

GROUNDWATER NEED ASSESSMENT LAKE CHAD BASIN

BY

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Acronyms

AGW-Net	African Groundwater Network
AMCOW	African Ministerial Conference on Water
BGR	Bundesanstalt für Geowissenschaften und Rohstoffe
BRGM	Bureau de Recherches Géologiques et Minières
CH	Continental Hamadien
CI	Continental Intercalaire
CT	Continental Terminal
FAO	Food and Agriculture Organization of the United Nations
LCBC	Lake Chad Basin Commission
LRBO	Lake/River Basin Organisation
GIZ	Gesellschaft für internationale Zusammenarbeit
mamsl	meter above mean sea level
NAP	National Action Plan
SAP	Strategic Action Plan
TBA	transboundary aquifer
UNESCO	United Nation Educational, Scientific and Cultural Organization

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1. Introduction

The African Groundwater Network (AGW-net), the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) and SPLASH have agreed on the need of bringing groundwater on the political agenda by promoting the integration of groundwater management into the mandate of Lake/River Basin Organisations (L/RBOs). The idea is by means of interviews to assess how far groundwater is taken into account and what kind of actions is needed to anchor groundwater in the activities of L/RBOs.

2. Objectives

The overall objective of the study is, based on the results of the consultations to selected L/RBOs, to develop targeted and prioritized recommendations for improving groundwater management in the L/RBOs. This report summarizes the bio-physical, socio-economic and hydro-geological conditions of the Lake Chad basin as well as the water governance framework in the Lake Chad Basin Commission, one of the nine selected LRBOs for consultations.

3. The basin and its water management

3.1. Bio-physical conditions

The Lake Chad Basin is an endorheic basin located in the central part of Northern Africa and occupies an area of about 2.3 Mill. km² (Fig. 1).



Fig. 1. Location of the Lake Chad Basin.

The basin is an extended plain mostly covered by medium to fine-grained sands. The surface height varies from 3,300 metres above mean sea level (mamsl) in the north (Tibesti Mountains); 3,000 mamsl in the NW (Ahaggar Mountains) and 3,300 mamsl in the SW (Adamawa Plateau) (Fig. 2) to 180 mamsl in the Pays Bas (lowlands in the centre of the basin).

The central part of the basin is characterized by two different landscapes subdivided by the 14°N parallel: sand dunes and the absence of surface water sources are typical for the northern part (Kanem), while the south is composed of superposition of sandy and clay richly watered by two main rivers that discharge in the lake. They are the Chari-Logone that supplies about 95 percent of the annual volume of water that reaches the lake and the Komadugu-Yobe that provides about 3 percent of the annual inflow into the lake (Fig. 2). The precipitation over the lake surface completes the remaining 2 percent.

Within the basin there are very important and well-known swamp regions: the Yaérés in the extreme north of Cameroon, Lake Fitri, the Massénya and the Salamat to the south and southeast of the Lake Chad respectively, and the Komadugu-Yobe to the north-east of Nigeria (Fig. 2). Because of its shallowness (the deepest point is at 4 m) most of the Lake Chad area in the southern pond and the whole of the northern pond can be considered as a swamp.

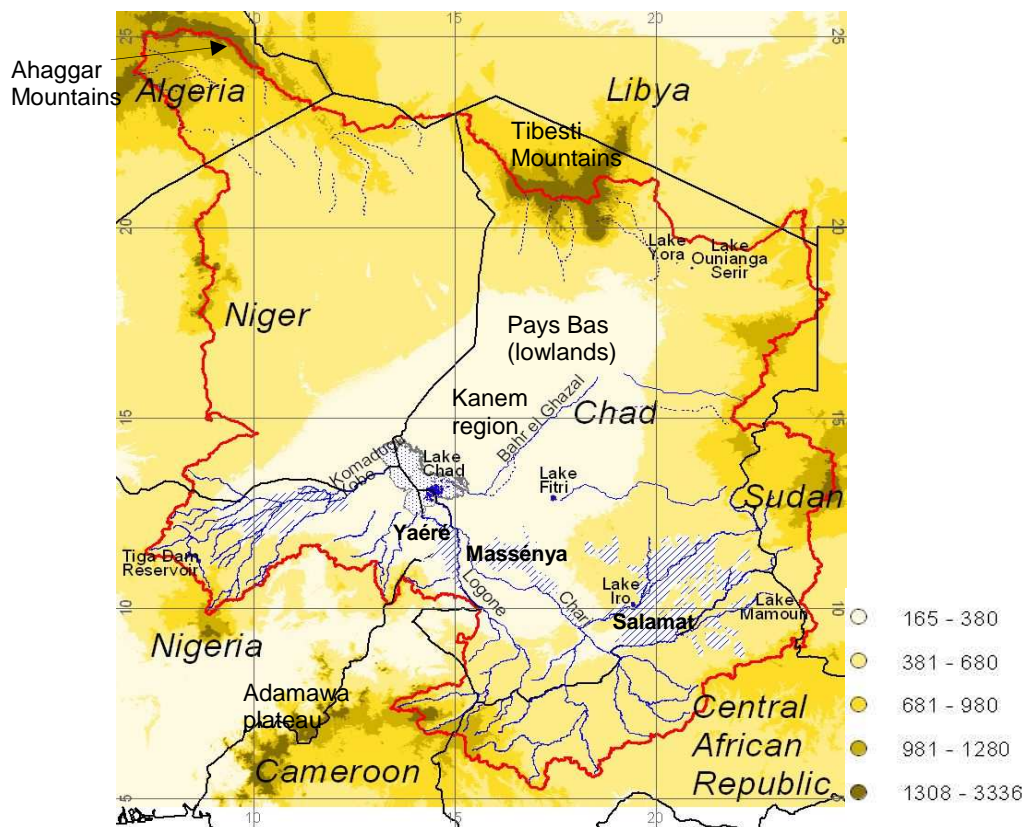


Fig. 2. Topography of the area, heights in m above mean sea level (mamsl). A flat plain of less than 380 mamsl occupies the central part of the basin, based on SRTM30 data (USGS Shuttle Radar Topography Mission).

