SAVING LAKE CHAD

Based on Proceedings of Sirte Roundtable, Libya, 17th December 2008

Prepared by
Engr. I. K. Musa
With Contributions from
Mohammed Bila,
Boubakari Mana and
Chaibou Mahaman

on
behalf of the

Lake Chad Basin Commission (LCBC)

and

International Commission of Irrigation and Drainage (ICID)

Contact address:

Lake Chad Basin Commission (LCBC)
CBLT Siége, BP 727, Ndjamena,
Chad Republic
Tel: +235 524145, Fax:+235 524137
e-mail:

International Commission on Irrigation and Drainage (ICID)
48 Nyaya Marg, Chanakyapuri, New Delhi 110021
INDIA
Tel: 91-11-26116837/26115679 Fax: 91-11-26115962
e-mail: icid@icid.org

PREFACE

This document entitled "Saving the Lake Chad" is yet another effort by Food and Agricultural Organisation of United Nations (FAO), International Commission on Irrigation and Drainage (ICID) and Lake Chad Basin Commission (LCBC) as part of the campaign to save Lake Chad launched in 1994 by LCBC member States to reach wider audience of the World community for assistance to meet the challenges facing the people of Lake Chad Basin as a result of the impact of global climate change.

The idea to publish this pamphlet emanated from the meeting of the Special Team (ST-LCB) of ICID which was held after the Roundtable Conference on Saving the Lake Chad in Sirte, Libya on the 17th December 2008.

Lake Chad is the largest, fresh water reservoir in the Sahel region of Africa. The Lake has been a cultural and trading Centre for many centuries and provided the vital transit place for trans-African merchants. The resources of the Lake and its basin provided the subsistence for the livelihood of more than 30 million people, most of whom are farmers, fishermen and livestock breeders. But today the resources are fast diminishing as a result of several decades of droughts and desertification caused by shortage of rainfall, high winds and temperature rise in the Sahel region. Most of the people are now refugees in their own land while many of them along with their herds have migrated southward and are still migrating.

Virtually all the wetlands in the region are either dried up or on the verge of drying up. The Lake itself has shrunk to almost one twentieth of its size when LCBC was born in 1964. This has led to serious environmental degradation in the basin such as loss of biodiversity, loss and/or modification of ecosystem, desertification and sedimentation of the water bodies.

Currently the climatic conditions of most parts of the Lake Chad region is hot and dry, with rainfall varying between 1,500 mm per year in the southern parts of the region to less than 100 mm in the northern parts of Chad, Libya and Algeria. Due to this situation, we are now witnessing a shift of isohyets up to 150 – 200 km south-wards and a drop in annual rainfall of about 200 – 1000 mm in most of the cities and villages of the basin in the last several decades.

Broadly speaking the challenges facing water management in the Lake Chad Basin include increasing freshwater availability, reducing water demand and enhancing water allocation mechanisms. In order to address these problems caused by the shortages of water within the basin, the LCBC and its member States have produced Master Plans, Strategic Action Plan and recently Strategic Action Programme all aimed at mitigating the impact of Climate Change in the basin.

However, the depletion of water resources of Lake Chad basin has long reached the limits for sustainable development. Therefore the problem of water shortages within the basin cannot be solved by efficient management since the largest amount of water loss is attributed

to evaporation and inadequate precipitation in the basin. Indeed the conditions in the Lake Chad basin require measures beyond management of the available water resources.

A major water transfer to the region is currently being considered to restore the lake, improve base flow and channel storage, arrest groundwater recession and falling water table, and to enhance groundwater recharge, so that a state of equilibrium may ultimately be attained.

It is however my conviction that, given clear policies and strategies, real commitments to implementation and a well structured and efficient LCBC, the challenges facing the Lake Chad Basin could be overcome and water for all uses would be available to eradicate poverty and achieve sustainable development in the Basin. The level of the needed financial resources is indeed very high and calls for commitment by all stakeholders including donors, governments, local communities, the private sector and the international community.

We are grateful to those governments and our Development Partners that have already encouraged us with their active support, and call upon all those friends of Africa to help create an awareness of the Lake Chad Basin and assist in the mobilisation of financial support necessary to overcome these challenges.

Finally LCBC remains grateful to all those that contributed to making this document available to all interested readers. Particularly Engr. I.K. Musa, the pioneer Director General of the Nigeria Agency for Integrated Water Resources Management, who anchored and edited the compilation of this document as well as Mahaman Chaibou, Boubakari Mana and Muhammad D. Bila all staff of LCBC who contributed immensely in the preparation of the document.

Engr. Muhammad Sani ADAMU
Executive Secretary of LCBC
2000 - 2009

Contents

1. INTRODUCTION

The Lake Chad Basin is home to about 20 million people and is on the brink of humanitarian and environmental disaster. The looming crisis which has common root cause of climatic change aided by anthropogenic activities has several facets: the Lake Chad has shrunk by as much as 90% over the past three decades; most of the citizens of the basin have no domestic water services – clean or even unclean – just to get by, many suffer from avoidable malnutrition and diseases caused by poor sanitation; the people and governments lack the wherewithal to solve the problems. Yet, if the situation is left unattended, it could lead to serious regional catastrophe with significant global repercussions.

The repeated droughts of the 1970s and 1980s, have led to drastic changes in the environmental conditions of the Lake Chad Basin which in turn has led to the drying up of Lake Chad, the encroachment of the desert, the decline of agriculture, livestock and fisheries which now threatens the social and economic well-being of people living in the basin. As **was succinctly expressed** by Mr Muhammadu Bello, a fisherman:

> "**I don't know what global warming is, but what I do know is that this lake is dying and we are all dying with it.**"

Muhammadu Bello and his nine children used to depend on Lake Chad for their livelihoods but as a result of shrinkage of the lake he is now a farmer as the waters vanished from his village, it is anybody guess what would become of him and his family, unless something is done to avert the imminent water crisis in the Basin.

A critical task of saving Lake Chad is to mitigate the shrinking of the Lake and conserving the ecosystem that it depend on without lossing the focus on and linkages to securing livelihood for the inhabitants that depend on the system. In doing so the report is anchored on the programme on the Millennium Development Goals[1] (MDGs) and the Vision articulated for the Basin. The choice of MDG is deliberate because it provides a global national programme and thus a thread that should bind the member nations and indeed the world to immediate response to the looming humanitarian catastrophe that threatens to engulf the basin.

This Report is the revised and prose version of what was first presented to a Roundtable discussion on Saving Lake Chad Basin held during the Ministerial Conference on Water for Agriculture and Energy in Africa[2]. It took in various suggestions and comments from the round table discussion. The report seeks to highlight the social, economic, political and environmental challenges that need to be urgently addressed to save the Lake Chad Basin.

