Responding to the Crisis of the Filling of the GERD: An International Insurance Approach?

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Outline of Presentation

- Overview of Nile Hydrology
- The Crisis of GERD Filling
- A Primer on Hydropower
- Uncertain Future of Nile Flows
  - Natural Variability
  - Impacts of Filling Policies
- Modeling Approach
- Engineering Impacts and Risks
- Economics Impacts and Risks
- Sharing the Risks: A Case for Insurance
Nile Hydrology

<table>
<thead>
<tr>
<th>Nr</th>
<th>River and Station Name</th>
<th>Data Period</th>
<th>Avg Ann Flow (km³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Main Nile at Dongola</td>
<td>1890 - 1995</td>
<td>84.1</td>
</tr>
<tr>
<td>2</td>
<td>Atbara at mouth</td>
<td>1903 - 1994</td>
<td>11.1</td>
</tr>
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<td>3</td>
<td>Main Nile at Tamarat</td>
<td>1911 - 1995</td>
<td>72.7</td>
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<tr>
<td>4</td>
<td>Blue Nile at Khartoum</td>
<td>1900 - 1995</td>
<td>48.3</td>
</tr>
<tr>
<td>5</td>
<td>White Nile at Mogren</td>
<td>1911 - 1995</td>
<td>26.0</td>
</tr>
<tr>
<td>6</td>
<td>Dinder at mouth</td>
<td>1917 - 1997</td>
<td>2.8</td>
</tr>
<tr>
<td>7</td>
<td>Blue Nile at Diem</td>
<td>1912 - 1997</td>
<td>48.7</td>
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</tbody>
</table>
Treaties Impacting Eastern Nile

• 1891 Protocol between Great Britain and Italy
  – Italy agrees no irrigation works on Atbara to impact Nile
• 1902 – Treaties between Great Britain and Ethiopia
  – King of Ethiopia engages to construct no work to arrest flow to Nile without Agreement of GB or Anglo-Egyptian Sudan
• 1925 Exchange of Notes between Great Britain and Italy
  – “hydrolic rights” of Egypt and Sudan to Nile
• 1929 agreement between Egypt and GB (for Sudan and Colonies)
  – that no works on Nile without Egypt’s Consent
• 1959 Republic of Sudan and United Arab Republic (Egypt)
  – Bi-lateral allocation of the Entire Nature Flow arriving at Aswan
<table>
<thead>
<tr>
<th>Category</th>
<th>1959</th>
<th>Current</th>
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<tbody>
<tr>
<td>Inflow at Dongola</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>Lake Nasser Loss</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Net Available</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td>To Egypt</td>
<td>55.5</td>
<td>61.5</td>
</tr>
<tr>
<td>To Sudan</td>
<td>18.5</td>
<td>12.5</td>
</tr>
<tr>
<td>To Others</td>
<td>00.0</td>
<td>0.0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>74.0</td>
<td>74.0</td>
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</tbody>
</table>
Grand Ethiopian Renaissance Dam

- The GERD (the 8th largest reservoir on Earth) will soon join
- Egypt’s High Aswan Dam (3rd largest) in the unprecedented combination of
  - two major, multipurpose dams operating on the same river system with
  - no agreement for coordination in place.
Grand Ethiopian Renaissance Dam

• At 6,000 MW, the dam will be the largest hydroelectric power plant in Africa when completed, as well as the 8th largest in the world.

• No IRRIGATION JUST HYDROPOWER

• The reservoir at 70 billion cubic meters will be one of the continent's largest. Able to hold the 1.4 times he mean annual flow of the Blue Nile with is 75% of Nile flow reaching Egypt and Sudan.

• According to the Ethiopian government, as of Summer 2016, the dam is 70% complete. Could start filling in less than a year !!!!!!!!
Why is it a CRISIS?
The GERD’s Location
High Aswan Dam

Filling the GERD with IMPACT EGYPT
BUT HOW AND BY HOW MUCH?