Climatically the basin is characterized by three different zones: hyper-arid to arid in the north, semi-arid in the centre and subtropical in the south. Mean annual rainfall varies from less than 50 mm in the north to above 1000 mm in the south. High temperatures throughout the year, very low humidity except during the rainy season from June to August,

intense solar radiation and strong winds lead to a high annual potential evapotranspiration of around 2,200 mm (Carmouze, 1976).

3.2. Socio-economic conditions

The 30 Mio people in the Lake Chad Basin belong to some of the poorest countries of the world¹. According to the UNDP ranking of human development, out of the 177 countries listed, Sudan occupies the position 141, Cameroon the 144, Nigeria the 159, Chad the 171, CAR the 172 and Niger the 177. The rural settlements show even larger poverty levels than the already high national averages (Alker, 2008).

Access to safe drinking water is low ranging for the year 2000 from 26% in Chad to 56% of the population of Niger (figures from the World Bank in UNEP, 2004). In rural areas, most of the water users obtain water directly from ponds during the rainy season or from hand dug wells in the dry period. Groundwater is the source for central water supply in the cities, but connection is not widespread due especially to the costs that cannot be afforded by a large part of population.

The sanitary conditions are very poor in all countries. Water prone infections like hepatitis, typhus and cholera are widespread. Malaria is endemic in the entire basin, except in the northern countries (Libya and Algeria).

Agriculture is the main activity in the region, mostly rain-fed in the south or recessional in the flooded areas. However, there is cash-crop irrigation (mostly rice and cotton) along the river courses. Between 1983 and 1994, demand for irrigation grew by 200% leading to overexploitation of the water resources which were already under stress due to severe droughts (UNDP, 2006). Groundwater irrigation is increasing in areas where precipitation is irregular (marginal lands), which is of concern due to the low irrigation efficiency.

3.3. Hydro-geological conditions

Most of the Lake Chad Basin is covered by Quaternary sands (Fig. 3) of different depositional origins. In the northern part of the basin prevails an aeolic deposition with the presence of dunes (Kanem region). Fluvatile, lacustrine and deltaic depositions that result in alternating sequences of thin layers of sand and clay and mainly clayey soils on the surface are typical in the south. Regionally, these Quaternary sands act as an unconfined transboundary aquifer with flow direction towards the Lake Chad and the NE along the Bahr el Ghazal. South of the 14°N parallel this aquifer shows a low hydraulic conductivity, especially vertical, due to the sequences of sand and clay. Furthermore, due to its flatness and low gradient (in average 0.0005), the horizontal flow is very slow (Vassolo, 2009).

At a depth of some 75 to 100 metres appears a thick layer of some 280 metres of clay from the Upper Pliocene age (Fig. 4). This layer separates the Quaternary sands above from the Lower Pliocene below. The Lower Pliocene is composed of sand and sandstone and has a thickness of 30 metres, underlain by the sandstones of the Continental Terminal (Tertiary) with a thickness of some 150 metres.

¹ Libya and Algeria in the northern part of the basin have a higher average GDP/capita.

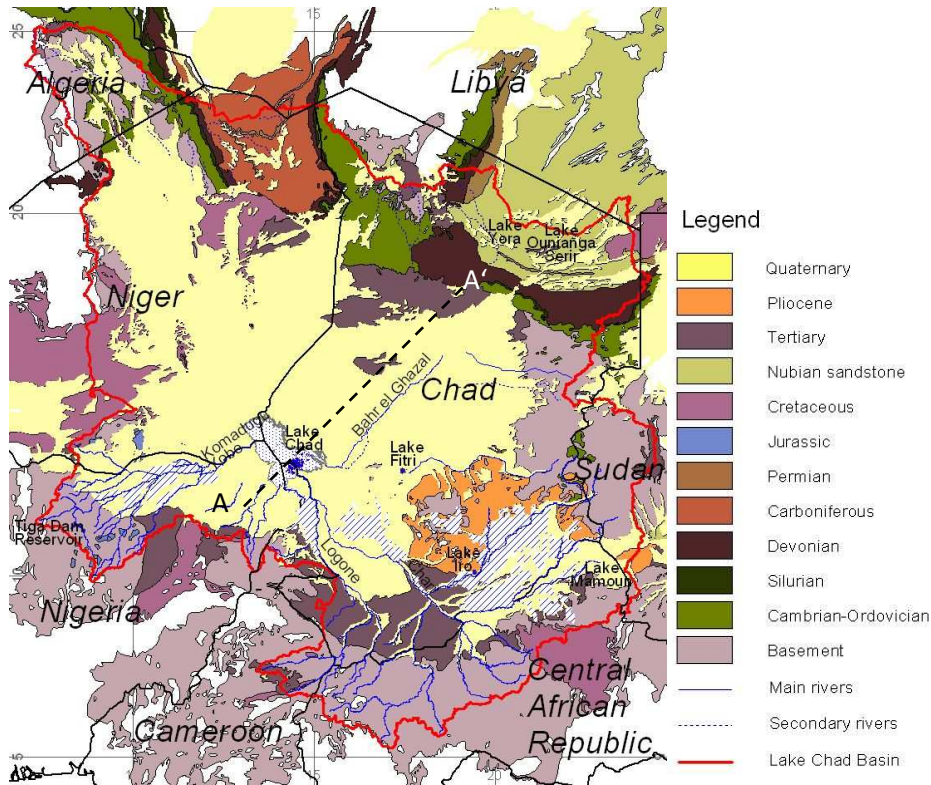


Fig. 3. Geology of the Lake Chad Basin. The next figure shows a cross-section drawn along the line AA'.