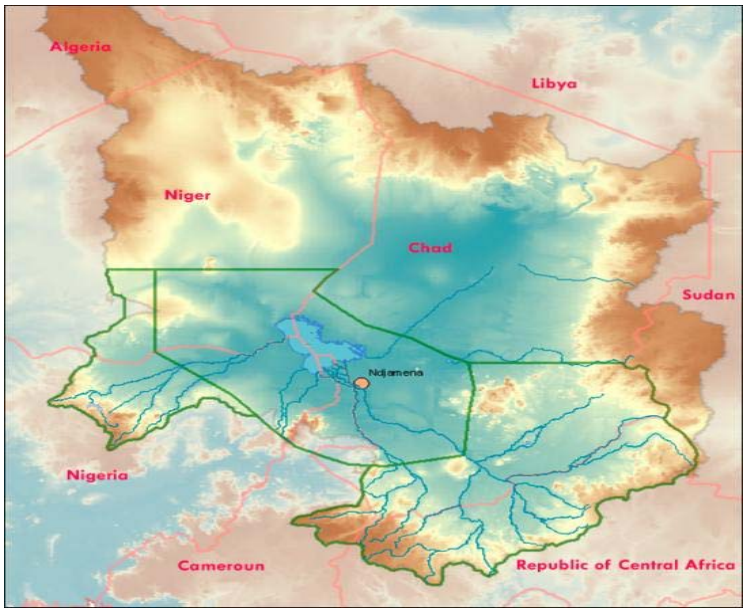
The specificity and critical points are thus saving the Lake Chad and it centrality to the attainment of the MDG in the region and this should underline the discussions and immediate global response. It requires focus at addressing the following:

- where does the basin stand at the moment?
- what are the lessons learned on the way leading the present situation?
- probably and more importantly in terms of saving the Lake Chad, what should we propose in terms of interventions for increasing the effectiveness of water to achieve the

[1] The eight MDGs – are blueprint agreed to by all the nations and the leading development institutions' that seeks to galvanize unprecedented efforts to meet the needs of the world's poorest.

[2] held in Sirte, Libya, between 15-17th December, 2008

MDGs?



2. CONTEXT AND THE SHRINKING LAKE CHAD

2.1 Physical and Socio-Economic

The Lake Chad Basin serves as a source of fresh water, fisheries, and pastoral and agricultural lands for a population of approximately 30 million people living in the basin situated in Algeria, Cameroon, the CAR, Chad, Libya, Niger, Nigeria, and Sudan.

The basin like other African basins is suffering more from Climate Change effects. This is unfortunate given the fact that the region has contributed insignificantly to the carbon emitted to date.

Fig 2.1: Hydrological and Conventional Basin

The Lake Chad hydrographic basin is theoretically 2 381 635 km², but the active basin is only 966 955 km² and it is characterized by wind erosion, silting, drought, and desertification.

Table 2.1: Area of the Active and Conventional Lake Chad Basin

Country	Surface of Active Basin (km²)	Conventional Basin (km²)
Algeria	93.6	-
Cameroon	50.775	56.80
Niger	691.473	162.375
Nigeria	179.282	188.000
C.A.R.	219.410	197.800
Sudan	101.048	-
Chad	1.046.196	381.980

Libya	-	-
Total	**2.381.635**	**966.955**

There are 4 climatic zones in the Lake Chad Basin corresponding to different types of isohyets, namely: Very arid Saharan, Moderately Arid Sahelo-Saharan, Semi-Arid Sudano-Saharan, Sudano-Guinean. The water scarcity and drought situation in the nations that constitute Lake Chad Basin are as follows:

Table 2.2: Water Scarcity and Drought in Lake Chad Basin

Country	Total Internally Renewable Water 10^{10} (m^3/yr)	% share of Total Flow Originating outside of Border	Projected 2025 Population (million)	Internal Run-Off per Capita (m^3/yr)	Annual Water Withdrawal per Capita (m^3)
Algeria	1.39	3	42.9	324	180(1990)
Cameroon	26.86	0	25.1	10,701	31(1987)
CAR	13.95	0	5.8	24,052	26(1987)
Chad	1.50	65	17.5	857	34(1987)
Libya	0.06	0	8.1	74	880(1994)
Niger	0.35	89	26.3	133	69(1988)
Nigeria	22.10	21	210.1	1,052	37(1987)
Sudan	3.40	77	54.3	626	651(1995)
TOTAL	69.61		390.1	1760	

Today the nations in the basin have a combined total population of about 237 million people, which is projected to reach about 390 million by 2025. Meanwhile, urbanization which is currently at about 50% is likely to rise to 70% by 2030. The following represent the Human Development Index (HDI) for the LCBC member states as at 2006.

Table 2.3: The HDI for LCBC member States out of 179 countries in 2006

Country	**HDI rank and value**	**Life expectancy at birth, years**	**Adult literacy rate, (% for Ages 15 and above)**	**Combined primary, secondary and tertiary, gross enrolment ratio (%)**	**GDP per capita (US$), and rank**
Central African Republic	0.352/ 178th	44.0	48.6	28.6	679/170th

Libyan Arab Jamahiriya	0.840/ 52nd	73.6	86.2	95.8	13,362/54th
Niger	0.370/ 174th	56.2	29.8	26.2	612/173rd
Cameroon	0.514/ 150th	50.0	67.9	50.8	2,043/133rd
Nigeria	0.499/ 154th	46.6	71.0	52.5	1,852/139th
Chad	0.389 /170th	50.4	25.7	36.5	1,470/147th

Source: Human Development Report 2007/2008, UNDP

The Lake Chad Basin is comprised of the following diagnostic basins:
Lake Chad: The Lake itself has a maximum surface area of approximately 25,000km², and has distinct morphological pools that become fully visible at a water surface elevation of about 279 meters. Although it is a closed basin within an arid zone, it has relatively low salinity. A major concern of the lake is shrinkage, haven shrunk from 25,000km² to the present expanse of less than 3,000 km². This has a negative impact on, among other things, irrigation schemes. The lake also serves as a critical, strategic area for global biodiversity, being home or supportive to 120 and 372 fish and bird species respectively. The adjacent land to the lake serves as an important grazing area for livestock. The current status of the Sitatunga, a swamp adapted to antelope, is also of concern. The lake fishery is an important source of protein for local populations.

