Project #15
EO CAPACITY BUILDING NEEDS FOR CONGO BASIN MONITORING

Par
Dieudonné Nsandisa Faka (PhD)
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SIZE OF THE AFRICAN CONTINENT COMPARED TO OTHER LAND MASSES

<table>
<thead>
<tr>
<th></th>
<th>SQUARE MILES</th>
<th>SQUARE KILOMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRAZIL</td>
<td>3,300,161</td>
<td>8,547,378</td>
</tr>
<tr>
<td>JAPAN</td>
<td>377,727</td>
<td>978,308</td>
</tr>
<tr>
<td>AUSTRALIA</td>
<td>2,966,189</td>
<td>7,682,394</td>
</tr>
<tr>
<td>EUROPE</td>
<td>1,905,731</td>
<td>4,935,820</td>
</tr>
<tr>
<td>U.S.A. (Continental)</td>
<td>3,120,066</td>
<td>8,080,934</td>
</tr>
<tr>
<td>TOTAL</td>
<td>11,669,874</td>
<td>30,224,835</td>
</tr>
<tr>
<td>AFRICA (including MADAGASCAR)</td>
<td>11,715,721</td>
<td>30,343,578</td>
</tr>
</tbody>
</table>
Opportunities & Challenges

Opportunities

- On the average, Congo River flow > 10 x Nile flow.
- Congo River is the cornerstone of DRC economy and livelihood [water supply, navigation, hydropower, agriculture, ecosystems, tourism, etc.].
- Also, important regional resource (extending into Angola, Congo B., Gabon Burundi, Cameroon, Central African Republic, Rwanda, Zambia, and Tanzania);
- Potential for water and energy exports.
- Opportunity for regional leadership.

Challenges

- Poverty, Disease, Clean Water Access, Deforestation, Climate Change.
  - Lack of adequate institutional and technical capacity;
  - Lack of adequate and reliable observational data, hydro-informatics tools, and trained human resources for holistic planning, utilization, and mgt.
- Transboundary water management.
General objective:

“To support the development of a comprehensive observational network, hydro-informatics system, and technical capacity building that will promote sustainable planning, utilization, and management of the DRC water resources.”

Phase I Specific Objectives:

(i) Compile all available data and develop the first version of a comprehensive hydro-informatics and decision support system (Congo DSS) to serve as depository of current and future water related data and facilitate data analysis, modeling, and regional assessments.

(ii) Develop the Congo River Basin Monograph that describes the Congo River Basin water resources, water uses, and critical development opportunities, challenges, and threats.

(iii) Begin building the technical capacity of the DRC institutions to effectively utilize data and information in water resources planning, utilization, and management.
<table>
<thead>
<tr>
<th><strong>REQUIRED DATA TYPES</strong></th>
</tr>
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<tbody>
<tr>
<td>(i) <strong>Hydro- graphic</strong> (digital elevation map (terrain); hydrographic river/lake network);</td>
</tr>
<tr>
<td>(ii) <strong>Land use</strong> (urban areas; regional growth centers; settlements; large scale agricultural developments; forests; wetlands; national parks; etc.);</td>
</tr>
<tr>
<td>(iii) <strong>Hydro- meteorological</strong> (rainfall/ temp/ evaporation/ solar radiation/ etc.; river stage and discharge; rating curves; flood and drought prone areas; borehole data; ground water table levels; etc.);</td>
</tr>
<tr>
<td>(iv) <strong>Agricultural</strong> (soil types and stratification; agricultural areas by crop type; yields; cattle farms; aquaculture ponds; etc.);</td>
</tr>
<tr>
<td>(v) <strong>Environmental and ecological</strong> (sediment and pollution loads; water quality of rivers, lakes, wetlands, and aquifers; ecosystem and biodiversity data; etc.);</td>
</tr>
<tr>
<td>(vi) <strong>Existing and potential infrastructure and development projects</strong> (transportation system; electrical grid; water and waste water treatment plants; water distribution systems; sewer systems; reservoirs and hydropower facilities; irrigation systems; levies; industrial and agricultural well fields; pumping stations; etc.);</td>
</tr>
<tr>
<td>(vii) <strong>Administrative and population</strong> (province and territory boundaries; urban areas tribal and ethnic groups; population density and composition; education and income levels; public health statistics; health centers/ hospitals; etc.).</td>
</tr>
<tr>
<td>(viii) <strong>Socioeconomic data</strong> (main industries; trade; current and future water and energy use and availability; other socio- economic indicators; etc.)</td>
</tr>
</tbody>
</table>
Hydro-Information's databases: challenges & Opportunities for Improvement

