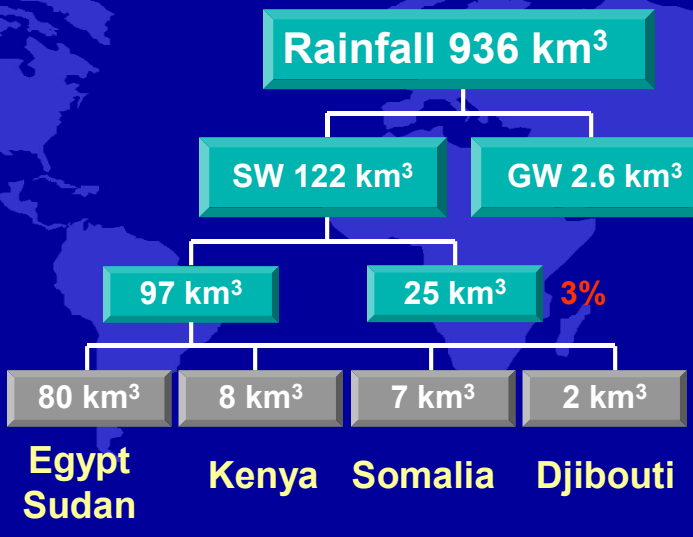
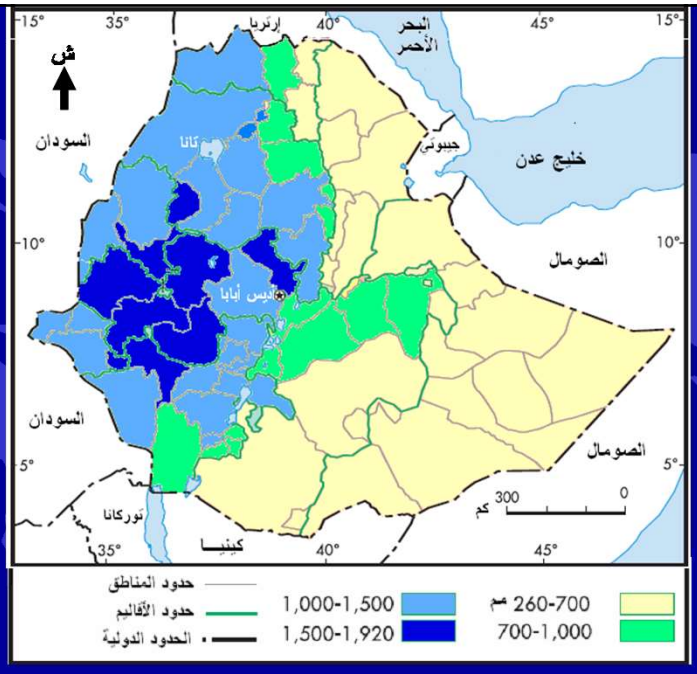
Water issues and environmental challenges in Ethiopia

WATER RESOURCES OF ETHIOPIA



Challenges

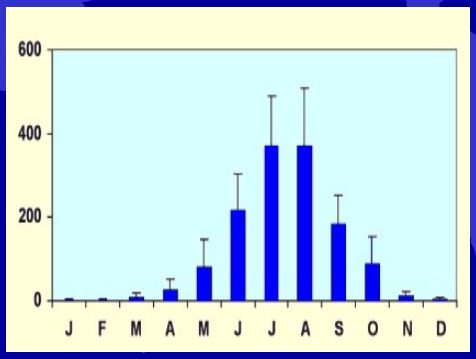
Rainfall spatial distribution



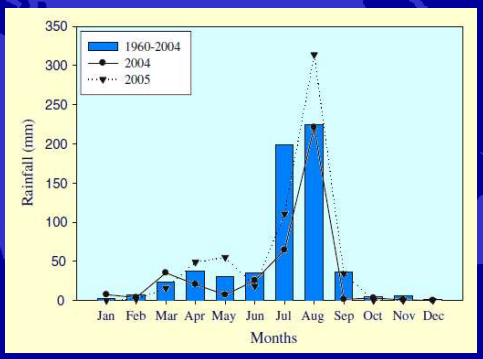
Average of rainfall in Ethiopia 1985-2005. World Bank, 2006

Challenges

1. Rainfall Spatial distribution
2. Rainfall temporal distribution — Short season



Mean rainfall (1992–2002) at Tana Lake (Wondie et al., 2007)

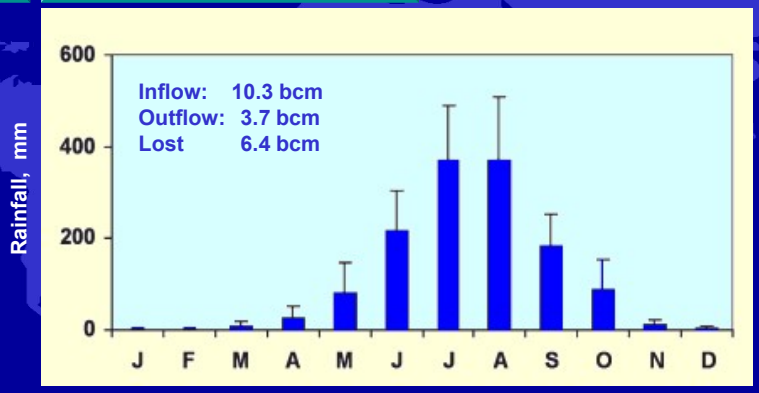


Monthly precipitation at Quiha (Tigray), Northern Ethiopia Northern Ethiopia

Preparations before the rainy season to capture rainwater.