Figure 2.2: The four states of Lake Chad, base on lake levels and typical inflows

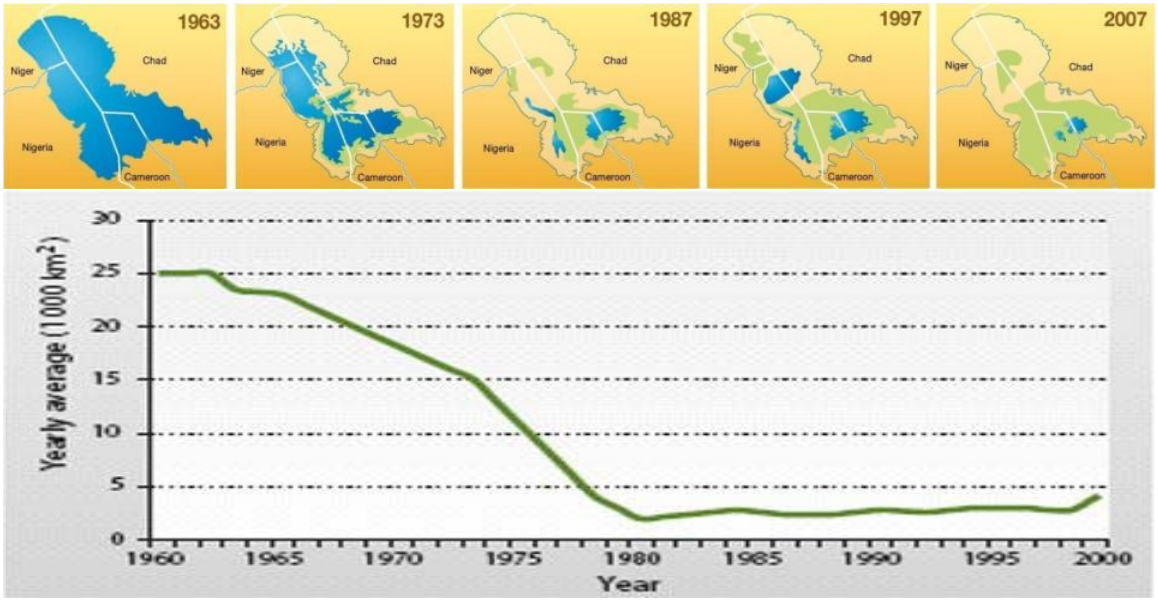
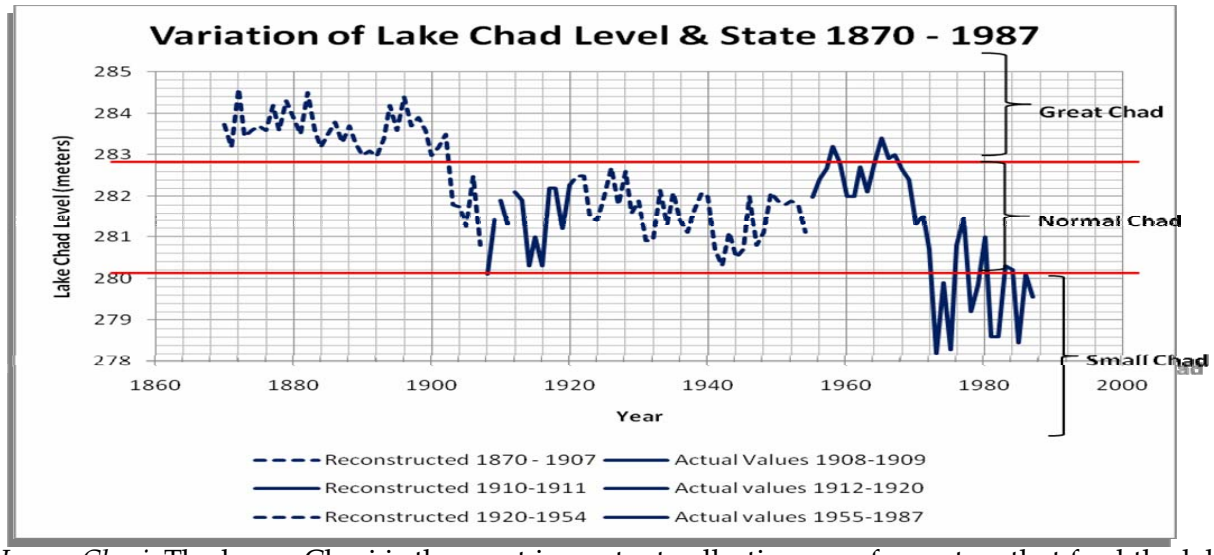


Table 2.4: Four states of Lake Chad (Tilho 1910;1928, Holz et al. 1984, UNEP, 2004)

State	Lake Level	Surface Area
Great Chad	water level of greater than 283m	open water area of 25,000 km²or more
Normal or Medium Chad	water level of 282m	open water area of about 20,000 km²
Little Chad	water level lower than 281m	open water area of 1,750 km², swamp of between 6,000 km2and 15,000 km²

Alimnetric Chad	period of no open water (lake has disappeared)

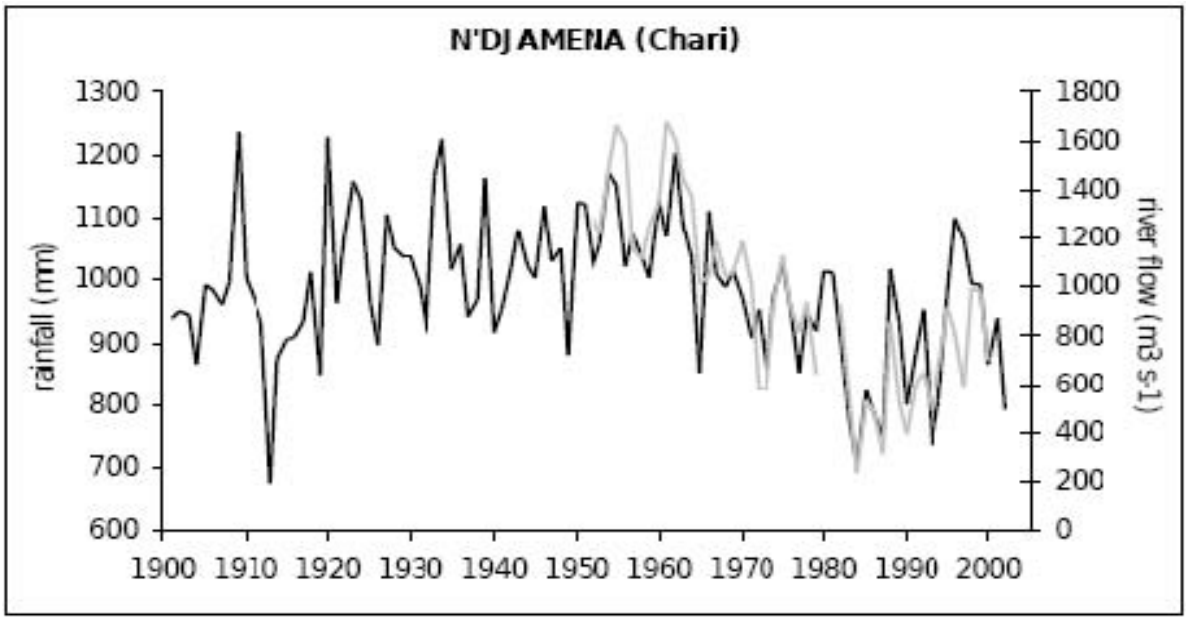


Lower Chari: The lower Chari is the most important collecting area for waters that feed the lake, having the largest permanent river. This basin spans the Sahelo-Sudanien zone and the Sudano-Sahelian zone. There is a national park (Dougia) and one Faunal Reserve (Mandelia) within this sub basin, both of which require adequately protection. The population is facing resource constraints related mainly to water scarcity. Economic diversification (cultivation of hydrophilic sorghums and millet, seasonal hunting and fishing, intensive livestock rearing) has been the traditional response to this constraint.

