

Lake Chad Development and Climate Resilience Action Plan



**Lake Chad Basin Commission (LCBC)
Cameroon, Central African Republic, Chad, Libya,
Niger, and Nigeria**

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This Lake Chad Development and Climate Resilience Action Plan (or simply the Lake Chad Action Plan) is an Initiative undertaken by the Lake Chad Basin Commission (LCBC) and the member countries of the Lake (Cameroon, Central African Republic, Chad, Libya, Niger, and Nigeria). It was prepared with support of the World Bank, in close coordination with the French Development Agency (AFD).

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The present Action Plan includes the comments and suggestions agreed-upon during the national consultations held October 18 to November 1st, 2015 with Cameroon, Central African Republic, Chad, Niger, and Nigeria and during LCBC's Experts meeting held on November 9, 2015. It was then validated during the Extraordinary Session of LCBC's Ministerial Council on November 13, 2015.

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Executive Summary

Lake Chad belongs to the tropical lakes faced with the challenges of poverty in a context of global warming and increasing population pressure. The area has high potential (food exporting hub, employment). The banks and islands of the Lake contained in 2014 a population of nearly 2 million people; this region was a food exporting hub, playing a key role for food security of a hinterland with nearly 13 million inhabitants and two metropolitan centers, N'Djamena, the capital of Chad, and Maiduguri, the capital of the State of Borno in Nigeria. The entire basin includes an estimated 47 million people. The rich lake biodiversity has enabled riparian communities to develop productive activities based on fishing, agriculture, and livestock farming. Recognized by the Ramsar Convention, the Lake is being classified World Natural Heritage Site by UNESCO. The value of Lake Chad resides in the ecosystem services it provides, and these are particularly precious in a sahelo-saharan regional environment characterized by aridity and the erratic availability of water resources.

However, it is also a fragile and vulnerable socio-ecosystem, exposed to hydrological shifts, of which climate change could become a key parameter, high population growth, and political crises. Due to its very shallow depth and the prevalence of wetlands, the lake system is highly vulnerable to pollution. Yet the exploitation of hydrocarbons is expanding in the basin and the Lake itself, and inadequate use of pesticides in agriculture may have an impact on animal health (ruminants and fish). The Lake system is also highly vulnerable to a significant change in the water inflows from its tributary rivers (either up or down). Most notably, a frequent return to a 'Dry Small Lake Chad' state, characterized by no water inflows to supply the Northern half of the Lake¹, as observed in decades of drought, would compromise all the activities on which depend the livelihood of about 500,000 inhabitants and the food security of nearly 4 million people in the Lake's hinterlands. The drying-up of the Northern half of the Lake would also cause migration to the Southern shores, intensifying pressure on resources for agriculture, fishing, and livestock farming in the rest of the lake area and related conflicts. This transition to a "Dry Small Lake Chad" could result from a decrease in precipitation due to climate change or to a significant increase in water withdrawals from the rivers feeding the Lake, mainly from the Chari-Logone which contributes more than ¾ of the Lake inflows. However, the future is uncertain. The population in the basin is expected to double in the next 30 years, while future changes in precipitation are unknown in this part of the world.

Moreover, the Lake is located in a geopolitical area with significant challenges for water and natural resources governance. It is shared between four States with relatively high poverty rates (Cameroon, Chad, Niger, and Nigeria) and dependent on a basin that includes six countries covered by the Lake Chad Basin Commission (LCBC), including the Central African Republic and Libya. In 2014-15, the Lake Chad region was struck by extensive violence, associated with the Boko Haram movement, in the whole North-East of Nigeria as well as border areas of Niger, Cameroon, and Chad. Tens of thousands of persons have been displaced. Trade has been disrupted and the regional economy destabilized. These challenges have strengthened the integrative dynamics developed in recent years between the States bordering the lake: border

¹ The Lake is made of two basins ("cuvettes" in French) of roughly the same size; one in the Northern part of the Lake and one in the Southern part separated by shallows (the Great Barrier). The rivers feeding the Lake flow into its Southern basin. When water inflows are below a certain threshold, the water level in the Lake is insufficient for water to pass the shallows and, as a result, the Northern basin dries up. This State of the Lake is called "Dry Small Lake Chad".

agreements, joint mobilization and solidarity to restore security, and joint projects. It is now expected to become more concrete and effective in the field of economic development.

Global warming risks combined with the current geopolitical crisis have prompted the preparation by LCBC of a Lake Chad Development and Climate Resilience Action Plan (PADLT) for the 2016-2025 period. The Action Plan is in line with strategic planning documents developed by LCBC during the past years (Vision 2025; Strategic Action Plan; Water Charter). Part of the projects/measures included in the present Action Plan come from LCBC's five-year investment plan (2013-2017) and its Emergency Program for youth and vulnerable groups in the region of Lake Chad (PURDEP) 2015-2016, as well as recent national planning documents for at least part of Lake Chad. Additional proposals have been included in order to be able to meet the vision proposed in a 10-year planning horizon.

The core idea of the Action Plan outlined in this document is that, in parallel to the restoration of peace and security, there is a need to turn Lake Chad into a rural hub for regional development. The Plan intends to contribute significantly to food security, employment, and the social inclusion of the youth by improving, in a sustainable way, the living conditions of populations settled on the Lake's banks and islands as well as the resilience of a system characterized by a strong demographic growth, high hydrological variability, and climate uncertainty. To achieve it, the Action Plan proposes actions in seven Priority Themes based on observations and knowledge gained so far and summarized as follows:

- **Supporting producers and their value chains** to increase food production and employment and to thereby allow the lake area to increase its contribution to food security and regional stability;
- **Securing access to natural resources, and managing conflicts**, and thereby help the socio-ecosystem of the lake (which has been effective so far to absorb the pressure exerted by population growth) to strengthen resilience and to increase its contribution to regional development;
- **Improving living conditions through public investments**, because people in the Lake area have, in the four countries, limited access to basic services that are well below the already low national averages; progress in this area will be necessary for developing the potential of the Lake and strengthening the resilience of riparian societies;
- **Facilitating transport and trade**: because the Lake Chad remains handicapped by poor access, which reduces the value of its agricultural production; better access is also needed for improving the living conditions of its inhabitants;
- **Preserving the environmental capital of the lake** itself, for it is the foundation of the system's productivity; including contributing to reducing one of the highest population growth in the World;
- **Better managing the water resources of the basin**, since the regional management has so far remained largely ineffective and given that the projected increase in water demand requires concerted management of the resource; it also suggests a regional response to the risks of pollution (agricultural, urban, industrial and oil sector) that threaten Lake Chad; and
- **Disseminating information, improving knowledge, and monitoring of the environment**; indeed, the implementation of a more effective development, based on clearly identified options, assumes the availability of more precise knowledge about the ecological and socioeconomic functioning of the Lake and basin. This also requires that the LCBC will better mobilize and share available information, and to facilitate participatory processes involving the stakeholders.

The four riparian States plus the Central African Republic and Libya, local powers (local governments or customary authorities), LCBC, and the civil society will be responsible for implementing the proposed actions. The Plan includes enhancing the capacity of LCBC in terms of data collection, sharing of information, and carrying out analyses useful to governance of the basin's shared natural resources.

The success of this Plan requires continuing on-going efforts to strengthen the LCBC.

The tentatively estimated cost of the Lake Chad Action Plan is about 916 million Euros.

Chapter 1: Introduction

1.1 Background

Lake Chad is an area with extensive poverty and is facing unknown threats of climate change, which explains the interest in this region in the context of COP 21. The surface area of the Lake has been highly variable over time. This is due to its shallow depth and exposure to high evaporation, linked to its closeness to the Sahara. Between 1950-1960 and 2000-2015, its average surface area, constituted by the open waters and the swamps, has almost been divided by three, from more than 22,000 km² to nearly 8,000 km².

The value of Lake Chad resides in the ecosystem services it provides, and these are particularly precious in a sahelo-saharan regional environment characterized by aridity and the erratic availability of water resources. Recognized by the Ramsar Convention, the Lake is being classified World Natural Heritage Site by UNESCO. The rich lake biodiversity has thus enabled riparian communities to develop productive activities based on fishing, agriculture, and livestock farming; these show remarkable abilities to adapt to climate variability. The banks and islands of Lake Chad contained in 2014 a population of nearly 2 million people; this region was a food exporting hub, playing a key role for food security of a hinterland with nearly 13 million inhabitants and two metropolitan centers, N'Djamena, the capital of Chad, and Maiduguri, the capital of the State of Borno in Nigeria. The entire basin includes an estimated 47 million people.² Lake Chad can be considered as a productive, high potential environment.

However, it is also a fragile and vulnerable ecosystem, exposed to hydrological shifts (of which climate change could become a key parameter), high population growth, and political crises. Indeed, one of the features of this Lake is that it is shared among four States with relatively high poverty rates (Cameroon, Chad, Niger, and Nigeria), in addition to being located in a sensitive geopolitical area, between Sahara and Sahel, and West and Central Africa.

This Action Plan is being produced in a difficult institutional and political context. The Lake Chad Commission, which includes the lake riparian countries and other States located in the upstream part of Lake Chad basin (CAR) or possibly connected with it underground (Libya), has endeavored to respond to crises linked to sharp fluctuations of the Lake observed during droughts in the 1970s and 1980s and to promote regional water resources management. Since the 1990s and until recently, the hypothesis of a gradual downward trend, suggesting the drying up of the Lake as a result of climate change, has spread. But this was not confirmed by the most recent scientific work³ that considered the current lake as a Small Lake Chad but relatively stable since 1973. The researchers point out the economic dynamism, especially linked to the use of the flood-recession potential provided by this Small Lake Chad, while recognizing the fragility of this system and its vulnerability to demographic pressure, climate uncertainty, and political tensions.

These differences in assessing the hydrological status, its causes, and consequences have made it difficult to mobilize funds and build an institutional framework for the development of Lake Chad. In particular, a water transfer project from Oubangui River to Lake Chad, developed in the late 1980s and updated several times since, has been an important element. Through this

² The part of the basin managed by LCBC corresponds to the active hydrological basin.

³ See for example Bertoncin and Pase, 2012; Lemoalle and Magrin, 2014.

proposed project, the riparian States and LCBC hope to avert the threat of a disappearance of the Lake, while strengthening regional integration. However, the uncertainties surrounding this project (hydrology trends in relation to climate change; environmental and social impacts; geopolitical risk; financing), make it a long-term initiative.

Since 2013-2014, Lake Chad and its regional environment have been affected by a crisis due to Boko Haram which has deeply affected the regional system: fighting, murders, suicide attacks, displacement of hundreds of thousands of people within Nigeria or seeking refuge in or around the Lake Chad area of Niger, Cameroon, and Chad. Insecurity and the context of conflict brought about a disruption of movements and trade flows which ensured the prosperity of Lake Chad: livestock, fishing, and farming products. The implementation of the current development projects is being hampered. The regional crisis involving refugees has led to the development of an emergency plan for the youth and vulnerable people in the Lake Chad region (PURDEP), proposed by LCBC.

For Lake Chad to reach its potential and to contribute sustainably to regional economic development, such emergency measures shall be combined with other short and medium-term actions. This Development and Climate Resilience Action Plan 2016-25 responds to this need.

The crisis related to Boko Haram has also strengthened integrative dynamic already begun between the Heads of State in recent years around the issues of borders, security, and reflection on the water transfer from the Oubangui to Lake Chad. This Development and Climate Resilience Action Plan may help to reinforce this dynamic in socioeconomic development.

1.2 Focus and Orientation of Proposed Action Plan

Lake Chad is typical of climate change issues in regions having an important natural potential within least developed countries. Indeed, they combine hydrology (variability), ecology (ecosystem richness and vulnerability), socio-economic matters (production of food and monetary resources, jobs), governance (articulation between regional and national policies; between sectoral policies), and political considerations (security, uncertainty management).

The aim of this Plan is to make Lake Chad a rural hub for regional development by improving the living conditions on its banks and islands in a sustainable way and to strengthen the resilience of a socio-economic system characterized by a strong demographic growth, a high hydrological variability, and climate uncertainty.

This Plan must allow valuing the substantial potential in the Sahel by helping populations and States to better adjust to an uncertain regional situation (climate and other). In view of the strong demographic growth around the Lake and in its hinterland, and considering the productive potential of lake Chad, based on the functions of the environment and know-how of its populations, priority must be given to strengthening the resilience of communities and the existing productive systems, employment, and the social inclusion of the youth, which is critical for the recovery of socio-economic balances and regional stabilization. It is complementary to other development projects benefiting the area, such as PRODEBALT (Sustainable Development Project in the Lake Chad Basin, to be completed in 2016) or Presibalt (Rehabilitation Program and resilience building for socio-ecological systems of the Lake Chad basin; 2015-2019).

In such a context, enhancing the value of Lake Chad and increasing the climate resilience of communities and production systems includes: a diagnosis and agreed priority actions with different time frames (emergency/short-term, medium-, and long-term) as well as sectoral and country actions.

1.3 Methodology

The development and climate resilience action plan proposed here deals primarily with Lake Chad itself, including the regions where populations earn a living directly from the Lake and its resources, that is flooded regions (open waters and swamps), islands, current shores, former shores and close hinterland, representing a territory of nearly 50,000 km², or a square of nearly 230 km. However, in many ways, the future of this lake region is closely associated with the future of its regional hinterland, or even of the Chad basin as a whole: rainfalls and hydrology in sudan-sahelian areas, pollution risk, migratory and trade flows, and public policies. These elements will therefore be considered both in the diagnosis and in action proposals, which will obviously not be limited to the lake area.

This Plan covers the period 2016-25. During appraisal one will need to distinguish between actions that may be taken in the current context marked by high insecurity, while others require an improvement of the situation. This Plan has been prepared through a three-stage approach, mobilizing two types of materials:

The diagnostic builds on the main findings of two recently published works outlining the most important scientific data available on Lake Chad: the collective work undertaken by the Research for Development Institute (IRD) for LCBC and *L'atlas du lac Tchad* edited by the magazine Passages⁴. These studies give an overview of Lake Chad system by providing data on its ecology, populations, economy, and governance.

The general ambition of the Plan is to make Lake Chad a rural hub for regional development by securing communities and the existing productive systems so as to increase food production, while promoting employment and social inclusion in a context of climate uncertainty within the basin. The seven proposed Priority Themes (see below) fit into the sustainable development vision outlined through different LCBC strategic planning documents (Vision 20125, Strategic action plan; Water Charter). More precisely, the projects and actions proposed were selected from the PURDEP, the five-year investment Plan 2013-2017 of the LCBC, national action plans designed by Lake Chad riparian countries, as well as the collective work of LCBC-IRD. Major projects for increasing the resilience of the Lake Chad system were also added. Projects are not mentioned here for which financing is already secured. The selection of projects was done according to their consistency with the diagnosis and plan guidelines, the subsidiarity between regional and national projects, the geographic scale considered (Lake Chad or the whole basin⁵

⁴ Lemoalle J. et Magrin G. (dir.), 2014. *Le développement du lac Tchad. Situation actuelle et futurs possibles*, CBLT, Marseille, IRD Editions 215p. (+ full contributions of experts on a USB flash-disk: 638p.); Magrin G., Lemoalle J., Pourtier R. (dir.), 2015. *Atlas du lac Tchad*, Passages, 225p.

⁵ For projects and activities corresponding to generic investments (basic services for example) the administrative districts were considered within a radius of about 30-50 km from the lake shores. This includes five Nigerian local governments bordering the Lake (Abadam, Kukawa, Marte, Mongulo, Ngala); for Chad: the two cantons of Mani and Assale (south shore) and all of the two departments and Mamdi Wayi that form the Lake; for Cameroon: the boroughs of Darak, Hile Alifa, Blangoa, Fotokol, Makari, Goulfey; for Niger: N'guigmi communes, Bosso, Gueskéro, Toumour, and Kabléwa.

when processes or activities have a direct impact on the Lake)⁶, and the strategic nature of the expected results.

The present Action Plan includes the comments and suggestions agreed-upon during the national consultations held October 18 to November 1st, 2015, with Cameroon, Central African Republic, Chad, Niger, and Nigeria and during LCBC's Experts meetings held on November 9, 2015. It was then validated during the Extraordinary Session of LCBC's Ministerial Council on November 13, 2015.

Chapter 2: Diagnostic: A Productive but Vulnerable Hub

Lake Chad, in its current state of a 'Small Lake Chad', is a socio-economic area with a relatively favorable situation in terms of ecosystem services and socio-economic activities. The stage of 'Small Lake Chad', observed since 1991, is particularly conducive to the enhancement of recession activities on the banks (agriculture, livestock). This system is, however, vulnerable, because it can be threatened by a sudden change in hydrological conditions (dryness) and by the escalation of tensions for access to natural resources. During 2014-15 it was strongly affected by the crisis linked to Boko Haram. The nature of climate change over the long term is not yet known. However, it is probable that water contributions into the Lake will be negatively affected by the rise in temperature as well as by increasing water consumption due to population growth and economic activities in the basin.

The diagnostic is based on the available data mobilized as part of the Expert Group Review carried out for the LCBC (2012-2014). The lack of some data (on groundwater, lake sedimentation, flood plains functioning, global warming, etc.) does not prevent one to understand the overall functioning of the Lake Chad system, but advocates for increasing knowledge and improved mobilization of available data to inform some choices. In addition, the deterioration of the security situation (2013-2015) prevented the refining of the socio-economic diagnosis, especially on Nigerian territory, and modified human settlement and the functioning of the regional economy.

