





# THE LAKE AND ITS ECOSYSTEMS

*“I apologize for  
not having seen,  
not having understood  
and not having  
remembered everything.”*

[ Manfred J. Kriegl ]

INTRODUCTION  
IS IT A LAKE?  
GEOGRAPHY  
HYDROLOGY  
SEASONAL FLUCTUATIONS  
THE BASIN  
CLIMATE  
HISTORY  
PEOPLE  
THE COUNTRIES

# THE LAKE AND ITS ECOSYSTEMS

# 1

NEAR DIKWA VILLAGE (BAGA), NIGERIA



LAND, WATER, VEGETATION, ANIMALS AND PEOPLE COMBINE TO FORM MANY DIFFERENT ECOSYSTEMS

## INTRODUCTION

The vast lands of the Lake Chad Basin are one of society's most ancient dwelling places. Encompassing territory from four different countries, the area is home to about 11 million people, who depend for their daily survival on the lake and its hinterland. The lake itself, and the wetlands of its basin, harbour a range of biodiversity that is of global importance. To give some idea, the area is the habitat of 176 species of fish and over 500 species of birds (including both resident and migrant species). This delicate ecosystem presents special challenges for the region but, managed wisely, the lake and its basin offer immense potential for genuine sustainable development and a sound future for the people who live there.

For thousands of years, Lake Chad has been an important cultural and commercial crossroads in Africa. The people who live in the region are drawn from a wide variety of different ethnic backgrounds and their very diversity represents one of the area's greatest assets.

Centuries of living on the shores of Lake Chad and in its basin have given these people an intimate knowledge of how best to make use of the lake's lands and water fluctuations. However, although many people continue to practise these techniques, much of the precious knowledge is now at risk as new technologies and crops, not necessarily suited to the terrain and the peoples, are introduced.



PORT OF BORO, ELEWA (N'GUICHMI), THE NIGER

## IS IT A LAKE?

Chad is a peculiar type of lake. Because of the wide seasonal and year-to-year fluctuations in water supply (rainfall and flow from tributary rivers), and high evaporation rates, its water volume can vary over the years from more than 70 billion m<sup>3</sup> to less than 10 billion m<sup>3</sup> <sup>[1-1]</sup>. \* The visual impact is striking: there are periods in which most of it becomes a vast, swampy land, hardly identifiable as a "lake" in the usual sense of the word (this happened, for example, during the severe droughts of the 1980s), and periods in which open waters cover such a large surface area that it looks like an open sea (for example in the early 1960s but, unfortunately, not in recent years).

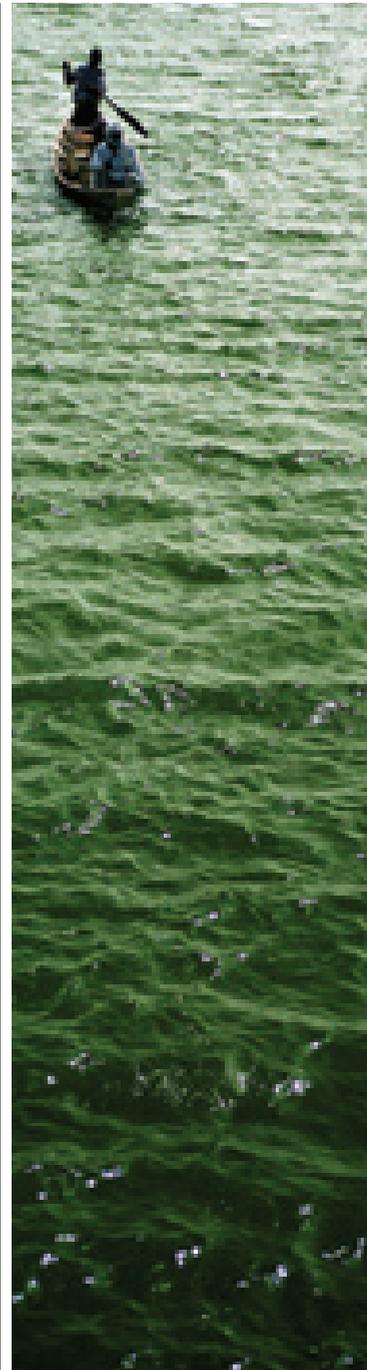
With these large variations, measuring the lake's surface area and comparing it with other lakes becomes a tricky exercise. Three different conditions of the lake have been identified according to its water level <sup>[1-1], [1-2], [1-3]</sup>.