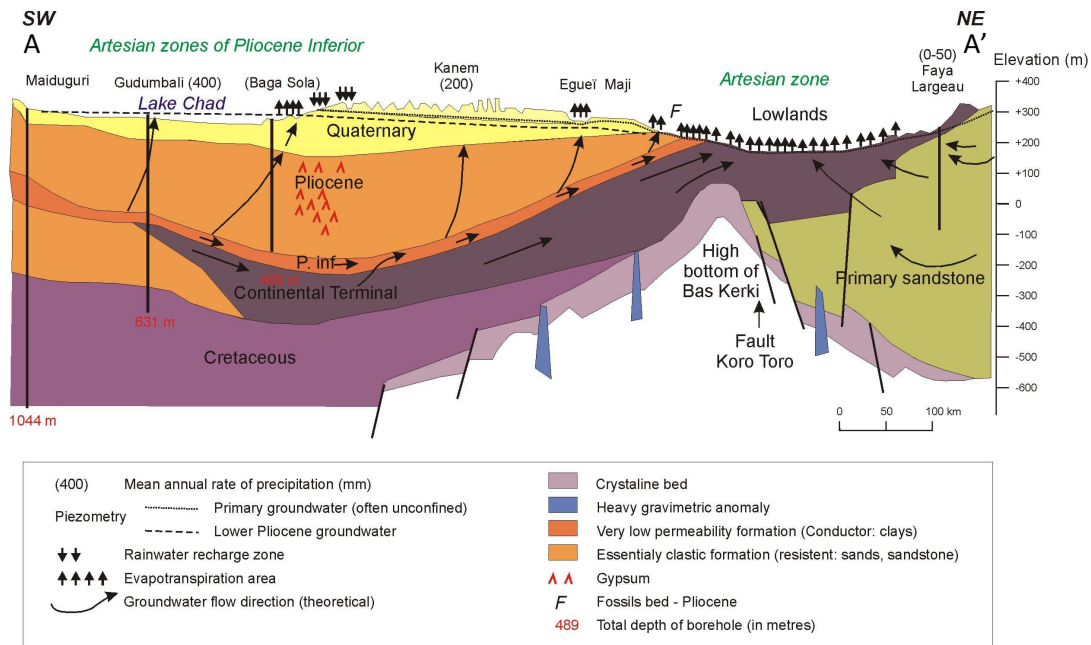


Fig. 4. Cross-section with the geology in depth, drawn between Maiduguri to the SW and Faya Largeau to the NE of the Lake Chad Basin (after Schneider & Wolff, 1992).

The Upper Pliocene is almost impermeable and builds thus an aquitard² that confines the sandstones of the Lower Pliocene and Continental Terminal (CT) from the upper Quaternary aquifer causing widespread artesian conditions in the central part of the basin. According to Eberschweiler (1993), both transboundary aquifers the Pliocene and the CT have similar good hydrogeological properties and comparable water chemistry, therefore they can be considered as a single aquifer.

The deepest layers are the sandstones and sands of Cretaceous age of the Continental Hamadien (CH) and Continental Intercalaire (CI), which have not been studied yet and its extension is unknown. Due to the lack of data, it is very difficult to describe their extension and estimate their hydrogeological properties. The granitic rocks of the basement build the basis of the hydrogeological system.

Aquifer recharge to the upper unconfined sands depends enormously on the availability of water from precipitation and the deposition characteristics of the aquifer. Indirect recharge takes place in the southern part of the basin, where the recharge is generally a product of surface water percolation from flooded areas, rivers and lakes. It has been estimated at 5 mm/a for the Massénya and Yaéré swamps. Isotopes analyses show the presence of direct recharge in the north caused by percolation of precipitation accumulated in the valleys between the dunes. However, the low tritium values indicate that this recharge took place in the past, at least more than 60 years ago.

Recharge to the Lower Pliocene and the CT takes place at their outcrops, either at the border or outside of the basin (Fig. 3).

3.3.1. Transboundary aquifers

All the aquifers in the Lake Chad Basin are of transboundary type (TBA) and require profound attention for the sustainable resource development.

3.4. Water governance framework for the Lake Chad Basin Commission

The Convention and Statute (1964) of the Lake Chad Basin Commission established basic rules on how to manage water resources and how to proceed in the case of large water projects that could affect neighbour countries in the basin.

In 2009, the Council of Ministers of the Lake Chad Basin Commission adopted the UN draft resolutions for transboundary aquifers as a basic document to rely on in groundwater management.

Actually, the Lake Chad Basin Commission is in the process of adoption of a Water Charter for the basin that will regulate the shared management of water resources and ecosystems. Although surface water is the main issue, groundwater has its place. For each member state a maximum of river water that can be extracted at predetermined reference points has been set based on an “ecological discharge”, that means “the minimum amount of flow to maintain good ecological conditions for the associated ecosystems” (LCBC, 2011). The countries must negotiate to determine the volume of water that each of them will be allowed to extract, if the ecological discharge is to be obtained.

² Aquitard is a geologic formation that may contain water but is incapable of transferring that water to the surface or to another geologic formation.

Despite the existence of a legal basis, groundwater management is not a concerted issue in the basin yet, especially because of the advisory role of the Lake Chad Basin Commission. All member states decide on large investments and constructions (dams, deep wells) without taking into consideration the possibility of affecting neighbour countries. International donors always finance this kind of large projects under the condition of a non objection from the LCBC, which is easy to get due to lack of technical staff in the LCBC that could decide on the contrary.

