Presentation from the 2012 World Water Week in Stockholm

www.worldwaterweek.org
THE NEXUS IN SCIENCE AND RESEARCH – NILE BASIN

Holger Hoff (SEI): Overview, Initial Scenarios

Charles Iceland (WRI): Hydropower, Vulnerability to and Impacts on Water Scarcity

Jakob Granit (SEI/SIWI): Water Energy Nexus Opportunities

Guy Pegram (Pegasys): Water Food Nexus Opportunities

Abby Onencan (Nile Basin Discourse): The Role of Science, Nexus, Cooperation
NEXUS CHALLENGES AND OPPORTUNITIES

- Very diverse basin (climate, ecosystems, cultures)
- Well endowed, but also degrading resource base
- Less than 15% of cultivated area irrigated, large yield gaps, low resource productivity
- Increasing food deficiency, in particular for cereals
- Rapid population growth: ~ factor 4 within 50 years
- < 10% of basin residents have access to electricity
- Only ~ 25% of hydro-power potential is tapped, but high evaporative losses
- Improved lake management for enhanced floodplain and aquatic ecosystem services
- Integration of nexus with national economic development and investment plans (e.g. Ethiopia)
- Regional cooperation on water, energy and food
VERY DIVERSE BASIN

Precipitation

(Food) Water Productivity

Precipitation (mm/yr)
- 0 - 100
- 100 - 300
- 300 - 500
- 500 - 800
- 800 - 1,000
- 1,000 - 1,200
- 1,200 - 1,400
- 1,400 - 1,600
- 1,600 - 2,200

kcal production per m³ of crop water use:
- Egypt: 3069
- Sudan: 787
- Ethiopia: 783
- Sweden: 7556

Karimi et al
BLUE NILE / LAKE TANA
INITIAL NEXUS ASSESSMENT (WEAP)

Food Production

- Including foreign direct investment scenarios

Energy (biofuels & hydropower)

- Lake levels (ecosystems / livelihoods)
  - Regime shift looming

Downstream flows
SPECIAL ROLE OF THE BLUE NILE & ETHIOPIAN HIGHLANDS

86% of water reaching Aswan Dam in a normal year originates in Ethiopia

Blue Nile: 59%
Baro/Akobo/Sobat: 14%
Tekeze/Atbara: 13%
White Nile: 14%
THE NEW RENAISSANCE DAM

Preliminary construction began in April 2011 on the Blue Nile River near the Sudanese border. Scheduled for completion in 2014, it is planned to be the biggest hydropower dam in Africa, with more than twice the generating capacity of the Aswan High Dam.
THE NEW RENAISSANCE DAM

- Initial caveats:
  - No environmental and social impact assessment has yet been published.
  - An International Panel of Experts is currently assessing the impact of the construction of the dam.

- Provides infrastructure Ethiopia needs for job creation, service provision and economic diversification.
- The Renaissance Dam could produce reliable water supply for irrigation.
- Can help Ethiopia’s neighbors meet growing energy needs, providing ~ 4,000 MW of power to regional partners over the next decade.

- Proposed Ethiopian Blue Nile dams would have evaporation rates several times lower than Sudan’s dams (although total evaporative losses from dams in the basin would likely still increase).

- Flood control would protect downstream settlements and prevent several billion cubic meters of water being lost to evaporation (though it would harm downstream farmers who depend on flooding for water supply).

- The dam would retain silt and would thus increase the useful lifetime of dams in Sudan and Egypt.

- Ethiopian efforts to expand irrigation comes on top of many other efforts among upstream riparians to use water for power generation, irrigation, etc.
THE WATER POWER NEXUS IN AFRICA – BASELINE WATER STRESS

30% of African power plant design capacity is located in areas of water stress concern.
THE WATER POWER NEXUS IN AFRICA – FUTURE WATER STRESS

39% of current African power plant design capacity would see water stress grow 2 to 8 times worse by 2025.
WATER TRADEOFFS WITH HYDROPOWER AND OTHER DAMS

- **Need for quick adaptation**: hydro and thermal power generators and public policy makers across the Nile River Basin will have to make large-scale adjustments in a relatively short time period in order to adapt to a rapidly changing water resource reality. Hydro and thermal power plants are both highly vulnerable to water scarcity and have large impacts on water availability for downstream users.