BLUE NILE

GERD

River Atbara

Blue Nile

White Nile

Flow in millions of cubic metres per day

May June July Aug Sept Oct Nov Dec Jan Feb Mar Apr
A PRIMER on RESERVOIRS AND HYDROPOWER
Converting Potential to Mechanical to Electrical Energy

\[ HP = a \times H(t) \times Q(t) \]

\( H \) = Elevation Difference

\( Q \) = Flow through Turbines
GERD STORAGE FEATUREs

Volume

74 BCM

47. BCM

15 BCM

3.5 BCM

1. BCM

0 BCM

Diagram:

- "Low Block" Overflow Spillway
- El. 640 Full Supply Level
- El. 624.9 Main Gated Spillway Sill Level
- El. 590 Min. Operating Level
- El. 560
- Intake to Turbine
- Penstocks
- Diversion Outlets (4 No, 8m DIA.)
- Power Station
- Turbine (15 No)
- El 500
GERD FILLING POLICY ASSESSED

• Minimum Release of 30 BCM per Year
  – The Blue Nile flow exceeded 95% of the time
  – The 1 in 20 year Drought

• 4 rates of Filling to Top of Conservation Pool
  – Unconstrained
  – 3 years
  – 5 years
  – 10 years
Simulated Inflow Sequences
GERD STORAGE

Mean over first 10 years

Billion Cubic Meters

GERD FILLING POLICY

NoGERD NoPolicy 3Yr 5Yr 10Yr
GERD RELEASE

Mean over first 10 years

Billion Cubic Meters per year

GERD FILLING POLICY

NoGERD  NoPolicy  3Yr  5Yr  10Yr
IMPACTS TO EGYPT

• IMPACT ON INFLOW
• IMPACT ON STORAGE
• IMPACT ON HYDROPRODUCTION
INFLOWS

![Box plot showing inflows under different GERP filling policies.](image-url)
IMPACT ON STORAGE
Trade Off

• How Much is Ethiopia Impacted by a slower fill policy?

• Let’s look at impacts on GERD Hydropower
GERD Hydropower

Mean over first 10 years

GWh per year

GERD FILLING POLICY

NoGERD  NoPolicy  3Yr  5Yr  10Yr
What is the Value if GERD Hydrower

- Average Annual Generation for a minimum annual release of 30 BCM is estimates at
- 11,000 GWh
- At $0.10 per kwh give an annual revenue of $1.1 billion
- Power in Kenya was selling at $0.14 per kwh
From Engineering to Economics

• The previous was reporting on Engineering Indicators
• What if we look at Economic Indicator
• We performed a Hydro-Economic Analysis
Effect on GDP (relative)

Mean Annual Difference in GDP relative to the Median No GERD Scenario, Over the First 5 Years

GDP: 272 billion USD (2013)
Population: 82.06 million (2013)
GDP growth rate: 2.1%
GDP/CAP: $3,314.46 (2013)
What is the Impact on Average

- On the Average 1,480 Gwh lost at HAD

<table>
<thead>
<tr>
<th></th>
<th>EGYPT GDP</th>
<th>ETHIOPIAN GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$ Million/year</td>
<td></td>
</tr>
<tr>
<td><strong>Filling</strong></td>
<td>5%</td>
<td>Mean</td>
</tr>
<tr>
<td><strong>NO GERD</strong></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>UnConst</strong></td>
<td>350</td>
<td>117</td>
</tr>
<tr>
<td><strong>3 yr</strong></td>
<td>117</td>
<td>58</td>
</tr>
<tr>
<td><strong>5 yr</strong></td>
<td>87</td>
<td>55</td>
</tr>
</tbody>
</table>
The Risks to Egypt of the GERD Filling

• Loss Hydropower and Irrigation Flow
  – On average small much less that gains at GERD
• BUT impacts are on low income and Farmers a very politically volatile segment of the Egyptian Economy
• Poor Society-Wide understanding of the greatly reduced role the Nile plays in Egypt Economy
• The Incredible Role it plays in national identity, psyche, and pride.
• Is there Room for Cooperation?

The Risks to Ethiopia GERD Filling Policies

• Loss Hydropower Revenues & Repayment Issues & slowing of Economic Growth
• The GERD has been funded significantly by domestic bonds
• Society-Wide understanding of an inflated role the GERD will play in Ethiopian Economy
• The Incredible Role GERD plays in national identity, psyche, and pride.
• JUST LOOK AT THE NAME
• Is there Room for Cooperation
A proposal

• The international community develop an insurance scheme similar to the Hydrologic Risk Fund of the Senegal River Basin or Crop Insurance.

• This will insure Both Egypt and Ethiopia against the losses they both fear from extreme events and allow them to develop an agreement based upon the clear win-win of the “mean-state” of the Nile.

• What do you think?