

## **RAIN WATER HARVESTING - A WAY TOWARDS SUSTAINABLE WATER MANAGEMENT IN LAKE CHAD BASIN**

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### **ABSTRACT**

*Lake Chad, sixth Largest Lake in the world is largest fresh water reservoir situated in Sahel region of Africa at the southern fringe of the Sahara desert. It supports more than 30 million people in Algeria, Cameroon, the C.A.R, Libya, Niger, Nigeria and Sudan. Geographically the lake basin is spread over 4 countries of Chad, Nigeria, Niger and Cameroon.*

*Surface area of Lake Chad has been approximated as 25,000Km<sup>2</sup> in 1963 and has shrunk to one tenth of its size i.e. 2,500 Km<sup>2</sup> due to droughts in the past decades, due to reduced rainfall, high evaporation and diversion of water from the rivers feeding it. With depletion of Lake Chad all the biodiversity is at threat while people living there have to frequently shift from one place to another as nomads.*

*Irrigated agriculture is the third largest contributor to the economy of the basin after fishing and agriculture. Natural conditions in the Lake Chad basin have favoured the promotion of irrigated agriculture with partial or total control of water. As of 1995, 213,400 ha were planned for irrigation, but only 33,824 ha could be developed and only 9.74% of the irrigation potential of the area has been utilised; of which Nigeria ranks first at 27.2% and C.A.R least with 0.8%.*

*The main problems therefore are low rainfall; high evaporation; shrinkage of lake Chad area; depleting species of fish, bird and flora; increase in nomadic population; depleting food security and eco system. To address these problems the broad strategy would be to increase the water availability in the lake gradually through series of measures; to improve Water use efficiency or to reduce water demand or requirements in basin through improved Water management practices; to develop Conjunctive use of surface and ground water. There is dire need that the Lake Chad and the existing associated wetlands are maintained at sustainable levels to ensure the social, economic and ecological security of the region.*

*Based on site visit, collection and analysis of primary and secondary data and discussions with senior most officials of Lake Chad Basin Commission and local residents of the basin, this paper is written. It suggests utilisation of rainwater (through groundwater recharging) in the form of small projects spread through the seven countries sharing the basin as a first step towards sustainable water management. The focus shall be on making a series of bunds and ground water recharging structures that can cater to smaller areas, mini-watershed schemes (40-50 ha) or micro-watershed schemes (2000-4000 ha) may prove to be extremely useful; integrate with cottage industries for food preservations and processing like small scale juice, jam, ketch up and other plants; supplement with packaging units. The diverse ethnic groups, nations and ecologies of the lake Chad basin all offer perfect platform for smaller projects which may be more practical and successful rather than big multipurpose projects and schemes.*

### **1. INTRODUCTION**

A cradle of ancient civilisations, lake Chad is the fourth Largest lake in Africa after Victoria, Tanganyika and Malawi and sixth Largest in the world. It is largest fresh water reservoir situated in Sahel region of Africa at the southern fringe of the Sahara desert. The lake has been a cultural and trading centre for many centuries and is life line support system of more than 30 million people in Algeria, Cameroon, the CAR, Chad, Libya, Niger, Nigeria and Sudan. Geographically the lake basin is spread over 4 countries of Chad, Nigeria, Niger and Cameroon.

A map showing Lake Chad Basin Member States is enclosed (Exhibit 1).

## 2. HYDROLOGICAL AND CONVENTIONAL BASIN

Theoretically the hydrological basin of Lake Chad is 2381635 Km<sup>2</sup>. Parts of Algeria, Cameroon, CAR, Chad, Nigeria, Niger and Sudan fall within this drainage basin. The conventional basin (the recognised basin by a legal convention of the states) is 966955 Km<sup>2</sup>. The conventional basin is related neither to the boundaries of the basin nor to the political boundaries of four states that are part to the convention.

A map showing Hydrological and Conventional Basin is enclosed (Exhibit 2) and geographical coverage in thousand Km<sup>2</sup> is given in Table-1

A statement showing Country wise present and projected population and yearly per capita runoffs and withdrawals is given Table-2.

Currently the population is approximated at 279.3 million and is estimated to reach 523.18 million by 2050.