Table 2.5: Typical Flows at Ndjamena

Period	Annual Chari Run-off	Lake Level	Related to
1870-1905	>40km3	>281.6	Great Chad
1950-1972	40km3	281.6	Normal or Medium Chad
1972-1982	21km3	<281	Small Chad
Wettest period	(1961)	53km3	
Driest period	(1984)	7 km3	

Figure 2.3: Evolution of Rainfall & Runoff at Ndjamena1900 -2000



Trend in Ndjamena rainfall and flow in river Chari. The dark line is rainfall while the grey line is river flow (after Conwayetal, 2008).

The Flood plains of the Logone: It occupy about 25,000 km^2, the most significant of which is the a 5,000km^2 Grand Yaeres. Among its major concern is the Maga Dam that was to support rice production, but is now moribund with a very disruptive effect on the ecology and economy of the Grand Yaeres and the Waza National Park. In addition to supporting large numbers of seasonally grazed livestock, the flood plains support major fisheries and fish spawning habitat.

The Komadugu Yobe: The river system drains 148,00km^2, and is a tapering stream- loosing a large part of its flow by infiltration and evapo-transpiration. It has the largest number of dams and population of all the sub-basins, however, poor management of the river system and reservoir operations have altered its water regime. The Hadejia-Nguru Wetlands, home to Nigeria's premier Ramsar site, is in this sub basin. The Kouri breed of cattle, unique to the LCB, is also found here.

The Borno Drainages: It is a featureless plain drained by three rivers (Yedseram, Ngadda, Gobio) that make a very negligible contribution to the lake's inflow. The Sambisa Game Reserve (important for elephant conservation), the Chingurimi Duguma and the Lake Chad Game Sanctuary Sectors of the Chad Basin National Park are situated in this sub basin. It is also home to the largest, failed irrigation scheme that has become moribund as lake levels have dropped.

Northern Diagnostic Basin: Noted for its Oasis, this is the largest diagnostic basin (807,360 Km^2). It supplies no inflow to the lake, as it is also the most arid sub basin. Major concerns here include the mobilisation of dunes by trampling livestock and the over harvesting of increasingly scarce trees.

Lake Fitri: This is a miniature version of Lake Chad. It is a rich source of pasture in a zone of scarcity. There is an intensified competition for the resources of this sub-basin amongst the indigenous populations, resulting in increased risk of conflict over resource use.

3 WATER MANAGEMENT OPTIONS

3.1 Preamble

Lake Chad Basin is faced with acute water scarcity. This was caused by climate change and exacerbated by human actions in three ways: population growth, pollution/misuse and unsustainable resource-use practices. Population pressure has contributed to the scarcity simply because the finite available water in the basin is being shared among more and more people. Pollution, loss or modification of ecosystems and biodiversity have contributed to water scarcity by way of polluting and overusing existing supplies – i.e. through the consumption of the resource's "capital" . Responses to mitigate the problems have been slow because of the inadequacy of sustainable development on the political agenda of the Member States; and a low standard of environmental education and awareness. These were worsened by institutional failures. The net effect of these problems is the deepening poverty in the sub region.

3.2 Trans-boundary Diagnostic Analysis (TDA)

A Trans-boundary Diagnostic Analysis (TDA) was conducted to identify the common trans-boundary problems. The TDA identified seven environmental problems of regional concern, which are listed here in order of priority:

a) ***Variability of Hydrological Regime(rivers and rainfall) and Fresh Water Availability*** has led to the decrease in the lake's volume by 95% between 1963 to date and the continuing decline in access to water, crop failures, livestock deaths, collapsed fisheries and wetlands services, etc. Furthermore, it also drives or contributes towards all the other six problems.

b) ***Water Pollution*** is caused mainly by the absence of working regulations and standards for environmental protection. Inorganic chemical pollution and eutrophication as well as the increasing oil exploitation in Chad, will give rise to increased pollution of water bodies, which will contribute to fisheries depletion and a possible increase in invasive species.

c) ***Decreased Viability of Biological Resources*** arising from inability of the regenerative rates of the plant and animal resources to keep pace with exploitation and disturbances. This phenomenon has a spiralling effect, leading to more unsustainable resources use and thus more degradation, leading to deepening poverty due to resources shortages and biodiversity loss and increasing variability of hydrological regime and fresh water availability.

d) ***Loss of Biodiversity*** of plant and animal species, as well as damages to ecosystem health. This reduces ecosystem productivity and thus resources availability, resulting in deepening poverty. It also contributes to the decreasing viability of biological resources.

e) ***Loss and Modification of Ecosystems,*** with the lake, for example, changing from open water to a marshy environment and destruction of about 50% of wetlands; due predominantly to reduced flows. This has led to the collapse of some fisheries and recessional rice cultivation, as well as loss of biodiversity and the decreased viability of biological resources.

f) ***Sedimentation in Rivers and Water Bodies-***which has affected channel flow patterns and reduced the inflows to the lake, as well as the colonisation of the silted sites by invasive species. It is driven mainly by unsustainable farming practices on marginal lands.

g) ***Invasive Species*** – such as typha grass and water hyacinth that have invaded the Lake itself and blocked the river channels diverting flows, destroying infrastrastructures and providing roosting ground for quelea birds

arising largely from poor water resources management, poor enforcement of environmental regulations and standards, and the absence of resource-use planning.

Figure 3.1: Typha blocked the river channel and turned the highway into a water course

Table 3.1: Priority Transboundary Problems and their Overarching Root Causes

Ranking	Description of the Water Problem	Overarching Root Causes
1	Changes and variability of hydrological regimes and fresh water availability	Low priority of sustainable development on the political agenda; low standard of environmental education and awareness; and population pressure and Climate Change.
2	Water pollution	Low priority of sustainable development on the political agenda; low standard of environmental education and awareness; and population pressure
3	Decreased viability of biological resources including fish stocks	Low priority of sustainable development on the political agenda; low standard of environmental education and awareness; and population pressure
4	Loss of biodiversity	Low priority of sustainable development on the political agenda; low standard of environmental education and awareness; and population pressure
5	Loss and/or modification of ecosystems	Low priority of sustainable development on the political agenda; low standard of environmental education and awareness; and population pressure
6	Sedimentation in rivers and water bodies as a result of upstream land degradation	Low priority of sustainable development on the political agenda; low standard of environmental education and awareness; and population pressure
7	Invasive species	low standard of environmental education and awareness; and population pressure

3.3 Environmental Management Challenges

- ***Legal and Regulatory:*** The LCBC Convention has not been sufficiently backed by the relevant national legislations. Sectoral laws related to water resources management in the member country would need to be streamlined and harmonised with regional perspectives.
- ***Institutional:*** The LCBC should be empowered to arbitrate water conflicts or sanction Member State. It should be able to foster basin level integrated water resources management and have the necessary funds for routine hydrological, livestock and resource monitoring.
- ***Economic and Financial***: The Basin has a rapidly growing population that is predominantly rural, with most livelihoods dependent on natural resource exploitation such as fishing,

agriculture, livestock rearing mining and oil exploitation. The countries within the region are among the poorest countries[3] in the world. The economies of the countries generally suffer from very low productivity, insufficient infrastructure that are deteriorating, the lack of a dynamic private sector, an oversized informal sector, vulnerability to domestic and external shocks; civil war in some, insignificant foreign aid and investment and the HIV/AIDS pandemic.

