC (Table 6). It indicates that 15 (42%) of the envisioned projects were not executed. As a result, recommendation for capacity building and reorganization of the LCBC's structure was made (Adenle, 2004).

Table 6 Status of projects identified in the Master Plan for development (Adenle, 2004)

No.	Title of Project	Expected Duration (yrs)	Status ^c
1	Lake Multipurpose Project	2	Status not reported
2	Feasibility Study on water transfer into lake Chad Basin ^b	1.5	Terms of Reference ready and project document ready ^a
3	Chari-Logone multipurpose project ^b	2	Awaiting final report of consultant
4	Komadougou–Yobe multipurpose project ^b	2	Incorporated in GEF initiative
5	Borno region multipurpose project	4.5	Nothing done yet (NDY)
6	Improvement of rainfed agriculture in the conventional basin ^b	0.25	Project with the African Development Bank on

			Integrated Pest Management ^a
7	Promotion of small-scale irrigation program ^b	1	Part of project No. 3 project
8	Mayo Kebbi investigations ^b	2	NDY
9	Groundwater investigations ^b	4	1 st phase on Chari-Logone part of the basin done with UNESCO assistance; 2 nd phase anticipated ^a
10	Improving the network of meteorological and hydrological stations in the LCB ^b	2.5	Started with World Meteorological Organization; Arab Bank for Economic Development in Africa to fund US\$250,000; trained 20 technicians in member states. Awaiting instruments to commence work ^a .
11	Food security preparedness scheme, combining irrigated agriculture, food processing, preservation and storage	0.5	NDY
12	Environmental and socio-economic assessment of water projects ^b	1	NDY
13	Comparative watershed management and research program	3	NDY
14	Basin-wide library	2	NDY
15	Classification and management of wetlands ^b	2	The program is called Globewet and includes work on Waza-Logone, Sambisa Game Reserve in Nigeria, and Lake Lere in Chad
16	Waza National Park study ^b	3	Incorporated in GEF
17	Hadegia – Nguru Wetland project ^b	3	Incorporated in GEF
18	Sambisa wetlands project ^b	2	Incorporated in Globewet
19	An international research center for irrigated development & management of fisheries in the LCB ^b	4	Fisheries aspect with the EU with respect to research in Lake Chad
20	Regional project for the conservation and development of the endangered Kuri livestock breed	5	Started with FAO, but needs funds to continue
21	Monitoring of natural resources and development activities ^b	5	NDY
22	Development and harmonization of the natural resources management codes ^b	2	NDY
23	Biosphere reserve at Lake Fitri	3	Part of Ramsar; started. Incorporated in Globewet
24	Biosphere reserve at Lake Lere	3	Incorporated in Globewet

25	Revegetation of northern diagnostic basin ^b	5	Incorporated in GEF
26	Research project for vegetation recovery in the LCB ^b	4	NDY
27	Basin-wide environmental educational program	2	Under the supervision of Chad. Already created a research institute in south Chad
28	Strengthening the Regional Agricultural Training School at Ngala	2	Under construction. Syllabus for training revised.
29	Early warning systems	2	NDY
30	Reinforcement of institutional mechanism and coordination of activities between LCBC states	1	Under the GEF initiative. Has just contacted member states to set up national committees for LCBC.
31	Basin-wide microwave communications	1	NDY
32	Basin-wide transportation network	1.5	NDY
33	Protection of endangered fauna species	1	National project
34	Study of potential small-scale agro-allied industries in the Conventional Basin	0.5	NDY
35	Utilization of sewage water for agriculture and pollution control ^b	2.5	NDY
36	Development of tourism	0.5	NDY

^a see recent project update in Chapter 1

^b Water Resources project

^c status as of February, 2004

2.2.2. Assessment of capacity-strengthening needs

The decision to restructure the LCBC was taken by the COM in January 2002 during its 49th Session in Yaoundé. The LCBC member states agreed to undertake an assessment of the LCBC's basic agreements and organizational framework in February 2003 (COM's 50th Session in Niamey). The main objectives of the assessment were to: (1) identify LCBC's characteristics (including its mandate historical and legislative context, institutional and financial structure) as well as key strengths and weaknesses of the organization, ability to implement the GEF SAP, and the level of stakeholder's involvement into its activities and decision-making processes; and (2) propose changes that address identified weaknesses including legal mandate, function, institutional and administrative structure, financial base, day-to-day operations, decision-making responsibility, and financial accountability. The assessment methodology reviewed the LCBC's recent as well as past efforts at regional water resources management from 1969 to 1998. It employed participatory methods (working with the LCBC staff, brainstorming, individual consultations, and general information sessions). The

assessment evaluated LCBC's new 2025 vision¹⁵ and reviewed the key social and structural factors that are threatening LCBC's ability to implement the new mandate for this vision. The assessment also reviewed LCBC's organization, management style, and human capacities. It also assessed the institution's ability to implement the SAP for the GEF initiative. In addition, a 3-day staff assessment workshop was held at the LCBC headquarters in N'djamena in September of 2005. During the workshop, the LCBC staff shared views and perspectives concerning the organization's weaknesses and strengths. Finally, feedback on the LCBC's performance was collected during a regional stakeholders meeting on the subject in Mauroa, Cameroon, during September 2005. Details of the key findings of the assessment, recommendations, and immediate actions needed were presented.

The key findings of the LCBC assessment included:

1. LCBC's efforts at regional water resources management have been insufficient in order to solve the disputes and to support management of the water resources;
2. the organization could not face challenges associated with managing the natural resources of the LCB in a multi-jurisdictional setting;
3. the organization has not been able to stop the degradation or manage the basin in any systematic way;
4. the organization lacks in developing regional policies, communication networking, and building technical and in-house capacities that support management of regional water and land resources;
5. the organization suffers from lack of accountability (fiduciary and substantively) and a weakening of capacities at all levels, which leads to inability to function on a day-to-day basis;
6. management performance has been weakened by irregular financial contributions from the member states to the organization;
7. the organization's credibility in the region has been eroded;
8. communication between the Secretariat and the Members is irregular; and
9. stakeholder participation is lacking.

The key recommendations for LCBC included the following (Hodge, 2006):

- Prioritize actions to insure effective leadership and reinforce political will.

¹⁵ LCBC 2025 Vision calls for a Lake Chad Region with:

1. Heritage and Wetlands maintained at sustainable levels to ensure the economic security of the freshwater ecosystem resources, sustained biodiversity and aquatic resources of the basin, the use of which should be equitable to serve the needs of the population of the basin thereby reducing the poverty level.
2. Regional and national authorities accept responsibilities for freshwater, ecosystem and biodiversity conservation and judicious integrated river basin management to achieve sustainable development.
3. Every Member State has equitable access to safe and adequate water resources to meet its needs and rights and maintain its freshwater, ecosystem and biodiversity resources.

- Mobilize scientific and technical expertise at local, national, regional, and global levels.
- Improve capacity through corresponding changes in governance and new institutional mechanisms.
- Promote national water supply regulations for shared use of water in member states.
- Obtain members' agreement to endorse the 2025 Vision statement and commit to the IWRM plan.
- Develop a mechanism for gathering stakeholder input into policy and decision-making activities.
- Update and improve function to reflect the new directives of the 2025 Vision.
- Establish strategic partnerships with the key academic and scientific institutions within member states to sustain the SAP.
- Consider establishing a 'quality control' mechanism to oversee progress.
- Integrate science into the decision-making structures as the central point for which the organizational changes and future planning and policy occur.
- Address communication problems and develop mechanisms that facilitate knowledge sharing and information flow throughout the region.
- Garner Members' commitment to the Institutional Assessment's plan of action.

The immediate actions that were recommended in the assessment pointed to:

1. Building capacity through strengthening activities at all levels (systemic, organizational, and individual) to address weaknesses in knowledge base, information system, and technical and operational abilities;
2. Developing an action plan for strengthening the financial and procurement management systems and procedures; and
3. Strengthening the LCBC secretariat through interventions including: workshops centered on enhancing knowledge, skills, capacity and relationships among the LCBC policy makers, managers and the public; leadership training and staff development; case analysis and appraisals for policy concerning land and water management; problem-solving exercises and decision-making seminars; and experimental innovation to improve inter-disciplinary and inter-governmental coordination.

2.2.3. Validation workshop for the capacity strengthening needs

A mission from the WB composed of a bank representative and two international consultants conducted a validation workshop (17-19 June, 2006) for the key findings presented in the assessment of LCBC capacity strengthening needs (BTOR, 2006). The participants included: delegations from the governments of the five member states, delegation from LCBC executive secretariat, representatives from the GEF, representatives from the WB, regional experts, consultants, and other relevant parties. Objectives of the workshop were to: (1) discuss and validate the Institutional Assessment Report (Hodge, 2006), and (2) prepare an action program.

Participants in the workshop agreed on the need to address all the main issues that were raised in the report, namely:

1. Fiduciary capacity
2. Organizational improvement
3. Management Capacity
4. Enabling legal and policy environment
5. Communications and knowledge networking
6. Knowledge base improvement
7. Common vision for future governance and management

The action program called for three levels of actions:

- a. Short-term/Immediate actions (within 12 months - by July 2007),
- b. Medium-term actions (by the end of GEF initiative – June 2008), and
- c. Long-term actions (post GEF initiative)

Following the workshop, the action program document was prepared (Bila, 2006b) for the attention of the subsequent meeting of the Council of Ministers in July 17, 2006. Also, a draft of the resolution to improve LCBC performance was prepared for the ministers' consent. The following actions were to be executed immediately (within 12 months):

- o Revise LCBC's mandate and improve its capability and productivity
- o Improve LCBC's human resources and managerial capabilities
- o Increase and improve resources to LCBC
- o Lift of LCBC's face, presence, trademark, documentation, and spirit
- o Strengthen involvement and response among state members
- o Improve information and communication among member countries and stakeholders
- o Carry on a thorough and extensive audit of achievements and costs on a quarterly basis
- o Carry on a thorough mapping of staff and their outputs from relevant government organizations and other institutions
- o Improve social participation and commitment with the lake and its basin communities

2.2.4. Recent remarks

The Executive Secretary of LCBC presented his assessment for problems of managing the water resources in many publications and presentations as summarized in the following quotation made in July, 2007 (Adamu, 2007a):

“Integrated water resources management in the Lake Chad, whether it is at national or regional level, has been very much hampered by the following facts which are still prevailing in the region:

1. Bad management practices
2. Poor decision-making
3. Poor data management

4. Absence or poor monitoring systems
5. Absence or poor conservation policies and/or systems
6. Lack of contingencies planning and resources mobilization
7. Lack of focus on part of managers
8. Deficient legal framework (laws, regulations, guideline tariffs, etc.)
9. Weak coordination among sectors at national and regional levels
10. Weak and persistent rural economy of Member States of LCBC
11. Poor stakeholders' participation.