- Data Scattered in Many Agencies
- Data not Effectively Used in Decision Making
- Observational Network Seriously Impaired
- Limited Technical Capacity to Analyze Data
- Lack of EO Data access
- Lack of data collection infrastructure (VSAT, ICT)
- Lack of high capacity storage facility
- Lack of funding for local activities
Climatic Observational Network: Past and Present

Le réseau de station climatologique

station en étoile noir dispose des données journalières
Study case:
1. Climate change Perception from autochthones

- 94% attesting that climate change has already been perceptible in the rural area:
- 83% experiencing fresh water resource « penuries »
- 90% expressed to have been threatened by hydro-meteorological natural disaster during the last 10 years
- 81% are aware that health is a climate related issue
- 74% talking about the increasing of extreme rainfall frequency;
- 52% noticed a decrease of rainfall amount during the rainy season;
- 73% raising up the decrease of number of rainy day during the rainy season;
- 93% attesting the delay of the onset and the early end of rainy season;
- 94% confirming the increase of ambient temperature.
# Key Climate risk and their trend

<table>
<thead>
<tr>
<th>RISQUE</th>
<th>IMPACT SOCIO-ÉCONOMI C</th>
<th>Live lost</th>
<th>DURATION (DAY)</th>
<th>SPREADWIDE (Km²)</th>
<th>FREQUENCY (%)</th>
<th>TENDANCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme rainfall</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>↑↑</td>
</tr>
<tr>
<td>Seasonal dryspell</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>↑</td>
</tr>
<tr>
<td>Floods</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>↑↑</td>
</tr>
<tr>
<td>Heat wave</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>↑↑</td>
</tr>
<tr>
<td>Coastal erosion</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>↑</td>
</tr>
</tbody>
</table>

**Légende :** les estimations sont calculées sur une échelle exponentielle.

**Impacts :** 1 = $1 per capita, 2 = S 10, 3 = S 100, 4 = $ 1000, 5 = $ 10,000

**Perte en vie humaine :** 1 = 1 personne par événement, 2 = 10 personnes, 3 = 100 personnes, 4 = 4,000 personnes

**Durée :** 1 = 1 jour, 2 = 2 jours, 3 = 100 jours (une saison), 4 = 1,000 jours (plus d’un an)

**Etendue spatiale :** 2 = 10 Km², 3 = 100 Km², 4 = 1,000 Km²

**Fréquence :** 1 = 1% de probabilité (événement rare), 2 = 10 % de probabilité, 3 = 100 % de probabilité (annuelle)
CLIMATE CHANGE VULNERABILITY MAP
Projection of dryspell according to GCM: Ratio of number of dryspell vs 1901-2000

2001-2030

2070-2100
Projection of flood risk: Ratio of number of day vs 1901-2000

Variation annuelle de pluie (2070-2100)

Change in rainfall intensity (2070-2100)
2. Study case: Urban Runoff management

- Recrudescence of floods des phenomena;
- Destruction of hydraulic infrastructure and habitats;
- Inadequacies between damage and rainfall intensity;
- Absence of drain infrastructures in urban extensions areas ;

Tentative de lutte antiérosive en vain

Etat de l’environnement cicatrisé à Kinshasa dans le bassin de la Funa: extension ville, occupation anarchique lit de rivière et ouvrage non entretenu.
L'image satellitaire IKONOS de l'année 2005 sur la bassin versant de la Funa amont à Kinshasa

En ligne bleue les cours d'eau et en blanc les limite des sous bassins

La pointe en rouge l'érosion Makaya à Kindele due à la rupture du bassin d'orage non entretenu
L’occupation de terre à mont Amba

RESULTATS (suite)

Produit grâce au logiciel ArcGIS et l’image IKONO 2005
3. Analyse des écoulements dans le bassin versant de mont Amba

Modèle du risque objectif acceptable

- For slope of 10%, le RISAC limit the land use up to 40%;
- For slope below 1% can allow land use up to 80%;
- For slope greater equal to 20% land use can go up to 30% of the total area.