- ***Information***: The region has severe limitations in available regional data and information. Data are often insufficient, inaccurate or not-harmonized, not readily available, and often in non-user friendly formats. There is also insufficient media attention to the environmental issues. The research and pilot studies conducted in the region under LCBC and the GEF Projects have however, contributed to the overall knowledge of the Lake Chad Basin environment and demonstrated the ability of the countries to cooperate in data and information exchange.

3.4 Environmental Quality and Water Resource Objectives (EQWROs)

The Strategic Action Programme identified that the foregoing priority trans-boundary problems in the LCB would most effectively be addressed through the following Environmental Quality and Water Resource Objectives (EQWROs):

- Improved quantity and quality of water in the Lake Chad Basin, especially the Lake;
- Restoration, conservation and sustainable use of bio-resources in the Lake Chad Basin;
- Conservation of biodiversity in the Lake Chad Basin;
- Restoration and preservation of ecosystems in the Lake Chad Basin;
- Strengthened participation and capacity of stakeholders, as well as the institutional and legal frameworks for environmental stewardship for the Lake Chad Basin.

There are however a variety of water policy options or programme which can be deployed to achieve these objectives. These are grouped into two categories: the supply-side approach; and the non-structural approach. The supply-side approach is structure-oriented requiring investments in water projects combined with engineering to capture, store, deliver water and to make the systems operate effectively. The supply side focuses on providing water and related services. Emphasis is however shifting towards non-structural approaches, which encompasses demand management, scientific research, education and persuasion to coordinate how humans use water - more generally known as adaptive strategies. The combination of two approaches is however more commonly preferred.

Box 1: Typology of Responses to Water Scarcity

Water Scarcity = disparity between supply (S) and demand (D) (S<D)
= increasing competition on scarce resources (Conflicts)

- **Supply Management**
  - Large water infrastructure projects including Inter-basin water transfer projects
  - Groundwater exploitation
  - Treatment and reuse of wastewater
  - Desalination of brackish and sea water
  - Development of marginal water sources
- **Adaptive Strategies**
  - Reducing demand through conservation/efficiency
  - Use of advanced technology and water saving device
  - Reduction of non revenue water uses
  - Other strategies involving self help, public education, incentives etc.
  - IWRM involving combinations of Supply and demand management (including allocation control and reallocation for equity or to phase out inefficient uses).

[3]

This section would examine the various strategic actions and programme that have been advanced to address the looming water crisis in the Basin.

3.5 Scenarios and water management options

The table 3.3 briefly describes the four water & lake management options, namely: 1) Great Chad with traditional land & water use; 2) Small Chad with existing and planned developments; 3) Normal Chad with existing and planned developments; and 4)Small Chad, that reflect increasing effects of climate change with existing and planned developments.

The prevailing scenario currently is that of the Lake Chad at "Small State" with planned irrigation development of 213,400 ha that was stopped at 33,824 ha and functioned only at 23% due to water shortage in the Lake Chad basin. In the "Small State" which has subsisted since the Sahelian drought of 1972, the Lake Chad natural hydrological system negates both the aspirations of the Lake Chad Vision 2025 and the African Water Vision. For all the scenarios, the highest water loss is due to evaporation. However, under the current climate change scenario, a 2°C rise in temperature is projected which will lead to a further loss of 7 km^3 of water from the Lake Chad with an annual net deficit of 2.5 km^3 from the basin.

The basin is mostly arid to semi-arid and livelihoods are mainly pastoralists, fishing and agro-pastoralist. Water scarcity is a feature of rural livelihoods thus rural poverty prevalence is high because water is a high limiting factor. Priority to access to water for poverty reduction, makes economic and social sense, but only if the benefits accruing from them can be increased.

Table 3.2: Status of the Planned Irrigation Schemes in the Basin

Scheme	Planned (ha)	Developed (ha)	Status
South Chad Irrigation Project Phases I and II (SCIP I&II)	67,000	2000-11,000	Not functioning
Baga Polder Project	20,000	1,000	Only about 200-500ha is cultivated
Jere Bowl	2,000	Not completed	Require inter-basin water transfer
SEMRY I, II and III	12,800		
Bongor	5,000		

The potential for conventional water intervention is rated between low-moderate. A careful review of the various alternative management options showed high potential for informal and adaptive water intervention such as reducing evaporation losses, reducing demand through conservation and increased water use efficiency, soil moisture management, water harvesting, etc.

Table 3.3: Lake Scenarios and Water Management Options

Scenario	State of Lake Chad	Characteristics	Remarks
1	Great Chad with traditional land & water use	***Annual Avg. Inflow greater than 40 km³*** o Fishing from the Lake rivers and seasonally inundated swamps o Cattle rearing in the Yaeres o Wildlife habitat in the seasonally inundated lands	***No more possible due to:*** o rainfall and run-off has been declining since 1960 o LCBC Member States have attained independence and are experiencing population growth of 2.7% o general quest for socio-economic development in the region
2	Small Chad with existing and planned developments	***Annual Avg. Inflow 21 km³*** o Lake habitat had change into a giant marsh land o 213,400 ha Planned, 33,824 ha developed; only 23% functional as at 1995 o Gross water requirement for schemes is estimated at 16.4 km³	***Water shortage affects operation of existing schemes and stopped further planned development***
3	Normal Chad with existing and planned developments	***Annual Avg. Inflow40 km³*** o Lake Level above 281 m o Allows the utilisation of the investment of 33,824 ha with possible development to 213,400 ha o Restore lake habitat, enhance carbon sink function in the vicinity of lake & arrest loss of biodiversity	***Requires inflow augmentation from 21 km³ to at least 40 km³***
4	Small Chad, increase climate change with existing and planned developments	***The 1972 –1982 average inflow 21 km³*** o Gross irrigation water requirements16.5 km³ o 2°rise in temperature will lead to further evaporation loss of 7km3 o the water balance in the Lake Chad basin will become a deficit of 2.5 km³	Peak water levels in the lake would be reduced by 0.2m and 0.4m for the south and north pools, respectively

In consideration of all of the foregoing, the optimal development scenario for the Lake Chad basin requires the restoration of the Lake Chad to its "Normal State" with lake level above 281 m and a sustained inflow of at least 40 km³per annum combined with integrated natural resources and environmental management (adaptive strategies).