Therefore for Lake Chad Basin to achieve its common Vision 2025 where land, water and all natural resources are conserved, sustainably exploited, managed in an integrated manner and shared equitably, in order to ensure poverty eradication, improved living standard in peace and security, these predicaments must be overcome.”

These comments by the LCBC's Executive Secretary indicate lack of action toward the mitigation measures suggested during the evaluation workshop.

In addition, recent remarks in The Transboundary Diagnostic Analysis (TDA; Bdiya & Bloxom, 2007) indicated that, although the LCBC member countries have been individually adjusting their various **institutional, legal, and policy** frameworks for water governance; each country is characterized by a multiplicity of agencies with overlapping and sometimes conflicting responsibilities. They have national policies and laws for management of land and water resources, nevertheless, with no integrated land and water resources management at the level of the LCB. There are no comprehensive policies in the forms of strategies, functional national water master plans, systems for inter-sectoral coordination, tariff setting and conflict resolution. Indeed, some national programs had an impact on natural resource and increased degradation, like Nigeria's hydro-agricultural infrastructures which destroyed down stream wetlands. Although the riparian countries are willing to address issues related to the sustainable management of the lake and its catchment area through LCBC, they have not backed this willingness with the relevant national legislations for implementation which should enforce appropriate measures, enactment of national laws, creation of standards, and reorganization of institutions. Meanwhile, members are in default of paying their dues for running the LCBC to carry its technical activities and have adequate staffing. In addition, LCBC has no legal mandate to enforce standards and it cannot sanction offenders. In conclusion, the TDA indicated that any attempt at reversing the degradation trends in the land and water resources of LCB needs to address the absence of sustainable development on the political agenda of the riparian countries. The national legal and institutional settings in the member countries have to be readjusted for promoting IWRM in the individual member countries and in the LCB. The TDA also indicated that the reconstitution of the LCBC is needed so that it can be more powerful, and that it should be better funded to perform its mandates and carry more responsibilities and programs.

2.6. Section concluding remarks

Examination of the above-mentioned sequence of events and the relevant actors can reveal when, who, and what is hindering the LCBC's strengthening process for almost

four years. In summary, the following actions took place chronologically at the shown respective dates:

1. 28 February 2004 - LCBC assessment for the German Government highlighted strengths and weaknesses of LCBC (Adenle, 2004)
2. 31 March 2006 - LCBC capacity-strengthening needs identified (Hodge, 2006)
3. 19 June 2006 - LCBC capacity needs validated (BTOR, 2006)
4. June 2006 - Action Program prepared for approval by the COM (Bila, 2006b)
5. 17 July 2006 – COM’s meeting concluded without clear resolution on the Action Program
6. July 2007 - Remarks by LCBC’s Executive Secretary (Adamu, 2007a) and the TDA (Bdliya & Bloxom, 2007) indicated the persistence of the identified weaknesses.

It is clear that the COM’s annual meeting of 17 July, 2006 and, if any, subsequent meetings (until July 2007) did not yet endorse the above-mentioned assessments nor the action program. The reasons for this halt in progress are not clear to the *author* or to other observers taking into account the following points:

- LCBC is the only regional institution that can implement the IWRM plan in LCB
- The original mandate and institutional foundations of LCBC are adequate for managing its regional responsibilities (Hodge, 2006)
- LCBC has the skeletal infrastructure, which needs substantial beefing up with finances, personnel, and equipment to meet the various needs
- The goodwill for improvement of the Executive Secretariat of LCBC is suggested in positively answering to and going through the assessment and auditing process.

In conclusion, delay in actions that address the LCBC capacity strengthening needs can be attributed to the legislative part of the organization (the COM and higher state authorities), which have no higher authority to supervise the promptness of their decision making process.

Thus, the size of the organizational weaknesses extends beyond the Executive Secretariat into the legislative entities in LCBC and its member states. However, in spite of its weaknesses, LCBC should be supported by the national, regional, and international organizations and donors to meet its mandates for IWRM. In addition to paying their dues to run LCBC with adequate staffing, support of the member states should be manifested by amending mandates of their national and bilateral organizations that deal with water resources in the region through enforcement of appropriate measures, enactment of national laws, creation of standards, and reorganization of such institutions. Such organizations have to secure LCBC’s approval before executing their local agendas. In other words, LCBC should be the highest approving authority in any process related to water resources in the region and should have a legal mandate to enforce standards and to sanction offenders. This authority should be reinforced and overseen by a more sophisticated mechanism to not only oversee progress in LCBC, but also to advise on actions, follow up with decisions, enforce decisions, and counsel the various donors. (Donors’ suspicion of the overall existing capacities may be the major factor in holding off substantial aid that is highly needed by the region.) This mechanism can be assigned by global organizations and donors that have a stake in the region (e.g., UN, WB, FAO, etc.) and should be actively involved until LCBC reaches the adequate level of

proficiency. A prototype of this mechanism has been devised by the EU-Africa partnership through the Delegation of the European Commission (DEC) which oversees all projects and donations from its member states.

2.7. Latest Developments

At the time of submitting this report, it came to the attention of the Science Advisor (the *author*) that a draft final report for the Institutional Assessment of LCBC has been prepared for consideration, validation, and adoption by the COM during an extraordinary meeting on the 12th and 13th of Jun, 2008 (Appendix 2) (personal communication May 20, 2008: Muhammad Sani Adamu, Executive Secretary, LCBC). This final Institutional Assessment report constituted the third part of the assessment of the capacity-strengthening needs of the LCBC (Hodge, 2006) and the validation workshop for the key findings in Hodge (2007). The report presents 34 recommendations related to member states responsibilities, LCBC convention and statute, relation between member states and LCBC, LCBC technical committee, LCBC technical interministerial committees, LCBC organization and staffing, and LCBC finance and budget. The estimated additional cost to implement the Institutional Assessment's recommendations is 17% of LCBC's recurrent budget, which is only 2% of the total LCBC budget. The suggested 6-month time frame to implement the Institutional Assessment is August 2008 to February 2009.

During the extraordinary meeting, the COM endorsed both the Institutional Assessment report and the SAP (personal communication July 26, 2008: Mohammed Bila, Regional Coordinator, UNOPS). The LCBC is in the initial stage of planning the implementation of the two reports. An Investment Plan for the first 5 years of the SAP is expected to be completed by the end of September, 2008. The Investment Plan will be the basis for a donor conference schedule for November 2008. Regarding the Institutional Assessment, a consultant is expected to commence the recruitment process of new personnel in September and will finalize the process by December 2008.

CHAPTER 3: Gaps in the existing efforts where future research and funding is needed

In order for the US to identify areas that need support from the Water for the Poor Act in LCB, it is important to identify gaps in existing effort where the support is most needed. The request for identifying these gaps was made by the Deputy Chief of Mission at the US Embassy in Chad, the coordinator of the Embassy Science Fellow Program at the US Department of State, and a member of the Senate Appropriations Committee for Africa Development. This chapter identifies some of the gaps in the existing efforts where future research and funding is needed from the *author's* perspective. The *author* presents relevant information from available sources and references, analyzes the information as needed, and concludes with remarks that highlight the salient assessment issues.

In order to identify the level of coverage of existing and anticipated water resources projects in LCB, the *author* believes that it is pertinent to identify all activities and their outcomes within a global frame of reference that relates to the UN Millennium Development Goals (MDGs) (see <http://www.undp.org/mdg/basics.shtml>) and the Integrated Water Resource Management (IWRM) framework (see Table 7 below). This process should identify and address progress in the areas of: 1) water resources (for surface and ground water); 2) hydraulic infrastructure for village, urban, and semi-urban areas (for water supply, wastewater, agriculture, pastoral, fisheries, tourism, transport, energy, industry, and mining); 3) environmental and ecosystem sustainable needs and pollution impact; 4) development of legal and institutional frameworks; and 5) transboundary issues and conflict management. In addition, it is pertinent to identify not only the status of all initiatives in each area, but also their anticipated achievements (based on their stated objectives, goals, and success indicators) in relation to the expected MDGs relating to water resources, which are identified in the UN-Water & Global Water Partnership (2007) as follows:

MDG 1: Poverty and Hunger (reduce the proportion of people who suffer from hunger):

- Infrastructure to store surface water, and further develop groundwater resources, is put in place
- The health and productivity of aquatic ecosystems – in particular related to fish productivity - is optimized and protected;
- Rural poor populations are protected against flood risks.

MDG 4-6: Health (reduce the under-five mortality rate; reduce maternal mortality ratio; halt and reverse the incidence of malaria and other major diseases):

- Discharges of human waste waters are treated for bacterial contamination to prevent diarrhea outbreaks;
- Toxic emission from industrial enterprises are controlled within international health standards;
- Pesticide release to groundwater, wetlands and surface water is controlled.

MDG 7: Environmental Sustainability (integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental

resources; reduce the proportion of people without sustainable access to safe drinking water and basic sanitation):

- Appropriate environmental flows are ensured to maintain wetlands goods and services;
- Safe water supply and sanitation expansion has reached or exceeded set target;
- Urban slum dwellers are protected against flooding;
- Social, economic and regulatory instruments are changing inappropriate water allocations and uses;
- Water conflicts across the sectors are mediated through participation of appropriate stakeholder groups.

To meet these MDGs, a structured framework was suggested (UN-Water & Global Water Partnership 2007) to address: 1) the enabling conditions to implement IWRM, 2) progress of specific IWRM change processes, and 3) extent of the contribution of IWRM to the implementation of the MDGs. Table 7 summarizes the indicators and terminologies for these issues. These terminologies will help identify gaps in the various activities that are being conducted in LCB.