2.1 Hydrology and Ecosystems

Lake Chad is a lake that experiences variations at different time scales. Its level, surface, and landscape vary constantly according to months, seasons, years, decades, centuries, or longer sequences of geological time. Its evolution in recent years, and especially since the early 1970s, is particularly poorly documented, although it is recognized that its surface area recorded in the 1980s a very drastic decrease, causing concern among the region's leaders.

Some recent scientific studies and documents provide updated data on the functioning and current situation of Lake Chad (Expert Group Review LCBC-IRD, 2014). Correlation calculations and modeling were used to estimate surface and level variations in the northern basin of the Lake from the mid-1970s. The main elements concerning these are summarized below and represent the basis for the development of management policies for this particular ecosystem.

⁶ The eligibility criteria of proposed projects based on the seven priority themes, and distances are explained under chapter 3.

The Lake is mainly supplied by the Chari (about 85% of total inputs), rain (between 7 and 14%) and other tributaries, including El Beid and Komadugu Yobe (2 and 1.5%, respectively). Losses are mainly from evaporation (95% of losses) and infiltration into the groundwater table (about 5%; see Table 1). Further observations of the river inputs and water-table fluctuations are necessary for updating this water balance.

There are currently no net water abstractions from the lake for irrigation, as the great Nigerian irrigated schemes are not functional. In the whole basin, surface water abstractions for various uses are estimated at less than 3 km³/year (Water Charter, 2012). The effects on the Lake of the Nigerian dams in the Yobe River basin are little known; they are probably limited across the entire lake but could be significant in the estuary of the river. The precise relationship between the lake and the groundwater is still insufficiently understood; the studies commissioned by LCBC on this subject need to be completed. Also, the diagnostic related to erosion and sedimentation in the basin (CBLT, 2013a) should be refined.

As a first approximation, the input of the Chari⁷ into the Lake determines its surface. Rain falling on the Chari catchment is thus the primary factor of the lake size. It was found that, when the rainfall in the basin varies by 10%, the Chari's discharge varies by approximately 30%. As a result, Lake Chad is an amplifier of rainfall variations, hence its fragility.

Table 1: Components of the Water Balance in Medium Chad and Small Chad Stage (km³/year)

Inputs/Losses km³/year	Medium Lake Chad 1954-1969	Small Lake Chad 1988-2010
Inputs km³/year		
Chari	42.0	21.1
El Beid	1.5	0.3
Komadugu Yobe	0.7	0.5
Direct rainfall	7.4	1.0
Losses km³/year		
Evaporation	48.8	22.6
Net seepage	2.3	1.0
Overflow	0.2	0

Sources: Vuillaume, 1981; Bader *et al.*, 2011.

The lake evolution as of the early 1950s illustrates the four states of the lake, from an inland sea to a vast swamp, which determine available natural resources.

2.1.1 Large Lake Chad

In the early 1950s, a very wet period for the basin, the Lake formed a large open water surface of about 24,000 km², surrounded by an undeveloped dune archipelago.

The 'Large Lake Chad' stage occurred for only short periods during the 20th century, with the most recent occurrence in the early 1950s. The landscapes of Large Lake Chad are similar to those of Normal Chad, with larger open water surfaces.

⁷ Measured near N'Djamena.

Table 2: Characteristics of the Different States of Lake Chad

Lake Chad	<i>Dry Small</i>	<i>Small</i>	<i>Medium</i>	<i>Large</i>
Inflows from the Chari	< 15	15 – 34	35 -43.	>43
Water level (m asl)	dry northern basin	different levels	280 - 282	>282.3
Number of water bodies	several	several	one	one
Total surface of the Lake	2000 - 6000	6000 -14000.	15000 -19000.	20000 - 25000.
Flooded area of the northern basin (km ²)	0	0 – 8000	9000	10000
Dominating landscape	swamps and savannas	swamps	dune archipelago	open water
Aquatic vegetation	++	+++	++	+

Source: Expert Group Review, 2014.

2.1.2 Medium Lake Chad

After 1953 and until the early 1970s, a little less humid period, the ‘Medium Lake Chad’ presented throughout the year a single water body, measuring between 15,000 and 22,000 km² at an altitude of 280-282 m, with two large basins, north and south, separated by the Great Barrier consisting of sand and vegetation, which prevents the water exchange between the two basins when the water level is too low.

Medium Lake Chad is characterized by the surface of open waters, the navigable areas between the islands of the archipelago, and a limited fringe of vegetation along the banks. The depth of the central area is 5.3 m in the northern basin and 2.7 m in the southern basin. Uncovered areas due to seasonal recession are minor, thus considerably limiting crop and livestock activities on the banks. This stage of ‘Medium Lake Chad’ is observed when the contributions from the Chari amount to between 35 and 43 km³/year.

As a result of rainfall variations, Medium Lake Chad or Large Lake Chad stages were interrupted by low-level stages. Three stages of Small Lake Chad are recorded since the beginning of the 20th century, the first one (1904-1915) has been described in detail by Tilho (1928). The second, around 1940, is only documented by oral tradition. The last shift to ‘Small Lake Chad’ occurred in 1973, and as of that date the Lake operates according to the ‘Small Lake Chad’ regime.

2.1.3 Small Lake Chad

As of 1973, the lake as a whole is more a swamp than a lake in its conventional sense. It is made up of several water bodies separated for at least a part of the year by shoals, especially the Great Barrier main sill between the southern and northern basins. This stage of ‘Small Lake Chad’ is observed when contributions from the Chari are below 35 km³/year. Permanent or seasonal swamps cover thus between 2,000 and 14,000 km² of the overall lake surface. Depending on whether or not one counts these flooded marshlands, the estimated surface of the Lake is very different, resulting thus in some different interpretations and misunderstandings.⁸ In the southern basin, around 1,700 km² of open water is located in front of the Chari Delta, with a water surface altitude between 279 and 281 m. It is surrounded by huge swamps. The

⁸ Open water corresponds to the usual image of a lake. However, the flooded marshes are home to a rich biodiversity; these provide habitat for fish and capture places for fishermen. It is therefore proposed to consider the lake surface area as including both the open waters and the flooded swamps that surround them.

northern basin is separated from the southern basin by the more-or-less permanently exposed area of the Great Barrier, which controls the hydrology of this part of the Lake. Across the Lake, fishing, agriculture (on major open areas during the recession), and livestock activities (due to the importance of the swampy vegetation) are booming. Thus, in its 'Small Lake Chad' state, the production potential of the Lake is actually at its maximum.

The map of Lake Chad around 2010 specifies the key ecosystems that make up the Lake. An open water area is located before the Chari Delta and in some shallows in the west. These are the deepest regions of the southern basin (with some points of the archipelago), between 1 and 3 m depth, which do not dry up during the driest episodes. They contain pelagic fish and migratory species. Around these open waters, the vast swamp of the southern basin, usually flooded, is rich in rooted or floating aquatic vegetation (Typha, Echinochloa), with a fish stock dominated by tilapia and catfish that tolerate well deoxygenated waters. The villages are located on partially submerged dune summits, or on floating vegetation mats. In the northern basin, which experienced more frequent dry periods, another rooted vegetation, that does not survive long flooding periods, has emerged. In the central area, a honey mesquite forest grew before dying asphyxiated by the return of water. It is used for charcoal. Here again, the fish community consists mainly of tilapia and catfish, sometimes with open-water species brought in by floods from the Komadugu Yobe or the southern basin, when these are substantial enough.

2.1.4 Dry Small Lake Chad

A new state has been recently defined to refer to a Small Lake Chad where the northern basin is not supplied with water and stays dry throughout the year. This occurs when the annual input from the Chari is below 15 km³/year. During a period of 'Dry Small Lake Chad' fishing is impossible, and livestock as well as crop activities are very limited in the northern basin; even the supply of drinking water becomes difficult. It is especially during these periods, where the honey mesquite and other savanna plants can grow at the bottom of the northern basin. The populations leave this area to look for activities in the southern basin where there is water left. This has potential to increase the risk of tensions due to high population density in that area.

2.1.5 A fragile and variable Lake

The fragility of the Lake results from the threshold effects in inputs: around 15 km³/year and 35 km³/year for state transitions between 'Dry Small Lake Chad'/'Small Lake Chad' on the one hand and 'Small Lake Chad'/'Medium Lake Chad', on the other hand.

Flooded surface extremes observed occurred:

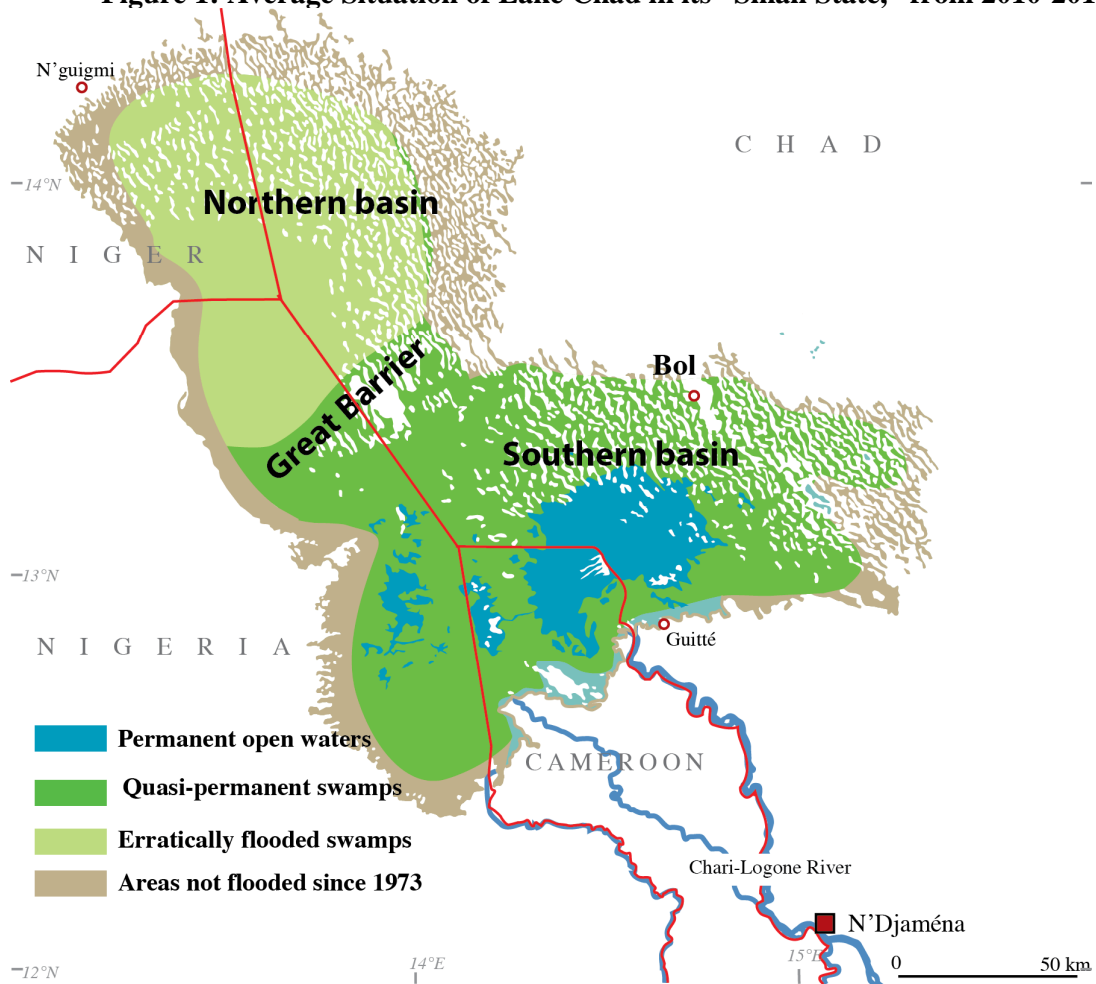
- in January 1985, after the dry year of 1984 recorded by the basin, the only area with water covering about 1,700 km² was that of open water before the Chari delta;
- In April-May 2013, 2014, and 2015 after relatively large river floods, the total flooded area was approximately 14,000 km².

As far as an average value is significant with such variations, the order of magnitude of the lake surface for the 2000-2015 period is approximately 8,000 km².

2.1.6 The current hydrological status (2000-2015)

At the beginning of the 21st century, Lake Chad is a ‘Small Lake Chad’ made up of four main sets: an open water area of nearly 1,700 km² in front of the Chari delta, swamps of the southern basin which are most of the time flooded, irregularly flooded swamps of the northern basin, and a perimeter of areas dried in the early 1970s during the transition between Medium and ‘Small Lake Chad’ (Figure 1).

Figure 1: Average Situation of Lake Chad in its “Small State,” from 2010-2015



The water surface of the Lake and its landscapes have been strongly modified during the transition between Medium and ‘Small Lake Chad’ in 1973, and particularly during the 1980s, where it was at the stage of ‘Dry Small Lake Chad’, before increasing again and stabilizing since 1994 in the state of ‘Small Lake Chad’.

Interestingly, ‘Small Lake Chad’ natural resources are more important and overall more productive than in the period of ‘Medium Lake Chad’, which has remained in memories as a time of affluence, largely due to a lower human pressure on less substantial resources and more abundant rainfalls in the region.

The current favorable situation around the Lake itself results on the one hand from **the increase in the amplitude of the seasonal variations compared to what was observed during the ‘Medium Lake Chad’** phase with a different internal water flow. Surfaces gained during the

annual recession of the Lake are more important, which is beneficial to flood-recession crops and probably fish growth (Kolding, van Zwieten, 2012). The extension of swamps provides huge vegetation biomass available for herds, and this is most useful during the dry season.

Challenges and opportunities. The current environmental conditions are optimal in terms of ecosystem services provided but present a real vulnerability to possible lake state changes (e.g. in terms of a possible transition to a 'Dry Small Lake Chad'). A better understanding of the functioning of ecosystems in the current context of a 'Small Lake Chad' would be helpful in that regard. It would also be important to better understand the hydrological functioning at the basin scale (new measurement system needed), sedimentation and invasive species in the rivers and the Lake as well as their impacts, changes in biodiversity, and possible options to secure water supply in the north basin.

2.1.7 Pollution risks

Finally, even though no large-scale pollution has yet affected Lake Chad, new risks have recently been identified. These are all the more important given that the Lake is vulnerable by its low depth and its position of receiving water from the whole basin. Risks relate to the increasing use of phytosanitary products in agriculture - whether on lake banks themselves or in the basin upstream. Others are associated with the important growth of basin cities: Kano, with 10 million inhabitants, is far from the lake (600 km) and connected to it by Komadugu Yobe that provides today limited water supplies. But N'Djamena (1.2 million inhabitants), experiencing very rapid growth, is located on the banks of River Chari and is relatively close (120 km).

Pollution risks are also related to the developments of the oil industry in the basin: exploitation of oil fields in the south (2003) then in the center (2011) of Chad; operation of a refinery in Djerma, near the River Chari, downstream N'Djamena (2011); oil exploitation in the east of Niger (Agadem block); the building of an exporting pipeline in the north of Lake Chad (starting in 2016); exploration in Lake Chad itself and in its immediate hinterland in Niger, Nigerian Bornu, in Chad, and in the Logone plains in Cameroon. These dynamics represent major risks for Lake Chad and need to be managed.

Artisanal mining activities in the upper parts of the Basin (RCA) also contribute to pollution risks in the Lake that should be better studied and managed.

Challenges and opportunities. Population growth and the dynamics of the regional economy have given rise to new risks of pollution for Lake Chad: agricultural, urban, industrial, and those related to hydrocarbons/the oil sector and other extractive industries. A regional management of these risks under the aegis of the LCBC could contribute to the necessary improvement of the governance of the basin's natural resources (as mentioned in the preceding paragraph).

2.2 People Faced with the Variability of Lake Chad

Lake Chad riparian communities are cosmopolitan people, which reflects the attractivity of its resources. They have developed original climate resilience modes characterized by strong mobility, multi-activity, and multipurpose land uses. Nevertheless, this system is fragile because it is threatened, beyond the current crisis, by tensions brought about by conflicts over resources in a context of increasing demographic growth.

2.2.1 Demographic polarization according to the Lake's states and its regional environment

Mobility is so far one of the main responses of Lake Chad basin populations to the variability of the regional environment and of the Lake. This must be analyzed from different angles.

Mobility of people between the Lake and the basin. On the one hand, there are links between the relative attractivity of the Lake within the basin and the overall climate situation in the sahel-sudan zone. During wet periods, as was the case in 1950-1960, the migratory pressure on the lake was relatively low. During drought periods in the Sahel, when rainfed farming and livestock raising activities – the two mainstay activities of the regional economy -- become threatened, Lake Chad resources become very attractive. At those times the Lake looks like a real oasis within the Sahel. This was notably the case during the 1970s and 1980s. These dry periods led then to important migrations of fishermen, farmers, and pastoralists coming from the hinterland and more remote areas, up to several hundreds of kilometers.