Challenges

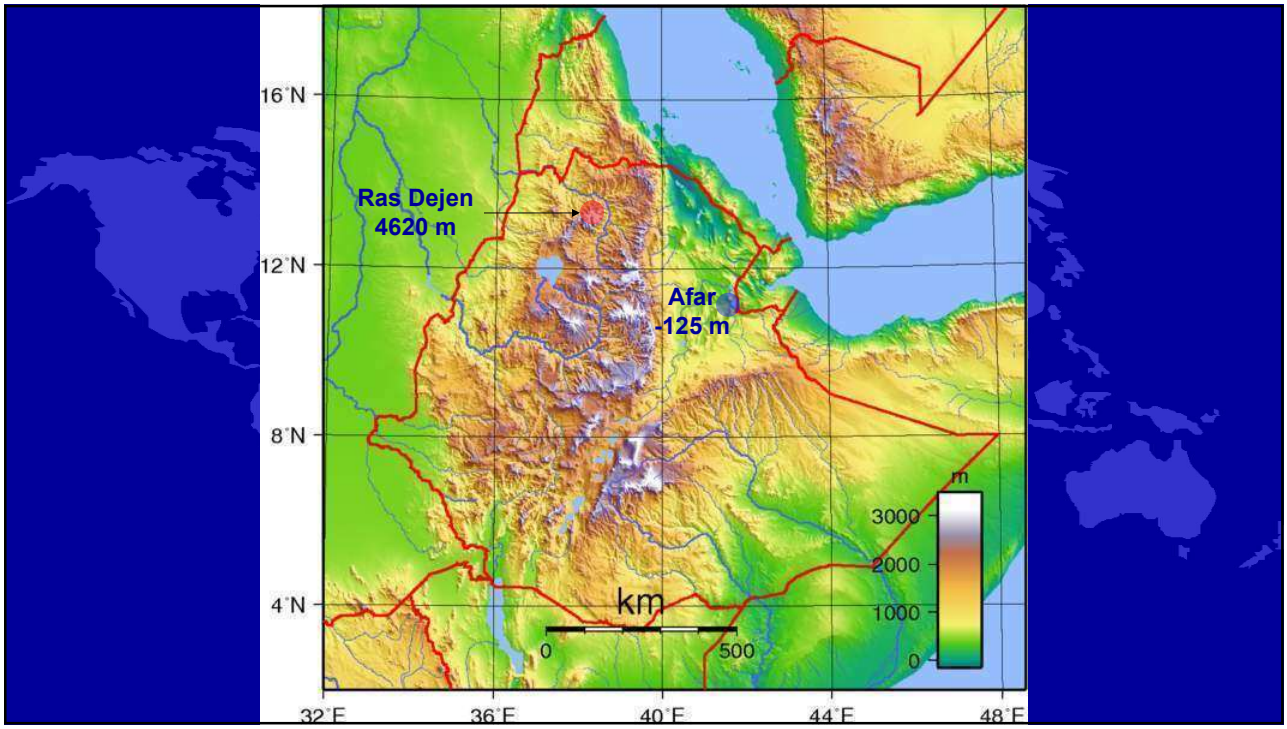
1. Spatial distribution
2. Temporal distribution
3. Evaporation



Mean rainfall (1992–2002) at Tana Lake (Wondie et al., 2007)

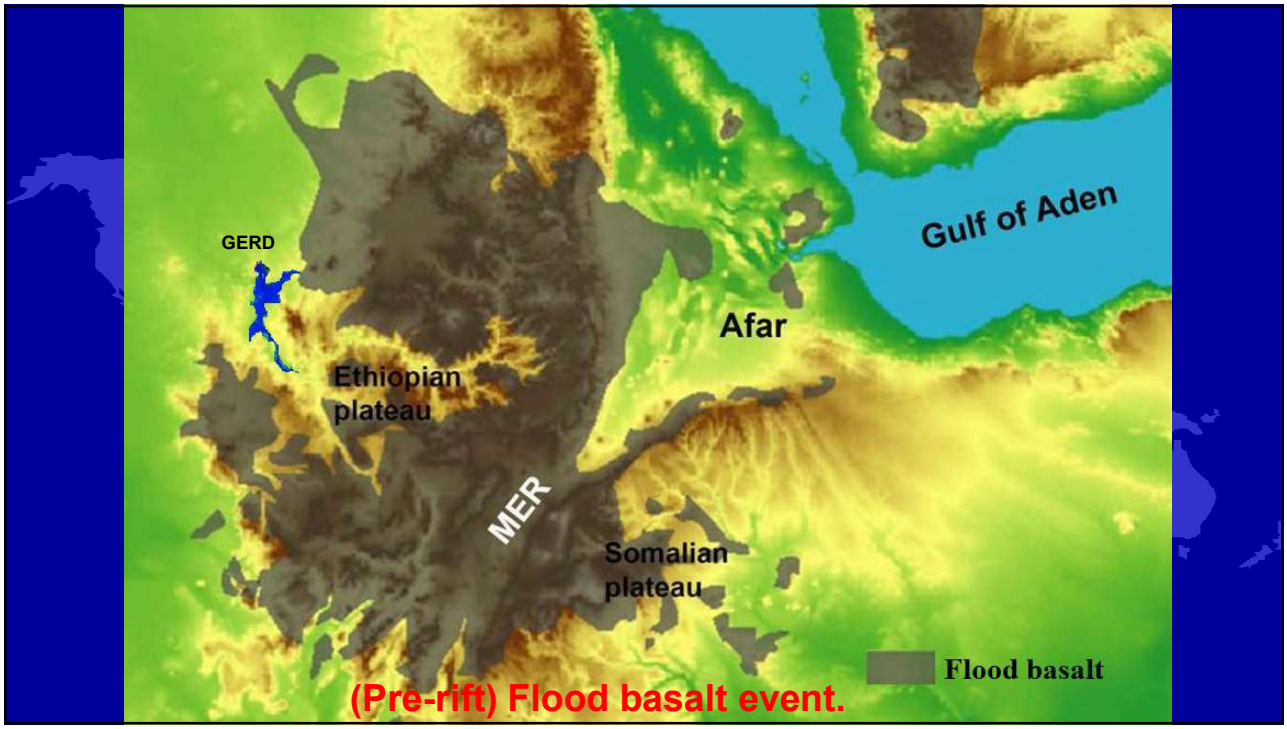
Challenges

1. Spatial distribution
2. Temporal distribution
3. Evaporation
4. Topography



Challenges

1. Spatial distribution
2. Temporal distribution
3. Evaporation
4. Topography
5. Type of rocks



(Pre-rift) Flood basalt event.