## 3. SHRINKING OF LAKE CHAD AND CONSEQUENT EFFECTS

Surface Area of Lake Chad has been approximated as 25,000Km<sup>2</sup> in 1963 and has shrunk to one tenth of its size i.e. 2,500 Km<sup>2</sup> due to droughts in the past four decades. The shrinking of lake started in the 1960's and this trend is continuing. The drying out is due to reduced rainfall, high evaporation and diversion of water from the rivers feeding it.

Use, overuse and abuse of wetlands and their resources are a threat to biodiversity, tribal communities that live in the region. The lake serves home for 120 fish and 372 bird species, while the adjacent lands serve grazing area for livestock's. The fisheries are the main occupation and eating product in the area.

With depletion of Lake Chad all the biodiversity is at threat while people living there have to frequently shift from one place to another as nomads. The second activity in which people are engaged in the basin is agriculture followed by irrigated agriculture.

### 3.1 Area under Agriculture/Irrigated Agriculture

The swamps or wetlands created out of shrinking of Lake Basin offer an excellent mixture of soil for cultivation but extreme evaporation in the region makes it a part of desert.

Irrigated agriculture is the third largest contributor to the economy of the basin. Natural conditions in the Lake Chad basin have favoured the promotion of irrigated agriculture with partial or total control of water. As of 1995, 213,400 ha were planned for irrigation, but only 33,824 ha could be developed with only 23% of the schemes functional. Table-3 shows Country wise area under irrigation.

It can be seen that only 9.74 % of the area at present is under cultivation whereas the potential is much beyond. There is dire need for the Governments to have more focus on irrigation schemes so as to give an impetus to the economy of the countries.

## 4. THE PROBLEM

The preceding paragraphs clearly give the problem as :

- **Low Rainfall** – Annual rainfall varies from 1500mm in south to less than 100mm in the north.
- **High Evaporation** – Annual losses by evaporation from the Yobe flood plains alone are estimated at 5 billion m<sup>3</sup> or about 50% of the annual inflow from Logone river.
- **Shrinkage of lake Chad area** – Since 1964 the area has reduced to one tenth of what it was before that.
- **Depleting species of Fish, bird and flora** – Due to increasing water pollution due to oil spills etc.
- **Increase in nomadic population.**
- **Depleting food security and eco system.**

## 5. ADDRESSING THE PROBLEMS

To address these problems the broad strategy would be :

- i. To increase the Water availability in Lake gradually through series of measures.
- ii. To improve Water use efficiency or to reduce water demand or requirements in basin through improved Water management practices.
- iii. To develop Conjunctive use of surface and ground water.

There is dire need that the Lake Chad and the existing associated wetlands are maintained at sustainable levels to ensure the social, economic and ecological security of the region.

In order to achieve sustainable management of natural (water and land) resources it is recommended that there has to be an integrated approach for management of natural resources of the Lake Chad Basin.

### **5.1 Ground Water**

The Lake Chad Basin has four principal subterranean aquifers. These are:

- Quaternary ground water resources, estimated at 150,000,000,000 m<sup>3</sup>:
- Lower Pliocene stock, at a depth of 250 m and having about 60m of usable thickness (in some parts of the Basin this aquifer is artesian in nature):
- Continental terminal aquifer, alternatively of sandstone and clay with a thickness of about 250 m.
- Continental Hamadian, is one of the major West African aquifer but is of little importance in the Conventional basin.

### **5.2 Surface Water**

The major tributaries of Lake Chad are the Chari and Logone rivers. These two contributes more than 90 % of water inflow to the lake (with annual discharge being 45,000,000,000 m<sup>3</sup>). Other rivers discharging into the Lake are the El-Beid, the Kamadonga-Yobe and the Yedson.

Annual rainfall varies from 1500mm in the south to less than 100 mm in the north.

### **5.3 Integrated Water Resources Management**

Water resources is the most important of all the natural resources and is the main driver for natural Resource Management or Integrated Water Resources Management. The draughts in last 3 decades have build tremendous pressure on management of water resources and this creates necessity for avoiding wasteful and inequitable use of basin's surface and ground water and for conjunctive use of surface and ground water.