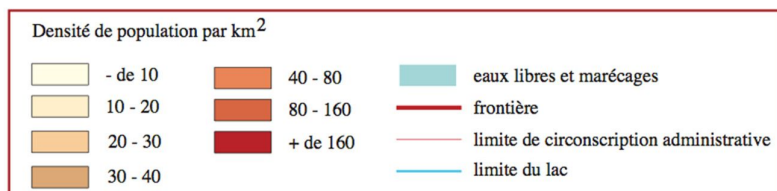
Fishermen are probably the most cosmopolitan population of Lake Chad: there are populations belonging to various West African nationalities (Mali, Ghana) as well as numerous people from remote regions in riparian countries (Hausa in Nigeria, Sara of Chad).

Farmers have settled in the Lake after being forced to move from their lands by difficult climate conditions and political crises, like the populations of Wadai, occupying Lake Chad south banks, who arrived in two waves, in the 1980s and then in the years 2000.

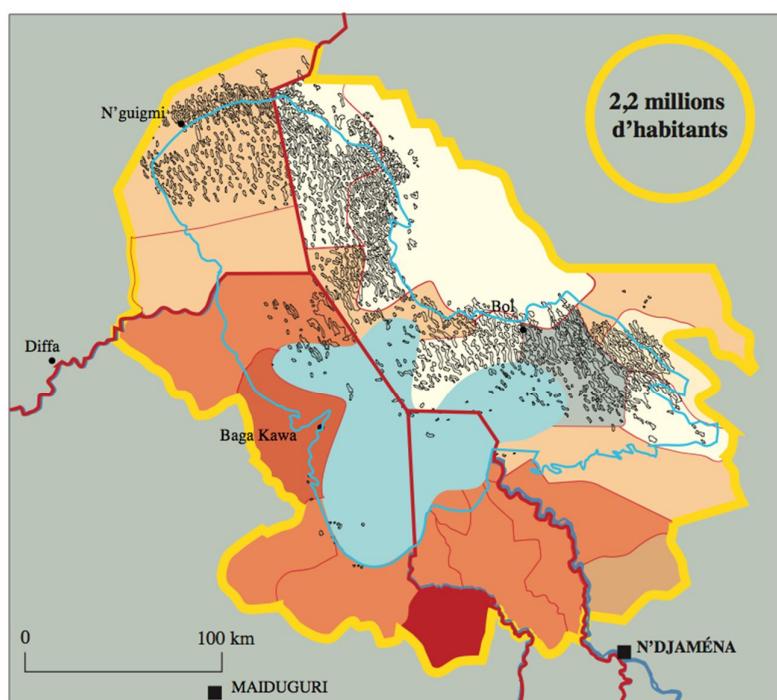
The exceptional pastoral resources of Lake Chad -- water and pastures -- make it also a key center of regional livestock farming (LCBC, 2013). Beside herds of native Boudouma or Kanuri agro-pastoralists, many groups of livestock breeders from the Sahara or Sahel (Toubou, Arabs, Peul) have settled the Lake in their rangelands. For them, the Lake has several functions: for some of them, it is a shelter in case of exceptional drought; for others, it has become the heart of a mobility system with a short radius associating insular and flood-recession pastures with the immediate hinterland; for others then it is a regular but seasonal stage (dry season) of longer distance mobility.

Internal mobility in Lake area. In Lake Chad, its banks and islands, migrations are also intense and shape relationships of communities with the environment. Shift periods in the lake state - notably the passage from Medium Lake Chad to Small Lake Chad during the 1970s - go with modifications in the organization of the habitat. New villages are settled near the new shores, while former ones remain, in a weak form when they can no longer provide a situation favorable to production and trade. Within the same lake configuration, like the one of Small Lake Chad, which has been prevailing since the 1970s, two forms of mobility may be identified. Each year, depending on the pace of flooding and flood-recession, fishermen move in search of fish, pastoralists seek pastures, and farmers look for flood-recession lands. These mobilities induce the building of temporary dwellings, but the families remain generally in fixed dwelling sites. During particularly low or high flooding years, these mobilities are heightened. These are more important in the northern basin because this is where variability of the natural resources is higher. Years of very high flooding are favorable to fishing - and to fishermen migrations (Boudouma, Hausa, others). Years without flooding - with the 'Dry Small Lake' configuration observed several times in the decades of the 1970s and 1980s - the populations of the northern basin are encouraged to go in search of livelihoods in the southern basin, where pressure on the resources then becomes high. Years of sustained flooding followed by strong flood-recession

Figure 3: Population Densities around Lake Chad



Densités de population autour du Lac en 2013



source : d'après recensements nationaux

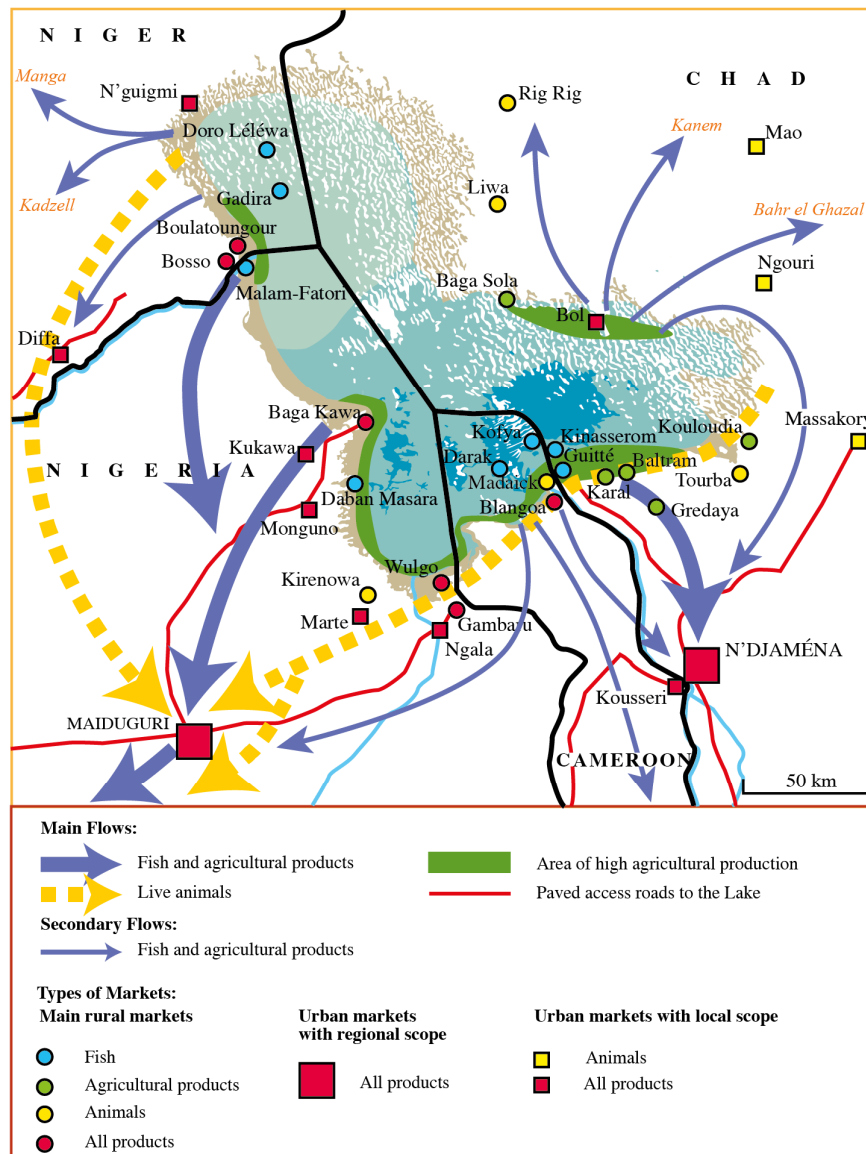
Source : Magrin, Lemoalle, Poutier, 2015. Atlas du lac Tchad.

Challenges and opportunities. Mobilities, directed from the hinterland to the Lake, or in the lakeside area, between the northern and the southern basin, etc., are linked to the attractiveness of the lake resources in their regional context. The challenges here are to both manage the cohabitation of groups in the context of a highly cosmopolitan population and manage the pressure on land and natural resources, which differs in different areas of the Lake according to population densities. The diversity of populations and their mobile practices represent opportunities as they combine complementary expertise likely to value the diversity and mobility of natural resources, and the existence of relatively sparsely populated areas still offers development potential. They may be used if socially acceptable conditions of access to resources are negotiated locally. Finally, since the mobility of resources and people is a key factor in the resilience of the system, the challenge for development projects is to take this into account.

2.2.2 A food-exporting and employment-providing hub

Until 2014, Lake Chad was a food-exporting hub within the Sahel (Figure 4). The fertility of its ecosystems and know-how of its populations made it an area producing large quantities of cereals, fish, vegetables, and meat.

Figure 4: Flows of Agricultural Products from Lake Chad

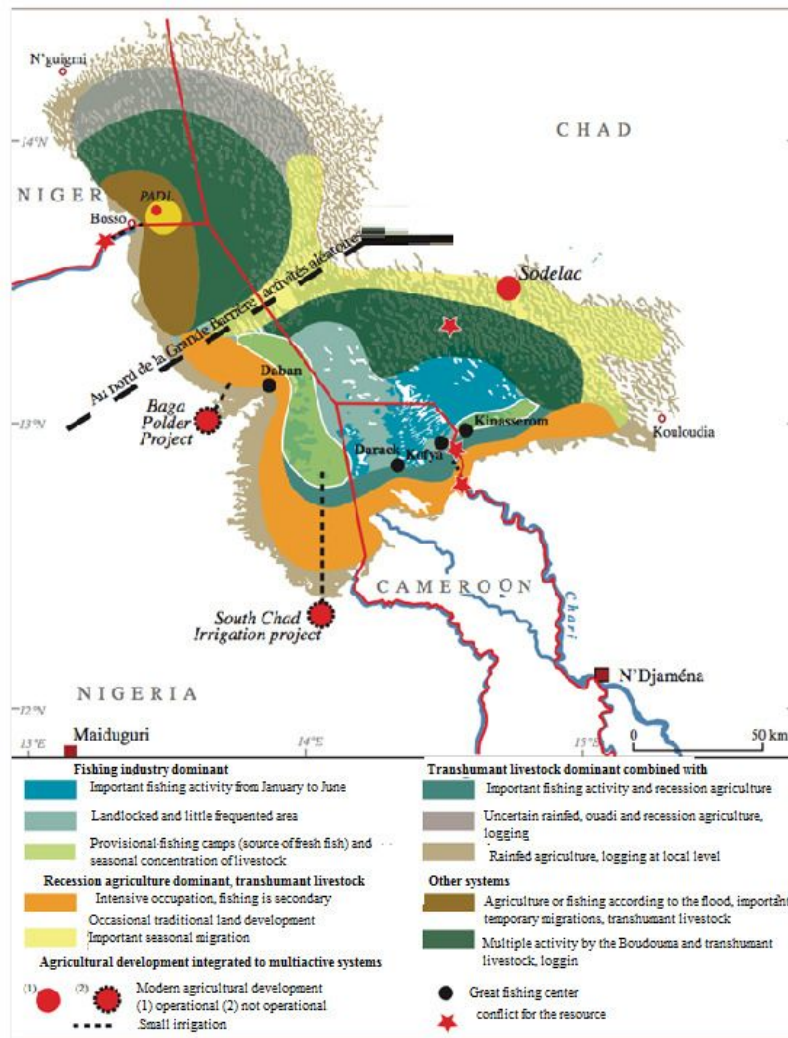


Source: Magrin, Lemoalle, Poutier, 2015. *Atlas du lac Tchad*

In 2010 it was estimated that Lake Chad annually produced 50,000 to 100,000 tons of fish (of which between half to two thirds were marketed), 600,000 to 900,000 tons of corn (270,000 to 540,000 tons marketed), plus various other farming products (cowpea on south banks, pepper in Komadugu Yobe, diverse vegetables on south and south-east banks), most of them being marketed. The huge number of herds in the lake or transiting there must also be taken into account. In 2014 it was estimated that 250,000 cattle had been marketed from Chad towards Maiduguri, and an important share of them moved through Lake Chad (World Bank, 2015). These agricultural products are often marketed in regional metropolitan centers: Maiduguri, a redistribution hub towards other centers of Nigeria as well as N'Djamena. The products are also sold in the Sahelian hinterlands of Lake Chad, which experience structural cereal shortages (Kanem in Chad, Serbewel in Cameroon, Manga and Kadzell in Niger, Borno in Nigeria).

The farming dynamism of Lake Chad is mainly based on complex systems, largely designed in an autonomous way by populations, remarkably adapted to the variability of the environment, and characterized by the articulation of 3 “M”: mobility, multi-activity, and multi-purpose nature. People's mobility follows resource mobility. Multi-activity means that an important proportion of the lake population are active in two or three of the main lake activities (fishing, farming, livestock, trade, and crafts) in proportions varying according to cultural traditions and environmental conditions. Multi-purpose nature refers to the use of the same regions by three activities (fishing, farming, livestock), which succeed each other depending on the pace of flooding and flood-recession (Figure 5).

Figure 5: Multipurpose Nature of the Lake Chad Region



Source: Magrin, Lemoalle, Pourtier, 2015. *Atlas du lac Tchad*

These systems, implemented by family farms, have managed to make a great deal of innovations: adoption of new plants and varieties; use of phytosanitary products;¹¹ varied developments of the environment to control flooding (building of small dikes, channels, and dams on the farm or village to protect oneself against flooding, or maintain or draw water during dry seasons). These systems are more sophisticated on the southern banks of the south basin, which is the most populated area. But they could equally be developed on all banks.

These systems tend to be labor-intensive and therefore use a large labor force. Although being successful in fishing requires a significant capital (financial, technical, relational), everyone can practice such an activity. Likewise, flood-recession farming is labor-intensive. Farming activities, including weeding, seeding, harvesting before flooding, etc., require daily laborers; this provides work for farmers having little land or migrants from the lake hinterland who can earn much needed income. However, the lack of a credit system constrains holders of land rights to mobilize the necessary labor force when needed. Likewise, this hampers the making of various types of improvements.

Numerous other activities that provide jobs are also derived from farming activities in the lake (processing, trade, crafts, and transport). However, the insufficiency of infrastructure allowing the conservation and processing of farming products, as well as the very variable accessibility conditions - overall poor conditions in the east of the archipelago (region of Bol in Chad) and the whole northern basin – prevent farmers and traders to fully achieve the existing potential. There are post-harvest losses, and the production of remunerating but fragile products is not encouraged. Likewise, the lack or weakness of support services to agriculture (extension, credit, and support to producer organizations) is detrimental to production systems: dangerous phytosanitary products are used without prior training or information, thereby endangering farmers and consumers. The lack of credit to finance the labor force or small investments slows down the scaling-up. Due to their weakness, producers' organizations are dominated by traders and other actors of the marketing branches such as State authorities.

Thus, while the active population in the region is increasing at a rapid pace, the possibility for the farming sector of Lake Chad to support job creation in farming and downstream product valuation activities needs assistance.

Challenges and opportunities. The Lake Chad system can produce even more food and employment as it does now and contribute to both regional food security and improving the living conditions of lake populations: production (agriculture, fisheries, and livestock) can be further intensified in many areas and new land can be developed. This requires support services to family farming, small investments to help adapt to environmental variability, and strengthening producer organizations. It also means enhancing production through an improved post-harvest value chain (storage, processing, trading). One should also secure mobility, multi-activity, and multi-functionality that characterize farming in the Lake and are the basis for its dynamism and resilience to hydrological and climatic variations.

2.2.3 Tensions around access to resources

The adaptation system of the Lake Chad riparian communities is vulnerable. On the one hand, it is exposed to potential high variations of the lake water balance - namely, the establishment of a 'Dry Small Lake Chad' configuration or a return to a 'Medium Lake Chad' would challenge

¹¹ Which would benefit from better support: the use by farmers of herbicides affects cattle ranchers and probably the health of the farmers themselves.

the distribution of people and land use geography (see lake evolution scenarios below). On the other hand, it is subject to risks related to pressure on resources. The most recent studies carried out on the Lake's southern banks in Cameroon and Chad¹² consider that, up to now, land use has not yet reached an overexploitation level of the environment, and there is still room for improving productivity, including in the more densely populated and more intensive systems. It should also be noted that annual flooding allows maintaining very fertile soils which do not seem to require any input. Fishing adapts itself rapidly to water and fish variations, often without major consideration for national regulations. It remains very productive, especially in the northern basin, despite the overexploitation which seems to have existed for several years now (with a drop in 2015 resulting from the prohibition of fishing in Niger as well as from the security situation).

There are constraints in labor force mobilization when works reach a peak, in land access, and notably in the maintenance of acceptable conditions for livestock movement. Thus, access to natural resources in Lake Chad is a challenge with a growing sensitivity. In formerly populated regions (e.g. Boudouma archipelagos, Kanembou polders), opposition between natives and non-natives create tensions. Elsewhere, notably in southern banks, a cosmopolitan settling of people took place in the 1970s to 1980s under the control of chiefdoms historically settled on the shores of the Lake (Kanouri, Arabs). The latter have initially guaranteed land rights tailored to exploitation methods of the environment through different activities, including livestock farming. Progressively, thanks to the demographic densification and establishment (unequal according to countries) of decentralization processes, access to land became a competition as part of local political games. Sometimes, rich urban dwellers, traders, or civil servants, grab large tracts of land in the southern banks of the Lake. These processes hamper the mobility and multipurpose principles of the region as well as the exclusion of the poorest from rights to resources.