Table 3.4: Estimated Costs of Some Water Management Options

Management Option	Estimated Cost range (U.S. cents per cubic meter of treated water)(*1995 estimate)*
Reducing demand through conservation/efficiency	5-50
Treatment and reuse of wastewater for irrigation	30-60
Desalination of brackish water	45-70

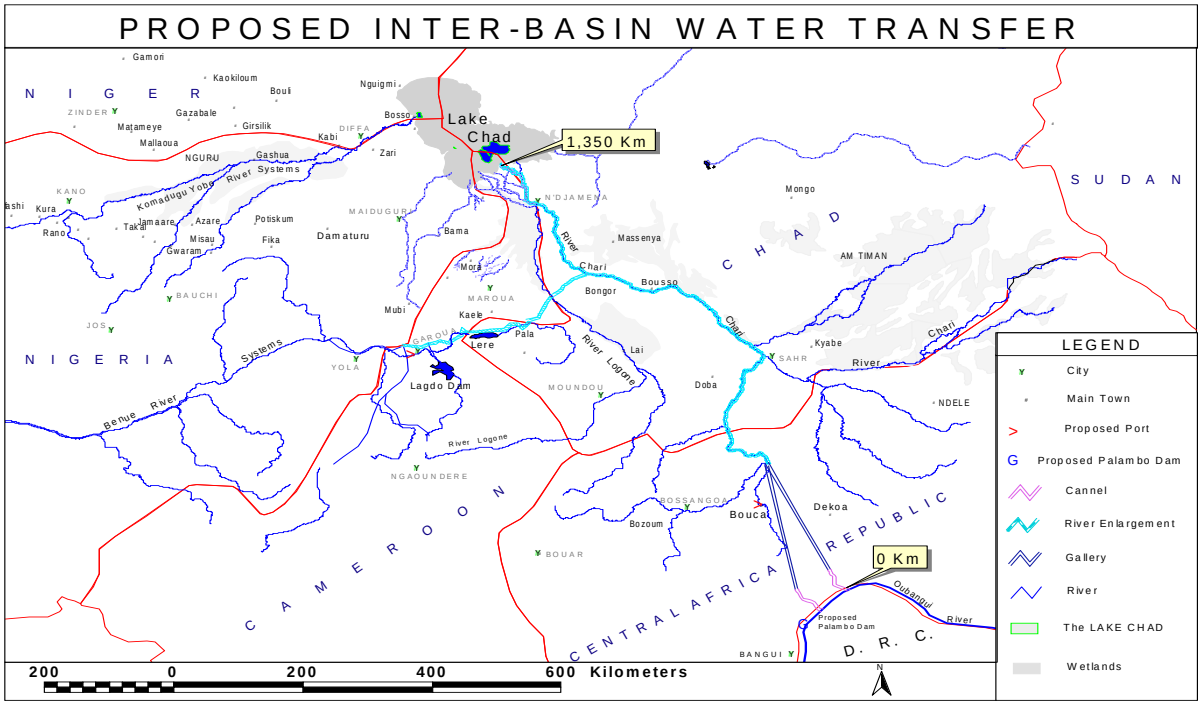
Development of marginal water sources	55-85
Desalination of seawater	100-150

3.6 Proposed Inter Basin Water Transfer from Oubangui River to Lake Chad

3.6.1 Evolution of the Project

The idea of an Inter-basin Water Transfer into Lake Chad was first muted in TRANSAQUA and developed in 1988 by BONIFICA, an Italian firm. BONIFICA advocated a gigantic plan for the construction of 2,500km navigable channel parallel to the proposed Lagos-Mombassa trans-equatorial road stretching from port of Mombassa in Kenya to River Niger. It was to draw its waters from tributaries of the river Congo. The primary objective of the BONIFICA project was to foster economic integration in the continent.

It was not however until 1994, during the 8thSummit of the Heads of States of Lake Chad Basin Commission that the Heads of State underscored the need for Interbasin Water Transfer as a lasting solution to the drying up of the Lake Chad. It also admitted Central African Republic (CAR) as full member of the Commission. Considering the magnitude of the BONIFICA project, it was agreed that the point of water transfer be river Oubangui instead of river Congo. At the subsequent Summit in 1996, the idea of an Inter-basin Water Transfer from Oubangui to Lake Chad got tacit support with the resolution to undertake all the necessary studies to ascertain its feasibility or otherwise.

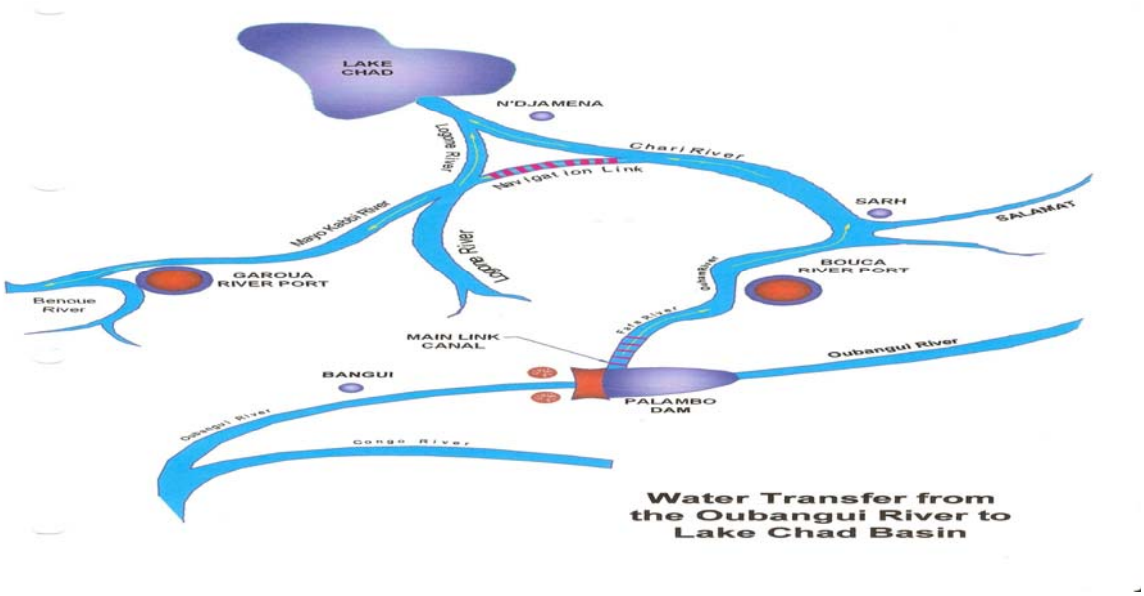


The CAR provided maps and documents that assisted in the reconnaissance study to identify the sites near Bangui between Zawara and Palambo for the dam. A study funded by European Economic Commission (EEC) in 1990 showed preference for the site at Palambo and using gravity to convey the water. Preliminary details of the project were thus collated and reviewed into a project document for feasibility study and engineering design. This was presented and approved at the 10thSummit, 2002 following which it was resolved that each member State should contribute 1 million dollars for the commencement of the study and a Management Committee and a monitoring Technical Committee were established.