Challenges

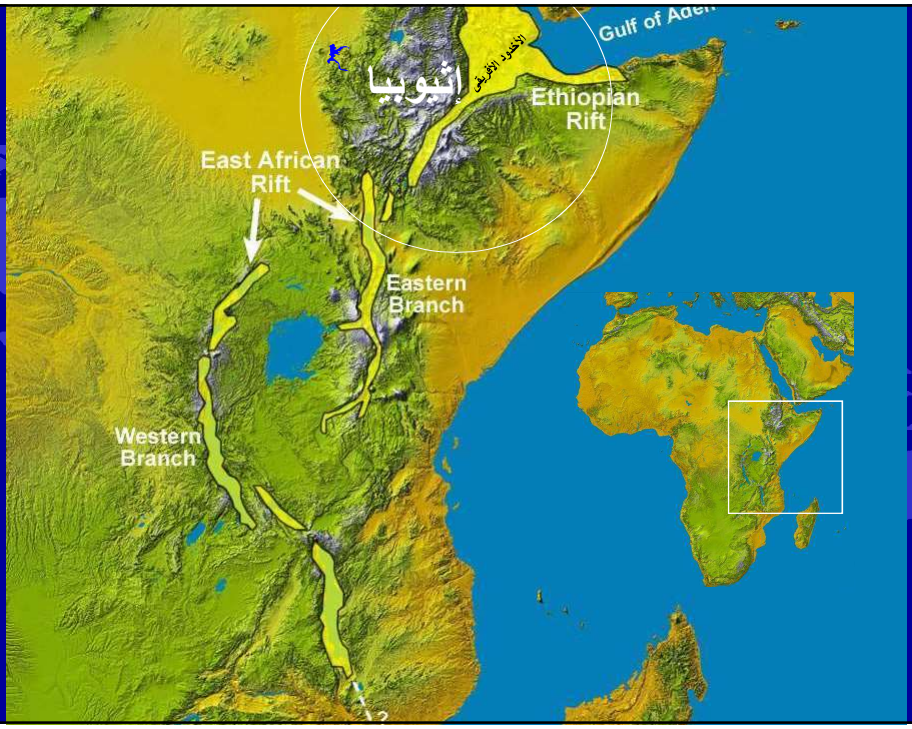
1. Spatial distribution
2. Temporal distribution
3. Evaporation
4. Topography
5. Rock Types
6. Erosion and Siltation

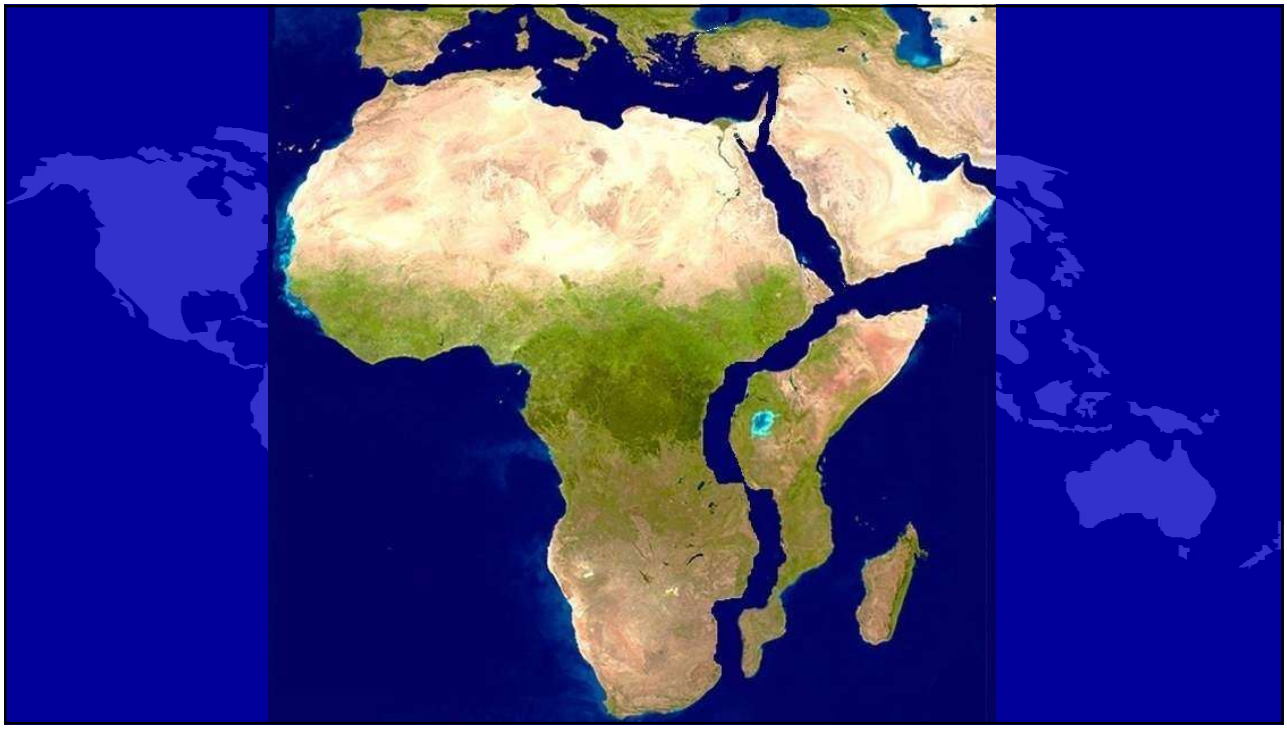
- Blue River & Atbara 525 top soil MCM/yr
- 100 m accumulated sediments in Tana Lake.
- 80% of cultivated lands suffers from soil degradation .