The Boko Haram organization has urban roots without any link with Lake Chad, but it is possible that, in the Lake Chad region, it may have benefited from the resource access problem. Thus, the enrolment of many young Boudouma people in Boko Haram groups¹³ may be a response to migratory pressure and limitations or losses of land rights.

Challenges and opportunities. The management of human pressure on natural resources is a major challenge if one wishes to increase the contribution of Lake Chad to regional development. The challenge here is less technical (the problem is not the whole resource depletion) than political at the local level: it is important to create the conditions to intensify and expand systems exploitation of the environment based on the "three Ms" (mobility, multi-activity farms, multi-functionality of space) that better value the specific and changing environment. This requires local action to prevent the exclusion of people (young, poor, women) or groups (e.g. indigenous or non-indigenous), but also to avoid exclusion of activities (e.g. livestock raising). The definition of inclusive mechanisms of access to resources is an important factor in the resilience of the system.

¹² Doctoral theses in agronomy of Charline Rangé and in geography of Audrey Mbagogo Koumbraït to be defended in early 2016 at AgroParisTech and university of Paris 1 Pantheon-Sorbonne.

¹³ Presentation of C. Seignobos during a seminar dedicated to Lake Chad at AFD, June 2015.

2.3 A Region Neglected in National Development Strategies

2.3.1 Lake Chad included intermittently in State strategies

Lake Chad held, in the past, a fluctuating place in the riparian states' development strategies. Some of them have tried to promote it, during the decades 1960-1970, with ambitious irrigation projects. This was the case of Nigeria (SCIP and Baga Polder Project) and Chad (Sodélac polders). The following difficulties encountered as well as economic, ecological or political crises led to a disruption (Nigeria) or resizing (Chad) of investments. Overall, in the four countries, Lake Chad is at the national periphery.

A contrast is noticed between the dynamism of the lake economy and the limited state investments in favor of populations living there. Controls and levies on trade are carried out by most of the civil servants operating in the lake area (customs officers, Water and Forestry agents), often without benefits for the States. The levels of infrastructure and access to services (water, health, education) are among the lowest at national level (Lemoalle and Magrin, 2014; Magrin *et al.*, 2015), in countries with indicators that are already among the lowest in the world (see Table 3 on education).

Table 3: Rates of Education of the Regions near Lake Chad

Region / State	Local rate of gross primary enrolment	National average	Country
Bornou	21	82	Nigeria
Diffa	57	63	Niger
Extrême-Nord	52	82	Cameroon
Lac	40	91	Chad
Kanem	69	91	Chad
Hadjer Lamis	46	91	Chad

Source: Atlas of Lake Chad.

Aside from a paved road in Chad (N'Djamena to Karal), access to Lake Chad from the exterior is at best poor (see Figure 6). In Nigeria, access roads, old and not regularly maintained, are in a poor state. The conditions of internal travel are difficult because of invasive water vegetation on the water body, which obstructs navigable channels, and the lack of maintenance of rural roads. The northern basin and the north-east archipelago are landlocked, and this slows down the diversification and intensification of the farming economy.

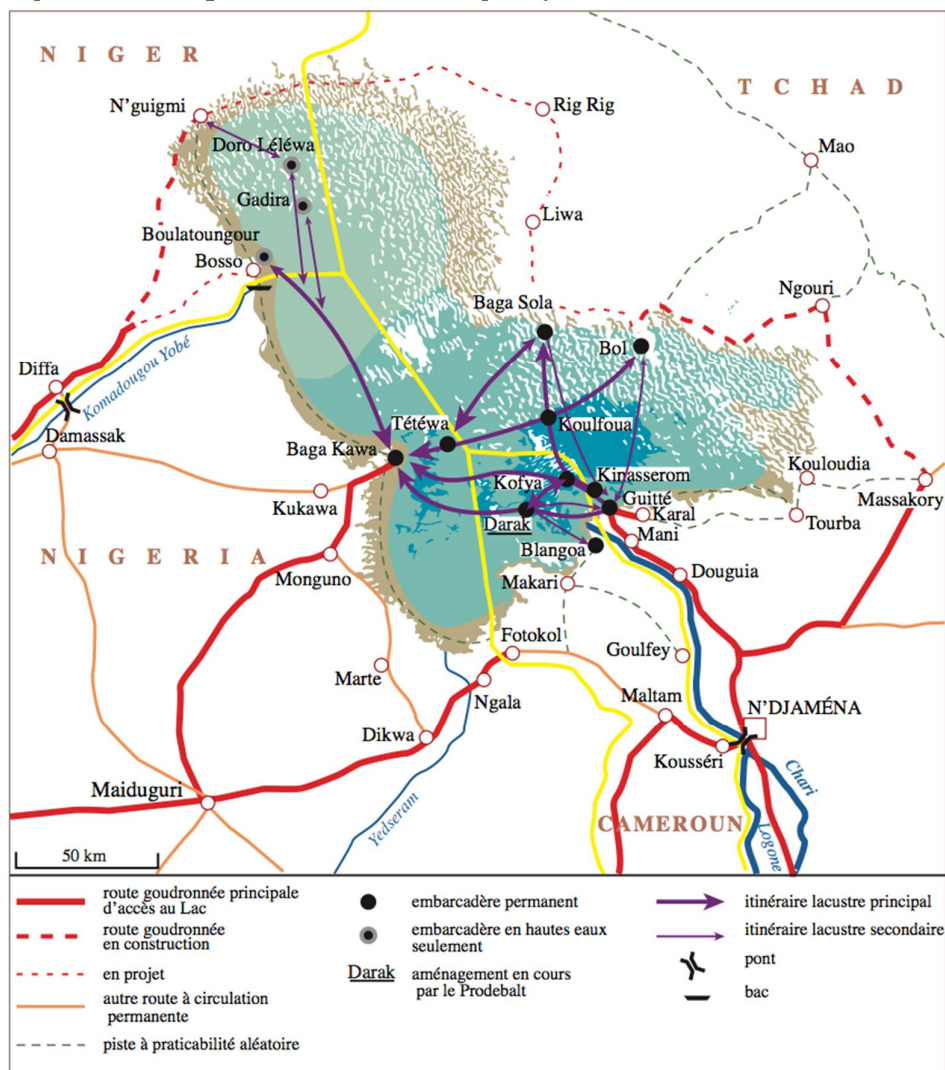
At the end of the years 2000, one saw a return of public investments in Lake Chad in the four riparian States. But these investments were limited, often irrelevant to the specificity of the lake environment (health, education), and finally compromised by insecurity.

Challenges and opportunities. To better enhance the natural and human potential of Lake Chad and enable it to play its role in terms of food security, employment, and regional and socio-economic stabilization, substantial public investments must be made. Better access to basic services, including rural roads, will improve the living conditions of the population. Improving accessibility, external and internal, is a strategic dimension: it is a key factor in the development of sparsely populated areas.

2.3.2 Insecurity in and around Lake Chad

Rural banditry and insecurity have a long history in the Lake Chad basin (Saïbou Issa, 2010), but never since the early 20th century has Lake Chad been affected by violence with such intensity as the one prevailing since 2014 and associated with the Boko Haram movement. Born in Maiduguri, this movement has been at the origin of growing violence starting from 2009 (bombings in city, attacks in villages), progressively disseminated in the State of Bornu and the neighboring States of Nigeria. The Lake was struck by fierce violence at the end of 2014 and early 2015, the most striking episode being the destruction of the borough of Baga Kawa, one of the main lakeside economic centers of Bornu. Numerous people of Nigeria sought refuge in Chadian and Nigerian islands. Members of Boko Haram hid themselves also in the lake islands, using a former refuge function observed several times in history - the last one dating from the 1990s. They carried out attacks on Chadian and Nigerian islands, forcing populations to flee towards safer places located on shores. The interruption of fishing and livestock businesses in the lake areas, suspected of financing directly or indirectly (through racket of traders) Boko Haram, has strongly slowed down and reoriented trade flows.

Figure 6: Transport Network showing very Limited Access



Source: Magrin, Lemoalle, Pourtier, 2015. *Atlas du lac Tchad*.

Even if one expects a decrease of insecurity compared with the crisis of 2014-2015, in the coming months, it is highly likely that some forms of insecurity will remain. The scale of population growth and the influx of young people into the labor market create additional social and political vulnerabilities. Enhancing the development of the Lake is a way to respond to this problem, along with the essential political and military actions.

Challenges and opportunities. Insecurity in Lake Chad articulates structural issues included over the long term along with a high intensity crisis one hopes will be cyclical. Investing in long-term development is a means of reducing insecurity. Development should be considered in a global perspective: the effort involves strengthening and improving the presence of the States in the service of the people, support local consultation processes to prevent tensions (land and social), and manage conflicts.

2.4 The LCBC and the Governance of the Basin's Natural Resources

LCBC was created on May 22, 1964 by the Fort-Lamy (today named N'Djamena) convention to manage the shared natural resources and promote regional cooperation for development. Since the end of the years 2000, LCBC has started a consolidation process by reorganizing itself, defining a vision (Vision 2025), developing a strategy (Strategic action plan), adopting common water management principles (Water Charter¹⁴), and by working to consolidate its environment information management through different projects.

Today, LCBC's mandate is the sustainable and equitable management of Lake Chad and other shared water resources of the basin, the preservation of the ecosystems of the Lake Chad conventional basin, the promotion of integration and preservation of transboundary peace, and security in the Lake Chad basin.

Despite efforts to strengthen LCBC over the years, it has not been able to fulfill its mandate completely (GIZ 2015b). In particular, it still fails to fulfill the functions related to the promotion of an equitable and integrated management of water and related natural resources in its basin. The Water Charter has not been ratified yet by the Parliaments of three of its member States and is therefore not operational. LCBC still struggles with its function of centralization, processing, and dissemination of information on natural resources in the basin.

Furthermore, civil society, specialized in development issues related to water resources and associated natural resources, has experienced a weak organization across the Lake Chad Basin. It is particularly weak in the area of Lake Chad itself.

Challenges and Opportunities. Improving water resources governance and natural resources of the basin related to safeguarding the productive potential of Lake Chad assumes that LCBC is able to set the parameters for water resources sharing between member States in the basin and have them respected in the spirit of the Water Charter. It must also develop its capacity for mobilization, analysis, and dissemination of environmental information to foster

¹⁴ The Charter defines notably water sharing rules between States, upstream and downstream, sub-basins, usages and users, so as to reconcile economic development and environmental preservation. It provides also for management rules of wetlands and deep waters, reviewing rules of new projects having impacts on water resources; the distribution of roles between national and regional authorities in terms of planning, monitoring and water police; a harmonization of information collection and dissemination tools; and the support to civil society participation and organization around environmental issues. Its implementation builds on the design of a hydrological model of the Chari basin and the Lake Chad system.

decision making, control, and participation in public policy. The current context of international interest for Lake Chad, combining response to climate change issues and regional security, requires and supports the implementation of the expected reforms. It involves increased mobilization of States to support the efforts of the LCBC.

2.5 Scenarios in Context of Climate Change, Demographic Growth, and Economic Development

2.5.1 Uncertainty about the nature of climate change in Lake Chad region

Climate change is often mentioned to explain the current state of Lake Chad and its possible disappearance. However, the existing models concerning a possible shift of the rainfall regime do not allow assessing climate evolution in West Africa or in the Lake Chad basin for 2050 and much less for 2100. This region in Africa is indeed one of the regions of the world where uncertainties about the evolution of rainfall regime are the strongest¹⁵.

It is important to note that alternatives dry and humid periods were observed at the end of the 19th and at the beginning of the 20th centuries, with episodes of Large and Small Lake Chads.

It is almost sure that the average temperature will be higher in 2099, by nearly 2 to 3 degrees, with a higher evapotranspiration and complex consequences on the ecology and agriculture as well as the water balance of the Lake and its basin. The calculations of GIZ (2015) give for a 'Small Lake Chad' an increase of the lake evaporation of 0.3 to 0.6 km³/year according to the development scenario considered (B1, increase of the average global temperature by 2 °C or A2 increase by 4 °C at the end of the century). What remains to be evaluated is the additional water quantity which will be lost per evapotranspiration over the whole basin because of the rise in temperature while assuming equal rainfalls. What is the proportion by which the flow of Chari will be reduced due to the rise of temperature? -- This might have a major effect on the lake state.

The projected temperature rise is expected to lead to a progressive shift towards plant varieties better adapted to a modified vegetative season. All else being equal, models lead to a negative effect of temperature on productivity in the Lake area. Farming practices, economic, social and political conditions will also play key roles in farming productivity.

But then, if one-off extreme rain events may be more frequent (droughts or floods), no trend on the average can be identified. The lake development policies must address this major uncertainty in the medium term, without forgetting the current strong inter-annual variability.

Considering the progress already made and ongoing research, it is hoped that climate models will be improved in the coming years. An improvement of the hydrological model of the basin and Lake will also be necessary to address the temperature rise and resulting evapotranspiration. It will allow fine-tuning the development options including the reflections on a possible water transfer from the Congo basin.

2.5.2 Scenarios: possible evolution of the Lake and its consequences

The scenarios on the impacts of climate change on Lake Chad must then take into account the fact that one does not know presently the future evolution of precipitation and water balance in

¹⁵ According to IPCC; Lemoalle and Magrin, 2014; GIZ, 2015.

the Lake Chad basin. They must incorporate also other variables, the most important one being water use in relation with demographic growth and economic development. Rainfall in the Lake Chad basin could be higher than the current values (close to those of the years 1950-1960 for instance, resulting in a contribution of Chari of 35-40 km³); they could be identical (1991-2014: 18-20 km³ of annual contributions by Chari to the lake); they could be lower (like in years of drought of the decades 1970-1980: Chari annual flow of 12 km³).

Demographic progress is a relatively less uncertain variable, at least at the basin level: projections suggest 66 million in 2025 and 129 million in 2050 (2.7 times more than the 47 million in 2013). This strong demographic growth may nevertheless have different consequences on water supplies to the Lake following the agreed development models: water consumption could increase slightly or strongly for the needs of irrigated agriculture, cities, or regional industries. Currently estimated at less than 3 km³ per year (all uses combined; Lemoalle and Magrin, 2014), water consumption might reach 7.5 km³ in 2050 (low assumption with water saving uses), or 15 km³, with a doubling of consumption per inhabitant¹⁶.

The water transfer project as proposed by CIMA (2011) would provide 6.7 km³.

It is to be noted that the passage to a 'Dry Small Lake Chad', very unfavorable to lake populations, is based on an input from river Chari of less than 15 km³ per year; and conversely the passage to a 'Medium Lake Chad' would occur with an inflow from River Chari of more than 35 km³ per year, the current situation (1991-2014) being between 18 to 20 km³.

The combination of these variables leads to the following lake evolution scenarios (LES; see Table 4)¹⁷ :

- LES1: increase in water inputs to the Lake bringing about the passage to 'Medium Lake Chad' (34 km³, corresponding to a rainfall regime of decades 1950-1960). This scenario would bring about, in the short term, a decrease of ecosystem services with a reduction of areas benefiting from flood-recession. However, there would be some compensation as this scenario would permit developing irrigation in presently unused schemes (e.g. SCIP and Baga Polder).
- LES2: water inputs similar to those of today (1991-2015: 18-20 km³), which would maintain the status of 'Small Lake Chad' under the effect for example of a moderate increase of abstractions compensated by a slight increase of precipitations on the basin. This corresponds to a lake of 8,000 km², optimal in terms of ecosystem services but vulnerable because it may shift to a 'Dry Small Lake Chad' regime in case of succession of dry years;
- LES3: water inputs similar to those of the 1980s (less than 15 km³), resulting from a drop in precipitation and/or a high increase of human consumption upstream¹⁸ which would bring about the passage to a 'Dry Small Lake Chad'. A frequent occurrence of 'Dry Small Lake Chad' would then be observed, leading to the abandonment of the

¹⁶ The basin population would be multiplied by 2.7 (from 47 million (2013) to 129 million inhabitants in 2050). By considering a doubling of water consumption per inhabitant, this would go from 3 km³ to 15 km³ per year.

¹⁷ Scenarios concerning the lake level are considered here to assess their consequences on riparian populations. These scenarios reflect the combination of climatic and anthropogenic factors.

¹⁸ The abstractions linked to irrigation are estimated presently at nearly 2 km³. A doubling of the population and a doubling of irrigation water consumption per inhabitant would represent an abstraction of 8 km³ per year.

northern basin and an increased pressure on the natural resources and lands of the lake southern basin as well as in the south of the conventional basin; and

- LES4: very low water inputs (less than 10 km³), reflecting a strong drought in the whole basin (and/or huge abstractions upstream).

Scenario LES2 is the most favorable for the Lake.