\* Numbers in square brackets refer to the bibliographic references on page 298

➤ When the water level is around 282 m above sea level, the lake is called *Normal Chad*. Open waters form two large basins, a northern and a southern one, almost completely separated by a narrow strip of land (the Great Barrier) located between Baga-Kawa on the western shore and Baga-Sola on the eastern shore. The northeastern parts of both basins are dotted with islands (which are the tops of sandy dunes) and with floating islands (named *îlots-bancs*) composed of vegetation. At a water level of 282 m above sea level, the surface area of the lake is about 20 000 km<sup>2</sup> and the water volume is 50 billion m<sup>3</sup>, with an average turnover period of 1.2 years. The maximum depth is about 5.5 m in the northern basin and 3.5 m in the southern basin. The last time the lake was in this condition was in the 1960s.

➤ At water levels lower than 281 m above sea level, the lake is called *Lesser Chad*. The two basins become completely separated by the Great Barrier. At lower levels, the surface area of open waters is reduced, large areas being covered with vegetation. Water levels can be different in the two basins; the northern basin often dries out completely (generally in July). In the southern basin, a surface area of 1 500–2 000 km<sup>2</sup> of open water normally remains near the delta of the Chari River, and around 6 000 km<sup>2</sup> are covered with floating vegetation. The lake has been in the Lesser Chad condition since 1973.

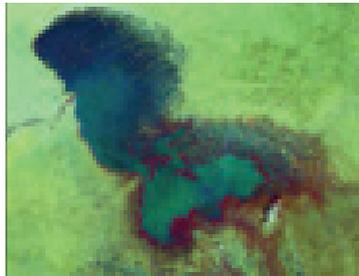
➤ At water levels higher than 283 m above sea level, the lake is called *Great Chad*. Open waters form a single large basin, exceeding 25 000 km<sup>2</sup> in surface area. Many islands disappear, and water can overflow into the Bahr-el-Ghazal depression, which becomes an effluent of the lake. This condition has not been reached in the last hundred years.



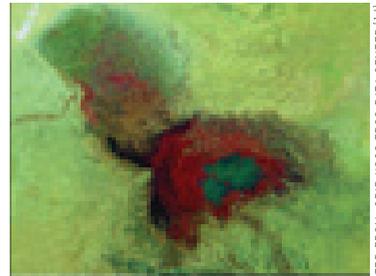
POINT OF DORO LELEWA (NGUIGMI), THE NIGER