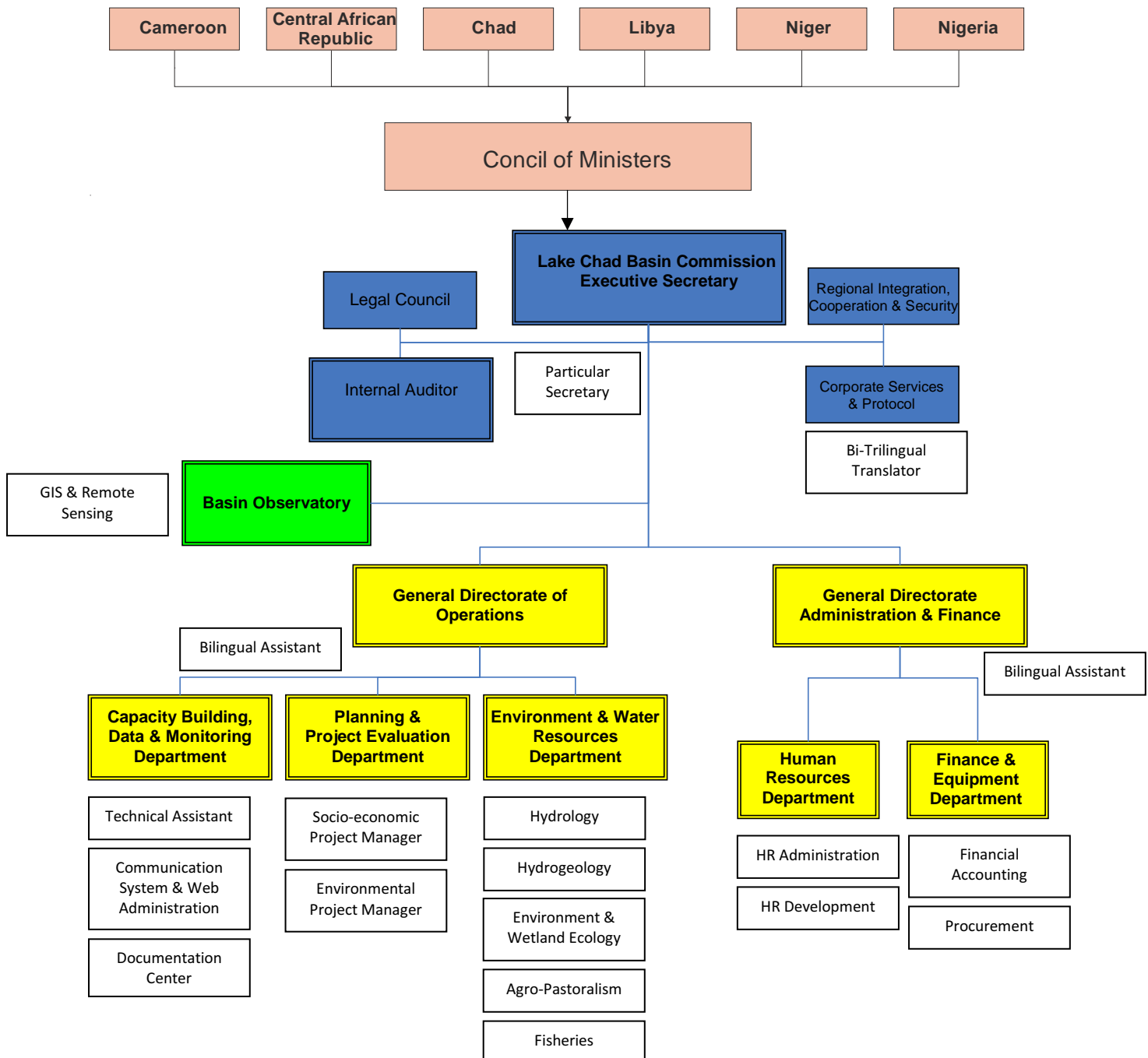


Fig. 5. Diagram of Lake Chad Basin Commission organisation

The LCBC secretariat is composed of a stab of 4 persons directly attached to the ES (legal advisor, financial controller, security and protocol). The Basin Observatory was created in 2008 aimed to watch over the resources of the basin. Further two branches

accumulate the technical staff: the General Directorate of Operations and the General Directorate of Administration & Finances. In all, the secretariat is composed of some 60 persons at the headquarters in N'Djaména and further 60 persons at the Ngala School, an agriculture school in Nigeria.

The key functions for the directing positions are (Pulver, 2010):

- Executive Secretary (political post, always Nigerian citizen):
 - Establish and maintain the stakeholders' trust and confidence in the LCBC's capacity and usefulness
 - Harmonise the member states' legal action for the protection and the sustainable use of the Basin's natural resources
 - Balance political, economical and social interests of the different stakeholders with the sustainability goals of the Vision 2025
- General Directorate of Operations (CV-driven post):
 - Plan and control the implementation of the Strategic Action Programme (SAP) for the Lake Chad Basin. Facilitate the roll-out of National Action Plans (NAP)
 - Identify, select and initiate research or impact studies deemed to be SAP relevant in consultation with the technical departments and the Basin Observatory
 - Elaborate LCBC annual activity report in cooperation with the General Directorate of Administration and Finance, and with the contribution of all departments and services of the CBLT
- General Directorate of Administration and Finances (CV-driven post):
 - In charge of the LCBC budget and investment planning and monitoring; support the resource and investment planning of the other departments
 - Review and implement rules and procedures of good administration of resources and services; monitor their application
 - Elaborate LCBC annual activity report in cooperation with the General Directorate of Operations

3.4.1. Groundwater governance framework

Through the Water Charter, which has to be signed and adopted by the member states, the LCBC will have a modern tool for transboundary water governance.

While transboundary surface water has been more or less extensively studied since the establishment of the LCBC, the knowledge of transboundary groundwater is very poor. When it comes to groundwater, only four transboundary projects can be listed since the creation of the LCBC:

- FAO project finished in 1973 that investigated for the first time the transboundary groundwater in the area through an extensive drilling programme, among others.
- BRGM project finished in 1993 (Eberschweiler, 1993) that set the first regional groundwater model including the Quaternary sands, Lower Pliocene and Continental Terminal.
- UNESCO project finished in 2003 that investigated the Chari-Logone region between Chad and Cameroon.
- BGR ongoing project, which has studied mainly the Quaternary groundwater in the Chadian part of the basin but intends to prolong the investigations towards Cameroon, Nigeria and Niger.

4. Interviews

The interviews took place in the headquarters of the LCBC regarding the staff of the organisation. After the will of the Executive Secretary, the interview to the Director of Water should replace his. It was not possible to reach any of the focal points. Following table lists the people interviewed:

Table 1. People who have been interviewed

No.	Title	Name	Position	Interview schedule ^a	Representation/organisation	Email	Telephone
1	Mr	Mohamed Bila	Remote Sensing and GIS Expert, LCBC	1	LCBC HQ	mdbila@yahoo.com	+23566817311
2	Mr	Atiku Ahmed	Director of Water and Environment, LCBC	1	LCBC HQ	atikasuk@yahoo.co.uk	+23522524145
3	Mr	Balarabe Belo	Legal Advisor - LCBC	1	LCBC HQ	balanrogo@yahoo.com	+23599449901

5. SWOT analysis

The main transboundary aquifer within the Lake Chad Basin is the quaternary aquifer, which is strongly used throughout the whole basin. Nigeria and Niger are already drilling deep boreholes (couple of hundred meters depth) to tap the deeper Lower Pliocen in order to comply with their needs.