Scenario LES3 is the pessimistic scenario with the greatest probability. It would mainly affect the northern basin, where nearly 500,000 inhabitants lived in 2014, distributed between Chad (approximately 120,000), Nigeria (approximately 200,000), and Niger (180,000) (Lemoalle and Magrin, 2014). However, the northern basin is the region of the Lake area where mobility is the most important and with the least known population. In years of favorable flooding, it attracts a significantly more numerous population originating from the region of Diffa (Niger) or the Nigerian hinterland, namely the lower Komadugu Yobe. These populations value successively the different available resources (fish and flood-recession lands). A sustainable return to the ‘Dry Small Lake Chad’ regime would bring about the disappearance of fishing and farming resources; only residual pastoral livestock raising could be maintained, at a lower level than what is observed in non-dry ‘Small Lake Chad’. This would bring about an increase of demographic and migratory pressure in the southern basin of the Lake, where it would heighten land tensions - or even migrations in longer distances towards cities.

Table 4: Lake Chad Evolution Scenarios

Lake evolution scenario (LES)	Annual abstractions	Factor	Consequences
LES 1	+ de 34 km ³	++ Rainfalls + Abstractions	- Ecosystem services + Irrigation
LES 2	15-34 km ³	+ Rainfalls + Abstractions	Optimal for ecosystem services
LES 3	10-15 km ³	= or – Rainfalls ++ Abstractions	- - Ecosystem services basin N Migrations v basin S
LES 4	- 10 km ³	- - Rainfalls ++ Abstractions	- - - Ecosystem services basin N - Ecosystem services basin S

Source: Lemoalle and Magrin, 2014.

This reasoning shall be reevaluated when climate change models have improved (assumed to be the case within next 5 years).

Whatever the case, insofar as a significant increase of abstractions for irrigation is a probable trend in the years to come in relation with demographic growth, it is critical to build the capacity of LCBC to help manage this tension and enforce negotiated and equitable allocation rules between States, upstream (basin), and downstream (Lake).

Chapter 3: Vision and Its Implementation

3.1 Vision: A Lake with even higher Potential

This Lake Chad Development and Climate Resilience Action Plan is based on the vision according to which, to meet the challenges of climate uncertainty and demographic growth, there is a need to support the existing capacities of the communities to adapt to and value this original Lake Chad environment characterized by a strong variability of the hydrology and a high mobility of resources and populations.

The objective is to make Lake Chad a rural hub for regional development in terms of production and employment by sustainably improving the living conditions on its banks and islands and by enhancing the system's resilience. Reaching this objective implies meeting the following challenges:

- keep improving the situation in terms of security;
- securing production systems and building the capacity of the Lake Chad system to produce food and employment (agriculture, fishing, livestock, services) without degrading the natural capital on which they are based;
- improving the delivery of basic services to populations;
- better managing the consequences on the Lake and its ecosystems of variability and climate uncertainty;
- planning and managing water abstractions in the basin; and
- protecting the Lake against pollution risks (agricultural, urban, oil sector).

This Action Plan addresses both the specificity of the Lake Chad socio-ecosystem and the more generic issues of its regional environment to which it would contribute.

Like in most parts of Africa, governments of the Lake Chad basin must meet two priority challenges: food production and employment. The magnitude of demographic growth requires an increased food production; the massive arrival of newcomers in the employment market due to the demographic transition (Losch *et al.*, 2013) requires the creation of jobs; otherwise social and political balances will be threatened. Poverty and under-employment are likely related to the Boko Haram crisis. Therefore, it is proposed that actions in this Plan give priority to labor-intensive activities (agriculture, infrastructure, services). Lake Chad may help meet food and employment needs at a regional level. However, while it is expected that it would make significant contributions, it cannot single-handedly be the solution to problems covering the whole basin.

Reflection about climate resilience of Lake Chad must address the situation of climate and hydrological uncertainty. In this context, adaptation to environmental variability must be a priority compared to the temptation of control of the environment through heavy investments, which turned out in the past to be unable to adapt to unexpected fluctuations of the environment. This suggests to giving priority for the moment to generally smaller investments with localized impacts, which would generate jobs and improve management of the environment at local levels. Making the Lake Chad socio-ecological system more resilient implies, besides maintaining the spatial multi-functionality of the region and multi-activity of exploitations, improving governance mechanisms determining the management and access to natural resources in order to avoid exclusion processes, socio-political tensions, as well as overexploitation.

These governance issues require enhanced efforts in the basin for water resources management (and related natural resources) by the countries together with the LCBC. This requires

strengthening the LCBC in its coordination, monitoring, and facilitation function for improved water and natural resources management, together with the lake riparian countries.

Improved monitoring will be needed for the components of this socio-ecosystem, including biodiversity, and the production of additional knowledge on key subjects, including on how to increase climate resilience.

3.2 Scope of the Action Plan and Project Eligibility Criteria

This Plan aims at developing and strengthening the resilience of Lake Chad. Achieving this objective requires public investment in and near Lake Chad, in its wider hinterland, and in the whole basin (see Table 5). For projects and activities corresponding to generic investments (basic services, agriculture, livestock), precincts were included in the lake area (i.e. within a radius of about 30-50 km from its shores), whose populations largely depend on the lake's resources in terms of farmland, pastures, and fishing. This includes five Nigerian local governments bordering the lake (Abadam, Kukawa, Marte, Mongulo, Ngala); in Chad this includes the two cantons of Mani and Assale (south shore) and all of the two departments and Mamdi Wayi that form the Lac; in Cameroon: the boroughs of Darak, Hile Alifa, Blangoa, Fotokol, Makari, Goulfey; in Niger the N'guigmi communes, Bosso, Gueskéro, Toumour, and Kabléwa were included.

Table 5: The seven Priority Themes and the Areas of Eligibility

Priority Themes	Areas of Eligibility
1. Support to producers and their value chains	Lake
2. Securing access to resources and prevent/resolve conflicts	Lake
3. Improving basic services	Lake
4. Transport and trade	Lake and hinterland
5. Preservation of environmental capital	Lake and basin
6. Water management (abstractions and pollution)	Basin
7. Information, knowledge generation, participation	Basin

The projects concerning the improvement of transport (construction and maintenance of roads and waterways) and trade (harmonization of rules, cross-border practices) concern the lake and its hinterland, which corresponds to a circle with a radius of about 300 km around the Lake, and where a large share of trade flows from the lake take place. It encompasses large riparian administrative regions (Diffa region of Niger, Borno state in Nigeria, Cameroon's Extreme North region, and the Lake regions of Hadjer Lamis, Chari, and Baguirmi N'Djamena in Chad).

A third set of projects will be carried out at the larger scale of the conventional basin (47 million inhabitants). This scale concerns actions for water resource management, pollution prevention (agricultural, urban, industrial, and from extractive industries), anti-erosion and riverine shoreline protection, and collection, monitoring and analysis of information and knowledge on the environment. The actions to be implemented in RCA and Libya correspond to this third

category. It is to be noted that all proposed projects must aim for complementarity with all existing projects.

3.3 Implementation of Action Plan

3.3.1 A classic approach in line with the subsidiarity principle

The implementation of the different projects under the Plan will be entrusted to different types of actors and according to the subsidiarity principle:

- LCBC will focus on coordination, facilitation, monitoring, and evaluation of the Action Plan, especially of projects having a regional or transboundary scope. It will undertake some actions, such as the development and application of resource management instruments as defined in the Water Charter and relating also to knowledge production or information management in consultation with the member States;
- Ministries of the different riparian States will implement projects falling within their areas of responsibility; and
- local powers (local government or customary authorities) and civil society organizations will also be involved in the implementation of some actions, especially related to local development, land development, and territory management, in coordination with the respective national authorities and social and political participation of the population.

A unit within LCBC would be in charge of the coordination and monitoring of the Plan in partnership with the member countries. It would also lead the implementation of the parts of the Plan for which LCBC or its units would be responsible.

Besides the regional actions that will be implemented by LCBC, most interventions will be executed by the usual sectorial or inter-sectorial agencies within each member State.

3.3.2 A special context

Beyond these principles, the specific context in which the Plan is proposed offers exceptional opportunities, while raising unique challenges.

Interest in climate change issues at Lake Chad, as evidenced in the context of the COP 21, is reinforced by the Boko Haram crisis in a troubled regional geopolitical area. Developing the Lake Chad area responds to the need for regional stabilization in the medium and long term. In addition, the recent publication of the collective expertise LCBC/IRD provides decision makers and donors a more complete and accurate view of the situation of the Lake and the opportunities it offers, which can facilitate the mobilization of substantial funding.

3.3.3 Time scales

Executing the Plan requires addressing the different time scales of objectives (short-term, medium-term, long-term). Some actions may be executed immediately, while others require a prior improvement of security conditions.

The execution of the Action Plan would start with the most secured shores, while support to local development initiatives will then be extended towards other shores and islands of the inner

lake as security is restored. More costly and risky investments possibly being subject to destruction (cold rooms, cereal storage facilities) would also be built later when security conditions allow it.

Example of short-term objectives:

- Providing assistance to displaced persons;
- Restoring trade conditions (people, livestock, goods) through the enhancement of inter-state dialogue as the situation becomes stabilized;
- Implementing local development actions where socio-political bodies allow it (presence of local authorities), based on local planning exercises;
- Rehabilitating damaged roads;
- Improving access to potable water supply and sanitation, and
- Making small investments in support to agriculture (small dikes, small dams, wells).

Examples of medium-term objectives:

- Supporting the producer organizations of various value chains;
- Promoting new local governance mechanisms of water and other resources;
- Implementing the Water Charter, including operationalizing the integrated water resources management in the basin so as, among others, to "control" abstractions and possible pollution sources; and
- Strengthening institutions in charge of the governance of basin resources and participation, and engaging in a dialog on water allocation rules (between States, upstream and downstream, and different uses).

Examples of long-term objectives:

- Studying and implementing groundwater mobilization for drinking water supply and irrigation so as to increase the resilience of communities to climate and hydrological variability; and
- Reevaluating, following an improvement of climate change models in the basin in Chad, the water supply strategy (strategic environmental assessment? feasibility study of a transfer?).

Chapter 4: Justification of Proposed Priority Areas for Investments

The Action Plan is organized according to seven priority themes as follows:

1. Supporting producers and their value chains;
2. Securing access to natural resources and preventing/resolving conflicts;
3. Improving living conditions through public investments;
4. Facilitating transport and trade;
5. Preserving the environmental capital of the Lake;
6. Better managing the water resources of the basin; and
7. Disseminating information, improving knowledge, and monitoring the environment.

4.1 Supporting Producers and Their Value Chains

Securing production systems¹⁹ (based on three main activities: agriculture, fishing, and livestock raising) requires deploying classical support services to agriculture (extension, credit, animal health, and producer organizations).

In agriculture, training in, and supervision of, pesticide and herbicide use is important - both for producers' health and to avoid pollution. The purpose is to allow a better availability of quality inputs and wise uses. Credit is also a crucial so as to meet equipment needs (motor pumps and other small-scale equipment) as well as labor force mobilization during periods of peak labor needs.

For livestock farming, efforts shall be focused on animal health and breeding (in addition to harmonization measures on rules and transboundary trade practices dealt with in item 4.4.). Indeed, the lake ecosystem may cause numerous livestock diseases. Besides, it is characterized by high pastoral mobility, notably transboundary mobility. The second focus area will be to support livestock farming systems' diversification - including the dissemination of innovations for more intensive practices on one part of herds (zoo-technology, fodder production) and the maintenance of mobility.

In fishery, proposed actions will include dissemination of good practices (fishing practices, fish stock conservation) and strengthening fishermen organizations.

Investments in storage and processing must allow improving the added value of farming and fishing production and limit post-harvest and post-capture losses. Thus, for fishing, improved kilns and solar dryers²⁰ shall be fitted out in the most landlocked regions where they are currently lacking (islands, north banks). Cold rooms allowing increasing the share of marketed fresh fish will also be installed. Settlement sites will be selected depending on the importance of fishing centers and their accessibility for traders. Special attention will be paid to the robustness of facilities, the control of energy consumption, training for their management and maintenance, and to avoid renewing the failures experienced in the past. Besides, fishermen shall be trained for a wise use of pesticides as they currently handle them without precaution for fish conservation. In agriculture, harvest storage sites will be built.

The producer organizations (POs) shall be strengthened. This will allow balancing relationships with traders within sectors and promote governance mechanisms at local levels (space and land management) as well as transboundary mechanisms (representatives of POs as interlocutors of States in dialog bodies over movements). POs will also be involved in construction and management of small-scale irrigation, small dams, cold rooms, and cereal storage facilities.

A set of measures aims at allowing riparian people to better adjust and better value fluctuating water resources. In the past, heavy developments were carried out, especially in Nigeria (SCIP, Baga Project). Built during the phase when the lake level was relatively high (in the 1970s), they never worked. The Action Plan includes the realization, maintenance, or enhancement of small water control developments for agriculture, corresponding to the needs, management, and maintenance capacities of the lake riparian populations: small dikes, village dams, and small-scale irrigation. These types of developments have already been carried out in an endogenous way by populations. They shall be improved technically, supported financially, and multiplied.

¹⁹ The securitization issue of access to resources and relationships between activities is addressed in 4.2.

²⁰ Smoking is generally used for big fish; drying for smaller ones.

The implementation of this type of intervention will be entrusted to the local and territorial development projects (LTDPs) implemented by local powers (local governments and or customary authorities), assuming sufficient capacity exists.

4.2 Securing Access to Natural Resources, and Preventing/Managing Conflicts

The features that made the system efficiency in the Lake Chad area relatively high so far and have allowed it to produce large amounts of food while adapting to a changing environment (i.e. the 3Ms: mobility of people in response to changing resources, multi-activity farms, and multi-functionality of space). Population growth (southern banks and coveted islands becoming saturated) and weakly regulated local power relationships cause increased tensions. These lead to social exclusion (youth, women, and the poor excluded from the best land) and from activities (e.g. livestock, in some areas).

In order for the tensions between individuals, between groups, or activities not to prevent the intensification of production systems, it would be important to define/improve locally negotiated rules for space management and access to natural resources.

Hence, two types of activities will be proposed in order to meet the following objectives:

- Securing, in an inclusive manner, access to the main productive resources (land, pasture, and fish). With regard to agriculture, a project will propose mechanisms to secure land access in order to avoid exclusion and facilitate women and youth's access to productive land and capital. In fishery, local agreements will be put in place to regulate fishing depending on the environmental conditions. In animal husbandry, pastoral routes will be secured between the Lake, its shores, and its hinterlands; and
- Facilitating the cohabitation between activities (agriculture, fishing, animal husbandry) with participatory, territorial, and spatial management mechanisms.

These projects will be implemented in three stages. Initially, they will focus on developing an intervention methodology, taking into account the specific challenges and drawing on existing experience in riparian countries (studies on land in the Bahr Linia Project in Chad; LCBC-Prodebalt study on land and pastoral management) or elsewhere in Africa (occupancy plans and land use in Senegal, for example)²¹, to support participatory processes leading to the establishment of local agreements based on the principles of democratic governance of natural resources and for the coexistence of uses and activities. One such option is opposed to autochthony as the basis for access to land; it is justified in a space of a largely cosmopolitan population.

In a second phase (2018-2021), pilot operations will be implemented (3 per country). Finally, in the medium term, the approach will be extended to all coastal areas of Lake Chad. States, LCBC, local authorities, and civil society will contribute to the implementation of these projects. The implementation will be carried out by legitimate local actors - local and customary powers and in conjunction with the relevant Ministries in the States concerned. LCBC will be responsible for methodological development and sharing of experiences. Local authorities and civil society organizations will benefit from coaching and capacity building measures in the implementation of this project.

²¹ These participatory planning processes are designed to define the rules for use of space within local communities involving numerous of villages (equivalent cantons or Local governments on the shores of Lake Chad). These approaches have been tested in Senegal since 2000 (see Aquino et al., 2002).

4.3 Improving Living Conditions through Public Investments

Areas belonging to the Lake Chad region generally have availabilities of public goods and services (education, health, water, roads, electricity, etc.) that are far lower than national averages, which themselves are unsatisfactory compared to international standards (Lemoalle and Magrin, 2014; Magrin *et al.*, 2015). The originality of the lake - natural potential, ecological and political vulnerability, transboundary dimension - justifies special efforts to catch up in terms of public investments. Such investments help to strengthen the resilience of societies to face environmental change. They will have to be conceived as complement to on-going projects such as Prodebalt.

Local Development Plans (LDPs) will be developed or updated using participatory approaches in order to plan and prioritize investment in basic services (water, sanitation, education, health, energy, roads, etc.). Local communities and customary authorities, depending on the situation, will be involved in their development.

Even with the current security conditions, it is possible for these LDPs responding to the basic needs to be financed and implemented within the short term, at least where local government bodies (local governments or customary authority) remain in place.

Among eligible infrastructures to be financed, it is important to make innovations that address the specific potentialities and constraints of Lake Chad. For example:

- For the improvement of drinking water supply using largely groundwater shall be considered, through simple systems (mini-networks); and
- There is a need to disseminate forms of education relevant to mobile populations experienced in some riparian countries (education of nomads in central Chad) intended for children of pastoralists and fishermen.

Public investments also concern infrastructure at a supra-local or regional level.

An electrification project will be implemented so as to promote the conservation and processing of farm products as well as non-agricultural activities (crafts) in rural areas. It shall be based on forms of decentralized energy, by seeking again adequacy between simplicity and robustness of facilities, organization of management and maintenance by beneficiaries. This program will target as a first phase boroughs and urban centers that contain the most important business activities.

In terms of education, there is a need to provide technical and vocational training centers relevant to the lake economy: mechanics and specialists in moto-pumps, solar panels / power, carpentry, construction and repair of pirogues, etc.