More the slope increase, less land use should be, in order to monitor runoff and prevent the flood in downstream area.

\[ \lambda = 72.3S^{-0.221} \]
III. RESULTATS (suite)

Les différents ouvrages de gestion des eaux de ruissellement à mont Amba

BASSIN DE RETENTION

BARRAGE A PERTIUS

LE RETARDEMENT DYNAMIQUE DE CRUE (RDC)
Main objectives

- Facilitate the access and improve capacity for EO data processing for environment monitoring and water resource management;

- Ensure the capacity building on water resource management;

- Ensure the Decision-Makers awareness on usefulness of the services and products elaborated.
Adopted Approach: Start by assessing sub-basin water resource
Specific objectives

To create the hydrology database of Congo sub-basin and to improve capacity building on water resource management

Data required

- Digital Elevation Model (DEM)
- Grids water thickness graphics of Congo river basin
- Evaporation data
- Runoff data
- Infiltration data
- Meteorological data
- EO data
  - Rainfall estimates (MPE, TAMSAT, SAF, etc)
  - Evapotranspiration (ETP)
  - Temperature
  - Spatial altimetry
  - Water level (ENVISAT, JASON2)
  - Land cover
  - Vegetation indexes (NDVI, fCover, fAPAR, LAI)
Component 2: Congo River Basin DSS Framework

Data Acquisition System (Ground Stations, Remote Sensors, Internet, Other Data Sources)

User-Data-Model Interface (Access to Data/Models/Results)

Database

Data Types:
- Geophysical
- Climatic
- Hydrologic
- Water Use
- Land Use/Cover
- Infrastructure
- ...

Data Analysis Tools

- Spreadsheets, GIS,
- Statistical tools, …

Models

- Hydrologic
- Water Quality
- Scenario Assessment
- …

Information to Support Water Resources Planning and Management Decisions
CAPACITY BUILDING NEEDS

Training on Remote sensing techniques and water resource assessment
Administration system of DDS
Programming with Ubuntu
Hydrology modeling
Integrated Water Resource Management
Techniques of EO data validation using in-situ data

Strategies
a) Training Package preparation (on DVD)
b) DDS reception station training (on-site)
c) E-Station training (type: on-the-job training)
d) Basic GIS and Remote Sensing training (type: On-Distance trainings)
e) Water management and Remote Sensing training
f) Curriculum Development for local Universities (Type: Support to Universities)
g) The “Service Oriented Training” consists of stand-alone training packages
CAPACITY BUILDING NEEDS (Cont’d)

- Provision of work tools
- Assistance on local work (e.g. data collection, suscription of internet connexion);
- Contribution in RS laboratory set-up,
- Capacity building in impact assessment
Phase II

Component 1: Consensus building toward a new water law.

Component 2: (i) Cont'd Development of Congo DSS; rainfall-runoff models; river and reservoir routing models; existing and planned hydropower facility models; hydropower economics; flood and drought forecasting and warning system; Release of Congo DSS Version 2.0.

(ii) Water resources and energy assessments pertaining to potential hydropower developments; water transfers, and other regional water projects; firm energy generation; reliability and value of energy exports; climate change impact assessments; mitigation strategies.

(iii) Training on the methods and applications of Congo DSS Version 2.0; technical capacity building program activities.
Phases II, III, and IV: General Scope (cont’d)

**Phase III:**
Component 1: Consensus building and institutional capacity building.

Component 2: (i) Development of Congo DSS cont’d; development of agricultural planning model; early warning system for agricultural drought; Release of Congo DSS Version 3.0.
   (ii) Agricultural sector vulnerability to climate variability; benefits and impacts of major irrigation projects; deforestation and land use change impact assessment on water resources; potential climate change impacts on agriculture; mitigation strategies.
   (iii) Training on the methods and applications of Congo DSS Version 3.0; technical capacity building program activities.

**Phase IV:**
Component 1: (i) Capacity building of newly established national and catchment authorities.

Component 2: (i) Development of Congo DSS Version III cont’d; development of groundwater and water quality models; potential water quality impacts of agricultural developments and deforestation; climate change impacts on groundwater resources and water quality; Release of Congo DSS Version 4.0.
   (ii) Technical training on Congo DSS Version 4.0 and capacity building.
En 2020, 75 à 250 millions de population seront exposés au manque d’eau (IPCC, 2007)

En 2025, près de 370 millions des africains seront affectés de manque d’eau douce.
– cette projection affectera le développement socio-économique du continent.
– Dans le bassin du Nile, le débit diminuera à plus de 75% en 2100, avec comme conséquence la réduction de la production agricole et l’augmentation de conflit.
- Le bassin du Congo sera un site de conflit
Conclusion

- EO Dataset are very important to overcome the lack /or the weakness of ground observation network;
- Effective planning of natural resource is supported by monitoring activities;
- Congo basin is corner stone of the sustainable development of the world
Pour terminer

merci de votre attention