The *author* believes that the next step in identifying gaps in activities is to collate information about initiatives and donors' support in LCB (see Chapter 1). Validity and accomplishments of old activities, however, should be evaluated and assessed in the literature review of the ongoing IWRM initiatives in LCB (e.g., current BMZ/GTZ/BGR projects, and anticipated EU projects). The more recent (after 2000) activities in LCB's IWRM are identified here. Donor activities in transboundary water cooperation in LCB are reflected in the historical participation of bilateral and multilateral support from donors, the size of donation, and the areas covered by these donations. This information is obtained from the G8-initiated survey for Africa (GTZ, 2007) and summarized in Tables 8, 9, and 10 for LCB. As of 2005, all specified donor support was directed to LCBC in the IWRM areas shown in Table 10.

**Table 7 IWRM processes and indicators
(UN-Water & Global Water Partnership, 2007)**

Process	Process Indicators – Enabling Conditions in Place	Performance Indicators - IWRM Change Process Taking Place
Enabling Environment	<ul style="list-style-type: none"> • Revision and amendment of policies and laws; • Water is mainstreamed into national development policies, strategies, plans; • Allocation of appropriate and sustainable funding in national budgets. 	<ul style="list-style-type: none"> • New legislation and standards, institutional capacity building is taking effect; • Water resources agencies are starting to administrate according to new IWRM principles
Institutional Framework	<ul style="list-style-type: none"> • Establishment of cross-sectoral coordination frameworks; • Change of ministerial and departmental mandates; • Formal involvement of stakeholder groups; • Launching of awareness and mobilization campaigns; • Decentralization and delegation of decision making at the river basin, provincial/local and community levels; • Capacity development of government staff and stakeholder groups. 	<ul style="list-style-type: none"> • Sector ministries are actively promoting and implementing the IWRM approach; • Water use organizations and the private sector is increasingly coordinating water use in cooperation with government authorities; • Awareness and management capacity is growing measurably in government and user groups.
Management Instruments	<ul style="list-style-type: none"> • Improvements in information management; • Water resources issue assessment; • IWRM strategy and plan development; • Countries produce coherent water resources development and management plans that support the achievement of the MDGs; • Demand management of user behavior and water use efficiency; • Social change instruments for public awareness, mobilization and conflict mediation; • Regulatory instruments and associated enforcement frameworks; • Economic instruments for behavioral change. 	<ul style="list-style-type: none"> • Monitoring and research programs are documenting the impacts and causes of major water issues; • Transparent, coherent and consensus-based planning and strategy making is taking effect in all sectors; • Social, economic and regulatory instruments are changing inappropriate water allocations and uses; • Water conflicts across the sectors are mediated through participation of appropriate stakeholder groups.

Table 8 Entities supporting initiatives in the region

Basin	Bilateral support from	Multilateral support from
Lake Chad	Germany (DE), France (FR)	EC, UNDP ^a , WB ^a
Niger	African Development Bank (AFDB), Canada (CA), FR, USA ^c	EC, UNDP, WB
Congo ^b	DE, AFDB	

^a UNDP and WB represent GEF

^b Congo River Basin is the donor of IBWT to LCB (see Chapter 1)

^c in the area of conflict management

Table 9 Progress of donor's contribution with time

Year	Number of donors	Range of donation per donor (€)	Total number of donors	Maximum donation per year (M€)
2002	1	250,000 - 500,000	1	0.5
2003	2	250,000 - 500,000	3	2
	1	500,000 - 1,000,000		
2004	2	250,000 - 500,000	3	2
	1	500,000 - 1,000,000		
2005	2	250,000 - 500,000	5	4
	3	500,000 - 1,000,000		
2006	2	250,000 - 500,000	5	5
	2	500,000 - 1,000,000		
	1	1000,000 - 2,000,000		
2007	2	250,000 - 500,000	5	5
	2	500,000 - 1,000,000		
	1	1000,000 - 2,000,000		

Table 10 Areas of participation from organizations and donors

Area Covered	Participating Organizations
Enabling Environment: Political, legal, and financial frameworks	EC, FR, DE, UNDP, WB
Institutional strengthening of basin organizations	EC, FR, DE, UNDP, WB
Management instruments:	EC, FR, DE, UNDP
• Developing IWRM plans	UNDP
• Conflict management	DE, UNDP
• Social change instruments	UNDP

In addition to the definitions presented in Table 7, more specific definitions for the areas covered in Table 10 can be obtained from respective references that deal with these areas. For example, information about political and legal frameworks can be obtained from FAO (2003). Specific definitions of what these areas include for LCB can be obtained from the project appraisal documents of the respective participating organization/donor and from relevant targeted studies. For example, institutional strengthening for LCBC is explained in the targeted work by Hodge (2006) (see Chapter 2). An example of integrated plan for water resources development and management on a national level (i.e., national water

policy development and the relevant action plan) can be found in SDEA (2003) for Chad. The *author* presents the following brief summary of these definitions for LCB.

Enabling environment: Political legal and financial frameworks:

The enabling environment includes adaptation of political, legal, and financial frameworks to accommodate the implementation of the IWRM plan. It constitutes revision and amendment of national policies, and reinforcement of political will and commitment to IWRM in LCB; assist in development of national and international policies and laws that relate to IWRM in the LCB states; enforcement of basin wide legislation; and enhancement of mechanisms for allocation of local, national, and international financial support to water issues in LCB.

Institutional strengthening of basin organizations:

Although LCBC was established in 1964, it needs strengthening not only through capacity building to meet its mandates (see Chapter 2), but also through political legal and financial frameworks (see previous definition). Strengthen the relation between LCBC and water resources partners in its member states. Strengthen the relation of LCBC with all stakeholders in LCB. Increase awareness and develop capacity of government staff and stakeholder groups in LCB.

Management instruments: Strengthen coordination between various actors in LCB for better information management and better water resource assessment, i.e.,

- **Developing IWRM plans:** Develop IWRM mechanisms for data monitoring, exchange, management, and analysis. Provide needed information technology (hardware, software, and models). Analyze water sources, allocation, management, sustainability, uses, stakeholders, and cost. Assess status of surface and ground water resources, environmental conditions, ecosystem health as well as hydraulic infrastructure (including water supply, wastewater, agriculture, pastoral, fisheries, tourism, transport, energy, industry, mining, pollution, conservation).
- **Conflict management:** Support legal and institutional frameworks, and manage transboundary issues and conflicts.
- **Social change instruments:** Increase public awareness, mobilization, and support for IWRM. Management of user's behavior related to water use efficiency and providing economic instrument for behavior change.

3.1. Identified Gaps

The following gaps in coverage of water resources areas can be identified from the above information when compared to the stated MDGs:

In place infrastructure to store surface water: Freshwater shortage has impacted heavily on the Basin's economic activities including the fisheries, agriculture, animal husbandry, fuel wood provision and wetland economic services (UNESCO, 2007). As reported in the Transboundary Diagnostic Analysis (Bdliya & Bloxom, 2007), the Komadugu Yobe river system has the largest number of dams and population; however, poor management of the river system and dam operations have altered the regime of the river system. Similarly, the Maga dam constructed on the Logone flood plains has a very disruptive effect on the ecology and economy of the Grand Yaeres and the Waza National Park. There appears to

be no report on the cumulative impacts of water diversions in the headwaters. The downstream consequences of diversions and storage are also not properly understood; in addition, there is a severe lack of up to date hydrological information for the whole basin and its rivers, as there is no functional hydrological monitoring network for the basin. Part of the ongoing and future activities by GTZ is directed towards surface water resources (Component 4, Table 4).

In place infrastructure to further develop groundwater resources¹⁶: There is a general lack of information on groundwater reserves, extent of "fossil" water vs. rechargeable water, and the impacts of groundwater extraction. There is no regular regional monitoring network, and there is insufficient knowledge on the interactions between surface water and groundwater. The impact of changes in the water table due to the reduction in surface (river) flows, wetlands extension, and lake area, and therefore their aquifer recharge function, and due to the indiscriminate sinking of boreholes that are often uncapped and free flowing, is also unknown (Bdliya & Bloxom, 2007; Adamu, 2007b). Part of the ongoing and future activities by BGR is directed towards groundwater resources (Component 4, Table 4).

Safe water supply meeting or exceeding set target: Access to safe drinking water for domestic use in LCB is very limited and water is mainly obtained using traditional methods (UNESCO, 2007).

Appropriate environmental flows ensured to maintain wetlands goods and services: Freshwater shortage has impacted heavily on the LCB's economic activities including fisheries, agriculture, animal husbandry, fuel wood provision, and wetland economic services (UNESCO, 2007).

Optimized and protected health and productivity of aquatic ecosystems – in particular related to fish productivity: There is a paucity of information on fish species, their importance and status in the basin. There is no comprehensive and up to date biodiversity profile for the basin that can support a concerted management intervention (Bdliya & Bloxom, 2007).

Protection of rural poor populations against flood risks: This risk is an impact of sedimentation in channels, which causes the local diversion of flows leading to the desiccation of channels that people have been depending upon for irrigated agriculture, as well as the flooding of communities by the diverted flow causing immense damages to infrastructure, fisheries and farmlands (Bdliya & Bloxom, 2007). (The gap in geomorphological information is mentioned below.) Some pilot projects have just commenced in 2007 for some vulnerable communities in the Komadougou-Yobe basin to address this gap (LCBC, 2008).

¹⁶ For Groundwater Management, support was only offered by Germany (DE) of up to 250,000 € (in 2006) and 250,000 – 500,000 € (in 2007) in the areas of Institutional Strengthening of Basin Organizations (LCBC) and Management instruments (Table 10).

Protect urban slum dwellers against flooding: There is a gap in protecting populations in the immediate vicinity of existing dams against dam failure; early warning systems may be needed for these communities (WB, 2002).

Sanitation expansion meeting or exceeding set target: Sanitary conditions for rural dwellers are particularly poor (UNESCO, 2007).

Treatment of discharges of human waste waters: The waste disposal facilities are severely limited (UNESCO, 2007).

Control of toxic emission from industrial enterprises: Water pollution may become a future concern due to increased application of agro-chemicals, oil industry, and mining activities (UNEP, 2004).

Control of pesticide release to groundwater, wetlands and surface water: The distribution and quantity of the chemicals in the environment is not known and there is currently a severe lack of monitoring and information networks regarding pollution risks, especially in major urban areas. There is also no information on the assimilative capacities of the local receiving environments in the LCB (Bdliya & Bloxom, 2007). In addition, application of groundwater with high ion concentrations can damage irrigable farmland (Adamu, 2007b).