A population project will be implemented to improve the necessary slowing of demographic transition (awareness, supporting education of girls, etc.).

In terms of health, Aids prevention and treatment programs shall be supported. The lake environment has indeed issues similar to gold-washing sites, polarizing cosmopolitan populations and promoting an intense monetary circulation among many young bachelors. A regional epidemics prevention / management system shall be established. A study shall be carried out, based on a consultation between health services of the four riparian countries on

the possibility to equip one or two hospitals providing transboundary services with technical equipment more sophisticated than in the existing hospitals.

4.4 Facilitating Transport and Trade

Lake Chad occupies a paradoxical place in regional trade: it is one of the major trade centers, but many areas of the Lake and its banks are still very difficult to access, and there are many obstacles hindering the movement of people and products on both sides of the borders. The opening up of the lake area is a *sine qua non* for the development of its productive potential along with a way to improve the living conditions of its inhabitants by facilitating their access to services.

In terms of external transport, road construction is needed in Chad, Niger, and Cameroon, and road rehabilitation is needed in Nigeria. The opening up of the northern basin and the eastern archipelago is particularly essential as well as that of the Cameroonian south shores. The Action Plan will finance the construction of the planned road portions that are not yet financed (Diffa Bosso, Niger Liwa border Blangoa Makari Kousseri) and rehabilitation of roads in poor condition (in Bornu: Maiduguri road to the lake). The implementation will be carried out by States.

Beyond the external transport one must, on the Lake, maintain navigable channels (making sure to locate ice plants and cold storage near the busiest axes). A bathymetric study will be conducted on the major axis Baga Sola to Baga Kawa. It will finance the maintenance of feeder roads in the Lake and its domestic banks to serve the most productive areas by small investments that are unlikely to be affected by a possible major change of the Lake level. Around the Lake, the Action Plan will also build and maintain a road on the outer banks, connecting cities and towns which serve as the interface between the islands and the hinterland. The Action Plan should also support the establishment of mechanisms to promote trade and movements of people between States, harmonize rules (customs, health, etc.) inter-country (fishing, farming, commerce); manage traffic (consultation mechanisms on the flow of transboundary livestock and agricultural trade); and reduce illegal collection of taxes at the border on primary products and borders. In general, improving the rule of law would constitute a favorable factor for encouraging trade and the reduction of social and communal tensions.

The demarcation process of the borders in and around the Lake should be carried to its conclusion in order to strengthen inter-state cooperation and peace.

4.5 Preserving the Environmental Capital of the Lake

Even though the environment of the Lake is largely dependent on variables in the basin, local conservation actions must still be undertaken in the Lake itself. It will be a part of preserving the environmental capital of the Lake in relation to the lifestyles of the inhabitants. A field of intervention will concern the sustainability of harvesting activities (soda, spirulina, monitor lizard, wood). The objective will be to enable the sustainability of income-generating activities based on harvesting, which requires a better knowledge of ecosystem boundaries and the establishment of appropriate practices in order not to jeopardize the system's regenerative abilities.

For wood it will include financing reforestation activities for species providing non-timber resources (food or pharmacopoeia). The southern Nigerian banks, as most deforested and also

the most densely populated, will be targeted by the afforestation. These activities will take into account lessons of past failures of reforestation and integrate, for example, profit-sharing based on the survival and growth of trees in the medium term. Classic projects to manage the consumption of traditional energy in order to avoid further deforestation will also be implemented (improved stoves, gas subsidy, and sensitization). Actions of protection *vis-à-vis* sand erosion will also be put in place, particularly north of Lake Chad (Chad and Niger), to avoid filling wadis and cultivable depressions.

Another theme of intervention is the control and possible use of aquatic invasive plant species. This will both finance the maintenance of the navigability of navigable channels (see above) and develop ways to enhance the use of these plants (fuel, energy, housing, etc.). These actions for the ecosystem will, to be the most effective, be accompanied by awareness-raising and environmental education. Reforestation and soil conservation activities will be incentivized at the basin scale. They will cover the plains of the Logone and Chari and the upstream basin in Central African Republic.

4.6 Better Managing and Protecting Water Resources of the Basin

Despite its age and the recent adoption of planning tools, the LCBC has so far failed to play its role of planning and control of the uses of the waters of the basin. Issues related to population pressure and uncertainty of climate change make it more urgent to step up its ability to effectively carry out the duties corresponding to the heart of its mandate - manage water resources and associated shared resources to promote sustainable development, peace, and regional integration. This will allow it to promote the functioning of the Lake as an integrated ecological and economic system, and so fulfill the tasks assigned by the African Union to basin organizations in the framework of the African Network of Basin Organizations (ANBOs).

To be effective in fulfilling its mandate, on-going efforts to strengthen LCBC will have to continue in accordance with what has been recommended in past studies (Laroche, 2008 and GIZ 2015b).

It is critical to implement the Water Charter as quickly as possible, which requires ratification by the parliaments of Nigeria and the CAR and the definition of procedures and specific management criteria for which the Charter provides general guidance, in order to control water withdrawals and pollution in the basin.

The operationalization of the Water Charter will involve the definition of parameters to share existing water resources, control water withdrawals, and enforce those parameters. In addition, LCBC will have to start managing water quality in response to the increasing risks related to pollution in the basin. A baseline study will be conducted. Then a common regulation will be designed and adopted related to discharges. A feasibility study will be conducted for building a treatment plant for wastewater in N'Djamena, drawing lessons from similar plants built in the region. Measures should be taken to ensure that rules are translated into practice (awareness, efforts against the marketing of dangerous products; the water quality monitoring devices downstream of major cities). It will also seek to declare the Lake Chad an area of high environmental vulnerability, which would prohibit, in the Lake and within a radius to be defined around it, the use of hazardous pesticides and any exploration activity, exploitation, or transportation of hydrocarbons. Emergency response plans in case of accidental pollution will also be developed under the aegis of the LCBC, from existing national regulations. Biodiversity monitoring activities are proposed under the theme below.

4.7 Disseminating Information, Improving Knowledge, and Monitoring of the Environment

Improved management of development and water in the Lake Chad requires improving the knowledge available on the socio-ecosystem, and also that existing data is analyzed and shared. Decisions to be taken in the allocation of resources between States, between upstream and downstream, and between uses assume that such a broad and informed debate can take place.

A full feasibility study, including environmental, economic, financial, technical assessments of a possible transfer of water from the Congo Basin to the Lake Chad Basin, will be carried out within the framework of inter-basin Committee (LCBC-CICOS) recently put in place. Scientific monitoring will be set up to feed the continuous reflection on the basis of new environmental data produced by the IPCC.

Participation and sharing of information on environmental issues and development across the Lake and its basin should also be improved. LCBC must play a central role in the organization of these debates and in building a shared vision on the development, management, and uses of the long-term resource pool, enabling forward thinking informed about the choices to be made in accordance with IWRM principles underlying the Water Charter. Years needed to refine the models of climate change (3 years? 5 years?) will be utilized to organize a debate within the six countries concerned, particularly among populations of the conventional basin, on the advantages and disadvantages of the transfer proposal. LCBC will be the linchpin of such a dialogue between governments, local people, and civil society. It is on this basis that the planning of the use of long-term water resources is to be achieved from the study of all response options to the inevitable increase in long-term water needs at the basin scale (mobilization of groundwater, efficient irrigation, water transfer, other).

Accompanying and securing productive systems of Lake Chad and improved natural resource governance implies better managing the available information and complement existing knowledge. LCBC has to play a central role in the centralization of data produced by States, analysis and dissemination of these data. First, it must improve the monitoring and collection of data on water resources. It should promote the mobilization and sharing of existing data, in particular supporting the observatory of the LCBC. It is also necessary to rehabilitate the hydrological and meteorological monitoring network at the basin scale by introducing modern methods of data acquisition (satellite data). These data are the basis, currently missing, for future decisions on water management and the Lake. The establishment of a network managed by the LCBC limited to a few strategic stations to enter the main hydrological dynamics seems the most efficient solution for progress in this area. It will be complemented by investment in national hydrological monitoring systems.

A better understanding of the impact of irrigation on the Lake is also necessary: one must study the current withdrawals (surface and groundwater) and conduct studies on the potential use for irrigation groundwater. Similarly, a better knowledge of hydrological functioning of flood plains and areas downstream of dams (Yaérés; Hadejia-Nguru in Yobe River; Yedseram) will be useful to optimize production (fisheries, crops, and livestock), minimizing evaporative losses and development of Typha. Regarding improved development and management at the scale of the Lake and the basin, it is essential to enhance the available knowledge in order to avoid investing in heavy equipment or civil works, which could, like the great Nigerian irrigation schemes during the 1970s, be designed against the tide of environmental rhythms of Lake Chad.

It is therefore appropriate food for thought about transferring continuous models with the latest data on climate change, through the establishment of scientific monitoring devices.

A study on water management in the Great Barrier Reef is recommended. It would explore a possible development of the Great Barrier Reef so as to regulate the flow of water between North and South basins by a system of valves. Similarly, the Action Plan will provide for improving the current hydrological model to better reflect the effects of climate change, including the main two parameters of temperature and evapotranspiration. A study of current sedimentation conditions would also be necessary to assess the utility of dredging programs and those of Lake dredging of rivers tributaries of the Lake.

Monitoring the evolution of biodiversity and ecology in the Lake is another study area. It will refine the diagnosis on the subject and thus help develop more relevant contingency plans. It will initially define a method, indicators, and homogeneous monitoring mechanisms across different sectors of the Lake and the four riparian countries. These will be developed by reconciling the criteria of relevance and simplicity. The study of ecosystem services of basin flood plains will fuel the debate on the risks and potential associated with the management of the resources.

Finally, support for productive systems of Lake Chad requires knowing them better. If recent scientific studies have analyzed their functioning across certain areas of the Lake, it should produce agronomic, economic, and demographic data across the entire Lake. The aim here is to focus on small studies, based on a representative sample of the diversity of situations in the Lake which take into account its dual areal organization (islands and domestic banks, external banks and hinterland) and "sectoral" (northern basin; south shores of Nigeria, Cameroon, Chad; archipelago northeast). To address these various issues, the LCBC will be supported in the management of information and documentation, ability to distill lessons, and to share experiences across the basin to facilitate a multi-level dialogue on the governance of the water.

Chapter 5: Envisaged Distribution of Investments

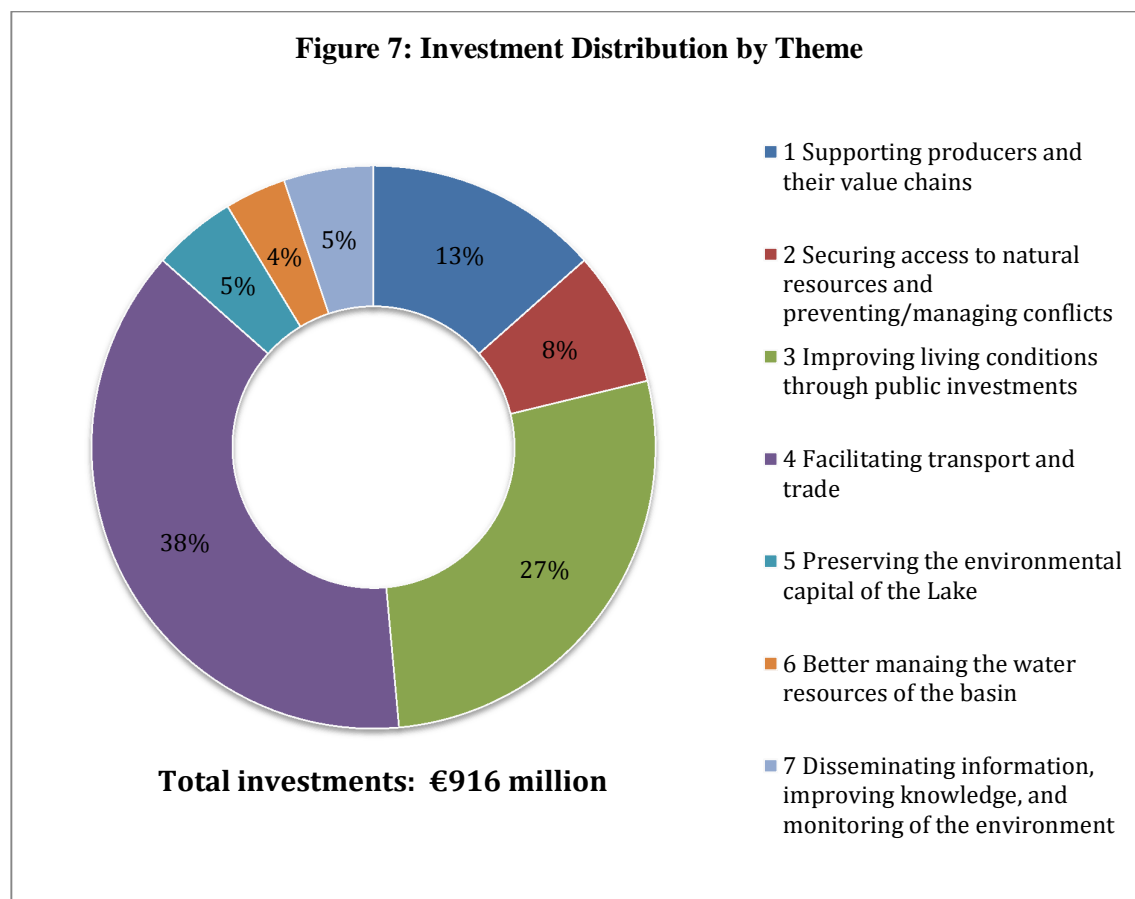
The total estimated amount of this Action Plan is approximately €916 million over 10 years. The proposed investments are detailed in the tables in Chapter 6. This amount, calculated from the estimated cost of each project proposed here, is only intended to provide an order of magnitude. Each of these amounts is expected to be specified by donors interested in relation to the actors (States or LCBC) during the preparation and appraisal of each of these projects. The breakdown presented below by theme, country, and geographical area reflects such an estimate. It will likely to be adjusted during the preparation/appraisal of the various projects that make up the Plan.

5.1 Breakdown of Investments by Priority Area

The projects are organized through the seven Priority Areas (see Figure 7; explained in Chapter 4) broken down into activities and projects - each project is briefly described with some activities.

The largest investment areas are infrastructure/transport (Priority Area #4; 38%) and access to basic services (Priority Area #3; 27%). They are followed by support to productive activities (Priority Area #1; 13%) and tenure security/conflict resolution (Priority Area #2; 8%).

Preserving the environmental capital and improved management of water resources in the basin (Priority areas 5 and 6) have a preliminary allocation of 4 and 5% respectively of total Action Plan investments). Improving the information base with data collection, monitoring, and analysis stands at an estimated 5%.

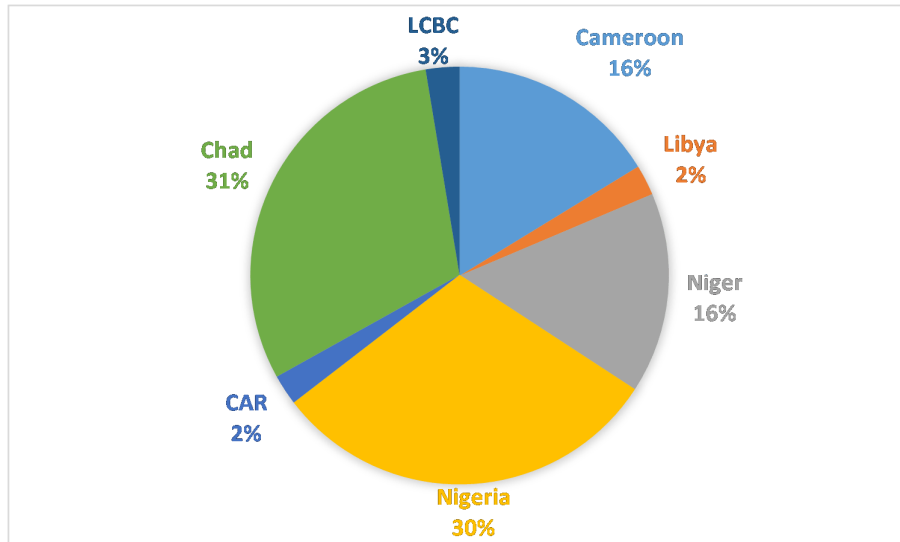


5.2 Breakdown of Investments by Country

The breakdown by type of tentative investments by the six countries concerned and the LCBC is presented in Figure 8.

Nigeria, which is the most populous country of the countries bordering Lake Chad, and Chad, to which about half of the area of Lake Chad belong, each receive approximately 30% of planned investments. Cameroon and Niger come next, with 16%. The Central African Republic and Libya, which receive investments under the Priority Areas of environmental conservation (Theme #5) under Water Resources Management (Theme #6) and the management of information and participation (Priority Area #7) receive about 2%. LCBC, which implements regional investment projects, accounts for 3% of the planned investments.