## **6. STRATEGY AHEAD/ WAY FORWARD**

- Focus on food security through irrigated agriculture through small scale irrigation schemes.
- Big dams though have been proposed may not offer practical solution owing to:
  - o High Costs.
  - o Arid Region.
  - o High evaporation losses.
- A series of bunds and ground water recharging structures that can cater to smaller areas, mini-watershed schemes (40-50 ha) or micro-watershed schemes (2000-4000 ha) may prove to be extremely useful.
- The rain water harvesting measures which could be recommended are :-
  - i. Ponds.
  - ii. Check dams.
  - iii. Contour bunding.
  - iv. Gully Plugging.
  - v. Percolation tanks.
  - vi. Anicuts.
  - vii. Subsurface dykes.

These would prove effective in recharging the ground water.

- Improve water use efficiency.
- The small land holdings can be dealt by individuals/corporates/ communities.
- Statistics show that during monsoon season there is enough precipitation which if stored and utilised properly could provide water throughout the year for irrigation. Even three crops could be grown with use of surface and ground water.
- Tube Wells run on diesel generating sets could help extraction of ground water in non-rainy season.
- Replicate successful food security famine strategies as adopted in the past.
- Integrate with cottage industries for food preservations and processing like small scale juice, jam, ketch up and other plants. Supplement with packaging units.

- The diverse ethnic groups, nations and ecologies of the lake Chad basin all offer perfect platform for smaller projects which may be more practical and successful rather than big multipurpose projects and schemes.
- Each individual scheme / plan can be tailor-made to the local requirements and conditions.

## 7. CONCLUSIONS

Thus to cater to the situation in the basin it seem imperative to utilise the rain water through rainwater harvesting structures which will also help in recharging the ground water. This would enable conjunctive use of surface and ground water in the region where soils are reported to be suitable for irrigated agriculture. This will help in economic and bio-diversity improvement in the basin as a whole.

It is felt that the initiative for utilisation of rainwater which are being wasted at present could be one of the important measure to amobierate the situation obtaining in the region, alongwith the other several long term measures such as Inter-basin diversion, hydro power generation, desisting /dredging, drawing up of Water charter for allocation & utilisation of water in basin countries etc. this would also prove to be a first step towards sustainable water resources management in the Lake Chad Basin.

## BRIEF PROFILE OF THE AUTHORS

Pooja Kapoor graduated in Civil Engineering from Delhi College of Engineering in 1998. As an Engineer she had worked on design of Water Harvesting Structures of Dadra and Nagar Haveli and Water Quality Monitoring in 4 districts of India. Technical assistance has been given by her in making of “Technical document for rainwater harvesting” and “Project document for Arsenic Mitigation centre”. Currently she is working as Deputy Chief Engineer in WAPCOS Limited, a Public Sector Enterprise under Ministry of Water Resources, Government of India and has worked on design of Irrigation schemes in Gambela region of Ethiopia, Champassack Province of Laos. She has also appraised and prepared project reports for augmentation of drinking water through tubewells in Mozambique and Cambodia.

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4. Master Plan for the Development and Environmentally sound management of the natural resources of the Lake Chad Conventional Basin, LCBC.
5. [www.un.org](http://www.un.org) World population ageing 1950-2050.
6. [www.state.gov](http://www.state.gov) Buereo of Public Affair : Electronic Information and Publication.

**Table-1 : Geographical coverage of lake Chad basin area**

| Country      | Surface of Active Basin<br>Thousand (Km <sup>2</sup> ) | Conventional Basin<br>Thousand (Km <sup>2</sup> ) |
|--------------|--------------------------------------------------------|---------------------------------------------------|
| Algeria      | 93.6                                                   | -                                                 |
| Cameroon     | 50.775                                                 | 56.8                                              |
| 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                                           |
| <b>Total</b> | <b>2,381.635</b>                                       | <b>966.955</b>                                    |