In general, the LCBC lack of effective institutional capacity and technical knowledge to confront the challenges of managing transboundary aquifers. However, efforts have been taken in the last years to improve the situation and allow the organisation to fully include groundwater in its activities.

5.1. Strengths

- The LCBC has a permanent secretariat.
- Groundwater is explicitly mentioned in the Convention/Statute from 1964 (Art. IV).
- A hydrogeologist has been appointed. Together with a hydrologist, an expert on fishery and an expert on humid zones, they build the Directorate on Water and Environment.
- A protocol on data exchange has been signed by the Council of Ministers. However, data exchange has not yet been implemented.
- A Water Charta has been compiled and is in the process of adoption. This legal document establishes the basis for an integrated water management and has been compiled taking into account the UN-Resolutions on transboundary groundwater. Allocation principles are here included.
- The secretariat includes an Observatory, which was created in 2008.

5.2. Weaknesses

- The organisation seems to act isolated from other sister organisations in the region.
- There is very little knowledge on the regional and world organisations working on groundwater.
- It lacks on management tools and structures to take care of IWRM and thus to include groundwater in their activities as required by the Convention.
- Communication between the secretariat and the riparian states is very weak.
- Focal points in the riparian states seem not to be interested in exchanging data with the secretariat. Although a data exchange protocol exists and has been signed by the Council of Ministers, it seems not to have any impact in the activities.
- There is no understanding on the water system. There is no knowledge on the connection between surface and groundwater.
- The Observatory seems not to have any database available.
- Prioritisation regarding the limited resources of the organisation seems to be done arbitrarily.

5.3. Opportunities

- The LCBC has received important international interest in the last years.
- An ongoing project financed by the German cooperation (BMZ/GIZ) is working on institutional strengthening. The strengthening of the installation of the LCBC in the riparian states is the next step forward.
- An ongoing BGR project aimed to strengthen the LCBC capacities regarding groundwater issues has help to create/improve awareness for the resource within the LCBC secretariat.
- The increasing pressure of the population on groundwater will lead to the riparian states to consider this issue in their agenda. Thus, the matter will also get the needed importance within the secretariat.

5.4. Threats

- In general, knowledge and management of groundwater in the riparian states is far from been adequate. This is the reason why the governments do not consider the issue as important and do not transfer the matter into the LCBC (lack of interest).

6. Conclusions

Although groundwater is included in the Convention/Statute of 1964, little has been done in this field since the LCBC was created.

The LCBC has been recently restructured (2010-2011) and the new organisation should be able to tackle the groundwater issue. At least the organisation appointed a full-time hydrogeologist and a new Basin Observatory has been created, which is responsible for bi-annual report writing on the state of the basin. However, a lot has to be done to arrive at international standards regarding groundwater management.

Staffs complain mainly about lack of knowledge (relationship surface – groundwater still unknown), lack of participation of riparian states, lack of data exchange (although a protocol on data exchange exists).

The organisation seems to work independently in the region. Apparently it has no cooperation with other similar institutions at regional or international level.

7. Recommendations

Recommendations are given as follows:

a. Monitoring, data and knowledge generation

There is no regular monitoring of groundwater level or water quality from the side of the riparian states, due especially to lack of understanding and limited financing resources. In the frame of an ongoing BGR project and with the involvement of the hydrogeologist, the LCBC has started to measure groundwater levels in a basic monitoring network considering mainly the quaternary aquifer. However, **the creation and equipment of an expanded monitoring network is urgent.**

A data exchange protocol has been signed by the Council of Ministers, but it has not yet any implication in the data transfer. In the riparian states, **awareness about the importance of data production and transfer to the LCBC is needed.**

b. Institutional/organisational/legal aspects

Although the groundwater issue is included in the Convention/Statute and a Strategic Action Plan (SAP) including the groundwater resources has been produced, the LCBC is still too weak. **It needs management planning and monitoring** to be able to act independently and to comply with the propositions of the SAP. Since March 2012, an ongoing LCBC/GIZ project is taking care of this matter.

Cooperation with the riparian states by means of the focal points is very weak and should be improved, probably by **creating focal structures.** They should be equipped by capable technical staff to be able to comply with the necessities of the LCBC. This issue will also be tackled by the ongoing LCBC/GIZ project in the next months.

c. Financial aspects

The LCBC budget is totally covered by contributions from riparian states but, like many other transboundary institutions in Africa, suffers under lack of financial support from the riparian states. The **visibility of the LCBC and the quality of their work should be improved** for riparian states to include the LCBC as a main issue in their government agendas.

d. Capacity building aspects

The **LCBC staffs need capacity building** (adequate personnel, equipment, and formation) to be able to elaborate groundwater related recommendations that can be used by decision makers of the riparian states. The ongoing LCBC/BGR project is taking care of this question.

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Appendix 1. Table of basic data for the L/R/ABO

River Basin	LAKE CHAD BASIN									
Major tributaries	Chari – Logone; Komadugu – Yobe									
Riparian states (LCBC members indicated in bold)	1. Alger 2. Cameroon 3. Central African Republic (CAR) 4. Chad 5. Libya 6. Niger 7. Nigeria 8. Sudan									
Upstream riparian states	Cameroon, CAR, Nigeria, Sudan (only seasonal small rivers that do not reach the Lake Chad)									
Downstream riparian states	Chad, Niger									
Total basin area (km ²)	2.3 million /1/									
Mean annual runoff (mill. M ³ /year)	23,350 (average since 1986) /2/									
Total population (mill.)	30 million									
Riparian state	Share (%) of basin area	Share (%) of population (Refer. 3)	Mean annual runoff (million M ³ /year) (Refer. 4)	Average rainfall in riparian basin part (mm/yr) (Refer. 5)	Primary land uses/cover in basin part	Primary water uses in basin part	Major cities in basin part (Mill. pop.)	Protected areas, national parks in basin part	Major water transfer schemes between states	Transboundary conflicts over rivers
1. Algeria	3.8	0.02	None	27	None	None		None		
2. Cameroon	2.1	5.41	4,700	970	Agriculture	Agriculture, domestic	Maroua (0.206 estim.2005)	Waza National Park		Border at the lake
3. CAR	9.3	3.10	23,300	1106	Agriculture	Domestic, aquaculture	Bossangoa (0.036 estim.2003)	National Parks		
4. Chad	43.9	20.79	28,000	337	Agriculture	Agriculture, domestic, livestock	N'Djamena (0.993 census 2009)	Zakuma National Parc		Border at the lake