Changing inappropriate water allocations and uses through social, economic, and regulatory instruments: This need is partially covered by the first phase of the GEF initiative (Component 2, Table5), which concentrates on enhanced regional policy initiatives and institutional mechanisms to address transboundary issues during and beyond the life of the project. Most of the activities in this component are still ongoing during the first phase of the GEF initiative (Chapter 1).

Mediation of water conflicts across the sectors through participation of appropriate stakeholder groups: Social impacts of freshwater shortage have included upstream/downstream conflict over who has the right to use the diminishing water resources. Social tensions have also been further provoked by the increased pressure on resources due to the migration of people from the drought stricken northern regions of the Basin into areas surrounding the Lake and associated river basins (UNESCO, 2007). The GEF initiative (Activity 3, Table 4) concentrates on engagement of stakeholder participation. However, not all stakeholder types are actively involved (see Chapter 1). Meanwhile, Activity 3.5, concerning regional participation of stakeholders at all levels, is stalled and continues to form a gap in this area.

In addition to the above-mentioned gaps that are related to MDG, the following additional gaps are quoted from the Transboundary Diagnostic Analysis (Bdliya & Bloxom, 2007):

- Absence of mechanisms for monitoring natural resources that can support effective resources use planning for stock and biological resources.
- There is lack of information on the types, locations, extents and functional status of the various ecosystems in the LCB.

- Geomorphological concerns have been poorly documented. There is little information concerning channel form changes; sediment load; aggraded streambeds burying surface flow; dune reactivation and dune formation. There is no mapping of down cutting or gulying on valley slopes. There is also no information on the locations, extents and impacts of sedimentation.
- There is a paucity of knowledge regarding available viable strategies for controlling the invasive species (e.g., typha grass that blocks river channels and diverts flows). Also very little is known of their locations, magnitudes and impacts.

3.2. Section concluding remarks

Financial support from the international community is reflected in Tables 8, 9, and 10. The number of donors increased during 2002 - 2007 from one to five donors including two bilateral (FR and DE) and three multilateral donors (EC, WB, and UNDP). Meanwhile, the amount of donations increased during the same period from 1 million € to 5 million €. All initiatives are directed towards support of the IWRM through: enabling the environment through strengthening of political, legal, and financial frameworks; institutional strengthening of LCBC; and improving management instruments for implementing IWRM, resolving conflicts, and enhancing social change (Table 7).

The *author* commends this level of participation from the international community as it concentrates on building the basis for a sustainable development in the area of water resources in LCB. Nevertheless, most of the MDGs are not entirely achievable through such efforts because they encompass more technical issues. The identified major gaps in meeting the MDGs fall in the following two main categories:

Infrastructures to: store surface water; further develop groundwater resources; provide safe drinking water; provide appropriate environmental flows to maintain wetlands goods and services; protect rural poor populations and urban slum dwellers against flood risks; expand sanitation; treat discharges of human waste waters.

Technologies to: monitor and collect data; control toxic emission from industrial enterprises; control of pesticide release to groundwater; protect wetlands and surface water; optimize and protect health and productivity of aquatic ecosystems including fish productivity.

CHAPTER 4: Conclusions and recommendations for US involvement

In this Chapter, the *author* responds to requests to present plausible water resources areas for future support from the US. **None of the presented recommendations are intended to derive policy but rather to assist policy makers in their prioritization and development of appropriate policies.**

4.1. Context

US programs in 47 African countries cover a number of the identified priorities under the MDGs that include economic development and growth as one of the priorities. Currently, the US Agency for International Development (USAID) has 23 bilateral and 3 regional missions in Africa to help improve health, education, economic growth, agriculture, and environment programs. Except for some USAID humanitarian activities, however, the *author* detects that there is no noticeable examples of US-Chad projects in many needed fields, especially water resources and the environment.

The US Government supported the UN-MDG No. 7 “Ensure environmental sustainability” which was adopted after the World Summit on Sustainable Development in Johannesburg in 2000. This MDG aims at reversing loss of environmental resources and reducing by half the proportion of people without sustainable access to safe drinking water by the year 2015. The Johannesburg Declaration specified the following procedure to meet this MDG, which lays the groundwork for US support:

- Create a joint platform for improved coordination and communication on water related development assistance
- Develop joint action programs to improve water governance and to achieve the stated targets
- Support the establishment and strengthening of river and lake basin organizations and appropriate legal frameworks
- Increase the transfer of knowledge and know-how and improve the knowledge base through institutional capacity building and targeted research programs
- Encourage the development of innovative financing mechanisms
- Develop financially sustainable strategies that include the implementation of policies on cost recovery which are sensitive to the needs of the poor

The US Water for the Poor Act of 2005 (GovTrack, 2005) was initiated to further the US foreign assistance objective of providing affordable and equitable access to safe drinking water and sanitation in developing countries. This act calls for promoting programs that develop river basin, aquifer, and other watershed-wide mechanisms for governance and cooperation. More precisely, the act would promote programs in developing countries to provide affordable and equitable access to safe water and sanitation by: (1) expanding affordable and equitable access to safe water and sanitation for underserved populations; (2) supporting the design, construction, and operation of water delivery and sanitation systems; (3) improving the safety and reliability of water supplies, including environmental management; and (4) improving the capacity of recipient governments and local communities. Sub-Saharan Africa with its 300 million inhabitants was identified as the

most in-need region and stepped up assistance to this region was encouraged (Food & Water Watch, 2007).

In order to complement national and international efforts, potential future assistance should be planned within the identified priorities in the TDA and the SAP for LCB. The TDA (Bdliya & Bloxom, 2007), a key output of the GEF initiative, is centred on the transboundary environmental problems that need to be addressed jointly by the international community and the LCBC member states. The analysis is intended to form the basis for the preparation of the SAP for the LCB. The TDA highlights the climatic features of the basin, emphasising the catalytic role being played by climate change in resources degradation. In addition, the TDA discusses the current institutional and legal settings for managing the basin. The seven transboundary problems that are identified and prioritized by the basin stakeholders include: **variability of hydrological regime and fresh water availability; water pollution**; decreased viability of biological resources; loss of biodiversity; loss and modification of ecosystems; **sedimentation in rivers and water bodies**; and **invasive species**. The highlighted (bold) problems directly impact water resources in LCB. The Strategic Action Plan identifies five Ecosystem Quality and Water Resources Objectives (Appendix 3). The highest priority is given to **improved quantity and quality of water in the LCB**, which is directly related to water resources in LCB and fits the criteria for Water for the Poor Act for 2005. The two indicators for this objective require that the quantity and quality of the Lake Chad is maintained at a sustainable level; and that a measurable decline in levels of the main contaminant groups in the water, sediment and biota is achieved. The US can assist in achieving these endeavors as recommended below.

4.2. Recommendations

Based on the assessment presented in this report and the gaps mentioned in Chapter 3, the *author* highlights the following water resources areas as the most in need for further attention by the international community in general and the US in particular. The population benefiting from such interventions and projects can include all 37 million living in LCB.

- Provide updated technology for **conservation of surface water** through: 1) improving irrigation systems to reduce evaporation and infiltration losses; 2) lining irrigation channels and enhancing anti-erosion banks; 3) reducing sedimentation in rivers and water bodies; 4) reducing bank overtopping, spilling, and controlling and managing flow to wetlands; 5) using underground pipes; 6) using drip and sprinkler systems; 7) applying efficient cropping patterns; and 8) reducing water blockage by invasive plant species.
- Assist in utilization of **sustainable exploitation of groundwater resources** through: 1) providing basin-wide monitoring network to analyze variations in water surface elevation, gradient, and water movement; 2) improving storage capacity, natural recharge, potential induced natural recharge, artificial recharge of aquifers through infiltration basins, canals, water traps, drainage wells, and sinkholes; and 3) providing technology to eliminate contamination from wastewater and improve sanitation conditions of rural populations.

- Provide technology for **rainwater harvesting** through: 1) surface storage in topographic depressions, 2) underground storage through aquifer recharge, and 3) reducing evaporation losses.
- Upgrade the **monitoring and information technology** system for water resources support and management including: 1) strengthening networks for monitoring surface water, groundwater, and rainwater; 2) providing upgrades of infrastructure hardware and software, and 3) training of technical staff. The World Meteorological Organization presented a proposal (WMO, 2005) to execute this need for an estimated cost of US\$ 2 billion.
- Assist in **water quality and pollution monitoring** for surface and ground water by providing: 1) sampling technology and equipment; 2) laboratory equipment for sample analysis; 3) training and capacity building for technical staff; 4) technology for identifying critical contaminants and hotspots; and 5) strengthening the water quality monitoring network.
- Positively support the **inter-basin water transfer** project throughout its phases of realization: feasibility study, design, construction, operation, and maintenance. Based on very rough estimates from similar projects around the world, the construction cost of this project could reach 15 billion € (23 billion US\$).
- Support **model development** for prediction and assessment of best management practices: 1) provide model software; 2) assist in data gathering for model implementation including satellite and GIS data; and 3) provide technical expertise and support.
- Improve road **infrastructure** and communication network to facilitate execution of various water resources projects.
- Assist in building and maintaining LCBC's **technology** by: 1) providing information technology hardware (computers, printers, plotters, networks); 2) developing centralized regional **databases** (including GIS) for environmental planning and monitoring trends in desertification and deforestation; and 3) developing a modern library and archival system for hard copies as well as electronic files.
- Promote environmental **education** in the Lake Chad Basin through: 1) encouraging the development of academic curricula and materials focusing on Lake Chad Basin environmental issues; 2) supporting academic partnerships at school and university levels; and 3) assisting universities to develop programs featuring Lake Chad Basin issues in ecology and environmental science.
- Foster the development of **research collaboration** partnership with the regional institutions and centers of expertise.

In addition to these explicit areas in water resources, the US can also participate in other areas related to the ecosystem/environment quality (see Appendix 3) that fit within the third item of the Water for the Poor Act (environmental management).

The *author* would like to emphasize that, until the ongoing capacity building efforts bear fruits, US support should be offered within a local mechanism that continuously oversees progress and releases funds as progress indicators are achieved. This mechanism should follow up on the various stages of a project from its inception: prefeasibility study, feasibility study, planning, design, execution, maintenance, and achievement of the expected short- and long-term benefits. The Delegation of the European Commission's role

in managing the EU's programs and projects in LCB is a good example of such mechanism.

