Earth Observation
For the Management of Lake Chad
Project 36

Project Activities Presented at the TIGER Capacity Building Facility II Workshop
(12 – 13th December 2011)

By
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Outline

- Brief Introduction
- The Study Area
- EO in Lake Chad Sub-Basins – KYB & BD
- Achievements from TCBF (Project 36)
- EO Data for Surface Water Management:
  - Lake Chad Water Cycle Regime
  - Agriculture and Fishing
- Major Challenges
- Conclusion and Recommendations
For about 4 decades, recurring droughts, decline in rainfall and degradation of vegetation cover have led to drastic changes in the environmental conditions of the Lake Chad Basin;

The receding of Lake Chad, desert encroachment, decline of agriculture, livestock and fisheries, threatens the socio-economic activities of over 37 million people in the Basin;

The approach to the monitoring of the environmental conditions of the Lake was initially fragmented (before 2002), thus policies and management decisions were based on unreliable information, out-dated observation networks that was inadequate for IWRM;
From 2004, the Lake Chad Basin, witness a turning point, with the coming of GlobWetland Project by ESA. The Basin was able to fully introduce the use of EO data where some baseline maps such as Land use land cover, Lake Chad Water Cycle Regime and Water Quality were delivered;

This presentation shows the link with Tiger 1 and shows the Management of the Basin in a sustainable way;

Hadejia Jama’are-Komadugu Yobe and Borno Drainages (HJ-KY & BD), sub-Basin of Lake Chad is the study area;

It would also show how the chain of information dissemination to the grass root;
The Entire Lake Chad Basin

Focusing on:
HJ-KY and BD sub-Basin is occupied by about 59% of the entire population;
HJ-KY and BD sub-Basin sustains about 21 million inhabitants

Contained over 22 major Dams in the Entire Sub-Basin;

2,446,659.00 Km² – L Wshed
274,054.29 Km² HJKYBD
Characteristics of Lake Chad

- Landlocked and far from sea and/or ocean;
- Unique, only in the world, such a large freshwater reservoir in a very hot and arid climate;
- High Temp., High ET and Low Rainfall over the Entire basin for the last 40 years;
- High Population Growth depending solely on declining natural resources;
- Almost at the Centre Africa.
Review of TIGER 1 (Baseline Data)
Why TCBF Targets Hadejia Jama’are-Komatadugu Yobe and Borno Drainage

Population dynamics

Over the last two decades the annual population growth in the region has ranged between 2.5 and 3.0% (World Bank 2002c). The current population within the region is estimated to be approximately 37.2 million people (based on ORNL 2003). The total population has increased by about 11.7 million since 1990. Population estimates for 1990 was 25.5 million people (UNEP 1999). The Basin’s population is unevenly distributed between the countries. Nigeria, Africa’s most populous country hosts an estimated 22 million people (about 59%) of the total population living in the region. Whereas the northern and eastern peripheral countries, Algeria, Libya and Sudan, only have approximately 2.7 million inhabitants in the Basin (about 7%), as it only represents just over 6% of the land area of the Basin (EROS Data Center 2002). Population densities are greatest in Nigeria and surrounding Lake Chad and decreases in the more arid northern locations. For example in the Tibesti Highlands the people are primarily nomadic pastoralists, and population densities are as low as 0-1 people/km2. The region is also experiencing rapid urbanization, as destitute rural
EO in HJKYB & BD of Lake Chad

274,054.29 Km²
Achievements from TCBF (Project 36)

- **Collaborative work between Stakeholders of Lake Chad:** Signed MoU on the Sustainable Development of the Lake Chad Basin (SD-LCB), initiated by DTCA;

- **In Terms of Software**
  - Training of 9 Research Scientists at ITC, who were drawn from collaborating Institutes on use of EO for water related issues;

- **In Terms of Hardware**
  - Allocation of Project Vehicles and Grant for fieldwork/verifications of EOD within the TIGER Basin (HJKY&BD);
  - Grant from Education Trust Fund to further fund 2 Scientists, at ITC

- **Formation of ESA Products User Community Scientists of the Lake Chad Basin;**

- **Visit of the Kano State Governor to ITC between Feb-Mar 2011**
Stakeholders with MoU on SD-LCB

- 13 Active Members (Signed MoU, 08th July 2009, IUCN, Kano)
  - Directorate of Technical Cooperation in Africa;
  - Centre for Arid Zone Studies, University of Maiduguri;
  - Bayero University, Kano, Kano State;
  - Raw Materials Research and Development Council (RMRDC);
  - University of Missouri, Kansas City, Missouri, United States of America;
  - Hadejia–Jama’are–Komaladugu–Yobe Basin Trust Fund, Damaturu, Yobe State;
  - Chad Basin Development Authority, Maiduguri;
  - Hadejia – Jama’are River Basin Development Authority, Kano State;
  - Lake Chad Basin Commission (LCBC), N’Djamena, Chad;
  - Lake Chad Research Institute (LCRI), Maiduguri;
  - National Space Research and Development Agency (NASRDA),
  - National Integrated Water Resources Management Commission (NIWRMC);
  - Kano University of Science and Technology, KUST, Wudil, Kanoa State;
# Achievements from TCBF (Project 36)