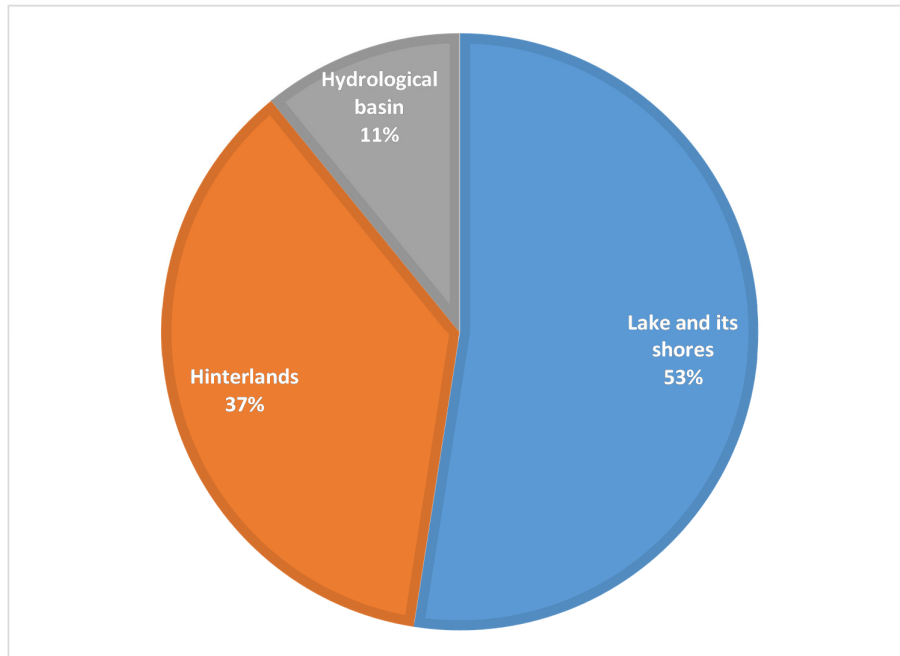
Figure 8: Distribution of Investments per Country and LCBC



5.3 Breakdown of Investments by Geographic Area

Investments by geographical area are shown in Figure 9.

Figure 9: Distribution of Investments by Geographical Area



Zone 1 corresponds to the area of Lake Chad, including its banks and islands, covered by the administrative districts as stated in Chapter 3, with around 2 million inhabitants who live directly from the resources of Lake Chad. This area would get a little more than half of the planned investments.

Zone 2 is the extended hinterland of Lake Chad, including major riparian regions populated by 13 million of inhabitants, in which most of the commercial relations of Lake Chad take place. This space is estimated to receive approximately 36% of planned investments.

Zone 3 refers to the conventional basin of Lake Chad with 47 million inhabitants, including the areas of the upstream basin. It has 11% of investments.

Chapter 6: Tables of Priority Themes, Activities, and Projects

THEMES	ACTIVITIES	PROJECT	DESCRIPTION	COST	% OF TOTAL	ZONE	SOURCE
CAMEROON				EURO	COST		
Supporting producers and their value chains	Agriculture	Support to agriculture (extension, inputs, producer organizations, credit)	Support to producers of recession crops and arboriculture in and around Lake Chad	2,000,000		1	PURDEP
Supporting producers and their value chains	Agriculture	Small water-related improvements	Studies. Realization dikes, small dams, small-scale irrigation at village level. strengthening capacity	2,000,000		1	PURDEP
Supporting producers and their value chains	Agriculture	Post-harvest	Adding value to post-harvest operations by storage and processing	1,000,000		1	New
Supporting producers and their value chains	Agriculture	Support to value chains	Studies. Support to producer organizations. Strengthening capacities for managing water	1,000,000		1	PURDEP

Supporting producers and their value chains	Livestock	Animal health	Studies. Veterinary equipment. Vaccinations. Training and financing of auxiliary means. Awareness raising for pastoralists.	2,500,000		1	New
Supporting producers and their value chains	Livestock	Diversification of livestock systems	Studies. Small solar stations. Support for intensification. Fodder. Small ruminants and chicken	2,000,000		1	PURDEP
Supporting producers and their value chains	Livestock	Support to producer organizations and value chains	Studies. Strengthening capacities of producer organizations (cattle raising; small ruminants; chicken)	1,000,000		1	PURDEP
Supporting producers and their value chains	Fisheries	Support to fisheries	Extension. Inputs. Credit. Support to producer organizations	1,000,000		1	New
Supporting producers and their value chains	Fisheries	Post-capture	Conservation and value addition post-capture. Cold chambers. Improved smoking	2,000,000		1	PURDEP

			facilities. Solar dryers				
Securing access to natural resources and preventing/managing conflicts	Land management	Land management for multi-purpose space management	Studies. Pilot projects. Strengthening local capacities. Scaling up during second phase.	4,000,000		1	PURDEP
Securing access to natural resources and preventing/managing conflicts	Land rights	Inclusive management of land and for tenure security	Studies. Pilot projects. Strengthening local capacities. Scaling up during second phase.	2,000,000		1	PURDEP
Securing access to natural resources and preventing/managing conflicts	Livestock	Securing access routes to and from the Lake	Studies. Pilot projects. Strengthening local capacities. Scaling up during second phase.	3,000,000		2	PURDEP, PQI
Securing access to natural resources and preventing/managing conflicts	Fisheries	Local fisheries regulations	Studies. Pilot projects. Etudes. Strengthening local capacities. Scaling up during phase 2	1,000,000		1	PURDEP
Improving living conditions through public investments	Planning	Local planning to prioritize public investments	Implementing local actions/priorities. Strengthening capacities.	1,500,000		1	New

Improving living conditions through public investments	Water	Rural and urban access to drinking water	Drilling wells (if possible with solar energy). Construction and rehabilitation. Strengthening capacities of management committees. Maintenance.	12,500,000		1	PURDEP, PQI
Improving living conditions through public investments	Water	Hygiene and sanitation	Latrines. Training on hygiene	1,000,000		1	PURDEP, PQI
Improving living conditions through public investments	Electrification	Urban and rural electrification	Electrifying villages and cities with solar energy, if possible. Training of maintenance and management committees	5,000,000		1	New
Improving living conditions through public investments	Education	Support to education	Construction of schools. Professional training. Education of mobile populations	10,000,000		1	New
Improving living conditions through public investments	Health	Support to health	Construction, equipment, and support for the functioning of health stations. Prevention of	10,000,000		1	New

			epidemics (cholera, AIDS)				
Improving living conditions through public investments	Population planning	Support to population planning	Family planning, sensibilization, education of girls	1,000,000		1	New
Facilitating transport and trade	Transport	Road construction and rehabilitation	Access to the Lake from Kousseri. Rehabilitation of 80 km. Construction of 40 km	60,000,000		2	New
Facilitating transport and trade	Transport	Maintenance of feeder roads	Improvement and light annual maintenance	800,000		1	New
Facilitating transport and trade	Transport	Improving and managing of navigation routes in the Lake	Improvement and light annual maintenance	4,000,000		1	PURDEP, PQI
Preserving the environmental capital of the Lake	Invasive aquatic weeds	Valuing wetland biomass	Research and development. Support to putting in place value chains (Typha and others)	500,000		1	New
Preserving the environmental capital of the Lake	Wood-based energy	Preservation of wood resources	Reduction of the consumption (improved stoves, use of gas, sensibilisation). Planting trees.	1,500,000		1	PURDEP, PQI

			Improvement of forests				
Preserving the environmental capital of the Lake	Water and soil conservation	Reforestation program of the banks and the sustainable management of land and water	Measures against erosion. Mechanisms for the financing of environmental protection	3,000,000		2	New
Preserving the environmental capital of the Lake	Biodiversity	Management of the biodiversity and the ecology	Implementation of a monitoring system. Publication of annual reports	2,000,000		1	PQI
Better managing the water resources of the basin	Water management	Implementation of the Water Charter	Institutionnel strengthening. Defining legal framework. Sensibilisation of GIRE for decision-makers and the public. Support for planning and monitoring	2,000,000		3	PQI
Better managing the water resources of the basin	Pollution	Monitoring of the water quality	Implementing a monitoring scheme for water quality	1,000,000		3	New

Better managing the water resources of the basin	Pollution	Prevention and management of pollutants from the oil sector	Improvement of implementation of the regulation. Emergency plans and their means of implementation	3,000,000		3	New
Disseminating information, improving knowledge, and monitoring of the environment	Hydrology	Rehabilitation of the monitoring network for surface water	Equipment renewal. Support for the collection and processing of data	1,000,000		3	New
Disseminating information, improving knowledge, and monitoring of the environment	Socio-economic information	Knowledge of population and population movements	Implementation of a monitoring system. Publication of annual reports	1,000,000		1	New
Disseminating information, improving knowledge, and monitoring of the environment	Socio-economic information	Information and public participation	Strengthening of capacities. Sharing of information. Organization of a national dialogue	2,000,000		3	New
Disseminating information, improving knowledge, and monitoring of the environment	Socio-economic information	Knowledge of the agricultural economy	Implementation of a monitoring system. Publication of annual reports	2,000,000		1	New
TOTAL CAMEROON				149,300,000	16%		
LIBYA							

Better managing the water resources of the basin	Water management	Implementation of the Water Charter	Strengthening the capacity of decision makers in IWRM; revision of the national water strategy; design a plan to reform the institutional framework for water	4,700,000		3	PQI
Disseminating information, improving knowledge, and monitoring of the environment	Hydrology	Improvement of groundwater monitoring	Improve groundwater monitoring in the Mourzuk and Koufra basins	15,000,000		3	PQI
Disseminating information, improving knowledge, and monitoring of the environment	Hydrology	Capacity building	Training in groundwater modelization and data collection	1,900,000		3	PQI
TOTAL LIBYA				21,600,000	2%		
NIGER							
Supporting producers and their value chains	Agriculture	Support to agriculture (extension, inputs, producer organizations, credit)	Support to producers of recession crops and arboriculture in and around Lake Chad	3,000,000		1	PURDEP

Supporting producers and their value chains	Agriculture	Small water-related improvements	Studies. Realization dikes, small dams, small-scale irrigation at village level. strengthening capacity	5,000,000		1	PURDEP
Supporting producers and their value chains	Agriculture	Post-harvest	Adding value to post-harvest operations by storage and processing	1,500,000		1	PURDEP
Supporting producers and their value chains	Agriculture	Support to value chains	Studies. Support to producer organizations. Strengthening capacities for managing water.	1,000,000		1	PURDEP
Supporting producers and their value chains	Livestock	Animal health	Studies. Veterinary equipment. Vaccinations. Training and financing of auxiliary means. Awareness raising for pastoralists.	4,000,000		1	PURDEP, PQI
Supporting producers and their value chains	Livestock	Diversification of livestock systems	Studies. Small solar stations. Support for intensification. Fodder. Small ruminants and chicken	2,500,000		1	PURDEP

Supporting producers and their value chains	Livestock	Support to producer organizations and value chains	Studies. Strengthening capacities of producer organizations (cattle raising; small ruminants; chicken)	2,000,000		1	PURDEP
Supporting producers and their value chains	Fisheries	Support to fisheries	Extension. Inputs. Credit.	1,500,000		1	PQI
Supporting producers and their value chains	Fisheries	Post-capture	Conservation and value addition post-capture. Cold chambers. Improved smoking facilities. Solar dryers	3,000,000		1	New
Securing access to natural resources and preventing/managing conflicts	Land management	Land management for multi-purpose space management	Studies. Pilot projects. Strengthening local capacities. Scaling up during second phase.	6,000,000		1	New
Securing access to natural resources and preventing/managing conflicts	Land rights	Inclusive management of land and for tenure security	Studies. Pilot projects. Strengthening local capacities. Scaling up during second phase.	3,000,000		1	New

Securing access to natural resources and preventing/managing conflicts	Livestock	Securing access routes to and from the Lake	Studies of existing devices. Pastoral water. Materialisation of the routes. Awareness. Consultation	4,500,000		2	PQI
Securing access to natural resources and preventing/managing conflicts	Fisheries	Local fisheries regulations	Studies. Pilot projects. Etudes. Strengthening local capacities. Scaling up during phase 2	1,500,000		1	PQI
Improving living conditions through public investments	Planning	Local planning to prioritize public investments	Implementing local actions/priorities. Strengthening capacities.	1,500,000		1	New
Improving living conditions through public investments	Water	Rural and urban access to drinking water	Drilling wells (if possible with solar energy). Construction and rehabilitation. Strengthening capacities of management committees. Maintenance.	15,000,000		1	PURDEP, PQI
Improving living conditions through public investments	Water	Hygiene and sanitation	Latrines. Training on hygiene	1,500,000		1	PQI

Improving living conditions through public investments	Electrification	Urban and rural electrification	Electrifying villages and cities with solar energy, if possible. Training of maintenance and management committees	7,500,000		1	New
Improving living conditions through public investments	Education	Support to education	Construction of schools. Professional training. Education of mobile populations	12,500,000		1	New
Improving living conditions through public investments	Health	Support to health	Construction, equipment, and support for the functioning of health stations. Prevention of epidemics (cholera, AIDS)	12,500,000		1	New
Improving living conditions through public investments	Population planning	Support to population planning	Family planning, sensibilization, education of girls	1,000,000		1	New
Facilitating transport and trade	Transport	Road construction and rehabilitation	Construction of the road from Diffa to Bosso (40 km)	30,000,000		2	New
Facilitating transport and trade	Transport	Maintenance of feeder roads	Improvement and light annual maintenance	1,500,000		1	New

Facilitating transport and trade	Transport	Improving and managing of navigation routes in the Lake	Improvement and light annual maintenance	3,000,000		1	PQI
Preserving the environmental capital of the Lake	Kouri (livestock race)	Preservation of the Kuri race	Support to existing structures	2,000,000		1	PQI
Preserving the environmental capital of the Lake	Invasive aquatic weeds	Valuing wetland biomass	Research and development. Support to putting in place value chains (Typha and others)	500,000		1	New
Preserving the environmental capital of the Lake	Wood-based energy	Preservation of wood resources	Reduction of the consumption (improved stoves, use of gas, sensibilisation). Planting trees. Improvement of forests	2,000,000		1	New
Preserving the environmental capital of the Lake	Water and soil conservation	Reforestation program of the banks and the sustainable management of land and water	Measures against erosion. Fixation of dunes	1,000,000		1	PQI
Preserving the environmental capital of the Lake	Biodiversity	Management of the biodiversity and the ecology	Implementation of a monitoring system. Publication of annual reports	2,000,000		1	PQI

Better managing the water resources of the basin	Water management	Implementation of the Water Charter	Institutional strengthening. Defining legal framework. Sensibilisation of GIRE for decision-makers and the public. Support for planning and monitoring	1,000,000		3	PQI
Better managing the water resources of the basin	Water management	Dredging of the Komadougou Yobe	Study on dredging operations.	1,000,000		3	PQI
Better managing the water resources of the basin	Pollution	Prevention and management of pollutants from the oil sector	Improvement of implementation of the regulation. Emergency plans and their means of implementation	3,000,000		3	PQI
Disseminating information, improving knowledge, and monitoring of the environment	Hydrology	Rehabilitation of the monitoring network for surface water	Equipment renewal. Support for the collection and processing of data	1,000,000		3	New
Disseminating information, improving knowledge, and monitoring of the environment	Socio-economic information	Knowledge of population and population movements	Implementation of a monitoring system. Publication of annual reports	1,000,000		1	New
Disseminating information, improving knowledge,	Socio-economic information	Knowledge of the agricultural economy	Implementation of a monitoring system.	2,000,000		1	New

and monitoring of the environment			Publication of annual reports				
Disseminating information, improving knowledge, and monitoring of the environment	Information and participation	Information and public participation in the GIRE of the basin	Strengthening of capacities. Sharing of information. Organization of a national dialogue	2,000,000		3	New
TOTAL NIGER				143,000,000	16%		
NIGERIA							
Supporting producers and their value chains	Agriculture	Support to agriculture (extension, inputs, producer organizations, credit)	Support to producers of recession crops and arboriculture in and around Lake Chad	9,000,000		1	PURDEP, PQI
Supporting producers and their value chains	Agriculture	Small water-related improvements	Studies. Realization dikes, small dams, small-scale irrigation at village level. strengthening capacity	10,000,000		1	PQI
Supporting producers and their value chains	Agriculture	Post-harvest	Adding value to post-harvest operations by storage and processing	4,500,000		1	PURDEP
Supporting producers and their value chains	Agriculture	Support to value chains	Studies. Support to producer organizations. Strengthening	2,000,000		1	PURDEP

			capacities for managing water.				
Supporting producers and their value chains	Livestock	Animal health	Studies. Veterinary equipment. Vaccinations. Training and financing of auxiliary means. Awareness raising for pastoralists.	4,000,000		1	ILSEM N
Supporting producers and their value chains	Livestock	Diversification of livestock systems	Studies. Mini solar stations. Support to intensification. Zootechny. Fodder. Small ruminants and aviculture	4,500,000		1	PURDEP
Supporting producers and their value chains	Livestock	Support to producer organizations and value chains	Studies. Strengthening capacities of producer organizations (cattle raising; small ruminants; chicken)	2,000,000		1	New
Supporting producers and their value chains	Fisheries	Support to fisheries	Extension. Inputs. Credit.	4,500,000		1	PQI
Supporting producers and their value chains	Fisheries	Post-capture	Conservation and value addition post-capture. Cold chambers.	3,000,000		1	PURDEP, Ministry of Water Resources