APPENDIX 1: Issues for the feasibility study of the Inter-basin Water Transfer project

The following extraction lists what needs to be done in the feasibility study for Inter-basin Water Transfer (IBWT) (LCBC, 2007).

The following specific problems would be covered in the feasibility study:

- Study for the causes (man-made and natural) of Lake Chad shrinking and environmental degradation of its basin.
- Precisely determining the site to be chosen at Palambo for siting the dam.
- Determining the minimum level of water behind the Palambo dam in a manner as to define with as much precision the altitude at the start of work and from there the point of the same altitude situated in the basin of the Chari River.
- Defining the arrival point of the conveyance canal of water in the Chari basin according to the necessary slope for an average flow of $900 \text{ m}^3 \text{ s}^{-1}$.
- Determining the flow of the channel according to water requirements in recipient countries.
- Aerial reconnaissance in order to establish the precise topography of the site to be excavated.
- Study of the sites likely to receive the excavated wastes (dumping site).
- Study of the structures required for crossing roads (bridges, culverts, etc.).
- Study and evaluation of the impact on the local populations and identification of villages to be moved.
- Study of the impact of the water transfer on navigation and creation of a port at Bouca.
- Study of impacts of existing or programmed developments in Oubangui and Congo rivers basins such as Inga dam.
- Study of the increase in the electrical energy potential created by the Palambo dam;
- Economical analysis of the programmed hydro-electrical production and pumping requirements.
- Study of the ratio cost/profit of the Palambo dam.
- Study of the eventual impact on the population and on socio-economic activities (fishery, livestock, irrigation, etc.) along the track of the canal and where the dam is implanted.
- Study of the chemical nature of Oubangui and Lake Chad waters to determine the impacts from the mixed water on the fauna and the flora in the basin.
- Study of the impact on the environment of the donor and recipient rivers basins, and evaluation of costs for minimizing these effects.
- Study of the method for crossing the ridges between the Chari and the Oubangui catchments (tunnel, open canal) while maintaining its navigability.
- Study on the preparation of a conveyance canal, the natural river channels and on the dredging needs of Lake Chad.
- Study of the navigation canal link between the Chari river, the Logone and the Mayo Kebbi as well as the navigation link with river Benue (inclined ladder).
- Study of the navigability of Oubangui river (from Palambo to Brazzaville) following the transfer of part of its waters.
- Study of the impact on tourism;

- Study of options and alternatives of socio-environmental and legal impacts.
- Study of national and international institutional and legal aspects pertaining to the water transfer.
- Study of the ratio cost/benefit of the project.
- Identification of similar or subsidiary projects likely to valorize the considerable investments that will be made.
- Preparing the Terms of Reference for detail engineering design and tender documents.
- Study of reduced models on:
 - Water distribution and simulation phenomenon as provided for by the water transfer project upstream and downstream of the dam.
 - Water behavior on various rivers ports situated downstream of the dam.
 - Water behavior on the site at Inga.

Engineering analysis would cover the following components:

Topography and geology

- Collecting and reviewing of the available maps of the area and establishing of the accuracy of maps covering the area; make a clear definition of the possible transfer routes and eventual sites for the structures;
- Collecting and reviewing of the available geologic maps with view to setting up the general geologic conditions of the water transfer zone and the possible ground conditions for hydraulic structures as well as digging of the canal;
- Stratigraphic study of the geological formations in the Lake Chad basin and along the canal;
- Prepare the designs of all the water-ways;
- Collecting and reviewing of the data on the seismic conditions in the project area.

Hydrology, hydrogeology and hydraulic

- Collect pertinent climatological, hydrological, hydro geological and hydraulic data existing in the Chad, Oubangui and Congo basins;
- Homogenize and analyze climatological and hydrological data and review the seasonal characteristics of the flow;
- Evaluation of flow characteristics into transfer sites and, where adequate data is available, evaluation of correlation relations;
- Evaluation of the hydraulic characteristics of the structures according to expressed needs;
- Validation of a hydrological and environmental base in the Lake Chad basin and the Congo-Oubangui sub-basin.

Technology

- Study of the conditions required for the off-take and transfer (intake by gravity, intake controlled by dam, pumping station, and so on);
- Study of the impacts of the water transfer project from Oubangui on Matadi Port in Democratic Republic of Congo (RDC);
- Evaluation of transfer alternatives and design of the transfer route;
- Evaluation of the opportunities for energy recovery on the deviation routes or other

- possibilities of producing energy such as hydro-electric installations at the dam sites;
- Legal implications of the quantity of water to be transferred in terms both of the domestic water regulation and the international water law;
- Evaluation of access to infrastructural sites and assessment of future needs for the execution of the plan;
- Evaluation of the requirements in electric lines to link the various points of the plan.

Studies on project variants

- Studies to meet the water requirements of the population situated along the layout of the works and of population of the Lake Chad basin;
- Study of the layout (including variants);
- Designing the structures for water transfer (including variants); storage (dams) and for production of hydro-electrical energy;
- Study of regulation systems (including tele-control and tele-surveillance).

Analysis of the effects of the project on the water balance of Lake Chad and Oubangui river basins

- Analysis of the modified flow regime on the rivers whose waters have been transferred and evaluation of reserved (minimum) discharges which must be maintained in these rivers;
- Economical analysis of water productivity for agriculture in the river basin in comparison with irrigated crops and fishery;
- Evaluation of the modified flow regime on the rivers of the Lake Chad basin into which water has been transferred;
- Evaluation of the modified flow regime on the levels of Lake Chad;
- Analysis of flow changes during low period (on the basis of daily discharge data);
- Evaluation of the modified flow regime on groundwater.

These studies should be undertaken using the mathematical model which has been developed for the conventional Lake Chad basin. Additional modules should be developed to control this transfer.

The impact of the water transfer project on the environment

- Study of the impact on the environment including mitigating measures and their costs (Congo, Oubangui and Lake Chad basin) during and after the transfer;
- Impact - study of water transfer from Oubangui on river downstream of Plambo dam;
- Identification of the possible impact on the Ouhman basins;
- Identification of the possible impact on transportation routes;
- Identification of the possible effects on the quantity of transferred water and on recipient waters and their passages;
- Identification of the possible impact linked with the transportation of contaminants or varied discharges, especially linked to the ecology of wet soils in the project area;
- Identification of the possible impact on groundwater resources;
- Identification of the possible impact on fauna and flora;
- Identification and study of the possible impact on the population and socio-economic activities;
- Analysis of impact on the aquatic bio-diversity particularly with regard to weeds.

APPENDIX 2: Institutional assessment of the LCBC

Quoted (with minor modifications) from LaRoche (2008).

The Institutional Assessment (IA) of the LCBC has been a three part activity spanning approximately three years. The content of this Final Draft of the IA has been based on a review, among many others, the Convention and Statute, the LCBC Rules of Procedure, The Africa Water Vision for 2025: Equitable and Sustainable Use of Water for Socioeconomic Development, the LCBC developed Lake Chad Vision 2025, and project activities undertaken, or in the process of being undertaken by donors and others active in the Lake Chad basin.

The third part of the IA, the subject of this report, takes into account further interviews with key stakeholders in and outside of the region. Three missions to the region have been undertaken. One mission was to Niamey, Niger and Abuja, Nigeria to consult with key individuals within the basin and attend the Technical Experts meeting prior to a Council of Ministers (COM) meeting. The second mission included attendance at a Project Steering Committee meeting of the GEF initiative. The consultant had hoped to spend time in N'Djamena for purposes of further interviews with the Executive Secretary, staff, key government officials, and also to have access to the files of the LCBC. Unfortunately, the civil unrest in Chad resulted in cancellation of the planned visit, and as of the writing of this report travel to Chad had not been authorized.

Recommendations

This report contains 34 recommendations that, if successfully implemented, would lead to a reinvigorated, product-oriented LCBC. The recommendations include:

To the Member States

1. The Member States formally reaffirm, through a resolution to be presented at a Heads of State meeting, their support for The Africa Water Vision for 2025: Equitable and Sustainable Use of Water for Socioeconomic Development.
2. The Member States formally endorse, through a resolution to be presented at a Heads of State meeting, Lake Chad Vision 2025.
3. The Member States empower the LCBC to reorganize itself consistent these two initiatives as well as with the Convention and Statute.
4. The Member States consider directing the LCBC to develop a Water Charter for the Lake Chad Basin, and adopt the Charter at the highest levels of Government, thereby creating a broader, more ecosystem based mandate to the LCBC.

Regarding the LCBC Convention and Statute

1. The LCBC should create a dedicated unit with the specific responsibility of creating a regionally-based data and information system as part of LCBC capacity to undertake a coordinated and systematic monitoring role for the natural resources of the basin, including the development of protocols for the collection, synthesis, storage, and dissemination of targeted data and information.
2. The Member States should consider adopting a formal procedure for referring disputes, or potential disputes, to the LCBC. The referred disputes could be studied by expert groups, convened on a case-by-case basis, and be comprised of nationals

from the affected Member States who would engage in a process of joint problem definition, joint fact finding, and development of joint conclusions and recommendations for submission to the Member States, through the LCBC. The process of referral of disputes to the LCBC could be modeled, and modified to fit the requirements of the Member States, after the successful model currently used by the International Joint Commission for Canada and the United States¹⁷.

3. The Member States should define a formal process for ensuring that “adequate notice” and timely and effective “prior consultations” will be undertaken as a means of reducing prospects for misunderstandings and disagreements with regard to planned works.

Regarding the Member States and the LCBC

1. To assure operational certainty and predictability for the LCBC, the Member States should establish a schedule for meeting prior funding commitments to the LCBC. Should it not be possible to meet these obligations, the Member States should determine new funding levels that they can meet and communicate this information to the LCBC.
2. To assure LCBC access to high quality professional staff, the member States should consider:
 - a. The establishment of smaller satellite offices, with specific assigned functions, in other Member States;
 - b. The establishment of pay grades and other incentives consistent with the need to attract and retain high quality professional staff in N’Djamena; and
 - c. Provision of the necessary funding to upgrade the communications capability of the LCBC consistent with its existing mandate and the new requirements it will have to meet as part of its reorganization.