<table>
<thead>
<tr>
<th>SN</th>
<th>Name</th>
<th>Profession/Rank</th>
<th>Address</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
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<td>7.</td>
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<td>10.</td>
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<td>+2348069382065</td>
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<td>11.</td>
<td>Fidelis Ominehum</td>
<td>Climatologist/Researcher</td>
<td>Lake Chad Research Institute</td>
<td>+2348032609557</td>
</tr>
</tbody>
</table>
9 Scientists benefited from TCBF @ ITC
Achievements from TCBF (Project 36)

- Allocation of Lead Scientists to On Going Researches
  - Lake Chad Water Cycle Regime (Garba Sambo)
  - Fish Farming and Prediction (Mohd Dawaya)
  - Agricultural Planning, AEZ and Monitoring (G. Sambo, Prof D. Gwary)
  - Rainfall Estimation, Duration, Temperature and Crop Growth (G. Sambo)
  - Proposed Kafin-Zaki Dam, Water Balance and EIA (Prof I Goni, Ijere and A. Nabegu and Garba Sambo)
  - Green Belt Planning, Mapping and Monitoring (Prof. H. K. Ayuba)
  - Precipitation and Drought Monitoring (Garba Sambo)
MERIS for Water Cycle Regime (WCR)

For its high temporal resolution, WCR of Lake Chad was made possible. The surface areas of the Lake between 2006/7 and 2010/11 were compared with baseline figure (of 2001) that was computed during the GlobWetland Project (ESA Tiger 1);

Considering the reference Year and Present:

- Baseline Year (1986 – 2001), Minimum water = 1969.88 km$^2$ while in 2010/11 = 1848.9 km$^2$;
- Baseline Year (1986 – 2001), Maximum water = 3159.17 km$^2$ while in 2010/11 = 2509 km$^2$;
For its temporal resolution, MERIS products are used to predict fish yield in the Lake Chad with auxiliary data.

<table>
<thead>
<tr>
<th>Month</th>
<th>Frequency of Information Needed (Interval)</th>
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<tbody>
<tr>
<td>February</td>
<td>Decadal (10-Day)</td>
</tr>
<tr>
<td>March</td>
<td>Decadal (10-Day)</td>
</tr>
<tr>
<td>April</td>
<td>Decadal (10-Day)</td>
</tr>
<tr>
<td>May</td>
<td>Decadal (10-Day)</td>
</tr>
<tr>
<td>June</td>
<td>5-Day</td>
</tr>
<tr>
<td>July</td>
<td>5-Day</td>
</tr>
<tr>
<td>August</td>
<td>5-Day</td>
</tr>
<tr>
<td>September</td>
<td>5-Day (Egg Laying Period)</td>
</tr>
<tr>
<td>October</td>
<td>2-Day (Hatching Period)</td>
</tr>
<tr>
<td>November</td>
<td>2-Day (Hatching Period)</td>
</tr>
<tr>
<td>December</td>
<td>Daily (Hatching Period)</td>
</tr>
<tr>
<td>January</td>
<td>Daily (Hatching Period)</td>
</tr>
</tbody>
</table>
As a result of benefits from TCBF training at ITC, the participants realised that they can use the knowledge to find the lasting solution of Dam under-utilisation.

There are about 22 Dams constructed within HJKY-BD.

### Dams in HJKYB & BD of Lake Chad

<table>
<thead>
<tr>
<th>S/N, Order of closure</th>
<th>Location</th>
<th>Surface Area of Reservoir Capacity (Km²)</th>
<th>Total Storage Capacity (x 10⁶ m³)</th>
<th>Rank in ascending magnitude</th>
<th>Catchment Area (Km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Brinin Kudu*</td>
<td>0.61</td>
<td>1.19</td>
<td>21</td>
<td>40</td>
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<tr>
<td>2</td>
<td>Buganda</td>
<td>3.76</td>
<td>22.14</td>
<td>9</td>
<td>207</td>
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<tr>
<td>3</td>
<td>Karaye</td>
<td>1.98</td>
<td>17.22</td>
<td>12</td>
<td>80</td>
</tr>
<tr>
<td>4</td>
<td>Kaffin Gana*</td>
<td>1.80</td>
<td>NA</td>
<td>19</td>
<td>NA</td>
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<tr>
<td>5</td>
<td>Tiga</td>
<td><strong>178.10</strong></td>
<td><strong>1,968.00</strong></td>
<td><strong>1</strong></td>
<td><strong>6,641</strong></td>
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<tr>
<td>6</td>
<td>Ibrahim Adamu*</td>
<td>2.63</td>
<td>7.99</td>
<td>16</td>
<td>NA</td>
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<tr>
<td>7</td>
<td>Ruwan Kanya</td>
<td>2.50</td>
<td>NA</td>
<td>17</td>
<td>NA</td>
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<td>8</td>
<td>Tomir (Tomas)</td>
<td>14.97</td>
<td>60.30</td>
<td>6</td>
<td>585</td>
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<td>9</td>
<td>Muhammadu Ayuba*</td>
<td>1.16</td>
<td>5.54</td>
<td>20</td>
<td>NA</td>
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<tr>
<td>10</td>
<td>Jakara</td>
<td>16.59</td>
<td>65.19</td>
<td>5</td>
<td>559</td>
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</tbody>
</table>
EO in HJKYB & BD of Lake Chad
NDVI anomaly
The team were given the contract to generate Baseline Data for Oil Exploration (November 2011) in terms of