SATELLITE IMAGE OF THE LAKE IN 1963 <sup>[14]</sup>



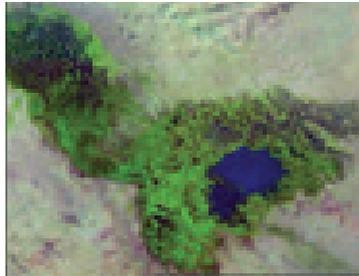
IN 1973 <sup>[14]</sup>



IN 1987 <sup>[14]</sup>



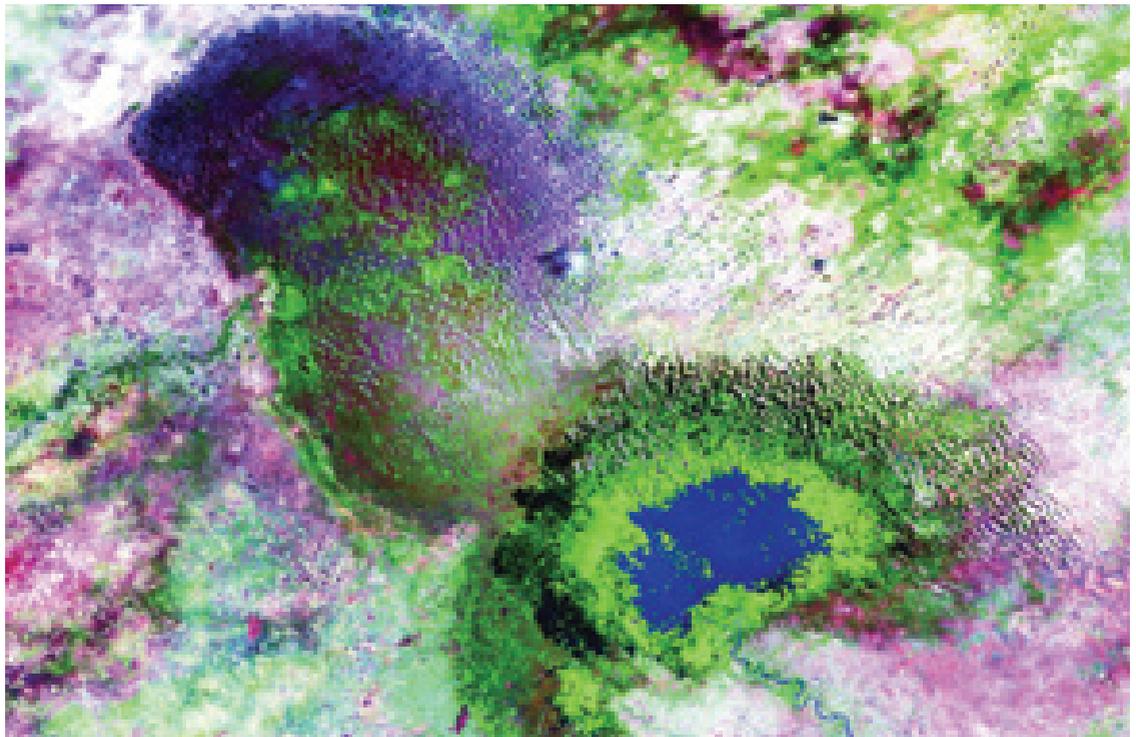
IN 1997 <sup>[14]</sup>



IN 2003 <sup>[14]</sup>



ABOVE AND BELOW: IN 2003 (ZOOM)



WITH ITS FLUCTUATIONS, LAKE CHAD IS EVER CHANGING

DATA ELABORATED FROM GRID USGS EROS DATA CENTER <sup>[14]</sup>





PORT OF BOSSO, THE NIGER

NOWHERE ELSE IN THE WORLD IS SUCH A LARGE FRESHWATER RESERVOIR FOUND SO FAR FROM SEAS AND IN SUCH A HOT AND ARID CLIMATE

<< LEFT: LAKE CHAD IS LOCATED AT THE SOUTHERN LIMIT OF THE SAHARA DESERT

## GEOGRAPHY

Lake Chad is located at the southern limits of the Sahara Desert, and lies between latitudes 12°30' and 14°30' N and longitudes 13° and 15°30' E. The nearest sea is the Gulf of Guinea, about 1 000 km to the southwest. The Mediterranean Sea lies about 1 750 km to the north. Lake Chad is the only lake in the world of such a size to be located at these latitudes and in such arid climatic conditions. Normal Chad, as defined above, with a surface area of about 20 000 km<sup>2</sup>, is the fourth largest of the great African freshwater lakes, after lakes Victoria, Tanganyika and Malawi. However, it is the world's third largest, totally landlocked lake, smaller only than the

Caspian and the Aral seas in Asia. The lake is shared by four countries: the Niger in the northwest, Chad in the east, Nigeria in the southwest and Cameroon in the south.

The western shore of the lake is rather flat and smooth, the only significant exceptions being the delta of the Komadugu-Yobé River and a peninsula near Baga-Kawa village. The southern shore consists mainly of the delta of the Chari River. The northern and eastern shores are full of dunes, formed during prehistoric arid periods; these also cover part of the surface of the lake, creating a great number of inlets and small islands.