**Table -2 : Country wise present and projected population and yearly per capita runoff**

| Country                                   | Present<br>Population<br>(million) | Present GDP<br>(billion) US\$ | Projected<br>2025<br>Population<br>(million) | Projected<br>2050<br>Population<br>(million) | Internal<br>run-off<br>per<br>Capita<br>(m <sup>3</sup> / yr) | Annual water<br>withdrawal per<br>Capita (m <sup>3</sup> ) |
|-------------------------------------------|------------------------------------|-------------------------------|----------------------------------------------|----------------------------------------------|---------------------------------------------------------------|------------------------------------------------------------|
| Algeria                                   | 36.3(2011)                         | 159.7 (2010)                  | 42.73                                        | 51.17                                        | 324                                                           | 180(1990)                                                  |
| Cameroon                                  | 20.4(2011)                         | 22.5 (2010)                   | 23.98                                        | 32.28                                        | 10,701                                                        | 31(1987)                                                   |
| C.A.R<br>(Central<br>African<br>Republic) | 4.4(2010)                          | 2.0 (2010)                    | 5.88                                         | 8.19                                         | 24,052                                                        | 26(1987)                                                   |
| Chad                                      | 11.2(2009)                         | 8.2 (2010)                    | 16.38                                        | 27.73                                        | 857                                                           | 34(1987)                                                   |
| Libya                                     | 6.4(2010)                          | 92.62 (2010)                  | 7.97                                         | 9.69                                         | 74                                                            | 880(1994)                                                  |
| Niger                                     | 15.2(2010)                         | 5.34 (2009)                   | 25.72                                        | 51.81                                        | 133                                                           | 69(1988)                                                   |
| Nigeria                                   | 152(2010)                          | 339 (2009)                    | 202.95                                       | 278.78                                       | 1,052                                                         | 37(1987)                                                   |
| Sudan                                     | 33.4(2011)                         | 66.6 (2011)                   | 49.55                                        | 63.53                                        | 626                                                           | 651(1995)                                                  |
| <b>Total</b>                              | <b>279.3</b>                       | <b>695.96</b>                 | <b>375.16</b>                                | <b>523.18</b>                                | <b>1760</b>                                                   | <b>1908</b>                                                |

**Table-3 : Country wise area under irrigation**

| Country         | Irrigation<br>Potential within<br>whole basin (ha) | Gross irrigation<br>water requirement<br>(Km <sup>3</sup> /year) | Area under<br>irrigation<br>(ha) | % area under<br>irrigation /<br>potential |
|-----------------|----------------------------------------------------|------------------------------------------------------------------|----------------------------------|-------------------------------------------|
| <b>Nigeria</b>  | 304,000                                            | 3.040                                                            | 82821                            | 27.2                                      |
| <b>Niger</b>    | 11,000                                             | 2.000                                                            | 2000                             | 18.2                                      |
| <b>C.A.R</b>    | 16,500                                             | 8.250                                                            | 135                              | 0.8                                       |
| <b>Chad</b>     | 277,500                                            | 4.163                                                            | 14020                            | 5.0                                       |
| <b>Cameroon</b> | 66,700                                             | 0.834                                                            | 13820                            | 20.7                                      |
| <b>Total</b>    | <b>1,163,200</b>                                   | <b>16.531</b>                                                    | <b>113,296</b>                   | <b>9.74</b>                               |

**Table -4 : Statistical data of Crop Production**

| S.No. | Crops                        | Production (MT) |          |         |          |        |        |
|-------|------------------------------|-----------------|----------|---------|----------|--------|--------|
|       | Country                      | Chad            | Cameroon | Niger   | Nigeria  | Libya  | C.A.R  |
| 1     | Millet                       | 620900          |          | 3843350 | 4124560  |        |        |
| 2     | Sorghum                      | 490300          | 900000   | 1304830 | 4784100  |        |        |
| 3     | Groundnuts, with shell       | 394400          | 460000   | 406245  | 2636230  |        | 140000 |
| 4     | Mangoes, mangosteens, guavas | 33300           |          | 175000  | 790200   |        |        |
| 5     | Onions Dry                   |                 |          | 390000  |          | 195000 |        |
| 6     | Sesame seeds                 | 35000           |          | 85694   |          |        | 50000  |
| 7     | Tomatoes                     |                 | 575800   | 67000   | 1860600  | 230000 |        |
| 8     | Cabbages                     |                 |          | 150000  |          |        |        |
| 9     | Dates                        |                 |          | 38500   |          | 161000 |        |
| 10    | Yams                         | 414900          | 410000   |         | 29148200 |        | 435000 |
| 11    | Cassava                      | 230700          | 3024000  |         | 37504100 |        | 678958 |
| 12    | Bananas                      |                 | 950200   |         |          |        | 126000 |
| 13    | Taro (cocoyam)               |                 | 1470000  |         | 2593860  |        | 118000 |
| 14    | Maize                        | 208900          | 1674400  |         | 7305530  |        | 150000 |
| 15    | Plantains                    |                 | 2604100  |         | 2733300  |        | 88000  |
| 16    | Pulses                       | 48800           |          |         |          |        | 31300  |
| 17    | Vegetables fresh nes         | 81200           |          |         | 5945600  | 61000  | 65000  |
| 18    | Rice, paddy                  | 130800          |          |         | 3218760  |        | 39000  |
| 19    | Bean Dry                     | 72800           | 285300   |         |          |        |        |
| 20    | Cotton Lint                  | 25500           |          |         |          |        |        |
| 21    | Olives                       |                 |          |         |          | 180000 |        |
| 22    | Almonds                      |                 |          |         |          | 29500  |        |
| 23    | Cereals nes                  | 452600          |          |         |          |        |        |
| 24    | Cashew nuts, with shell      |                 |          |         | 594000   |        |        |
|       |                              |                 |          |         |          |        |        |