Regarding the LCBC Technical Committee

1. Clear terms of reference should be developed by and for the TC, in coordination with the Executive Secretary, and the Terms of Reference should be reviewed and approved by the COM.
2. Assuming the terms of reference of the TC include executive functions rather than technical responsibilities, its name should be changed to reflect the policy level role it is assuming.
3. The TC should be comprised of the designated LCBC Focal Points only, who would be responsible for reflecting the inter-ministerial views of their in-country counterparts at meetings of the TC.
4. The TC should structure its agendas to have part of its meetings dedicated to closed executive session to discuss sensitive matters of personnel, budget, and resolutions to be recommended to the COM; and open sessions to discuss substantive matters of interest to selected, invited observers.

¹⁷ Article IX of the Boundary Waters Treaty of 1909.

5. The TC should meet at least once annually, and its meetings should involve the Executive Secretary of the LCBC and members of the LCBC staff as directed by the Executive Secretary, or as may be requested by LCBC country Focal Points.

Regarding LCBC Technical Interministerial Committees

1. As is the case for the TC, The COM should direct that clear terms of reference be developed for the IMC, including the a description of the IMC membership from each of the member States.
2. The formation, meetings of and inputs to the LCBC from IMCs should be the responsibility of the respective LCBC country focal points.

Regarding LCBC Organization and Staffing

1. The LCBC must shift its organizational emphasis to the production of regularized, high quality, scientifically sound reports that would provide the basis for increased Member State confidence in its functions, and provide potential donors evidence, through product delivery, that the LCBC is providing an indispensable service to the Member States, the region, and the Lake Chad Basin ecosystem. This shift underlies the content of the proposed, updated organigram for the LCBC.
2. To address the need for the LCBC to be more “product oriented” there should be a requirement for preparation, presentation, and dissemination of a Biennial State of the Lake Chad Basin Ecosystem Report (Report). The report would provide a general overview and assessment of the overall health of the ecosystem, would be both reactive and proactive, and place special attention on selected issues as determined by the LCBC, its Boards, and other advisors.
3. To provide the necessary, senior leadership for preparation of the Report the LCBC staffing pattern should include a newly created position of Chief Director of a newly created Basin Observatory, seen as necessary to oversee an expanded scope and increased importance of science and technical abilities within the Commission.
4. The LCBC should consider creating a Water Resources Experts Committee (WRC). Such a committee, a part of the Basin Observatory, would create stronger working linkages between the Secretariat of the LCBC and professional, water-based human resources of the Member States. The committee would be comprised of 10 senior level water resources specialists from, and in the employ of the Member States (2 nominated from each Member State).
5. WRC members would serve in their personal and professional capacity, rather than as government representatives.
6. The WRC would be staffed by a Secretary – a staff professional employed by and stationed within the LCBC, and named by the Chief Director of a newly created Basin Observatory – and 2-3 other LCBC staff water resources specialists. The LCBC could consider the possibility of occasionally securing short-term, seconded staff from donor countries.
7. A major responsibility of the WRC would be preparation of a biennial report on water quantity, quality, and use related issues and concerns as determined by the Board, and this report would be incorporated into the LCBC prepared biennial State of the of the Lake Chad Basin Ecosystem Report. The WRC would elect co-chairs, who would, through the Board Secretary, organize necessary Board meetings and

- preparation of reports. The WRC would select its own chairman at its first scheduled meeting. WRC terms of reference would require further definition.
8. The LCBC should consider creating an Environment, Science and Planning Committee (ESPC). The SAB would provide needed scientific capacity to the LCBC, and, by extension, to the Member States. It would be responsible for developing recommendations on all matters related to research and the development of scientific knowledge pertinent to the Lake Chad Basin. Such a broad mandate would require a multi-disciplinary approach and, accordingly, members with expertise in the natural, physical and social sciences, including socio-economics, would be appointed from Member States by the LCBC, working through the Commissioners.
 9. A major responsibility of the ESPC would preparation of a biennial report on scientific issues and concerns as determined by the Board, and this report would be incorporated into the LCBC prepared biennial State of the of the Lake Chad Basin Ecosystem Report. The ESPC would elect co-chairs, who would, through the Board Secretary, organize necessary Board meetings and preparation of reports. SAB terms of reference would require further definition.
 10. The ESPC would be comprised of 10 members from the Member States, upon the recommendation of the LCBC. Members would have backgrounds in both the “hard” and “soft” sciences¹⁸; would create stronger working linkages between the Secretariat of the LCBC and professional resources of the Member States and organizations within Member States; Board members would serve in their personal and professional capacity, rather than as government representatives. The ESPC would also select its own chairman at its first scheduled meeting.
 11. As with the WRC, the ESPC would be staffed by a Secretary – a staff professional of the LCBC and 2-3 other LCBC staff specialists with a mix of scientific backgrounds to ensure a mix of the “hard” and “soft” sciences (i.e. a mix of engineering, biological, chemical, and social science expertise.) Also as with the WRC, there would be the possibility of occasionally securing short-term, seconded staff from donor countries.
 12. Science as used in the context of the ESPC should not be confused with research. There is no intent to have the ESPC of the LCBC undertake any basic or even targeted research. The role of the ESPC should include a compilation of existing research to strengthen conclusions and recommendations that may be made as part of the Biennial State of the Lake Chad Basin Ecosystem report.
 13. In parallel with implementation of new organization chart (organigram) for the LCBC, and consistent with existing Rules of Procedure, the COM should direct the Executive Secretary to:
 - a) Prepare for its review and approval a plan and timetable to ensure effective intra-LCBC communication;
 - b) Prepare guidelines and the structure for conducting annual staff appraisals; a process for the timely resolution of grievances;
 - c) Develop plans for a funded approach for the creation of training opportunities for all LCBC staff; and

¹⁸ “Hard” sciences would include, *inter alia*, biology, chemistry, and engineering; “soft” sciences would include, *inter alia*, sociology, and political science, and economics.

- d) Explicitly describe an approach that would result in balanced representation of LCBC personnel across Member States.

14. The Executive Secretary should oversee preparation of contingency plans to assist staff in times of emergency, either within Chad to assist staff in coping with an emergency such as the recent civil disturbance, or in the event of an emergency that should face staff members while on official travel outside of Chad.

Regarding LCBC Finance and Budget

1. The COM should direct the Executive Secretary to report on progress made to date on implementing the 33 recommendations contained in the report titled Revue du Control Interne et de Procédures Comptable au 31 Décembre, 2006. This is seen as necessary to begin building Member States and donor confidence in the financial workings of the LCBC.
2. The COM should oversee an annual, independent audit of the LCBC.
3. Any questions of financial or management of the LCBC should be investigated as part of the annual, independent audit.
4. The LCBC should create a Donor Consultative Committee (DCC). The role of the DCC would be to encourage and facilitate continued and expanded donor involvement and consequent positive investment in, and commitment to, the work of the LCBC. The DCC would be convened directly through the LCBC Executive Secretary.

Projected Additional Cost of IA Implementation

It is well understood that the COM must get a sense of the likely additional cost that would result from their approval of a reorganized LCBC. The estimated additional costs that are described in the following section are intended to be high estimates, on the assumption that it is always better to go back to the COM and show that costs were less than anticipated, rather than more. Further, an assumption in the analysis that follows is that the non-professional staffing structure of the LCBC will continue unchanged, with the exception of two additional support positions for the expanded number of professional staff. This is a generous assumption, given the tentative conclusion of this IA that considerable duplication exists within the support structure of LCBC.

The recurrent cost of the LCBC Secretariat in the 2008 budget is 1,117,462,169 FCFA. The total approved 2008 budget for the LCBC, including project costs and the LCBC contribution to project costs is 9,311,895,232 FCFA. It is estimated that the additional costs of implementing the recommendations of this IA would add 195,300,000 FCFA to the recurrent portion of the LCBC budget. This equates to an approximate 17% increase in the *recurrent* LCBC budget. The increased costs associated with the measures recommended in this IA amount to an approximate 2% of the *total* LCBC budget. The specific additional costs, and an explanation of each, are summarized below:

- *Additional personnel.* The additional personnel include 7 new professional positions and two support positions. These new staff members are seen as necessary to create and sustain the staff infrastructure that could develop the Biennial State of the Lake Chad Basin Ecosystem report, staff the two new Committees foreseen in this IA,

and meet other, ongoing obligations of the LCBC. The total additional cost is 82,500,000 FCFA. Annex 1 of this IA lists the current professional positions of the LCBC and their base and total salaries. Annex 1 of this IA lists the recommended staffing pattern of a reorganized LCBC, by professional position, and the projected base and total salaries for each.

- *Post Adjustment.* There seems to be a consensus that it is necessary to create additional incentives to recruit and retain high quality LCBC professional staff. The recommendation is to add a 20% so-called Post Adjustment to existing professional staff salaries. The Post Adjustment has been added as a separate budget line in Annex 2. This Post Adjustment adds 27,800,000 FCFA to the budget.
- *Staff Development.* During conduct of the first phase of the IA, staff made clear that lack of professional development opportunities inhibited recruitment and retention of LCBC staff and this view is shared by others who have been interviewed for this IA. Thus availability of professional development opportunities is seen as important to the recruitment and retention of high quality LCBC staff. The recommendation is to create a Staff Development fund of 25,000,000 FCFA.
- *Travel and Subsistence for WRC and ESPC members.* Two meetings per year are foreseen for each of these Committees as they participate in the preparation of the biannual State of the Lake Chad Basin Ecosystem reports. In addition, there would be additional travel for sub-committees as determined by the respective Committee Secretaries. The rationale for the creation of these two new Committees is to satisfy the need for greater involvement of country personnel in the activities of the LCBC. This greater level of involvement would result in greater country “buy-in” to the LCBC and its work, increase the professional services available to the LCBC, and gives the LCBC more direct access to sources of Member State data and information. The estimated additional cost would be 25,000,000 FCFA.
- *Miscellaneous Costs.* This would include such things as the annual audit, the possibility of retaining a search firm for filling professional positions at LCBC, and relocation expenses for newly hired staff. There may be other costs associated with the reorganization of the LCBC, and this fund would allow for the absorption of such costs. An amount of 35,000,000 FCFA would be retained in this fund.