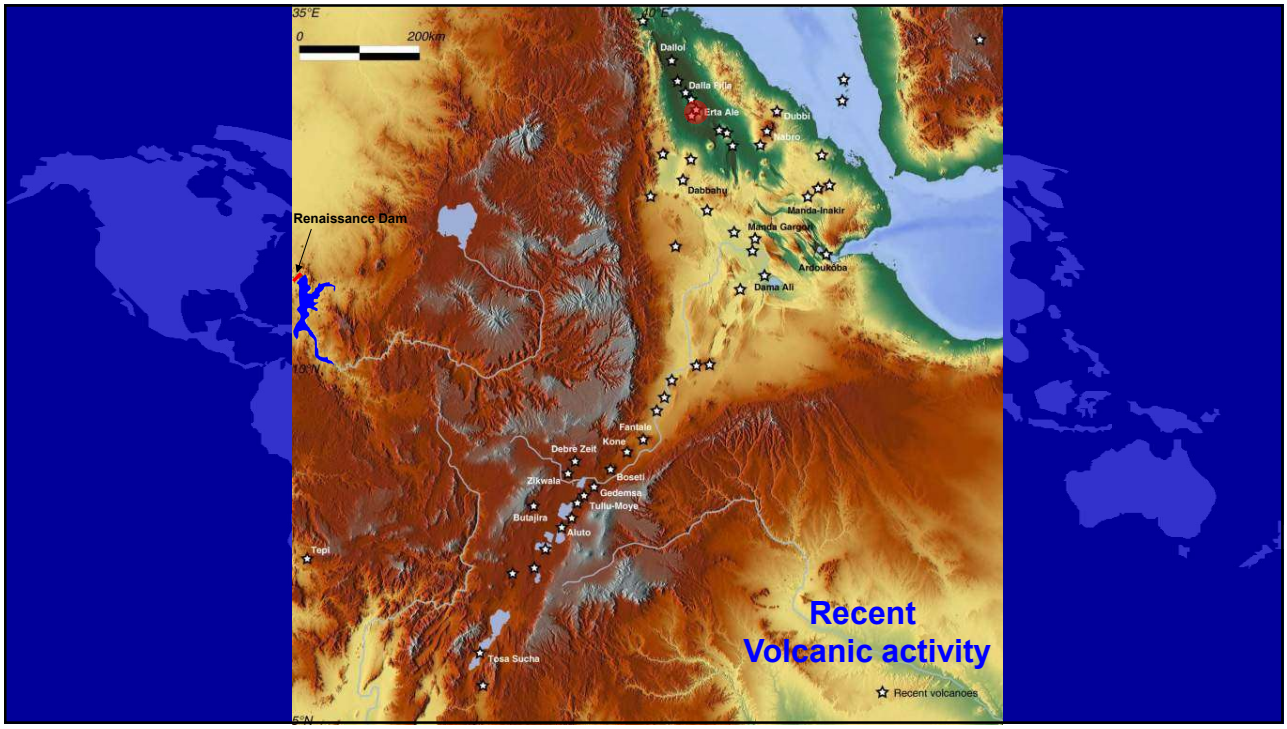
Challenges

1. Spatial distribution
2. Temporal distribution
3. Evaporation
4. Topography
5. Rock Types
6. Erosion and Silt Load
7. Tectonics & Earthquakes

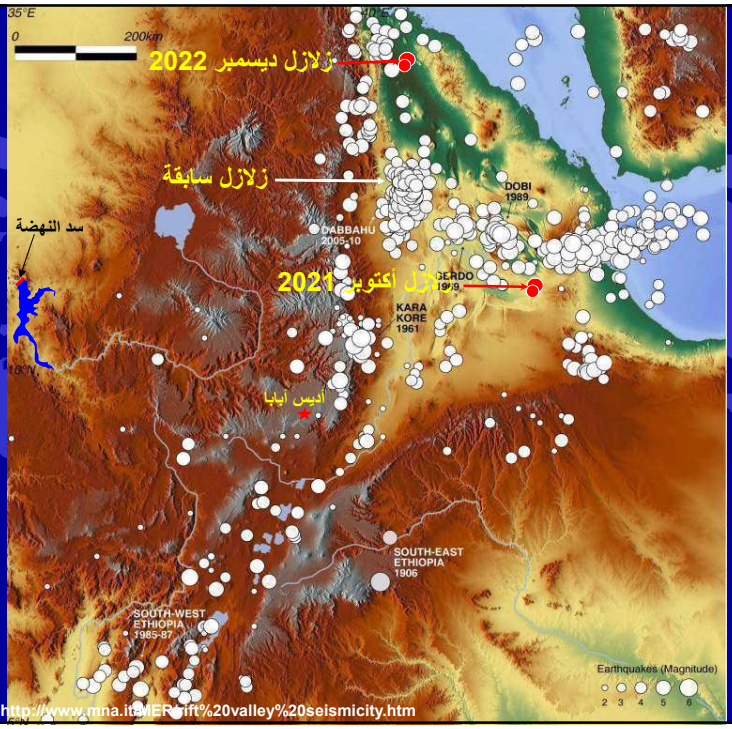
Buildings, Bridges, Dams and Water Supply Networks are at Risk.

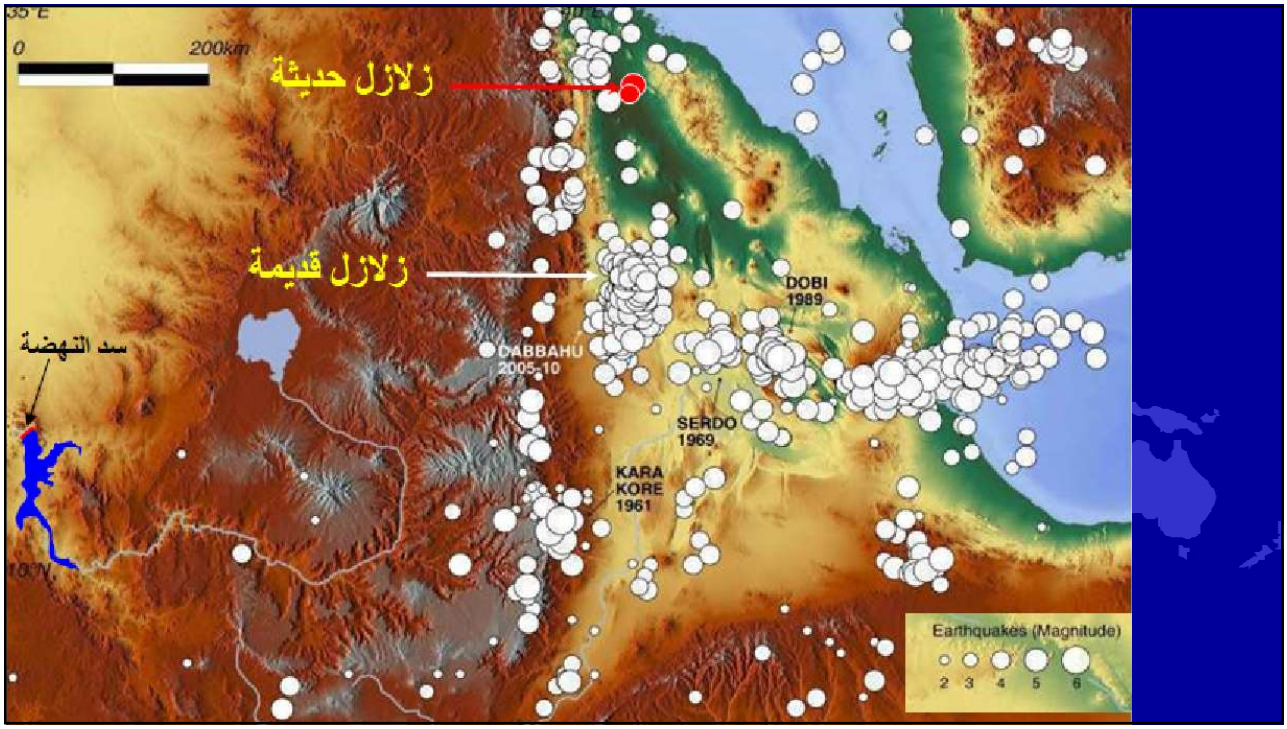





35°E
0
200km
40°E
Dalloi
Dalla Filla
Erta Ale
Dubbi
Dabbahu
Manda-Inakir
Manda Gargori
Ardoukoba
Dama Ali
Renaissance Dam
13°N
Fantale
Kone
Debre Zeit
Boseti
Zikwala
Gedemsa
Tullu-Moye
Butajira
Aluto
Tepi
Tesa Sucha
6°N
Recent
Volcanic activity
Recent volcanoes

The active Lava Lakes of Erta Ale "Smoking Mountain".
Active basaltic shield volcano.
http://en.wikipedia.org/wiki/Erta_Ale




35° E
0
200km
زلازل حديثة
زلازل قديمة
سد النهضة
DOBI
1989
DABBAHU
2005-10
SERDO
1969
KARA
KORE
1961
Earthquakes (Magnitude)
2 3 4 5 6


A ground rupture created during the September 2005 the sun rifting event in the Dabbahu segment in the Afar rift.