EXHIBIT – 1

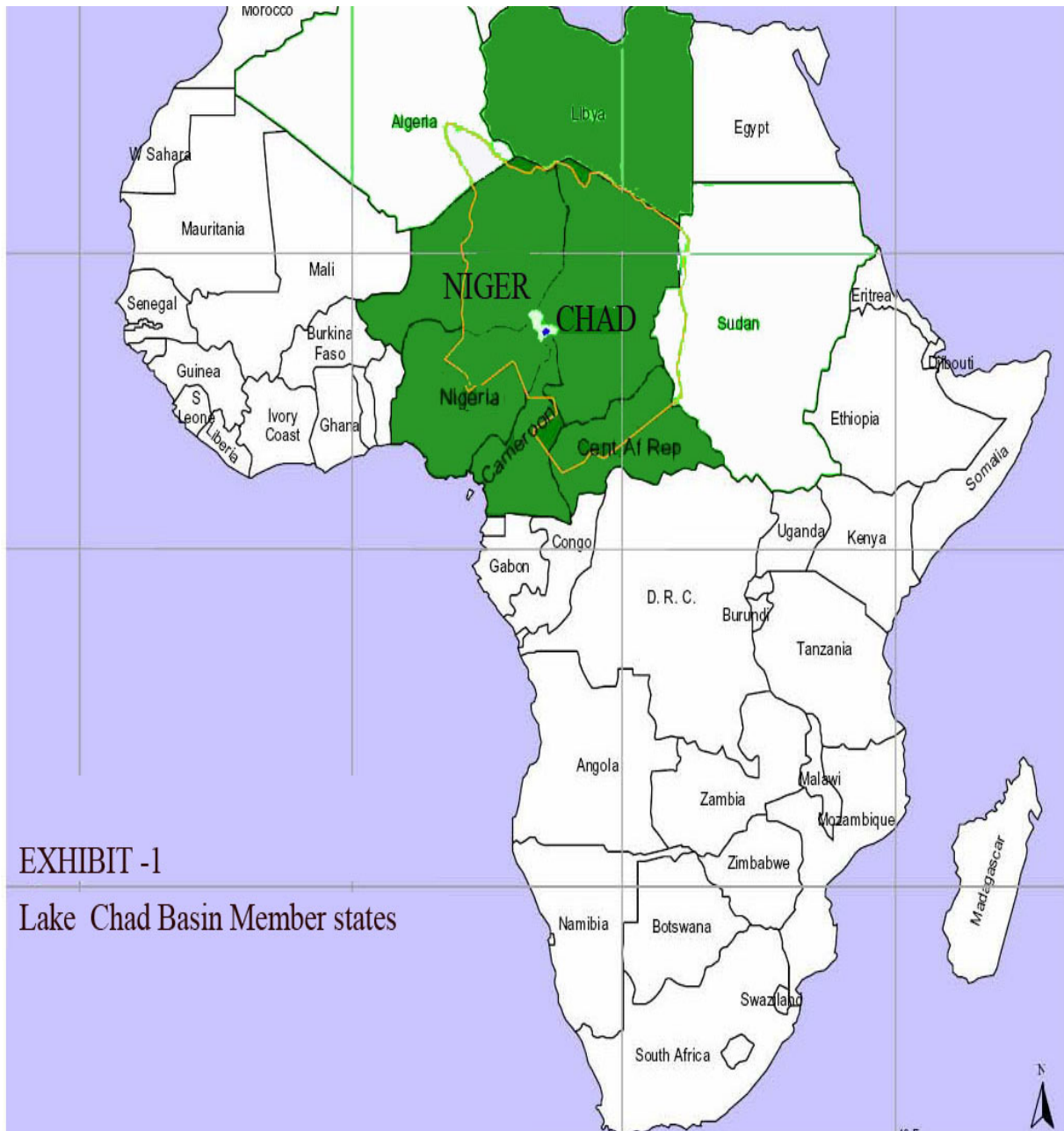