- **Dams and water consumption**: there are large evaporative losses from dams (although it is important to note that some dams evaporate at a much faster rate than others). Dams can also facilitate other consumptive uses of water such as irrigation, industrial and municipal use. It is difficult to predict in advance what the exact repercussions of large-scale dam construction will be.

- **Tradeoffs**: as water stress increases in many parts of the Nile River Basin, policy makers will increasingly need to decide whether to allocate scarce water resources to irrigators, power generators, industries, and/or municipalities.
FOUR FINDINGS FROM SIWI’S WATER AND NEXUS RESEARCH PROGRAM SUPPORTING IMPLEMENTATION AT THE NILE REGIONAL SCALE

Dr. Jakob Granit
Centre Director
Stockholm Environment Institute, Stockholm
1. POLICY COHESION IN ENERGY AND WATER CALLED FOR

(Granit, Europe’s World #21, Special Section on Water; )

Water is a central component in today’s and tomorrow’s energy mix

(Granit. J. & Lindström. A., 2011)

• Water is critical for fuel production and power generation
• Power is needed to manage water and supply it to consumers, agriculture and industry

World energy consumption forecast to grow by 49 percent from 2007 to 2035 (IEA, 2011)

• Access to modern electricity is 3 – 10 % in Nile countries except Egypt (100%)

Water scarcity and quality degradation is escalating due to multiple demands

• Real issue in many part of the world, relevant in parts of the Nile basin

Water and energy policies are and have been developed in isolation

• NBI, since 1999, provides a new attempt to break these silos
2. POWER PLANNING TOOLS NEED TO ASSESS ALL AVAILABLE ENERGY AND WATER RESOURCES AT THE APPROPRIATE SCALE

(GRANIT, J., KING, R. M. & NOËL, R., 2011)

Energy assets such as HEP, oil, coal, wind, solar, and bioenergy are spatially distributed in all regions globally

- Water (surface & ground) crosses boundaries in the Nile basin
- Upstream & downstream issues

The generation of RE electricity through e.g. hydropower and bioenergy provides a direct feedback loop to water management

- HEP and other indigenous power sources provide future price security and reduces foreign exchange requirements for fuel purchases

Pre-investment tools such as Strategic Environmental Assessment (SEA) allows for a systematic and comprehensive process of evaluating power generation options and for power and water program development

- The environmental, social, technical, economic and financial impacts of projects and their alternatives should be evaluated in conjunction
- Findings can be used in publicly accountable decision-making
- Will support detailed project planning work and modeling (LEAP and WEAP)
3. REGIONAL POWER MARKET DEVELOPMENT IMPROVES EFFICIENCY AND RELIABILITY

Electric power trade can transfer the benefits from transboundary water management to load centers supporting integration in a region


- East African Power Pool (EAPP), NBI Power Trade

Co-management of electricity networks in a market will get each country access to a larger set of cost-effective energy sources

- Many countries already share electricity grids in the Nile basin, new interconnections are being planned around Lake Victoria ring and between Ethiopia and Kenya

Power and transboundary water cooperation offers a rationale for wider expansion supporting broader economic integration


- African Union (AU); East African Community (EAC); Common market for Eastern & Southern Africa (COMESA)
4. LARGE SCALE WATER STORAGE HAS A KEY ROLE TO PLAY IN THE W-E NEXUS FROM A REGIONAL PERSPECTIVE (LINDSTRÖM, GRANIT, WEINBERG, 2012)

Large-scale water storage supports economic development, builds water security and buffers against increasing rainfall variability

• Large potential still exists in the Nile Basin

Well-designed water storage and hydropower systems can enhance both climate change adaptation and mitigation

HEP is a renewable source of fuel for electric power generation that efficiently can enable other RE sources in a power system

• Hydropower & pumped storage can support the deployment of other sources of Renewable Energy (RE), peaking capacity
• Ethiopia HEP potential 30,000 MW; Sudan 5,000 MW; Uganda 2,000 MW

Environmental and social consequences at the local and regional levels need to be addressed up-front when developing water storage