Challenges

1. Spatial distribution
2. Temporal distribution
3. Evaporation
4. Topography
5. Rock Types
6. Erosion and Siltation
7. Tectonics-Earthquakes
8. Landslides

Rock falls, Debris slides and avalanches, debris flows and mudflows

Gibe II

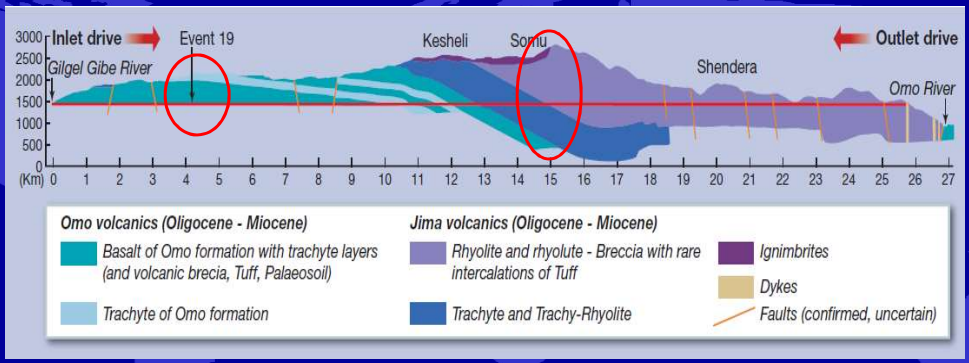
15 m section of its headrace 26-km tunnel collapsed after 10 days.
Jan 13, 2010

http://www.tunneltalk.com

Gibe II

Oct 2006
June 2007
Fault with mud at
P=40 bar

14 Jan 2010



26 km tunnel, 6-m diameter
505 m drop, 428 MW (4 turbines @107 MW EACH)
€373 Million, January 14, 2010

http://www.tunneltalk.com

- Inaugurated on November 14, 2009,
- running two more years (2007-2009),
- unforeseen geological conditions,
- US $ 100 over-budget ($360 million),
- loss of the lives of 47 workers, three Chinese.

Tekeze Project - Heavy river flow overtopping dam at 2000 m^3/sec (9 August 2006).

http://www.panoramio.com/photo_explorer#view=photo&position=513&with_photo_id=76171558&ss_play&order=date_desc&user=6471315

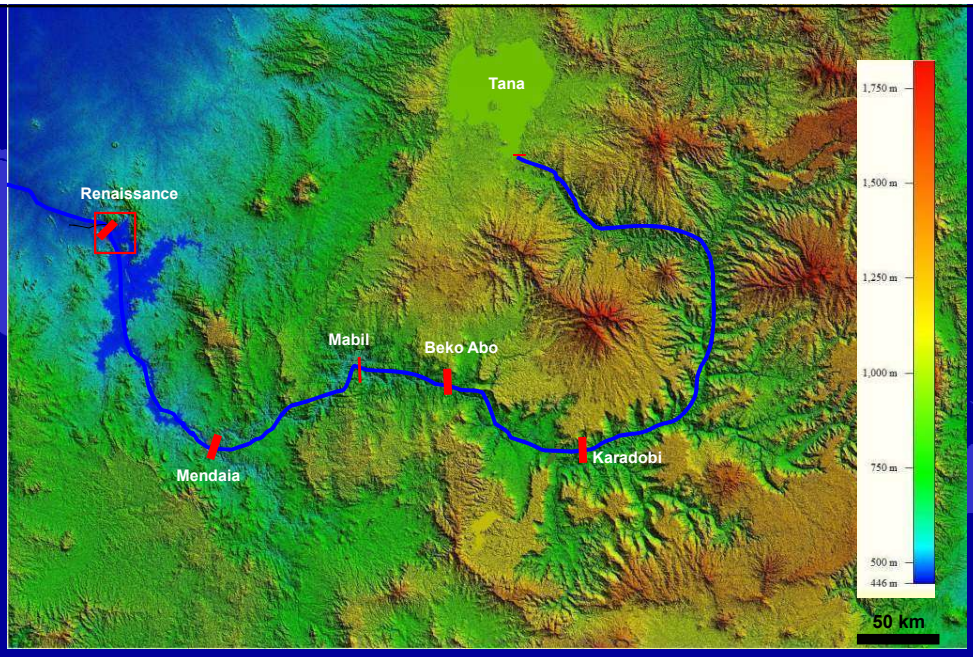
Challenges

1	PPT. Spatial dist.
2	PPT. Temporal dist.
3	Evaporation
4	Topography
5	Rock Types
6	Erosion and Siltation
7	Tectonics
8	Landslides