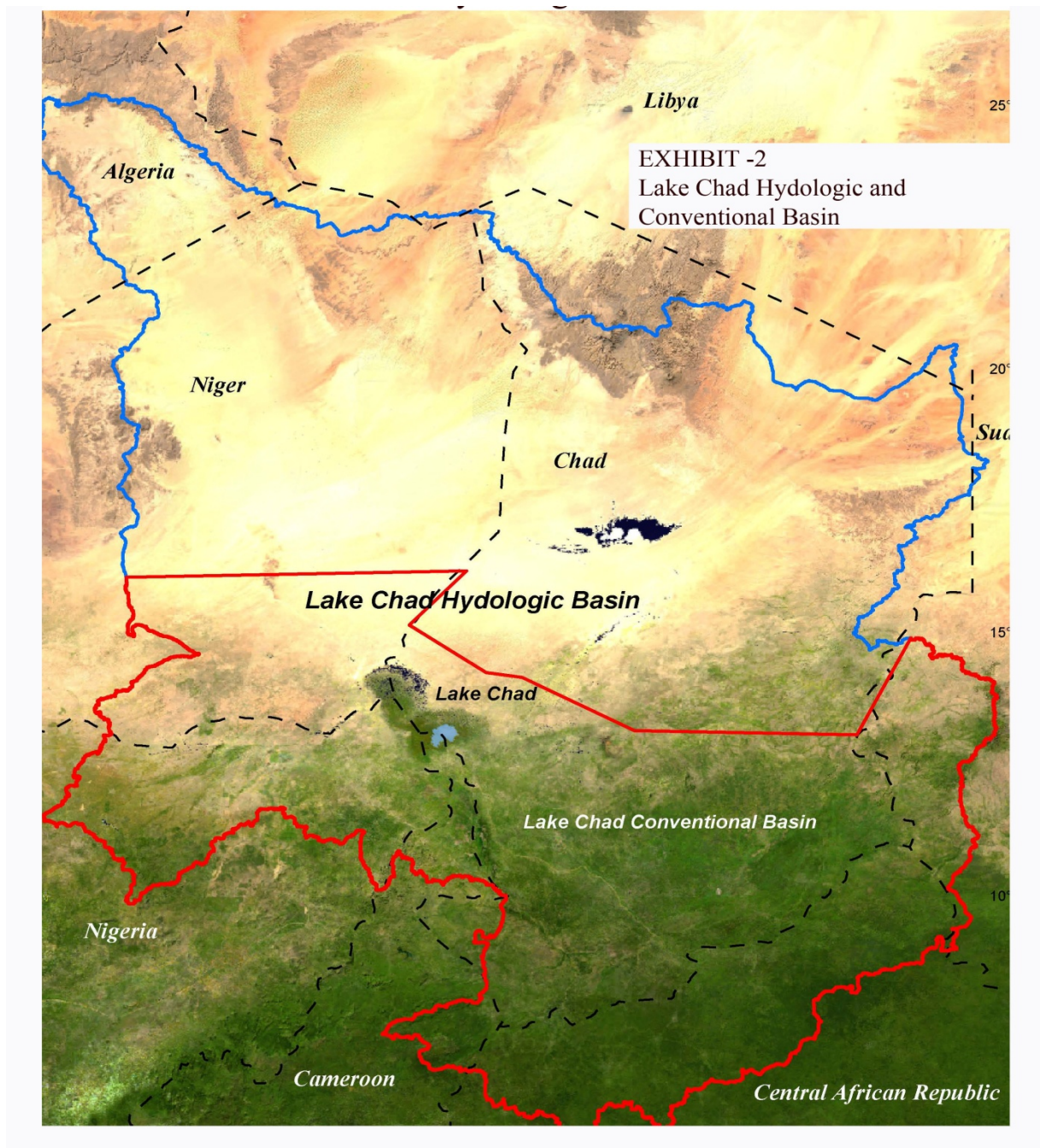