According to water level, the outline of the lake varies significantly, as do the shape and surface area of open waters. The eastern section of the lake is a network of narrow, shallow canals among the islands, making navigation almost impossible. The number of sandy islands in the lake can vary between 400 and 800 according to the water level<sup>[1.5]</sup>. They form a northeastern archipelago (in the northern basin), and a southeastern and an eastern archipelago (in the southern basin). Apart from these islands, the eastern part of the lake is dotted with floating islands, formed by aquatic vegetation of phanerogams (*Papyrus*, *Phragmites*, etc.)<sup>[1.6]</sup>.

## The floating islands of Lake Chad

7 March 2002  
Bol, Chad

Leaving Bol, we make our way out into the open waters of the lake, aboard a long, motor-powered canoe (pirogue), through the floating islands: an experience worth remembering. Moving slowly and with considerable difficulty, the canoe follows a narrow and twisting path that has been opened up with immense patience by local fishermen.

The floating islands are dense and compact enough to bear the weight of the timid sitatunga gazelle<sup>(1)</sup>; enough to support the weight of the cattle that graze here; and enough to support the weight of fishermen, when the only way forward

into the open waters is to get out of the boat and physically push the islands away with long poles.

Sometimes the canoe gets entangled, squeezed between islands propelled by the wind, as if trapped by ice floes in the northern seas. This did not happen to us, but some Nigerian fishermen, who generally own larger boats, have been known to have their vessels trapped by the islands for several days.

Luckily, we move forward, albeit at a painfully slow pace for kilometres, awestruck by the giant papyrus that towers over our heads. We find ourselves constantly bumping into the light trunks of *Aeschynomene elaphoxylon*, covered with yellow flowers that open like butterfly wings. The sides of the canoe brush noisily against the thick reeds, grasses and rushes that grow all around us. Innumerable aquatic birds

rise up in flight as we approach, only to settle again at a safe distance soon afterwards.

Our invaluable guide from SODELAC<sup>(2)</sup>, Abdallah Adam, observes: "You see, it's all this massive vegetation which deceives satellite photographs. The fact is that the water increases and diminishes depending on the amount of rain, the year and the influx of water from the rivers. It's true that the level shrank a great deal after the drought of the 1970s, but to determine the real surface of the lake the satellite is inadequate. From up there the immense masses of vegetation that you see seem like solid ground, but instead they are all Kirtà, the floating islands. Underneath them there is water, kilometre after kilometre, and there are fish, lots of them".

"You need to see it for yourself; if you don't verify it in person, the satellite photographs tell

LAKE CHAD (BOL), CHAD



THOUSANDS OF FLOATING ISLANDS, COMPOSED OF PAPYRUS AND PHRAGMITES, MAKE NAVIGATION AND FISHING DIFFICULT

a pack of lies,” comments Abdallah, “because they can’t perceive how much the tendency has been reversed in the past four or five years. The water level is rising again, much more than anyone thinks.”

After an hour of laborious navigating through the tangle of vegetation, with the impression of travelling on land rather than by boat, at last we find ourselves out on the wide open lake, a plain of calm waters as far as the eye can see, opaline blue, merging into the vast, uniform sky without a break at the horizon.

NOTES:

- (1) The sitatunga gazelle (*Tragelaphus spekei*) is considered to be a living vestige of an ancient animal in danger of extinction. Until a few years ago, they could be seen swimming near land. It is now hard to see them, but they can be heard moving in the tall vegetation, perfectly at ease and safe even in these unprotected areas.
- (2) M. Abdallah Adam is Chef de Cellule technique de la SODELAC (Société de développement du Lac Chad), N’Djamena, Chad.