3.6.2 Objectives of the project

The primary objective of the project is to halt the drying-up of Lake Chad and other wetlands as well as to gradually restore the Lake to its normal level for sustainable development of the basin. Secondarily, to also:

- Facilitate the navigation and transportation of goods as well as tourism etc;
- Generate 700MW of electricity through hydropower;
- Regulate the Oubangui River in order to prolong its current period of navigation
- Clear the region of its landlocked nature and achieve regional economic integration, cooperation and security;
- Act as a catalyst for the re-establishment of fishery and irrigation activities;
- Promote poverty alleviation, drought mitigation and control of desertification.



Source NESPAK

3.6.3 Proposed Component of the IBWT Project and Specific Studies thereon

The following are the main component of the proposed interbasin water transfer project:

1. Palambo Dam
    a. Water release regulation
    b. Water level adjustment
    c. Hydroelectric power generation (~700MW)
2. 150-170 km long tunnel/canal to connect the two basins
3. River training/dredging to ensure discharge of 900 m^3/sec
4. Construction/rehabilitation of identified river ports;
5. Necessary measures to improve the environment;
6. Desilting and linking the North and South pool of the lake.

To achieve these it has been proposed to undertake the following environmental impact assessment studies of the project on:

- The Lake Chad;
- The Chari River and the canal route to link Chari River to the Logone, Mayo Kebbi and Benue rivers
- The Tributaries of Chari and Oubangui rivers
- The portion of Oubangui situated downstream of Palambo dam right to the confluence with river Congo

3.6.4 Activities completed and the way forward

The Terms of References (TOR) of the feasibility study was completed and approved by the Summit after obtaining the no-objection of the two Congo. Subsequently, the required financial resource for the feasibility study has been mobilized, and tenders invited for bids to undertake the feasibility study. The bids were opened late in 2008 and have been evaluated. The evaluation report with recommendation is awaiting award to recommended bidder by the Council of Ministers.

To ensure strict compliance with international best practices the AU-Economic Commission sponsored Workshop to Prepare Guidelines for Inter-basin Water Transfer recommended that International Peer Review Team be put in place to monitor the processes. This should also be complimented with LCB Water Charter, which is currently under preparation.

The largest amount of water loss is attributed to evaporation (evapo-transpiration which is significantly greater than rainfall) and climate change would increase the evaporation losses which would need to be mitigated otherwise the benefits of water transfer would be short-live.

3.7 Adaptive Strategies to Climate Change and Water Scarcity

Human activity is the main cause of climate change upsets and can be reversed or at least mitigated through ADAPTIVE STRATEGIES. Various trans-boundary water resources studies have revealed several strategies and factors with significant potential to provide low cost abatement opportunities, but which have received insufficient attention from most riparian and funding agencies to date. These include: a) intra-sectoral allocative efficiencies that include the use of improved methods of irrigation; the selection of more appropriate crops; etc; b)inter-sectoral allocative efficiencies ; c) virtual water flows involving food security at a national and regional levels; d)strengthening information gathering and sharing; and e) creating enabling environment for economic growth. Specifically, the key adaptive strategies enumerated in the table 3.5 would be briefly highlighted.

Table 3.5: Key Adaptive Strategies to Climate Change

Adaptive strategy	Brief Description of Requirements and Solutions
Rainwater harvesting and small storage	Legal framework for rainwater management Knowledge transfer Cloud seeding Development of eco-roof technologies
Water reuse to meet multiple water uses	Reclaimed water from municipal, industrial, domestic recycling for non-potable purposes, such as eco-enhancement, agriculture etc
Aquifer recharge and aquifer storage and recovery (ASR)	Conjunctive water management Aquifer Storage and recovery (ASR) system; and Utilising the capacity of floodplains
Soil Moisture Management especially in rainfed areas	Conservation agriculture to reduce the impacts of dry spells and improve water use efficiency practices and technologies
Agricultural and other insurance policy;	Facilitate risk management and mitigate negative consequences of adverse effects of climate change
Improved observation network to facilitate better prediction	To improve design, water conservation and reduce loses and negative effects arising from extreme events
Development and Management Instruments to create more favourable environment for economic growth	IWRM and water efficiency Plans, policy and legislation; Social, economic and environmental impacts mitigation and promotion of alternative supplies at catchment scale City of the future; Virtual water transfer; etc

3.7.1 Rainwater harvesting

There is tremendous potential for rainwater harvesting in the Basin, which has significant advantage of being essential self-help solution. It however require a legal framework forits management which would require pilot projects to fine-tune especially with regards to identification of which system offer greater benefits that of individual homes/buildings or a system that covers a whole city and that covering the catchment. Research is required on socio-economic review of the system. These together would enable quality monitoring and regulatory frameworks; apportion O&M responsibilities; risk mitigation (if any); public awareness; stakeholder involvement; cost models; financing; incentives etc; to be identified.

In particular, research and development of eco-roof technologies, including sustainable treatment technologies for multi-function roofs (i.e. reed roofs +reed bed + storage + on-site solar + disinfection + Cooling of photovoltaic panels etc) would be required. This could be supported by demonstration and integration study in cooperation with the construction industry. Furthermore, pilot study on cloud seeding, ways of reducing evapotranspiration and low-cost greenhouses would be required. Afterwards the knowledge gained would then be transferred through cooperative projects with NGOs for installation of low tech, low O&M, and best practices for optimum water usage.

3.7.2 Water reuse

Water reuse from reclaimed water from municipal and industrial use as well as domestic recycling for non-potable purposes, such as eco-enhancement, agriculture etc has tremendous potential in the basin. There is however the need to institutionalize risk assessment based approach for managing these water reuse systems by providing guidelines for risk assessment based framework; deployment of best available technologies and ensure efficiency of natural attenuation;
balancing non-potable water reuse with potable purposes and aquifer recharge; and using appropriate indicators and surrogates. Meanwhile, it would be necessary to provide innovative hybrid technologies to remove persistent pollutants; explore reuse of municipal effluents to industrial purposes. This has to be supported with adequate water quality assessments in relation to specific uses and technologies.

3.7.3 Managed Aquifer Recharge and Aquifer Storage and Recovery (ASR)

There currently exist substantial water storage capacities in the basin; especially in Komadugu-Yobe sub-basin, that can relatively be inexpensively utilized for augmenting water supply by integrating existing reservoirs with groundwater aquifers (called conjunctive water management); aquifer storage and recovery (ASR) system; and utilizing the capacity of floodplains downstream of flood control reservoirs to accommodate (store and attenuate) controlled flood flows, provided that the land used are adapted to this purpose.