Appendix 1. Table of basic data for the L/R/ABO

5. Libya	0.1	0.00	None	29	None	None		None		
6. Niger	29.0	5.97	200	78	Livestock, agriculture	Agriculture, domestic, livestock	Zinder (0.238 census 2010)	None		Border at the lake
7. Nigeria	7.6	59.49		594	Agriculture	Agriculture, domestic	Kano (3.739 estim.2006)	None		Border at the lake
8. Sudan	4.2	5.22	negligent	478	Livestock, agriculture	Agriculture, domestic, livestock		None		
Year of formal recognition of Lake/Basin Org.	N'Djaména, 22 nd May 1964									
Primary mandate of Lake/Basin Org.	Development of Chad basin and in particular the utilization of surface and ground waters shall be given widest connotation and refers in particular to domestic, industrial and agricultural development, the collection of the products of its fauna and flora (Refer. 6)									
Type of Org.	<input checked="" type="checkbox"/> Lake Basin Commission <input type="checkbox"/> Technical Committee <input type="checkbox"/> Lake/River Basin Authority									
Name of treaties or legally recognized agreements governing water mgt. in the basin	1. Water Charter: all state members of LCBC (to be adopted) 2. Joined Commission: Nigeria and Niger (Refer. 7) 3. Joined Commission: Cameroon and Chad, virtually not working (Refer. 7) 4. Cameroon Nigeria Mixed Commission: Cameroon and Nigeria (Refer. 7)									

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6. Lake Chad Basin Commission (LCBC), 1964. Convention and Statute, Article IV.
7. Conceptualizing Cooperation on Africa's Transboundary Groundwater Resources, 2008. Deutsches Institut für Entwicklungspolitik. ISBN: 3889853641.

Appendix 2. Transcripts of interviews

Reply from LCBC HQ

Questionnaire for [LCBC](#)

Name: [Mr. Mohamed Bila](#)

Institution (if different from RBO): _____

Function - please let us know your job title, role and main responsibilities:

Title: [Remote Sensing and GIS Officer](#)

Role and responsibilities:

[Perform remote sensing duties in the LCBC](#)

How many years in present position: [2 years](#)

Background education: [BSc Geology and MSc Geography](#)

Country: [Nigeria](#)

E-mail address: mdbila@yahoo.com

Gender: Female: ___ Male:

Telephone number for possible follow up phone call: [+235 66 81 7311](#)

Date of Interview: [27th March 2012](#)

Interview performed by: [Dr. Sara Vassolo](#)

Place of interview: [N'Djaména](#)

Or if done by telephone: _____

Questions:

1. Governance:

- a. What is the principal and legal role/mandate of LCBC with respect to groundwater:
- | | | |
|--|------------------------------|-----------------------------|
| i. To allocate GW: | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| ii. To oversee GW mgt.: | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| iii. To monitor TBAs in basin: | Yes X | No <input type="checkbox"/> |
| iv. To advise riparian states on issues related to GW: | Yes X | No <input type="checkbox"/> |
| v. To implement joint GW development projects: | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| vi. Other. Specify: | | |

- b. Does LCBC have a staffed permanent Secretariat?

[Yes](#)

- c. Does the constitution/agreement establishing LCBC specifically/explicitly address GW and groundwater issues?

[No](#)

- d. If yes, how?

- e. Which water management instruments/schemes do you use? (e.g. management plans, action programs, monitoring and information systems, etc.)

[None](#)

- f. To what extent is groundwater already considered in your water management structure and what actions/initiatives/programmes are you using to foster groundwater management within your organisation? (e.g. groundwater working group at LCBC)

[None](#)

Appendix 2. Transcripts of interviews

- g. Do you collaborate with organisations/programmes/institutes/projects that have a groundwater component (African networks e.g AGWNET, WATERNET; policy decision makers (e.g. AU, AMCOW, AGWC, etc.) and international donors)?

AGWNET, AMCOW, BMZ

- h. Are you aware of the AMCOW work plan? If yes: Are there any activities you have taken on board due to the AMCOW work plan?

- i. Do you know about the existence of the UN resolution on transboundary aquifers?

Yes

2. Society/collaboration/inclusion:

- a. What are the major uses of groundwater within the basin?

Domestic water supply

- b. What are the main water challenges your basin/lake is confronted with? (e.g. groundwater pollution, (ground-) water shortage, institutional, etc.)

Weak institutional capacity to manage groundwater

- c. Are there great disparities between the water conditions and challenges in the riparian states? Also in the level of groundwater development and management?

Riparian states have similar challenges and conditions in water conditions

- d. Also in the level of groundwater development and management?

Similar challenges and conditions in the management of groundwater

- e. How is the exchange of knowledge/data and cooperation between the L/RBO and the riparian states' water mgt. structures?

None existing

- f. Do you find the commitment of the riparian states to include GW on the political agenda sufficient?

No

- g. Does this influence your functionality?

Yes. Functionality would be better if groundwater is given prominence in the political agenda

- h. What are you doing to strengthen the participation of the riparian states? (e.g. are formal structures, like stakeholder forums, in place with clear roles and responsibilities in water resources management and in the decision making process, are regular meetings taking place, etc.)?

Nothing exist at the moment

- i. Do you exchange knowledge, experience with other RBOs?

No

Appendix 2. Transcripts of interviews

3. Science/data/capacity building:

- a. Is there a good understanding to which extent groundwater-surface water interaction determines water balance and water quality in your basin and across riparian territories?