• See eg: World Bank Safeguard policies; WCD; Equator principles; UNEP Dams and Development; IHA Hydropower sustainability Assessment Protocol
• See preparation of the Rusumo Falls HEP and multipurpose project (Burundi, Rwanda and Tanzania)
To use virtual water/water footprinting to promote improved efficiency of water use for productive agriculture and trade in the Nile Basin countries

- Analysis, documentation and training
- 10 commodities with deep-dives 2 per country
- Distinction between green and blue water

- Comparative advantage of agriculture production and trade
  - Yield (production) and water requirement (climate)
- Opportunity cost of water and land use
  - Net impact or green and blue water
WATER FOOTPRINT ESTIMATES:

CEREALS
VIRTUAL FLOWS OF WATER TO AND FROM EGYPT

Virtual Water Trade flows in Rice, Egypt (2005-2009)

- Virtual Water exports from Egypt
- Virtual Water imports to Egypt

Only significant VW flows are shown, relative size of arrow shows relative flow
WATER FOOTPRINT ESTIMATES

COFFEE & KENYA BEEF

WF of Coffee

WF of Beef in Kenya
## COMPARATIVE WATER FOOTPRINT

### Calory per Cubic Metre

<table>
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<tr>
<th></th>
<th>Burundi</th>
<th>DRC</th>
<th>Ethiopia</th>
<th>Kenya</th>
<th>Rwanda</th>
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<td>0.26</td>
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<td>0.17</td>
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### Value ($) per Cubic Metre

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CONSIDERATIONS FOR DIFFERENT CROPS

- **CEREALS (MAIZE, WHEAT & RICE)**
  - Regional trade & comparative advantage
  - Food self-sufficiency & food security
  - Current account balance & virtual water trade

- **FOOD CROPS (BANANAS & BEANS)**
  - Country self-sufficiency
  - Trade for climate variability

- **ANIMAL PRODUCTS (BEEF)**
  - Comparative advantage and opportunity costs

- **CASH CROPS (TEA, COFFEE & FLOWERS)**
  - Global comparative advantage
  - Supply chain competitive advantage
• Development of hydropower
• Irrigation
• Flood control
• Industry
• Food Security
• Health outputs
• Environmental services for biodiversity conservation and tourism
• Energy is required in water pumping and treatment. As water becomes scarcer, additional energy demands arise from pumping over longer distances or from greater depth, or from alternative means of production, such as desalination.
• The Nile Basin Initiative (NBI) and the Nile Basin Discourse (NBD) have been promoting joint multi-purpose projects for a long time with an aim of minimizing the costs, increasing the benefits and embracing the Nexus approach.
GOVERNANCE AND THE NILE

**NBI**
- Create Shared Vision
- Enable environment for investment projects

**CFA**
- Legal and institutional framework for cooperation
- Adoption and ratification by riparians

**NBC**
- Executive body
- Implementation of investment projects
- Administration of funding

**Transitional cooperative arrangement**

**Legal and Institutional Framework**

**Permanent river basin organisation**
REPOSITORY INFORMATION

(a) Geographic, hydrographic, hydrological, climatic, ecological and other natural factors;
(b) Social and economic needs;
(c) Population;
(d) The effects of the use or uses of the water resources in one Basin State on other Basin States;
(e) Existing and potential uses of the water resources;
(f) Conservation, protection, development and economy of use of the water resources and the costs of measures taken to that effect; and
(g) The availability of alternatives, of comparable value, to a particular planned or existing use.

SCIENTISTS
Clear evidence based analysis to show the nexus between water, food and energy

NBD
HUDUMA - Increasing accountability of Nile Basin Initiatives to citizens through technological innovation

NBI repository
NBSF, Nile-IS, DSS (being disseminated for trial use and population). Maiden State of Basin Report being finalized. Comprehensive Basin-Wide Power Development and Trade Options study completed and Ongoing Pre-identification studies
KEY MESSAGES

• The allocation of scarce water resources for different purposes, including for vital ecosystem functions is a key issue for the Nile Basin.

• The Role of NBI as the receptor and custodian of the Nile Basin information (data) is critical and should be continue to be supported fully.

• The involvement/intervention of an independent, well respected/accepted and institutionally / scientifically capable NBI, NBD and Network of Scientists, is a priority in fostering Nile cooperation.