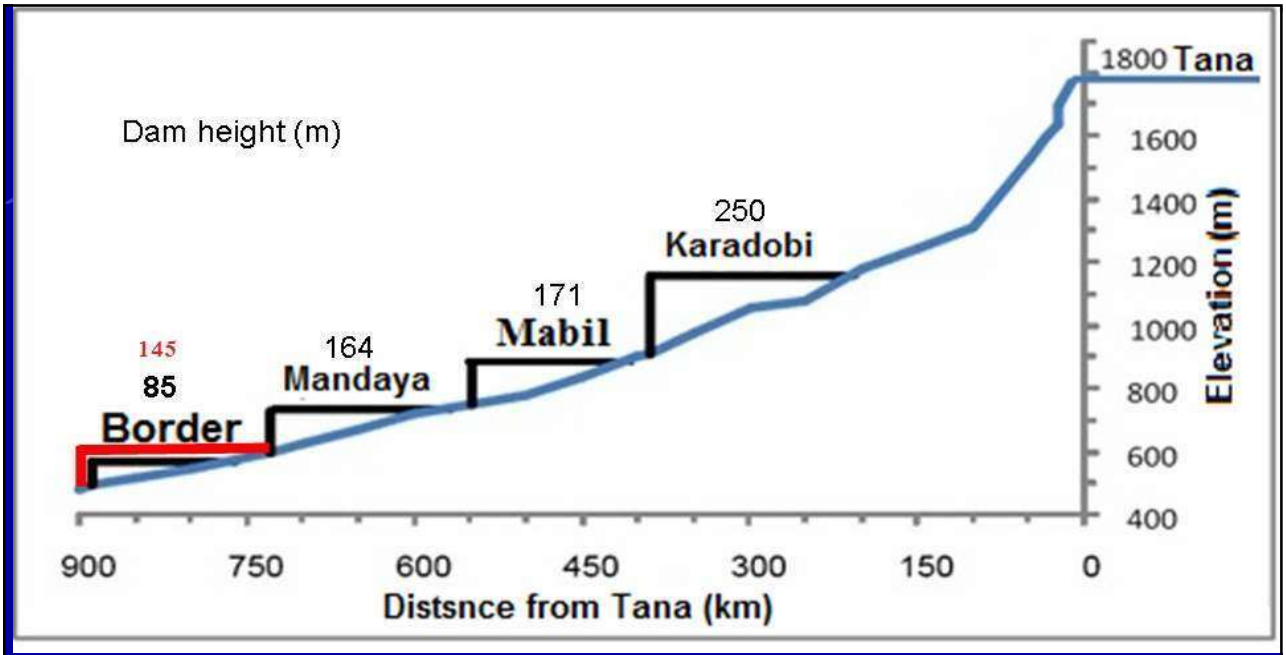
122 billion m3

- Tekeze = Atbara
- Abbay = Blue Nile
- Baro-Akobo=Sobat

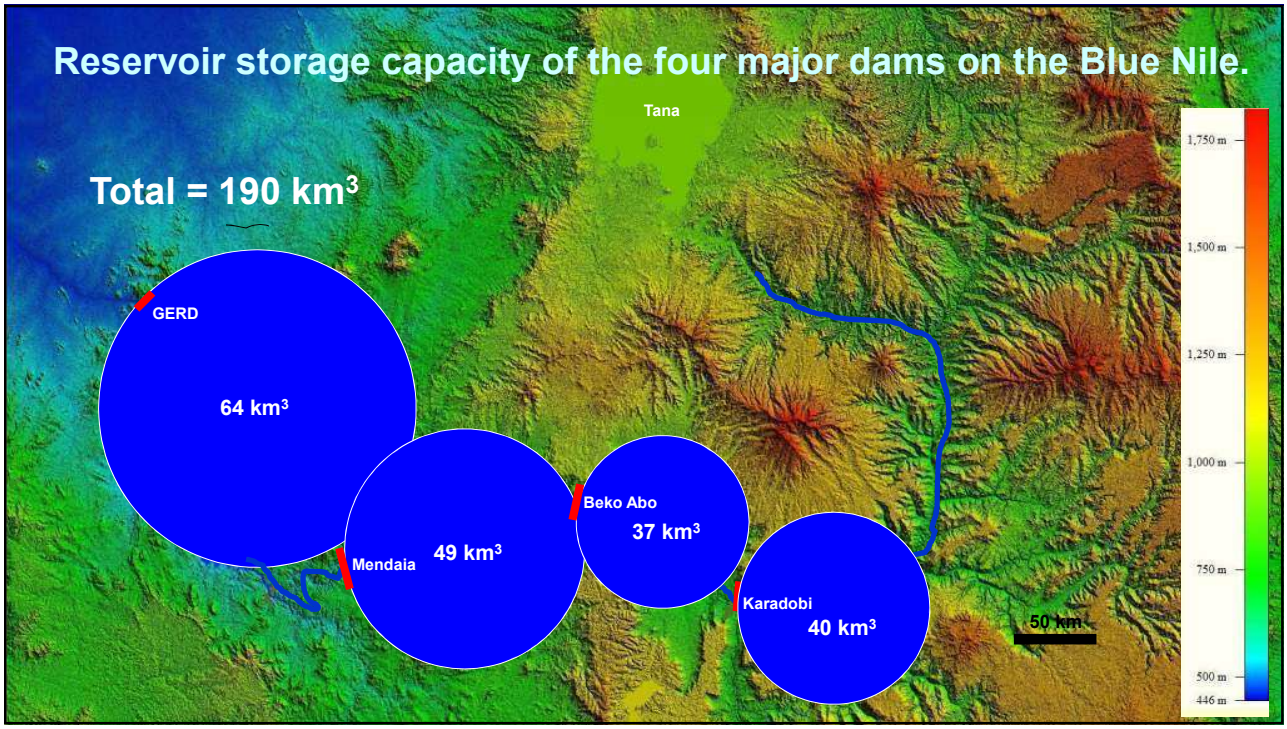
AFDEC, 2006

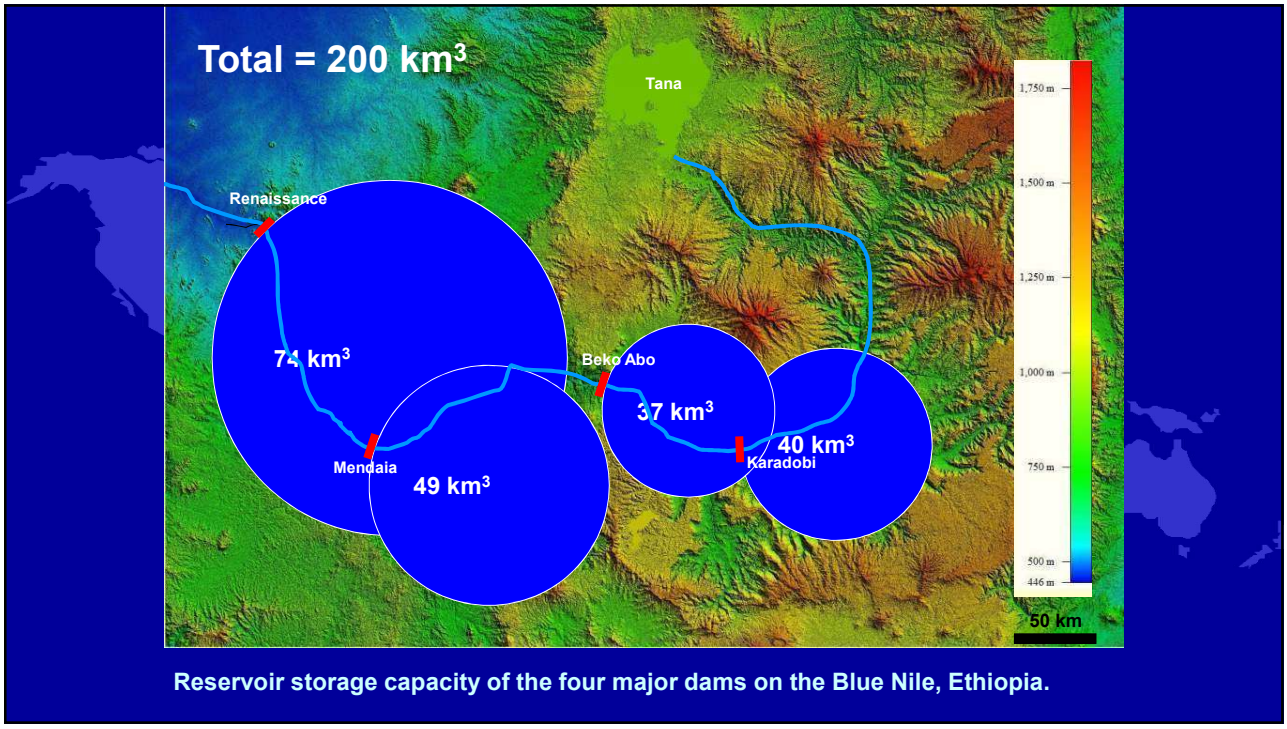