No. Little has been done to study the groundwater-surface water interaction

- b. Where are you in the process of managing TBAs (also fill in Table 4 for individual TBAs)?

- | | |
|---|-------------------------------------|
| i. Identification | <input checked="" type="checkbox"/> |
| ii. Delineation | <input type="checkbox"/> |
| iii. Diagnosis | <input type="checkbox"/> |
| iv. Conceptual/numerical model | <input type="checkbox"/> |
| v. Allocation principles | <input type="checkbox"/> |
| vi. Implementation of joint infrastructure projects | <input type="checkbox"/> |

- c. Which data, if any, do you collect related to groundwater in the basin?

None

- d. What data bases, information portals, and monitoring networks exist in your organization, where groundwater is (or could simply be) added?

An observatory was created in 2008. Programme on groundwater still to be created

- e. What is the process/mechanism for data sharing with the riparian states' national groundwater dept.?

A data sharing agreement exists but yet to be implemented

- f. How many hydrogeologists, or staff with hydrogeological background, are working in your organization? Are all allocated posts filled?

2 (two). One hydrogeologist with full responsibility

- g. Do you find your present capacity (in terms of human and financial resources) sufficient to address groundwater management appropriately?

No

- h. How is prioritisation made in your organisation to meet the limited resources (e.g. human, financial, technical resources)?

Prioritisation decision taken by chief executive

- i. What capacity building on groundwater is ongoing or planned?

BGR study ongoing

- j. What in particular is lacking regarding capacity on GW management

Monitoring capacity, incomplete knowledge, linking knowledge to policy

Reply from Remote Sensing and GIS Officer - LCBC

Appendix 2. Transcripts of interviews

Reply from LCBC HQ

Questionnaire for [LCBC](#)

Name: [Mr. Atiku Ahmed](#)

Institution (if different from RBO): _____

Function - please let us know your job title, role and main responsibilities:

Title: [Director of Water and Environment](#)

Role and responsibilities: [Advice executive secretary on water and environmental issues in the basin](#)

How many years in present position: [1 year](#)

Background education: [Water Engineer](#)

Country: [Nigeria](#)

E-mail address: atiksuk@yahoo.co.uk

Gender: Female: _____ Male: X

Telephone number for possible follow up phone call: [+235 22 52 4145](#)

Date of Interview: [25th Nov. 2011](#)

Interview performed by: [Dr. Sara Vassolo](#)

Place of interview: [LCBC](#)

Or if done by telephone: _____

Questions:

4. Governance:

- a. What is the principal and legal role/mandate of LCBC with respect to groundwater:
- | | | |
|--|--------------|-----------------------------|
| i. To allocate GW: | Yes x | No <input type="checkbox"/> |
| ii. To oversee GW mgt.: | Yes x | No <input type="checkbox"/> |
| iii. To monitor TBAs in basin: | Yes x | No <input type="checkbox"/> |
| iv. To advise riparian states on issues related to GW: | Yes x | No <input type="checkbox"/> |
| v. To implement joint GW development projects: | Yes x | No <input type="checkbox"/> |
| vi. Other. Specify: | | |

- b. Does LCBC have a staffed permanent Secretariat?

[Yes](#)

- c. Does the constitution/agreement establishing LCBC specifically/explicitly address GW and groundwater issues?

[Yes, in the Member States Convention of 1964](#)

- d. If yes, how?

[The convention establishes that the LCBC should care about the natural resources of the basin, including groundwater](#)

- e. Which water management instruments/schemes do you use? (e.g. management plans, action programs, monitoring and information systems, etc.)

[Management plan, Strategic Action Plan \(SAP\)](#)

- f. To what extent is groundwater already considered in your water management structure and what actions/initiatives/programmes are you using to foster groundwater management within your organisation? (e.g. groundwater working group at LCBC)

Appendix 2. Transcripts of interviews

None

- g. Do you collaborate with organisations/programmes/institutes/projects that have a groundwater component (African networks e.g AGWNET, WATERNET; policy decision makers (e.g. AU, AMCOW, AGWC, etc.) and international donors)?

UNESCO, FEM, AMCOW, BMZ

- h. Are you aware of the AMCOW work plan? If yes: Are there any activities you have taken on board due to the AMCOW work plan?

No

- i. Do you know about the existence of the UN resolution on transboundary aquifers?

Yes. States must cooperate to manage transboundary basins, use rightly and fairly the resources. States must not damage aquifers, they have to protect them and manage the groundwater resources

5. Society/collaboration/inclusion:

- a. What are the major uses of groundwater within the basin?

Livestock and human watering, industrial use

- b. What are the main water challenges your basin/lake is confronted with? (e.g. groundwater pollution, (ground-) water shortage, institutional, etc.)

Pollution, bad sanitation

- c. Are there great disparities between the water conditions and challenges in the riparian states? Also in the level of groundwater development and management?

Yes

- d. Also in the level of groundwater development and management?

Yes

- e. How is the exchange of knowledge/data and cooperation between the L/RBO and the riparian states' water mgt. structures?

Starting collaboration processes

- f. Do you find the commitment of the riparian states to include GW on the political agenda sufficient?

Yes

- g. Does this influence your functionality?

There is knowledge and sensitization that helps on the work

- h. What are you doing to strengthen the participation of the riparian states? (e.g. are formal structures, like stakeholder forums, in place with clear roles and responsibilities in water resources management and in the decision making process, are regular meetings taking place, etc.)?

Appendix 2. Transcripts of interviews

We are on the process of getting regular meetings with the technical committee (a group of technicians from the member states)

- i. Do you exchange knowledge, experience with other RBOs?

No

6. Science/data/capacity building:

- a. Is there a good understanding to which extent groundwater-surface water interaction determines water balance and water quality in your basin and across riparian territories?

No

- b. Where are you in the process of managing TBAs (also fill in Table 4 for individual TBAs)?

- | | |
|---|-------------------------------------|
| i. Identification | <input checked="" type="checkbox"/> |
| ii. Delineation | <input checked="" type="checkbox"/> |
| iii. Diagnosis | <input checked="" type="checkbox"/> |
| iv. Conceptual/numerical model | <input type="checkbox"/> |
| v. Allocation principles | <input checked="" type="checkbox"/> |
| vi. Implementation of joint infrastructure projects | <input checked="" type="checkbox"/> |

Beginning collaboration with UNESCO through ISARM

- c. Which data, if any, do you collect related to groundwater in the basin?