- Land use/cover
- Drainages network System
- Geology and Hydrogeology
- Waste Management
- Potential Impacts and Mitigation measures
Damasak, Borno State

Lat: 13° 13' 10.1"
Long: 13° 17' 05.2"
Early Warning and Environmental Monitoring

- Precipitation Duration
- Number of Rain Days (Weekly, Monthly and Annually);
- Maximum Consecutive Dry Days (Weekly and Monthly);
- 7-Day Total Rainfall;
- 30 Day Total Rainfall;
- Number of Days Since a Rain Day (past 30 days)
Small brightness temperature differences (<11K) between WV06.2 and TIR10.8 is a strong indicator of precipitating clouds.
General rule from Convective Cloud, the Analysis and Modelling:

- $-12^0C$ = Presence of water droplet
- $-12^0$ to $-30^0C$ = mixture of water droplets and ice crystal;
- Below $-40^0C$ = Ice
Integrated Regional Planning

- Creation of Agro-Ecological Map in an Integrated National Development
  - AIM: To alleviate poverty in a Region
  - Results to be communicated with Peasant Farmers via Lake Chad Research Institute (LCRI) radio network
- Problem 1: Decline in Agricultural Produce: Comparative performance of Agro-Ecological Zones in a Region
  - Clue:
    - Agro-Ecological Zones Map;
Agro-Ecological Zoning (AEZ)

- New Ideas as a result of 4th TCBF, and already gotten SM data (1Km) from TUVienna mail.
- ftp.ipf.tuwien.ac.at
- SHARE Request from IPF web: Soil Moisture 1 km

AEZ Map

- Moisture Zones
- Moisture Availability
- Temperature Zones
- Temperature Map

Mean Annual Rainfall Image

ET_p Map

GDEM (30m)

Meteorological Data (Temperature to be Calibrated from Weather Stations)
Lesson Learn on DDS Installation

- DDS installed in February 2011
- First refer to Dish pointer site (below) and type your location;
- Insert the Satellite name (Atlantic Bird)
- If there is obstacle, adjust the potential position of the Dish;

http://www.dishpointer.com/

- Be careful to be near your Internet/Network, preferably V-Sat. Overlooking this statement can cost a lot in terms of sustainability of V-Sat;

- Situation of University of Maiduguri DDS:
  - 24 hours Power is connected to 10 KVA Solar Panel Inverter to the DDS;
  - Needed to Re-position the V-Sat;
Major Challenge

- Research on Precipitation quantification from space
- Memory Space utilisation
  - 15 min Temporal Resolution generates 4 files per hour, 96 files per day, 2880 files per month or 34560 files per annum. In this situation, computer processor suffers.
- Dissemination of Information to target population
- Fewer number of specialists/bulky processing/cumbersome
- Electricity and Internet Facility, though solar inverter proves expensive, its cost effective thus solution.
- Sustainability of the Infrastructure
Data Sharing and Information Dissemination

EO Data extracted and processed from University of Maiduguri. The Information to be broadcasted by Lake Chad Research Institute via:

Radio massages;
Cell phone text massages;
Telephone Calls
Communication Services

EO Data extracted and processed from University of Maiduguri. The Information to be broadcasted by Lake Chad Research Institute via:

- Radio massages;
- Cell phone text massages;
- Telephone Calls

Lake Chad Basin Commission

GEONETCast – DDS Research Community

Government Agencies

Extension Workers/Peasant Farmer’s Group

District Level

Local Government Level

University of Maiduguri
Conclusion and Recommendations

Conclusion

- The TIGER Initiative (TCBF) has made a remarkable impact in the Lake Chad Basin particularly Hadejia Jama’are Komadugu Yobe and Borno Drainages.
- TIGER Opens eyes the Basin in terms of EO processing and analyses;
- Gradual transfer of EO Analyses ITC/Lake Chad with the necessary arrangement put in place

Recommendations:

- TIGER to continue until real TIGER is found in Africa
- Looking forward to seeing Culture Meris in Archives;
Thank you for your kind attention