The proposed four major dams on the Blue Nile in Ethiopia.

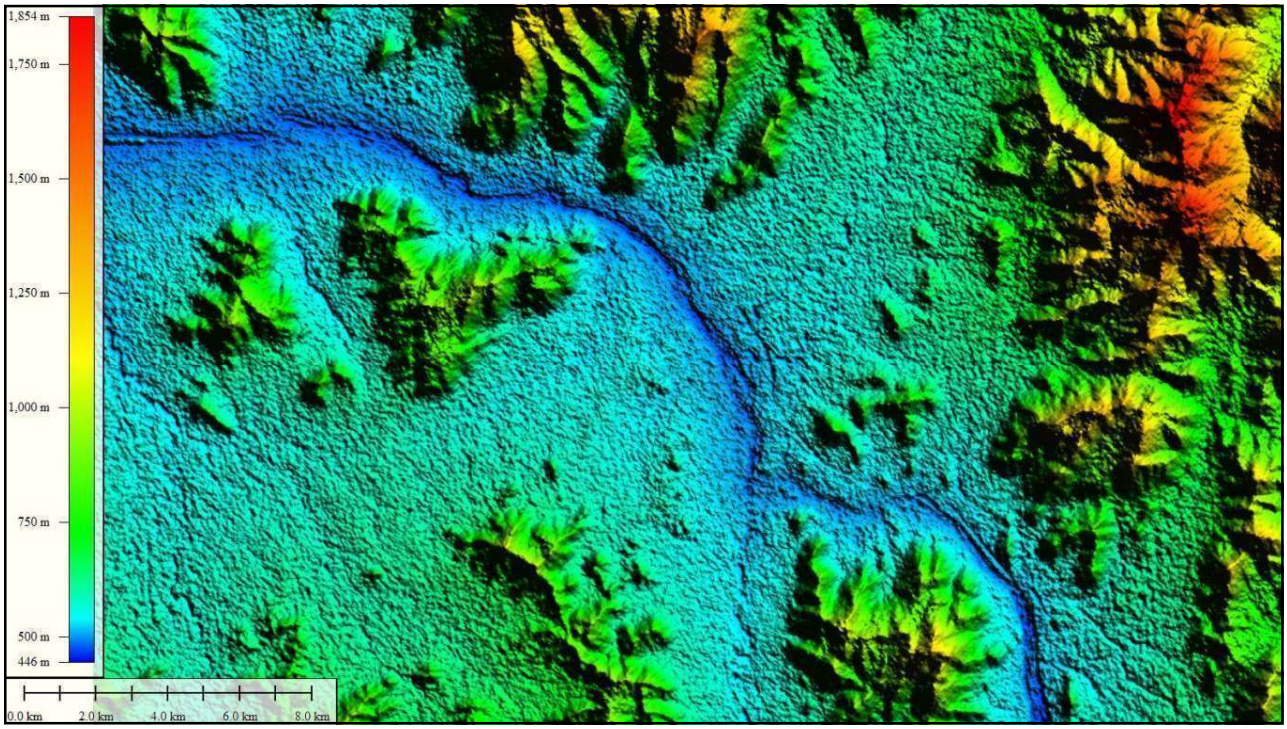


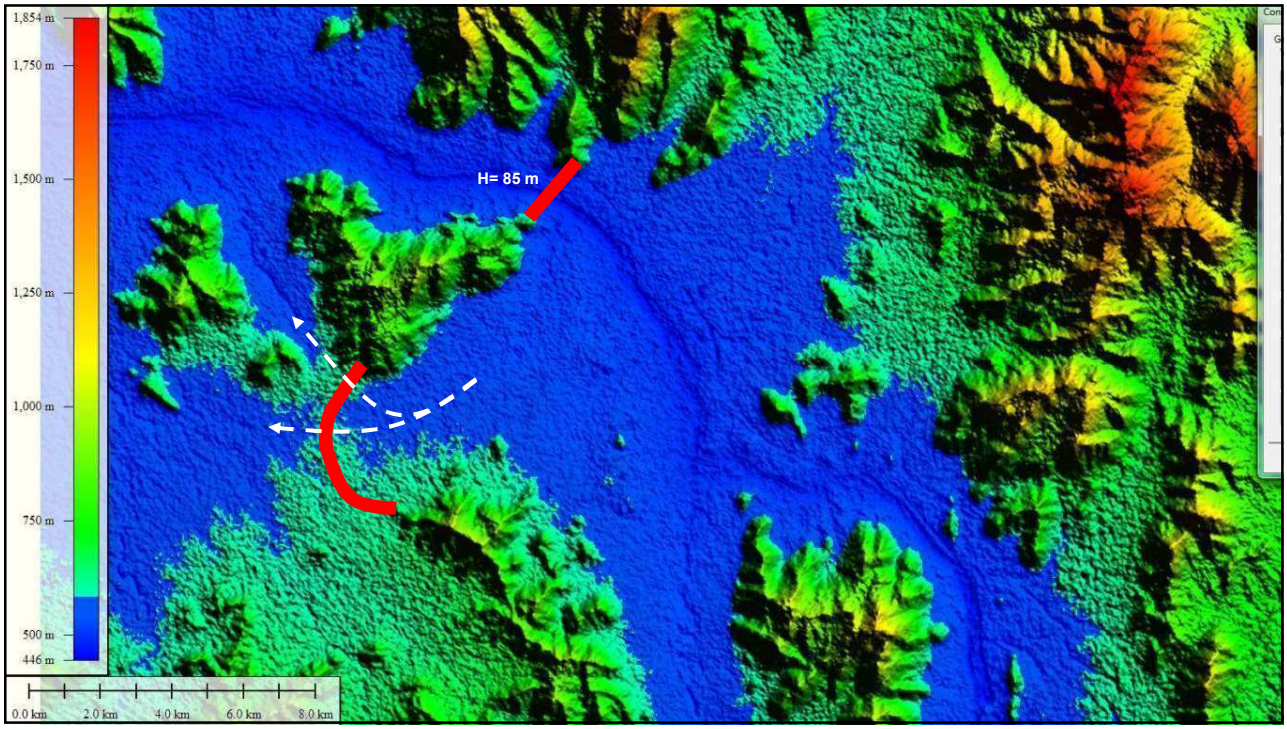
The Ethiopian water projects on the Blue Nile.