Note that most large irrigation and hydropower dams have also flood control function. These strategies also have the potential to restore the environmental damage that these dams may have caused that were not contemplated before.

3.7.3 Intra-sectoral efficiencies and Conservation agriculture

Member states of LCBC utilize water inefficiently, especially in 'thirstiest' sector – agriculture – even though the region is water stressed. Very considerable improvements in water use efficiency can be achieved through introduction of high technology irrigation systems such as sprinkler and drip irrigation to produce more food per drop of water; use of mulching and zero-tillage as well as other practices to reduce evapo-transpiration; dry toilet applications - where only the urine is flushed using approximately 0.1 litres of water each use and the solid is dried over a period of about six month after which it can used as manure or burnt or buried;

the selection of appropriate crops or regulation and prohibition of cultivation of high water consuming crops.

3.7.4 Development Instruments

There are several development instruments that can be deployed to improved water use efficiency and ensure optimum allocation of water for the greatest socio-economic benefits. To ensure long-term sustainability of all structural solutions to water management, they need to be supported with adequate social, economic and environmental impacts mitigation as well as consider the promotion of alternative supplies at catchment scale. Other instruments would include:

- exploring the concept of city of the future – eco-city with synergy on water, energy, urban design;
- promotion of new dietary habits that is based on crops that are favourably disposed to scarce water situation such soya beans etc;
- virtual water transfer – through importation of high water consumption crop (national, regional and international) - this however require ability to pay for such food items or cross-subsidy;
- adaption of economy towards low-water consuming economic activities and design and mix of supplies in response to climate change etc;
- effective risk management of extreme events of drought and floods that are not preventable, involving careful assessment of the risks; implementing both structural (dams, irrigation facilities and dikes) and non-structural measures (land-use planning, forecasting, response plans, etc) to reduce risks; and sharing risk by way of insurance policy (crop insurance) and other risk transfer mechanisms; and
- population control and relocation among many others.

3.7.5 Improved observation network

The aspects of climate change that has the most significant impact on freshwater are those associated with high uncertainty. Managing under uncertainty is therefore a defining characteristic of adaptation strategy in freshwater. Recent years have seen improvements in seasonal and long term climate prediction, which has facilitated drought-management practices, but this is predicated on availability of adequate reliable data. Improve data management (collection, collation, analysis and dissemination) would lead to more accurate prediction of extreme events, more efficient designs of structures, better conservation and utilisation of the resources.

4. Financing and the Way Forward

In 1964, the four nations of Chad, Cameroon, Niger and Nigeria that surround the Lake Chad created Lake Chad Basin Commission (LCBC) to ensure the most efficient use of the basin land, water and other natural resources as well as the coordinated regional development. At its 8th Summit of the Heads of States of Lake Chad Basin Commission in 1994, which now include Central African Republic and Libya, it acknowledged the need to launch a campaign to 'Save Lake Chad' and its basin with the aim of:

- reversing the ecosystem degradation;
- re-establish the former levels of Lake Chad and other wetlands; and
- to develop sustainable and integrated water resources management in the basin.

The main rationale for the save the Lake Chad campaign derived from the desire of the Lake Chad Basin Commission and the Member states to seek assistance from development partners financial and otherwise to resuscitate the dyeing Lake Chad and to optimize the use of the scarce natural resources of the basin to attain the MDGs. The Member States share the desire for the sustainable management of the natural resources and biodiversity of the Lake Chad Basin for the benefit of present and future generations, and recognize their role and responsibility in conserving the global value of the biodiversity resources; but are only too aware that they cannot do it alone. They require support and assistance from all its development partners and indeed international community to save the Lake Chad.

The issues and the attendant looming water crisis have regional significance and must be addressed as a matter of urgency. The Lake and its related resources are at the fulcrum for the socio-economic development of the basin. Analyses shows that water stress is the most critical problem of the region (perhaps coupled to global climate change). The population is still expanding, and in some nations doubling with every two to three decades. It is no coincidence therefore, that several of the MDGs are tied intimately to access to adequate freshwater water of required quality. Consequently, if the looming humanitarian and environmental catastrophe is not urgently averted, poverty would deepen in the basin and further conflict appear to be inevitable – both within the member states and between them. Accordingly, the following conclusions and recommendations in this regard, are considered relevant for consideration by all stakeholders:

- **Environmental Management and Cooperation** as exemplified by the charter creating LCBC need to be supported with further development of specific policies and be backed with adequate financing to address and implement trans-boundary water management issues entrusted to the Commission**.** Policy development and trans-boundary management issues are insufficiently attended and funded by the member countries and amongst most development partners are inadequate to date. Unless LCBC is provided with adequate powers and resources to function autonomously, it cannot satisfactorily discharge its role as the impartial arbiter and manager of the common pool resources of the basin.

- **A holistic vision and programme is vital**: Rivers and Lake are defined not only by their annual flows, but by their flow regimes. The basin wide effects of the shrinking of Lake Chad and drying up of several wetlands on socio-economic development of the people and the steady decline in the ability to maintain critical ecosystem and biodiversity; their impacts on various sectors of the population (especially the marginalized and poor segments) and the population displacement among many other factors that they would

engender are too disastrous to contemplate. The drive for the proposed inter-basin water transfer project has been slow and tortuous, involving careful consideration of many variables; but then that is how it should be, if appropriate decisions are to be made and mistakes avoided in the future. It is however further suggested that if found feasible – it should be packaged in a holistic fashion, which would extend well beyond Integrated Water Resources Management (IWRM) to include several development instruments and policy measures. This would ensure that the ultimate solutions to the looming crisis are tailor made uniquely to the basin, and the co-riparian states. This should not however be seen as a support for the knee-jerk reactions of certain activist groups from western countries that postulate that large scale water developments are no longer necessary; instead it is clarion call for holistic vision, painstaking attention to details, adequate participation, equitable sharing of benefits between donor and recipient basin that are necessary for sustainable and enduring solution to the problems.

- **Adaptive strategies to cope with climate change and attendant water scarcity** as seen here require more than infrastructure development. It also involves behavioral change. Adaptive strategies are the core substance of sustainable development and are about systems to manage the processes of change rather than mere structures. Some of the adaptive strategies could complement and in fact ensure economic, social and environmental justification of many conventional projects. Consequently, mitigation and adaptation are not alternatives; we need them both and may involve measures that go beyond the water sector. They may not deal with all the challenges of climate change, however they can, if provided with supportive enabling policy, legislation, regulations, and properly and impartially implemented as well as backed with vigilance, capacity building, foresight provide opportunity to cope with the basin water scarcity more sustainably. Adaptive strategies require substantial investment in research and development to articulate them. Most states and citizens of the basin have limited resources to capture those opportunities, thus principle of "polluter pay" should be applied to enable them to be supported because they have contributed insignificantly to the carbon emitted to date even though they experience the worse effects of the climate change. The basin needs all the support and assistance of development partners to seize the opportunities.