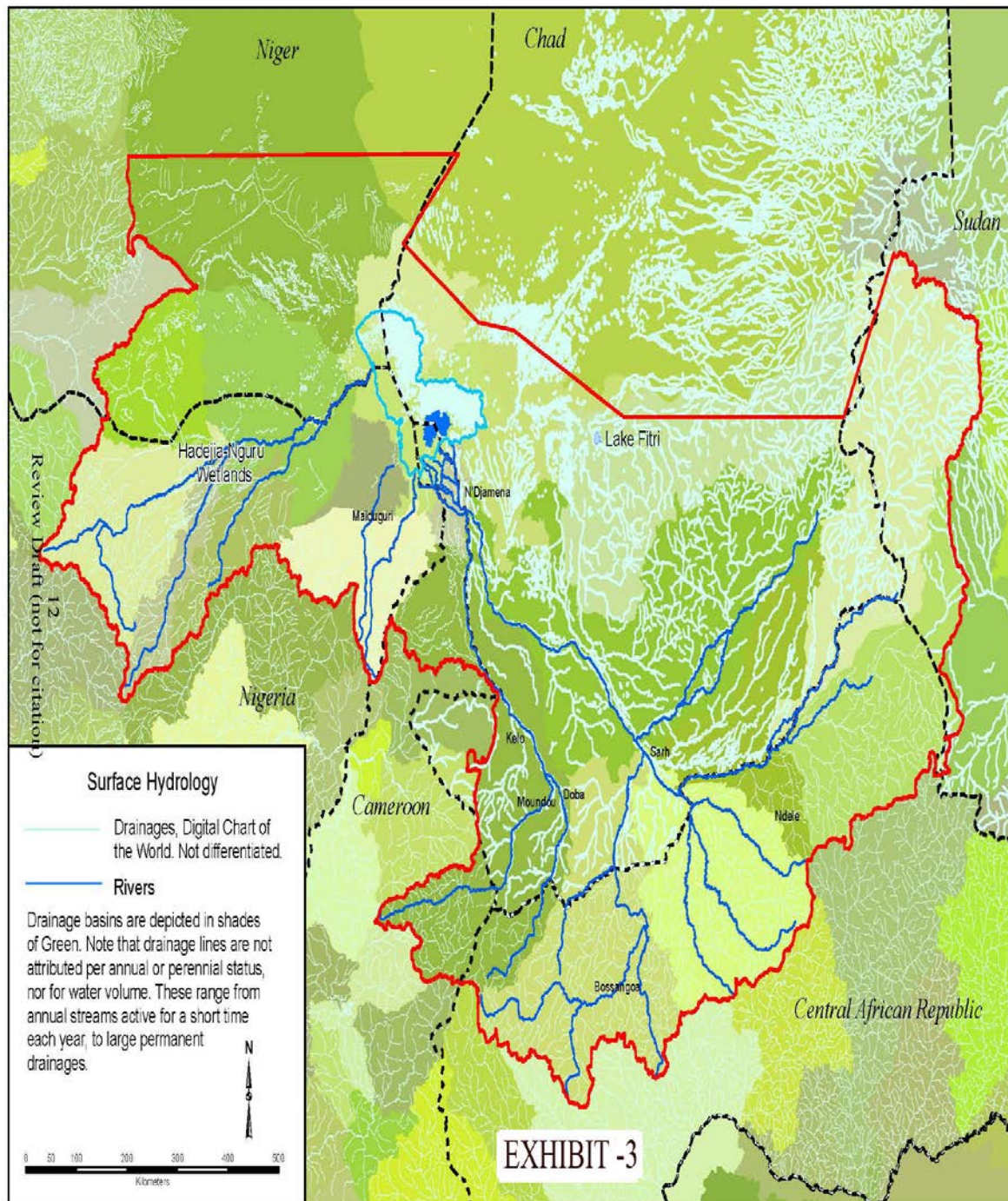
EXHIBIT -1

Lake Chad Basin Member states

**EXHIBIT-2**



**EXHIBIT-3**



**EXHIBIT-4**

D  
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S  
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