LAKE CHAD (BOL), CHAD

FLOATING ISLANDS ARE RICH SITES OF BIODIVERSITY



OPEN WATER (BOL), CHAD

BUSHFIRES DOT THE HORIZON OF THE LAKE'S OPEN WATERS

## HYDROLOGY

The main influent rivers of Lake Chad are the Chari, which flows through Central African Republic, Chad and Cameroon and also collects the waters of the Logone (Cameroon and Chad), the Komadugu-Yobé (the Niger and Nigeria), the Yedseram (Nigeria) and the El-Beid (Cameroon). Of the volume of water supplied to Lake Chad each year, the Chari accounts for more than 90 percent and is the only river that flows all year round; the others normally flow only for a few months.

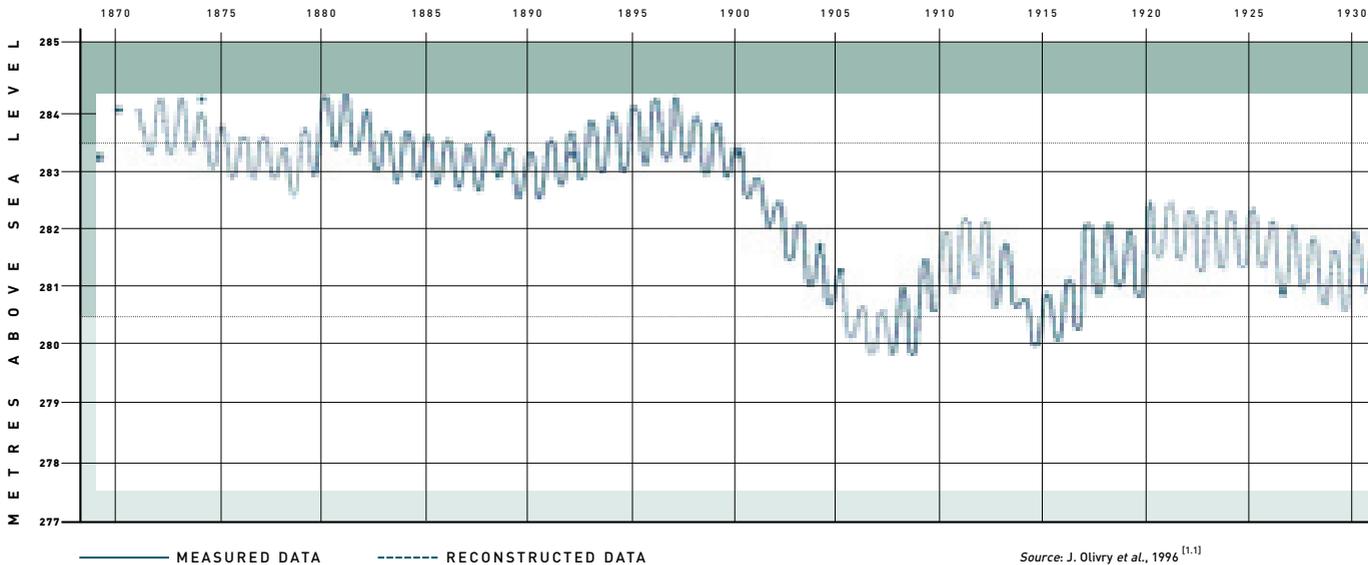
The lake has no outlets and has a high water loss from evaporation. The mean annual evaporation from the lake surface,

calculated on the basis of measurements in climatic stations around the lake, is 2 250 mm per year <sup>[1.7]</sup>. Annual losses in the *yaéré* (floodplains on the southern shore) are estimated at 5 billion m<sup>3</sup>, equivalent to 30 percent of the annual flow of the Logone <sup>[1.6]</sup>. Despite this, the lake is not salty like other landlocked lakes, although the water tastes brackish. This is because the salinity of the river water is low and some of the dissolved solids precipitate, while some are absorbed by plants <sup>[1.3]</sup>.