Table 11 Implementation dateline for LCBC's institution assessment

1 August, 2008	The Executive Secretary issues a staff directive officially apprising all staff and focal points of scope and content of the LCBC reorganization. Assignments made regarding space accommodation for new staff and internal organization necessary to the reorganized department structure.
1 August, 2008	The ES, with direct assistance from LCBC focal points, begins recruitment of WRC and ESPC committees.
1 August, 2008	Search firm selected to undertake job description review and initiate candidate search both within and outside of the basin.
1 September, 2008	New LCBC positions advertised.
1 October, 2008	Closing date for applications.
15 October, 2008	Rankings of candidates completed. Scheduling of interviews begins. Panel consisting of ES, Department Heads, and Focal

	Points.
3 November, 2008	Initial interviews completed.
3 November, 2008	Appointments made to the WRC and ESPC.
10 November, 2008	Employment offers extended. Arrival dates negotiated. As necessary, COM contacted for permission to advertise for unfilled positions outside of the basin.
17 November, 2008	Extra-basin recruitment of LCBC personnel begins.
15 December, 2008	Closing date for applications from extra-basin recruitment effort.
22 December, 2008	Rankings of extra-basin applications completed.
5 January, 2009	Scheduling of interviews for extra-basin candidates begins.
19 January, 2009	Employment offers extended to successful extra-basin candidates. Arrival dates negotiated.
1 February, 2009	Secretaries to the WRC and ESPC appointed.
1 February, 2009	Full Implementation underway.

APPENDIX 3: Strategic Action Plan (SAP) development and prioritization

Quoted (with minor modifications) from De Mora (2008)

SAP Overview

The TDA identified and prioritized seven transboundary problems in the Lake Chad Basin. These areas of concern, and their root causes, could be most effectively and appropriately addressed through the following five Ecosystem Quality and Water Resource Objectives:

- I. Improved quantity and quality of water in the Lake Chad Basin
- II. Restoration, conservation and sustainable use of bioresources in the Lake Chad Basin
- III. Conservation of biodiversity in the Lake Chad Basin
- IV. Restoration and preservation of ecosystems in the Lake Chad Basin
- V. Strengthened participation and capacity of stakeholders, and institutional and legal frameworks for environmental stewardship for the Lake Chad Basin

Each of the above objectives consists of a number of targets that are comprised of inter-related interventions that address the root causes of the concern areas. For the regional level interventions, the Member States and the international partners shall work collectively to take the required steps to fulfill the intervention. The national level supporting interventions will be the responsibility of the Member States. The objectives, their targets and interventions are listed here.

Objective I: Improved quantity and quality of water in the Lake Chad Basin

Indicator I.1: The quantity and quality of the Lake Chad is maintained at a sustainable level with reference to the average during the 1960s

Indicator I.2: A measurable decline in levels of the main contaminant groups in the water, sediment and biota

Target 1: Develop and initiate implementation of strategies for managing surface waters

- Assess the current knowledge about the occurrence, flow and quality of surface water, including its interaction with Lake Chad.
- Carry out a review of legal and institutional framework for managing surface water and make adjustments to reflect current needs, as necessary.
- Design a regional program of surface water management measures.
- Implement demonstration of sound surface water management.
- Strengthen national network monitoring of surface water and rainwater

Target 2: Develop and initiate implementation of strategies for managing groundwater

- Assess the current knowledge about the occurrence, flow and quality of groundwater, including its interaction with Lake Chad.
- Carry out a review of legal and institutional framework for managing groundwater and make adjustments to reflect current needs, as necessary.
- Design a regional program of groundwater management measures.
- Implement demonstration of sound groundwater management.

- Strengthen national network monitoring of ground water

Target 3: Develop regional strategies to reduce water pollution

- Undertake a comprehensive assessment of sources of pollution to surface and groundwater in the Lake Chad Basin.
- Undertake a comprehensive review and harmonization of existing laws and regulations relating to pollution management
- Develop recommendations for harmonization of pollution discharge and emission, and water quality standards.
- Develop and introduce economic instruments to encourage reduced pollution loads.
- Reduce untreated discharges from municipal sources.
- Develop a Regional Persistent Organic Pollutants and Persistent Toxic Substances (POPs/PTS) Program to be coordinated with POPs enabling activities in Stockholm Convention signatory states.
- Undertake a comprehensive assessment of contaminated aquatic and terrestrial environments and develop a regional action plan to remediate areas of pollution concern identified.

Target 4: Implement a regionally coordinated water quality monitoring programme

- Develop and implement a regional surface water quality monitoring program focused on critical contaminants and hotspots.
- Develop and implement a regional ground water quality monitoring program focused on critical contaminants and hotspots.
- Provide report on contaminant levels the in Lake Chad Basin every three years, and make proposals for remedial actions.
- Strengthen the water quality monitoring network (e.g. through establishing an Earth Observation System)

Target 5: Foster regional and international research and cooperation between water scientists

- Develop a regional network for water scientists, encompassing researchers in academia, government agencies, and non-government organizations (NGOs).
- Foster the development of research collaboration between regional centers of expertise and international organizations and institutes.

Objective II: Restoration, conservation and sustainable use of bioresources in the Lake Chad Basin

Indicator II.1: Measurable and sustainable increase of the qualitative production of bioresources in the countries of the Lake Chad Convention Basin with reference to the average of the 1960s

Indicator II.2: Measurable and sustainable increase in livelihood of the populations of the countries in the Lake Chad Convention Basin are restored

Target 1: Establish the sustainable use and management of riparian and lacustrine zones

- Strengthen national regulation on planning and management of lacustrine and riparian zones.
- Strengthen technical capacity at local and municipal government level for planning and introduce economic instruments to promote rational use of natural resources.
- Develop regional databases including GIS for environmental planning and management.
- Develop regional guidelines for environmental planning and management, and undertake a pilot project in each LCBC Member State.
- Development of ecotourism pilot projects based on existing and successful models from other regions.

Target 2: Promote environmentally sound agro-pastoral practices in the Lake Chad Basin

- Promote the best environmentally sound traditional agricultural practices based on soil fertility management and the use of biopesticides.
- Establish and promote best practice recommendations for the use of agrochemicals based on agro-ecological zones.
- Demonstrate through pilot projects environmentally sound agro-pastoral practices such as soil conservation, creation of surface and groundwater protection zones, use of natural fertilizers, use of resistant crop strains and intensive livestock breeding.
- Promote the best environmentally sound traditional pastoral practices
- Combat eutrophication in sensitive zones by controlling soil and water contamination from agriculture and other nutrient sources.
- Establish and apply soil information system for planning sustainable agriculture.

Target 3: Promote the management of fisheries resources

- Formulate and implement a regional Fisheries Protocol within the framework of the Lake Chad Basin Convention.
- Strengthen the regional cooperation for fisheries management, by formulating a regional strategy for integrated management
- Improve the productivity of the fisheries

Target 4: Improve livelihoods in lacustrine and riparian communities to reduce dependency on unsustainable fishing practices

- Promote more selective fishing methods and aquaculture.
- Promote alternative income sources and the adoption sustainable livelihoods in fishing communities.

Target 5: Promote the sustainable management of timber and non-timber forest products (NTFP) and pastoral production

- Promote a strategy for the supply of fuel wood.
- Maximizing the value of NTFP (*e.g.* Gum Arabic, medicinal plants, aromatics, pesticides etc).
- Promote reforestation with *Jatropha* and the study of its potential as a biofuel.

- Support the creation of community forests and their management.
- Promote and maximize the value of precious species and varieties (e.g. Kouri, blue algae).
- Develop eco-tourism.
- Develop fodder production.

Target 6: Manage transhumance areas

- Identify new transhumance areas.
- Develop and manage transhumance corridors and grazing areas.
- Adapt and harmonize regulations concerning transhumance.

Objective III: Conservation of biodiversity in the Lake Chad Basin

Indicator III.1: Reverse the trend of biodiversity degradation

Target 1: Increase regional collaboration to achieve strengthened protection for biodiversity

- Draft and adopt a Biodiversity Protocol to the Lake Chad Basin Convention.
- Establish a regional biodiversity monitoring system.
- Develop an international research program on Lake Chad Basin biodiversity related issues.
- Harmonize the legal and regulatory instruments on biodiversity conservation and establish a permanent transboundary consultation framework.
- Develop a common methodology to conduct EIAs in all the countries of the Lake Chad Basin.
- Establish a sub-regional network for the exchange of experiences based on ecological monitoring observatory of biodiversity in the Lake Chad Basin.
- Promote the creation of and support the sustainable management of transboundary protected areas and undertake their mapping.
- Encourage the creation of biological corridors.

Target 2: Ensure key threatened and/or extinct species are maintained or restored to viable levels

- Make an inventory of key threatened/endangered species.
- Ensure adequate legal protection for key threatened species.
- Provide improved in-situ and ex-situ conservation for key threatened species.
- Create a gene bank of key threatened species.
- Encourage the re-introduction of certain species that are extinct

Target 3: Control invasive species and their harmful effects

- Make an inventory of invasive species
- Foster regional commitment to the control of invasive species in a Biodiversity Protocol and other appropriate regional agreements.
- Develop regional procedures for the study and management of invasive species
- Undertake pilot demonstration of strategies/approaches for controlling invasive species

Objective IV: Restoration and preservation of ecosystems in the Lake Chad Basin

Indicator IV.1: Restored and preserved aquatic and terrestrial ecosystems

Indicator IV.2: Increased productivity of the ecosystems

Target 1: Combat desertification

- Encourage implementation of National Action Plans to Combat Desertification.
- Apply remote sensing and GIS techniques to monitor trends in desertification
- Develop and implement projects and programs to restore degraded ecosystems in critical desertification areas.
- Develop remedial techniques for the management and preservation of pastoral ecosystems in desert areas

Target 2: Combat deforestation

- Encourage domestic energy strategies based on participatory forestry management to ensure sustainable supply of fuel wood and other alternative sources of energy.
- Apply remote sensing and GIS techniques to monitor trends in deforestation.
- Develop and implement reforestation projects and programs.
- Develop remedial techniques for the preservation and management of existing forests.

Target 3: Identify and restore riparian and lacustrine habitats

- Develop and apply a standardized methodology for the assessment of the ecological quality of riparian and lacustrine habitats.
- Design and implement projects and programs for the restoration of riparian and lacustrine habitats.