			Improved smoking facilities. Solar dryers				
Securing access to natural resources and preventing/managing conflicts	Land management	Land management for multi-purpose space management	Studies. Pilot projects. Strengthening local capacities. Scaling up during second phase.	8,000,000		1	ILSEM N
Securing access to natural resources and preventing/managing conflicts	Land rights	Inclusive management of land and for tenure security	Studies. Pilot projects. Strengthening local capacities. Scaling up during second phase.	5,000,000		1	New
Securing access to natural resources and preventing/managing conflicts	Livestock	Securing access routes to and from the Lake	Studies of existing devices. Pastoral water. Routes markings. Awareness. Consultation	5,000,000		2	ILSEM N
Securing access to natural resources and preventing/managing conflicts	Fisheries	Local fisheries regulations	Studies. Pilot projects. Etudes. Strengthening local capacities. Scaling up during phase 2	3,000,000		1	PQI
Improving living conditions through public investments	Planning	Local planning to prioritize public investments	Implementing local actions/priorities. Strengthening capacities.	1,500,000		1	New

Improving living conditions through public investments	Water	Rural and urban access to drinking water	Drilling wells (if possible with solar energy). Construction and rehabilitation. Strengthening capacities of management committees. Maintenance.	25,000,000		1	PQI
Improving living conditions through public investments	Water	Hygiene and sanitation	Latrines. Training in hygiene	4,500,000		1	New
Improving living conditions through public investments	Electrification	Urban and rural electrification	Electrifying villages and cities with solar energy, if possible. Training of maintenance and management committees	12,500,000		1	New
Improving living conditions through public investments	Education	Support to education	Construction of schools. Professional training. Education of mobile populations	20,000,000		1	New
Improving living conditions through public investments	Health	Support to health	Construction, equipment, and support for the functioning of health stations. Prevention of	20,000,000		1	New

			epidemics (cholera, AIDS)				
Improving living conditions through public investments	Population planning	Support to population planning	Family planning, sensibilization, education of girls	1,000,000		1	PQI
Facilitating transport and trade	Transport	Road construction and rehabilitation	Rehabilitation of the road from Maiduguri to the Lake (300km)	100,000,000		2	New
Facilitating transport and trade	Transport	Maintenance of feeder roads	Improvement and light annual maintenance	2,300,000		1	New
Facilitating transport and trade	Transport	Improving and managing of navigation routes in the Lake	Improvement and light annual maintenance	4,600,000		1	ILSEM, PQI
Preserving the environmental capital of the Lake	Sustainability of gathering and hunting	Monitor lizard	Study. Sensibilisation. Management of exploited populations	500,000		1	New
Preserving the environmental capital of the Lake	Invasive aquatic weeds	Valuing wetland biomass	Research and development. Support to putting in place value chains (Typha and others)	500,000		1	New

Preserving the environmental capital of the Lake	Wood-based energy	Preservation of wood resources	Reduction of the consummation (improved stoves, use of gas, sensibilisation). Planting trees. Improvement of forests	3,000,000		1	ILSEM N
Preserving the environmental capital of the Lake	Water and soil conservation	Reforestation program of the banks and the sustainable management of land and water	Measures against erosion. Mechanisms for the financing of environmental protection	3,000,000		2	ILSEM N
Preserving the environmental capital of the Lake	Biodiversity	Management of the biodiversity and the ecology	Implementation of a monitoring system. Publication of annual reports	2,000,000		1	PQI
Better managing the water resources of the basin	Water management	Implementation of the Water Charter	Institutional strengthening. Defining legal framework. Sensibilisation of GIRE for decision-makers and the public. Support for planning and monitoring	2,000,000		3	PQI
Better managing the water resources of the basin	Water management	Dredging of the Komadougou Yobe	Study on dredging operations.	2,000,000		3	PQI

Better managing the water resources of the basin	Pollution	Monitoring of the water quality	Implementing a monitoring scheme for water quality	1,000,000		3	New
Better managing the water resources of the basin	Pollution	Prevention and management of pollutants from the oil sector	Improvement of implementation of the regulation. Emergency plans and their means of implementation	3,000,000		3	PQI
Disseminating information, improving knowledge, and monitoring of the environment	Hydrology	Rehabilitation of the monitoring network for surface water	Equipment renewal. Support for the collection and processing of data	1,000,000		3	New
Disseminating information, improving knowledge, and monitoring of the environment	Socio-economic information	Knowledge of population and population movements	Implementation of a monitoring system. Publication of annual reports	1,000,000		1	New
Disseminating information, improving knowledge, and monitoring of the environment	Socio-economic information	Knowledge of the agricultural economy	Implementation of a monitoring system. Publication of annual reports	2,000,000		1	New
Disseminating information, improving knowledge, and monitoring of the environment	Information and participation	Information and public participation in the GIRE of the basin	Strengthening of capacities. Sharing of information. Organization of a national dialogue	2,000,000		3	New
TOTAL NIGERIA				278,900,000	30%		
CAR							New

Preserving the environmental capital of the Lake	Water and soil conservation	Reforestation program of the banks and the sustainable management of land and water	Measures against erosion. Mechanisms for the financing of environmental protection	5,000,000		3	PQI
Better managing the water resources of the basin	Water management	Implementation of the Water Charter	Institutional strengthening. Defining legal framework. Sensibilisation of GIRE for decision-makers and the public. Support for planning and monitoring	4,000,000		3	New
Better managing the water resources of the basin	Pollution	Monitoring of the water quality	Implementing a monitoring scheme for water quality	2,000,000		3	PQI
Better managing the water resources of the basin	Pollution	Mechanisms to control the pollution risks from petroleum	Studies on the improvement of legislation	1,000,000		3	
Better managing the water resources of the basin	Pollution	Access of tanneries to alternative, less polluting techniques	Studies and training; support to producer organizations	500,000		3	PQI
Better managing the water resources of the basin	Pollution	Strengthening the capacities of small miners for a responsible	Studies and training; support to producer organizations	2,000,000		3	ILSEMN, Ministry of Water Resources

		exploitation of mining resources					
Disseminating information, improving knowledge, and monitoring of the environment	Hydrology	Rehabilitation of the monitoring network for surface water	Equipment renewal. Support for the collection and processing of data	3,000,000		3	New
Disseminating information, improving knowledge, and monitoring of the environment	Information and participation	Information and public participation in the GIRE of the basin	Strengthening of capacities. Sharing of information. Organization of a national dialogue	2,000,000		3	New
TOTAL CAR				19,500,000	2%		
CHAD							
Supporting producers and their value chains	Agriculture	Support to agriculture (extension, inputs, producer organizations, credit)	Support to producers of recession crops and arboriculture in and around Lake Chad	6,000,000		1	PURDEP, PQI
Supporting producers and their value chains	Agriculture	Small water-related improvements	Studies. Realization dikes, small dams, small-scale irrigation at village level. strengthening capacity	7,500,000		1	PURDEP
Supporting producers and their value chains	Agriculture	Small water-related improvements	Improvements in the wadis and polders	2,000,000		1	PURDEP

Supporting producers and their value chains	Agriculture	Post-harvest	Adding value to post-harvest operations by storage and processing	3,000,000		1	New
Supporting producers and their value chains	Agriculture	Support to value chains	Studies. Support to producer organizations. Strengthening capacities for managing water.	2,000,000		1	New
Supporting producers and their value chains	Livestock	Animal health	Studies. Veterinary equipment. Vaccinations. Training and financing of auxiliary means. Awareness raising for pastoralists.	5,000,000		1	PURDEP
Supporting producers and their value chains	Livestock	Diversification of livestock systems	Studies. Small solar stations. Support for intensification. Fodder. Small ruminants and chicken	4,500,000		1	PURDEP, PQI
Supporting producers and their value chains	Livestock	Support to producer organizations and value chains	Studies. Strengthening capacities of producer organizations (cattle raising;	2,000,000		1	PURDEP

			small ruminants; chicken)				
Supporting producers and their value chains	Fisheries	Support to fisheries	Extension. Inputs. Credit.	3,000,000		1	PURDEP, PQI
Supporting producers and their value chains	Fisheries	Post-capture	Conservation and value addition post-capture. Cold chambers. Improved smoking facilities. Solar dryers	3,000,000		1	New
Securing access to natural resources and preventing/managing conflicts	Land management	Land management for multi-purpose space management	Studies. Pilot projects. Strengthening local capacities. Scaling up during second phase.	8,000,000		1	New
Securing access to natural resources and preventing/managing conflicts	Land rights	Inclusive management of land and for tenure security	Studies. Pilot projects. Strengthening local capacities. Scaling up during second phase.	5,000,000		1	New
Securing access to natural resources and preventing/managing conflicts	Livestock	Securing access routes to and from the Lake	Studies of existing devices. Pastoral water. Materialisation of the routes.	5,000,000		2	PQI

			Awareness. Consultation				
Securing access to natural resources and preventing/managing conflicts	Fisheries	Local fisheries regulations	Studies. Pilot projects. Etudes. Strengthening local capacities. Scaling up during phase 2	3,000,000		1	New
Improving living conditions through public investments	Planning	Local planning to prioritize public investments	Implementing local actions/priorities. Strengthening capacities.	1,500,000		1	New
Improving living conditions through public investments	Water	Rural and urban access to drinking water	Drilling wells (if possible with solar energy). Construction and rehabilitation. Strengthening capacities of management committees. Maintenance.	20,000,000		1	PURDEP, PQI
Improving living conditions through public investments	Water	Hygiene and sanitation	Latrines. Training in hygiene	3,000,000		1	PQI
Improving living conditions through public investments	Electrification	Urban and rural electrification	Electrifying villages and cities with solar energy, if possible. Training of maintenance and	10,000,000		1	New

			management committees				
Improving living conditions through public investments	Education	Support to education	Construction of schools. Professional training. Education of mobile populations	15,000,000		1	PURDEP
Improving living conditions through public investments	Health	Support to health	Construction, equipment, and support for the functioning of health stations. Prevention of epidemics (cholera, AIDS)	15,000,000		1	New
Improving living conditions through public investments	Population planning	Support to population planning	Family planning, sensibilization, education of girls	1,000,000		1	New
Facilitating transport and trade	Transport	Road construction and rehabilitation	Construction of 120 km of the road toward the border of Niger	120,000,000		2	New
Facilitating transport and trade	Transport	Maintenance of feeder roads	Improvement and light annual maintenance	3,000,000		1	New
Facilitating transport and trade	Transport	Improving and managing of	Improvement and light annual maintenance	8,000,000		1	New

		navigation routes in the Lake					
Preserving the environmental capital of the Lake	Sustainability of gathering and hunting	Monitor lizard	Study. Sensibilisation. Management of exploited populations	500,000		1	New
Preserving the environmental capital of the Lake	Sustainability of gathering and hunting	Natron	Study. Support to improve the profitability of exploitation.	500,000		1	New
Preserving the environmental capital of the Lake	Sustainability of gathering and hunting	Spirulina	Study. Support to improve the profitability of exploitation.	500,000		1	New
Preserving the environmental capital of the Lake	Kouri (livestock race)	Preservation of the Kuri race	Support to existing structures	2,000,000		1	PQI
Preserving the environmental capital of the Lake	Invasive aquatic weeds	Valuing wetland biomass	Research and development. Support to putting in place value chains (Typha and others)	500,000		1	New
Preserving the environmental capital of the Lake	Wood-based energy	Preservation of wood resources	Reduction of the consumption (improved stoves, use of gas, sensibilisation). Planting trees. Improvement of forests	3,000,000		1	PQI

Preserving the environmental capital of the Lake	Water and soil conservation	Reforestation program of the banks and the sustainable management of land and water	Measures against erosion. Fixation of dunes	4,000,000		3	New
Preserving the environmental capital of the Lake	Biodiversity	Management of the biodiversity and the ecology	Implementation of a monitoring system. Publication of annual reports	2,000,000		1	PQI
Better managing the water resources of the basin	Water management	Implementation of the Water Charter	Institutional strengthening. Defining legal framework. Sensibilisation of GIRE for decision-makers and the public. Support for planning and monitoring	2,000,000		3	New
Better managing the water resources of the basin	Pollution	Monitoring of the water quality	Implementing a monitoring scheme for water quality	300,000		3	New
Better managing the water resources of the basin	Pollution	Study on a water treatment plant in N'Djamena	Feasibility study	1,000,000		2	PQI

Better managing the water resources of the basin	Pollution	Prevention and management of pollutants from the oil sector	Improvement of implementation of the regulation. Emergency plans and their means of implementation	2,000,000		3	PQI
Disseminating information, improving knowledge, and monitoring of the environment	Hydrology	Rehabilitation of the monitoring network for surface water	Equipment renewal. Support for the collection and processing of data	1,000,000		3	New
Disseminating information, improving knowledge, and monitoring of the environment	Socio-economic information	Knowledge of population and population movements	Implementation of a monitoring system. Publication of annual reports	1,000,000		1	New
Disseminating information, improving knowledge, and monitoring of the environment	Socio-economic information	Knowledge of the agricultural economy	Implementation of a monitoring system. Publication of annual reports	2,000,000		1	New
Disseminating information, improving knowledge, and monitoring of the environment	Information and participation	Information and public participation in the GIRE of the basin	Strengthening of capacities. Sharing of information. Organization of a national dialogue	2,000,000		3	New
TOTAL CHAD				279,800,000	31%		
LCBC							
Securing access to natural resources and preventing/managing conflicts	Land management	Land management for multi-purpose	Elaboration of a methodology. Distilling lessons of experience.	2,000,000		1	New

		space management					
Improving living conditions through public investments	Health	Support to health	Feasibility study for a regional hospital in the lake area	500,000		1	New
Facilitating transport and trade	Transport	Bathymetric study of navigation routes in Lake Chad	Study	500,000		1	New
Facilitating transport and trade	Trade	Harmonization of trade regulations and standards	Study on existing rules (in general and for different value chains). Putting in place of harmonized rules	500,000		2	New
Facilitating transport and trade	Trade	Improvements in practices of cross-border trade	Improving or putting in place a framework for a dialogue on border trade. Sensibilization in order to reduce illegal taxes.	500,000		2	New
Facilitating transport and trade	Trade	Boundary demarcation	Rehabilitation of boundary demarcations in the Lake	3,200,000		1	PQI
Preserving the environmental capital of the Lake	Biodiversity	Management of the biodiversity and the ecology	Elaboration of a methodology and application	1,000,000		1	PQI

Better managing the water resources of the basin	Water management	Implementation of the Water Charter	Institutional strengthening. Support to planning and monitoring	500,000		3	PQI
Better managing the water resources of the basin	Pollution	State of play	Updating the World Bank study, and definition of a methodology for monitoring.	500,000		3	New
Better managing the water resources of the basin	Pollution	Defining and designating the Lake as a highly sensitive environmental zone	Legal study. Measures toward classifying Lake Chad as highly sensitive	4,000,000		1	PQI
Disseminating information, improving knowledge, and monitoring of the environment	Inter-basin transfer	Undertaking a more complete feasibility study	On the environmental impact, technical aspects, economic aspects, financial aspects, geopolitical aspects in the Chad and Congo basins	2,000,000		3	PQI
Disseminating information, improving knowledge, and monitoring of the environment	Inter-basin transfer	Scientific Monitoring Cell	Scientific watch for capitalization of useful information to deepen reflection on transfer	4,000,000		3	New
Disseminating information, improving knowledge,	Hydrology	Study on sub-surface water	Deepening of existing studies. Implementation of	100,000		3	New

and monitoring of the environment			a monitoring system.				
Disseminating information, improving knowledge, and monitoring of the environment	Hydrology	Study on possible improvements for the Great Barrier		300,000		1	New
Disseminating information, improving knowledge, and monitoring of the environment	Socio-economic information	Knowledge of population and population movements	Definition of an adapted methodology for monitoring	300,000		1	New
Disseminating information, improving knowledge, and monitoring of the environment	Socio-economic information	Knowledge of the agricultural economy	Definition of an adapted methodology for monitoring	1,000,000		1	New
Disseminating information, improving knowledge, and monitoring of the environment	Information and participation	Information and public participation	Strengthening of capacities. Sharing of information. Organization of a national dialogue	3,000,000		3	PQI
TOTAL LCBC				23,900,000	3%		
TOTAL PLAN				916,000,000	100%		

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Acronyms and Abbreviations

AFD	French Development Agency/ <i>Agence Française de Développement</i>
AfDB	African Development Bank
CAR	Central African Republic
CRU	Cambridge Research Unit
GIZ	Gesellschaft für Internationale Zusammenarbeit
IPCC	Inter-governmental Panel on Climate Change
IWRM	Integrated Water Resources Management
LCBC/ <i>CBLT</i>	Lake Chad Basin Commission/ <i>Commission du Bassin du Lac Tchad</i>
LDP/ <i>PLD</i>	Local Development Plan/ <i>Plan Locale de Développement</i>
LOAP	Land Occupancy and Allocation Plans
LTDP	Local and Territorial Development Plan
PRODEBALT	Lake Chad basin Sustainable Development Program
PURDEP	Priority Development Emergency Program for the youth and vulnerable people in lake Chad region
RID/ <i>IRD</i>	Research Institute for Development/ <i>Institut de recherche pour le développement</i>
SAP	Strategic Action Plan
LDC/ <i>SO DELAC</i>	Lake Development Company/ <i>Société de développement du lac</i>