The lake is very shallow (its maximum depth is about 5.5 m in the Normal Chad condition <sup>[1.1]</sup>). This means that its water level is greatly influenced by the balance

between water loss (mainly from evaporation) and water supply (mainly from tributary rivers, the flow of which depends, in turn, on rainfall patterns throughout the entire basin). Because of the large variations of yearly rainfall values, the water level varies consistently across the years, as shown in the figure below. For example, during the droughts of the 1980s, the 200 mm isohyet was some 300 km south of its position in the 1950s <sup>[1.6]</sup>, which meant practically no rainfall at all for some years over most of the lake area. The maximum flow of the Chari in 1984/85 was less than 20 percent of that in 1961/62. The surface area of open waters in the lake shrank dramatically to about 2 000 km<sup>2</sup> in 1990 <sup>[1.1]</sup>.

**LAKE LEVELS AT BOL (CHAD) FROM 1870 TO 1995, SHOWING YEARLY AND SEASONAL FLUCTUATIONS**



Source: J. Olivry et al., 1996 <sup>[1.1]</sup>



POINT OF BOSSO, THE NIGER

LAKE LEVEL IS GREATLY INFLUENCED BY RIVER FLOW



GREAT CHAD  
NORMAL CHAD  
LESSER CHAD



ABOVE AND RIGHT: THE RHYTHM OF LIFE AROUND THE LAKE IS DICTATED BY SEASONAL WATER FLUCTUATIONS

## SEASONAL FLUCTUATIONS

Apart from the long-term periodic changes in lake level, the basin's ecosystems experience seasonal fluctuations that probably represent the most significant feature of the area, around which people, animals and vegetation have had to adapt their lifestyles.

The availability of water over the year depends on the seasonal peaks of rainfall, river flow and lake level that succeed each

other from July to January. As a consequence, despite the shortness of the rainy season, two to four crops per year can be obtained by exploiting these natural fluctuations and the water storage capacity of the soils.

During the rainy season (from July to September), rainfed agriculture is practised. Both the lake level and river flows are at their minimum. In November, river flows reach their peak, and soils

along the banks are flooded. In January, the river flows decrease, and agriculture is practised in the recessional land along the banks.

At the same time, the lake reaches its peak level and covers its maximum surface area. Immediately afterwards, in February, the lake waters start to recede and agriculture is practised in recessional land around the lake.



PORT OF BLANGOUA (KOUSSERI), CAMEROON

## Seasonal water cycles in the Lake Chad Basin

- 1 The year shown in the figure below starts in July, i.e. at the beginning of the rainy season. At this point, there has been practically no rain for almost nine months; the land is dry and all the rivers are dry, with the exception of the Chari, the flow of which is a bare 10 percent of its maximum. The lake level is low. Temperatures are high (around 35°C at Bol).
- 2 The rainy season lasts for three months, with peak rainfall in August and a sharp decrease during September. River flows

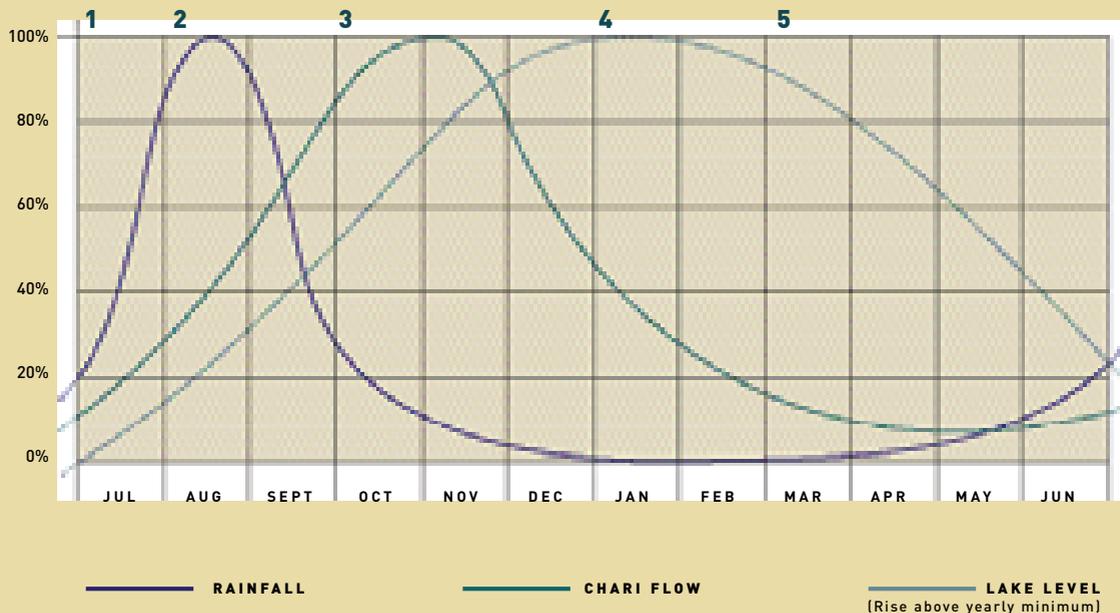
start to increase, but at a somewhat slow pace: it takes time for them to collect rainwater from the large area of the basin. Temperatures start decreasing, but are still high. Owing to a negative balance between evaporation and supply, the lake level keeps decreasing, reaching a minimum in July.