Target 4: Develop and implement land conservation and restoration strategies

- Assess current knowledge on types and levels of soil degradation, management, use and constraints.
- Promote and maximize better soil and water conservation techniques (anti-erosion banks, other soil protection and restoration techniques, *etc.*).
- Promote research and applications of modern technologies through the creation of an agro-ecological databank.
- Revise the legal and institutional framework to ensuring sound management and use of soils.

Target 5: Restore and maintain wetland ecosystems

- Make an inventory of wetlands and assess the current environmental and economic status of the wetlands.
- Develop and implement strategies for the restoration and maintenance of key wetlands.
- Implement pilots or demonstration projects for the restoration and maintenance of the wetlands.
- Support the designation of wetlands as Ramsar sites.
- Develop and implement National Wetlands Management Plans and in particular those classified as Ramsar sites.

Objective V: Strengthened participation and capacity of stakeholders, and institutional and legal frameworks for environmental stewardship of the Lake Chad Basin

Indicator V.1: Enhanced participation of stakeholders in the National Action Plans and SAP implementation

Target 1: Increase participation of public and stakeholders of Lake Chad Basin countries in management of the environment

- Establish a Lake Chad Basin NGO Forum in order to provide support and advice.
- Implement a Lake Chad Basin Public Participation Strategy through its incorporation in the National Action Programs.
- Set up a fund for micro-grants addressing riparian and lacustrine community development schemes and local environmental issues, in partnership with the private sector and international donor community.
- Set up “Friends of Lake Chad” program with annual competition sponsored by local, national and international companies.

Target 2: Improve communication and information sharing among the stakeholders

- Create a press bureau to improve country, regional and international awareness of the Lake Chad Basin environmental issues and encourage the media to participate in the dissemination of information.
- Provide regular training to journalists in order to strengthen environmental journalism and improve media coverage of environmental issues.
- Establish media and film festivals, in conjunction with NGO Forum, on ecology to focus on the links between human behavior and natural ecosystem functions.
- Establish “Lake Chad Day” and develop specific awareness raising for specific target groups.
- Strengthen awareness of environmental issues on Lake Chad Basin through partnership with the national and international media.

Target 3: Promote environmental education in the Lake Chad Basin

- Encourage the development of academic curricula and materials focusing on Lake Chad Basin environmental issues.
- Encourage academic partnerships at school and university levels.
- Assist universities to develop programs featuring Lake Chad Basin issues in ecology and environmental science in partnership with international institutions.
- Strengthen the Ngala School in order to develop and implement Information/Education/Communication program addressed to the public on the Lake Chad Basin environment.
- Provide a basic ecology training course for local riparian and lacustrine enterprises, and targeted populations emphasizing win-win scenarios and sound environmental stewardship.

Target 4: Increase the understanding on the part of traditional, elected and administrative officials at all levels on the importance of environmental issues

- Develop environmental awareness training programs.
- Establish a network of local councils to enhance the participation of local elected officials in implementing Lake Chad Basin environmental policies.
- Develop training programs for regional and municipal authorities on modern techniques for the management of resources and wastes.

Target 5: Develop active partnerships between lake Chad Basin NGO Forum, local and multinational enterprises and other stakeholders in the region and other Basin authorities

- Promote environmental partnerships between NGO, government and private sector to address specific Lake Chad Basin issues by implementation of Lake Chad Basin Public Participation Strategy.
- Develop Stakeholder Dialogue Groups at national level and exchange experience at regional level to improve dialogue opportunities for stakeholder groups who may be in conflict with natural resource management.
- Create linkages with other Basin's organizations to provide opportunities for sharing experiences.
- Revive the network of Lake Chad Basin Parliamentarians in order to undertake continuous advocacy actions targeting decision-makers in order to mainstream environmental concerns in budgetary resources allocations at the national level.

APPENDIX 4. Synopses of international activities in Chad and the region

International involvement in LCB and the region is becoming more visible because Chad is ranked 173 out of 177 on the United Nations Development Program (UNDP) human development index. Chad's environment is fragile, subject to climatic and non-rational use of resources. Moreover, Chad suffers from the influx of more than 200,000 refugees from Darfur onto its territory and there are also 40,000 refugees from the Central African Republic in the south. Chad suffers from an insufficiently organized and motivated administration, which affected many sectors such as agriculture, education, health, electricity, and potable water, among others.

Except for some USAID humanitarian activities (see below), there is no visible examples of US-Chad projects in many needed fields. In contrast, France has strong partnership with Chad and is the leading partner in terms of volume of assistance. France has been a major player in many areas to promote good governance; ensure strong, sustained economic growth; improve human capital; improve living conditions for vulnerable groups; and to restore and protect ecosystems. Other donors in Chad include the Breton Woods institutions (International Monetary Fund (IMF) and World Bank (WB)), the European Commission (EC), the African Development Bank (ADB) and Arab institutions (Islamic Development Bank, IDB) and Arab Bank for Economic Development in Africa - Banque Arab pour le Developpement Economique en Afrique, BADEA), and those of the United Nations (Development Program (UNDP), Food and Agriculture Organization (FAO), World Health Organization (WHO), Children's Fund (UNICEF), World Food Program (WFP), High Commission for Refugees (HCR)). Other partners in terms of assistance include Germany, Taiwan, Switzerland, Libya, Egypt, and the Saudi Development Fund. **IMF** is focused particularly on macroeconomic stability, improved fiscal performance and the long-term reduction of external and internal arrears. Budgetary support was given by other donors, in addition to France: the WB; the African Development Bank with its economic management support project; the EC with its good governance support project; and the UNDP. The **WB** intervenes in the area of health and the fight against AIDS, public water services, education, local rural development, and development in urban areas. The **ADB** is lead manager in education and plays a role in the rural sector, transport, health and the fight against AIDS. The **IDB** plays a role in health, water and education (bilingual Franco-Arabic teaching). The **EC** intervenes in transport and water. **German cooperation** (German Development Bank (KfW) and German Technical Cooperation (GTZ)) has a strong presence in the area of local and rural development. **Swiss cooperation** acts directly to help the population in education, health and rural development. The **FAO** is a lead manager alongside France in the area of food security, the **UN institutions** are heavily involved in helping refugees from Darfur who are living in camps in the east of Chad (World Food Program (WFP) and High Commission for Refugees (HCR), in particular). The bilateral donation from **Taiwan** finances rice-growing infrastructure and projects.

US programs in Africa

The US is participating in a number of the identified priorities under the UN Millennium Development Goals. The US is providing assistance to 47 countries in Africa. In addition to enhancing strategic partnerships and encouraging democratic transitions, the US priorities in Africa include strengthening fragile states, regional and sub-regional

organizations, regional security capacity, counterterrorism cooperation and capacity, economic development and growth (USAID, 2008). The USAID currently has 23 bilateral missions in Africa and three regional missions that support activities in countries with a limited USAID presence. These activities are directed to help improve health, education, economic growth, agriculture, and environmental programs. Development assistance for FY 2008 would cover the following Foreign Assistance Objectives:

Governing justly and democratically (\$220.3 million): To enhance stability and increase the capacity of governments to govern justly, strengthen democratic institutions, professionalize security forces, promote key reforms, fight corruption, and work closely with civil society organizations to enhance reform and help citizens hold their governments accountable.

Investing in People (\$4.1 billion): Provide significant funding to countries experiencing the most serious effects of the HIV/AIDS pandemic and expand malaria prevention and treatment with the goal of reducing mortality by 50 percent in target countries. Increase access to quality education by supporting training of new teachers and providing textbooks and scholarships for children. Support water and sanitation development and conservation programs.

Economic Growth (\$519.1 million): Stimulate private sector development, increase trade competitiveness, and integrate African nations in the global economy. Encourage agricultural and economic growth interventions through partnerships with other donors and regional African organizations.

Humanitarian Assistance (\$376.3 million): Increase awareness to prevent, mitigate, and respond to humanitarian crises.

ANNEX 1: Potential requirements of the work assignment

The following potential requirements of the work assignment for the Science Advisor were in the preparation process two days before the unanticipated abrupt end of the assignment and were yet to be finalized. Most of the requirements are covered in the various sections of this report as specified by the underlined reference between the brackets:

1. Reports on the effectiveness of the Lake Chad Basin Commission (LCBC). (Chapter 2, and Appendix 2)
2. Reports on the status of (and opinion on) relevant projects funded by the Global Environmental Facility (GEF) and the European Union (EU). (Chapter 1)
3. Reports on the status of the Inter-basin Water Transfer (IBWT) from the Oubangui River to Lake Chad (feasible, recommended, prospects). (Chapter 1, and Appendix 1)
4. Highlights various US programs which have supported relevant bilateral or regional scientific collaborations. (Appendix 4)
5. Advises and assists embassy officers with environmental issues, particularly Lake Chad and other water issues. (Introduction, Chapter 3, and Appendix 3)
6. Drafts a cable on relevant environmental and scientific issues. (Preface, and Executive Summary)
7. Sets up and maintains contact list in the environmental field. (Annex 1)
8. Contributes to guest lists for public affairs and representational functions as required and attends environmental function at designated places. (25 underlined names in Annex 1)
9. Liaises with LCBC and provides technical program policy, planning information, and technical consultation as required. (Chapter 4, Appendix 3, and all section concluding remarks)
10. Conducts site visits and collects information on problems and possible solutions. (Chapter 3)
11. Sets up appointments with Ministries engaged in scientific work, including the Ministry of Environment, Interior, Education, and Health to identify and collate their priorities for water and other environmental issues, if any. (Appendix 3)
12. Prepares discussions/talks with local universities to inform students of research and priority areas for US scientific research, patents, etc.¹⁹
13. Prepares to host “earth day” event at the embassy in April, 2008¹⁹
14. Drafts article for local newspaper on Lake Chad issues (*time permitting*)¹⁹

¹⁹ N/A due to evacuation of the Science Advisor during civil unrest and intense rebel activities in Chad

Contact list relevant to water resources and the environment

List of contacts²⁰ relevant to water resources in LCB with Name (last, first), Organization and Position; and (if any) Address, Telephone, and Email. Underlined names are suggested as guests for public affairs and representational functions by the US embassy in Chad. (The source contact list - in French - was obtained through personal communications January 10, 2008: Letizia Beltrame, Regional Programs Coordinator, DEC, N'Djamena, Chad.)

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²⁰ An exhaustive list of more general contracts for Chad can be found at:
http://www.un.org/esa/sustdev/tech_coop/sdea/english/pdf/10_Appendix_1.pdf

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