Groundwater level and quality for the quaternary aquifer

- d. What databases, information portals, and monitoring networks exist in your organization, where groundwater is (or could simply be) added?

Surface water allocation model (WEAP)

- e. What is the process/mechanism for data sharing with the riparian states' national groundwater dept.?

Data exchange protocol has been signed by the Council of Ministers, however there is no regular data exchange

- f. How many hydrogeologists, or staff with hydrogeological background, are working in your organization? Are all allocated posts filled?

One permanent hydrogeologist

- g. Do you find your present capacity (in terms of human and financial resources) sufficient to address groundwater management appropriately?

No

- h. How is prioritisation made in your organisation to meet the limited resources (e.g. human, financial, technical resources)?

Function budget is prior to development budget

- i. What capacity building on groundwater is ongoing or planned?

Appendix 2. Transcripts of interviews

No

- j. What in particular is lacking regarding capacity on GW management

Equipment, human resources, financial resources

Reply from Director of Water and Environment - LCBC

Appendix 2. Transcripts of interviews

Reply from LCBC HQ

Questionnaire for [LCBC](#)

Name: [Mr. Balarabe Belo](#)

Institution (if different from RBO): _____

Function - please let us know your job title, role and main responsibilities:

Title: [Legal Advisor](#)

Role and responsibilities: [Advice executive secretary on legal issues in the basin](#)

How many years in present position: [2 year](#)

Background education: [Law degree \(LLB\), MBA](#)

Country: [Nigeria](#)

E-mail address: balanrogo@yahoo.com

Gender: Female: _____ Male: [X](#)

Telephone number for possible follow up phone call: [+235 99 44 9901](#)

Date of Interview: [25th Nov. 2011](#)

Interview performed by: [Dr. Sara Vassolo](#)

Place of interview: [LCBC](#)

Or if done by telephone: _____

Questions:

7. Governance:

- a. What is the principal and legal role/mandate of LCBC with respect to groundwater:
- i. To allocate GW: Yes **No x**
 - ii. To oversee GW mgt.: **Yes x** No
 - iii. To monitor TBAs in basin: Yes No
 - iv. To advise riparian states on issues related to GW: **Yes x** No
 - v. To implement joint GW development projects: Yes **No x**
 - vi. Other. Specify:

- b. Does LCBC have a staffed permanent Secretariat?

[Yes](#)

- c. Does the constitution/agreement establishing LCBC specifically/explicitly address GW and groundwater issues?

[Yes](#)

- d. If yes, how?

[***By the LCBC Convention/Statute \(Art. IV\) "the utilization fo surface and ground waters shall be given widest connotations"***](#)

- e. Which water management instruments/schemes do you use? (e.g. management plans, action programs, monitoring and information systems, etc.)

[***Strategic Action Plan \(SAP\)***](#)

- f. To what extent is groundwater already considered in your water management structure and what actions/initiatives/programmes are you using to foster groundwater management within your organisation? (e.g. groundwater working group at LCBC)

[None](#)

Appendix 2. Transcripts of interviews

- g. Do you collaborate with organisations/programmes/institutes/projects that have a groundwater component (African networks e.g AGWNET, WATERNET; policy decision makers (e.g. AU, AMCOW, AGWC, etc.) and international donors)?

Yes

- h. Are you aware of the AMCOW work plan? If yes: Are there any activities you have taken on board due to the AMCOW work plan?

No

- i. Do you know about the existence of the UN resolution on transboundary aquifers?

Yes

8. Society/collaboration/inclusion:

- a. What are the major uses of groundwater within the basin?

Groundwater used for domestic purposes and also for agriculture

- b. What are the main water challenges your basin/lake is confronted with? (e.g. groundwater pollution, (ground-) water shortage, institutional, etc.)

Surface water shrinkage, groundwater shortage, lack of effective institutional controls

- c. Are there great disparities between the water conditions and challenges in the riparian states? Also in the level of groundwater development and management?

Yes

- d. Also in the level of groundwater development and management?

Yes

- e. How is the exchange of knowledge/data and cooperation between the L/RBO and the riparian states' water mgt. structures?

Low level of exchange and collaboration, there is room for improvement

- f. Do you find the commitment of the riparian states to include GW on the political agenda sufficient?

No

- g. Does this influence your functionality?

Yes, in an indirect manner

- h. What are you doing to strengthen the participation of the riparian states? (e.g. are formal structures, like stakeholder forums, in place with clear roles and responsibilities in water resources management and in the decision making process, are regular meetings taking place, etc.)?

Appendix 2. Transcripts of interviews

- i. Do you exchange knowledge, experience with other RBOs?

No

9. Science/data/capacity building:

- a. Is there a good understanding to which extent groundwater-surface water interaction determines water balance and water quality in your basin and across riparian territories?
- b. Where are you in the process of managing TBAs (also fill in Table 4 for individual TBAs)?
 - i. Identification
 - ii. Delineation
 - iii. Diagnosis
 - iv. Conceptual/numerical model
 - v. Allocation principles
 - vi. Implementation of joint infrastructure projects
- c. Which data, if any, do you collect related to groundwater in the basin?
- d. What databases, information portals, and monitoring networks exist in your organization, where groundwater is (or could simply be) added?
- e. What is the process/mechanism for data sharing with the riparian states' national groundwater dept.?

Data exchange protocol signed by the Council of Ministers but not yet implemented
- f. How many hydrogeologists, or staff with hydrogeological background, are working in your organization? Are all allocated posts filled?

One permanent hydrogeologist
- g. Do you find your present capacity (in terms of human and financial resources) sufficient to address groundwater management appropriately?
- h. How is prioritisation made in your organisation to meet the limited resources (e.g. human, financial, technical resources)?
- i. What capacity building on groundwater is ongoing or planned?
- j. What in particular is lacking regarding capacity on GW management

Reply from Legal Advisor - LCBC