- 3 By October the rains stop, but river flows quickly increase, reaching a maximum in November. The areas along the banks get flooded. Temperature decreases, reaching a minimum at the end of December (around 14°C at Bol). Water balance in the lake is now positive and the water level increases. Recessional lands along the shores begin to get flooded.

- 4 In January the season is still dry and river flows reduce dramatically. By February it is again only the Chari that keeps flowing. Temperatures start increasing again. The water level in the lake reaches its maximum in mid-January. The mean difference between high and low levels is about 0.7–1 m, which means that large areas around the lake are flooded.

- 5 March to June is the hot dry season, the most difficult season for people, animals and vegetation. There is no rain, very little water in the rivers and high temperatures. The lake waters progressively recede. At the end of June, the process starts all over again.

**SEASONAL PATTERNS OF RAINFALL, CHARI RIVER FLOW AND LAKE WATER LEVEL RISE, EXPRESSED AS THE PERCENTAGE RATIO OF THE MONTHLY VALUE DIVIDED BY THE YEARLY MAXIMUM VALUE**



Source: Based on data taken from C. Bouquet, 1990<sup>[1.5]</sup>

## The Lake Chad Basin Commission

Extract from the Convention and Statutes relating to the development of the Chad Basin, signed at Fort Lamy (N'Djamena), on 22 May 1964 <sup>[1,8]</sup>

“The Member States solemnly affirm their determination to intensify their cooperation and efforts towards the development of the Chad Basin ...

“The Chad Basin shall be open to the exploitation of all Member States who are parties to the Convention, in respect of the sovereign rights, of each of them and in accordance with the terms and conditions of the present Statutes, subsequent revisions or regulations or special agreements ...

“The exploitation of the Chad Basin and especially the utilization of surface and underground waters has the widest meaning and refers in particular to the needs of domestic and industrial and agricultural development and the collecting of its fauna and flora products ...

“The Member States undertake to refrain from adopting, without referring to the Commission beforehand, any measures likely to exert a marked influence either upon the extent of water losses, or upon the form of the annual hydrograph and limnograph and certain other characteristics of the Lake, upon the conditions of their exploitation by other bordering States, upon the sanitary condition of the water resources or upon the biological characteristics of the fauna and the flora of the Basin ...

“The Member States shall draw up common rules to facilitate as far as possible navigation and transport on the Lake and the navigable waterways of the Basin and to ensure the security and control thereof.”



PORT OF BOL, CHAD

THE RECENT PROGRAMME OF ACTION BY THE LAKE CHAD BASIN COMMISSION EMPHASIZES COORDINATED PROTECTION OF CROPS, ANIMALS AND FORESTRY

### The Strategic Action Plan (1998)

The recent programme of action emphasizes antidesertification measures, coordinated protection of crops, animals and forestry, and

of Lake Chad. Improvement in road and railway links between member countries is also a major concern of the Commission <sup>[1,9]</sup>.