Reservoir storage capacity of the four major dams on the Blue Nile, Ethiopia.


1,854 m
1,750 m
1,500 m
1,250 m
1,000 m
750 m
500 m
446 m
0.0 km
2.0 km
4.0 km
6.0 km
8.0 km


1,854 m
1,750 m
1,500 m
1,250 m
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750 m
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446 m
H= 85 m
0.0 km
2.0 km
4.0 km
6.0 km
8.0 km

Advantages Grand Renaissance Dam

1. Clean renewable energy production 6,450 → 5150 MW.
2. Irrigation (200,000 Acres) in the dry season.
3. Navigation and tourism.
4. Sediment manage and life span for Sudan-Egypt's dams.
5. Minimizing the evaporation.
6. Flood control.
7. Reducing water load at the High Dam Lake.
8. Water flow all year in Sudan.
9. Double the hydroelectric generation of dams in Sudan.
10. Recharge the Gezira GW aquifer in Sudan.

Disadvantages

1. High cost US $4.8 ➔ >$8 billions.
2. Loss of agricultural (200,000 Acres), grazing and forest lands.
3. People displacement (30,000 capita).
4. Flooding of some mining areas (Au, Fe, Cu, Pt, building stones, ...
5. Short life span (60 years @ 250 Mm^3/yr sediments from 15 Bm^3.
6. Increasing of earthquake potential in the storage area.
7. increase the transmission of malaria.
8. Low efficiency of power generation (27%).
9. Political conflicts with downstream countries.
10. Temporary loss of storage (60 Bm^3) for 5 yrs.

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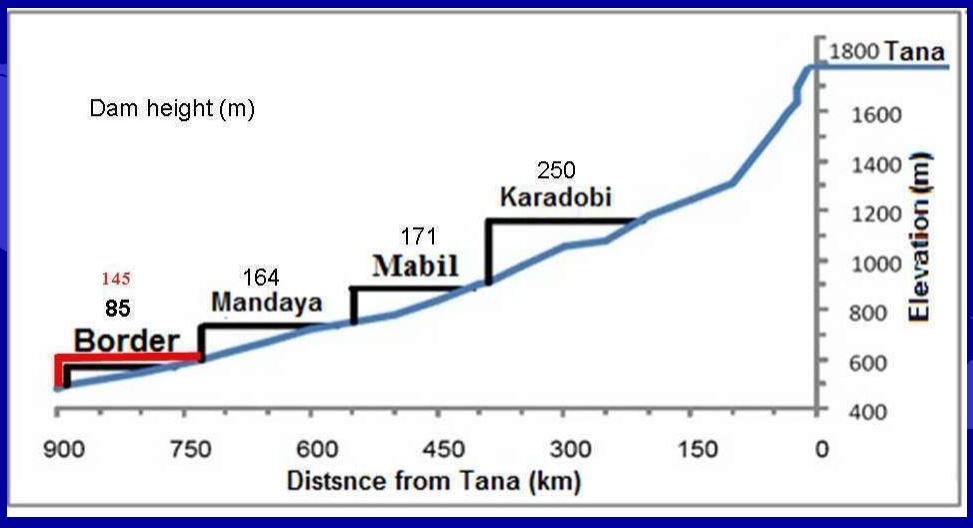
11. Loss of annual water (Evaporation 3 km^3, infiltration ??, agriculture??).

Right bank river section 200m downstream of center line, gneissic granite intersected by 4 joint sets. ENTRO, 2007



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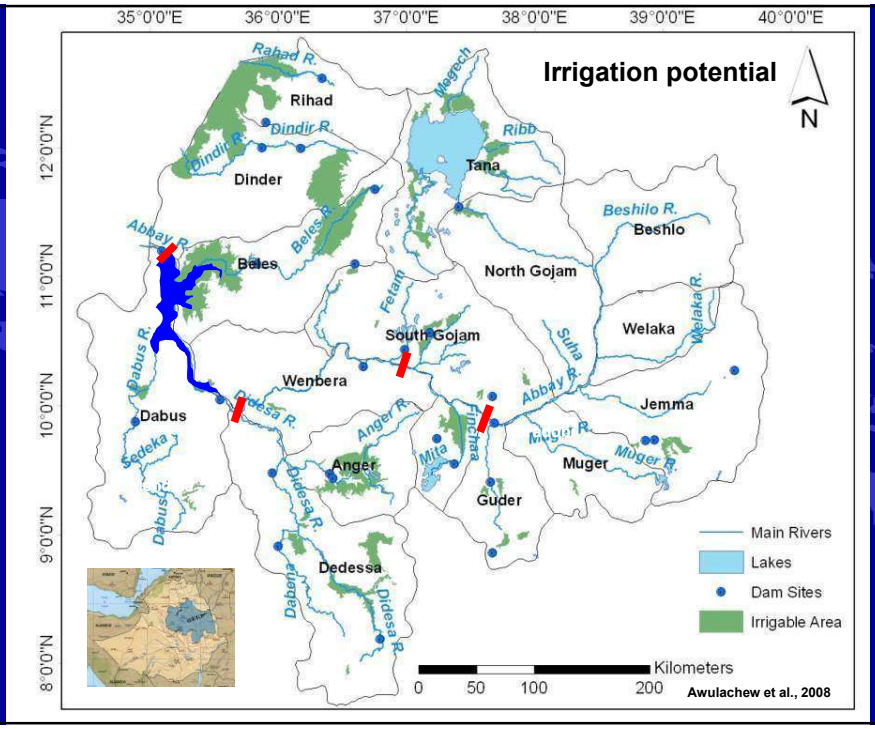

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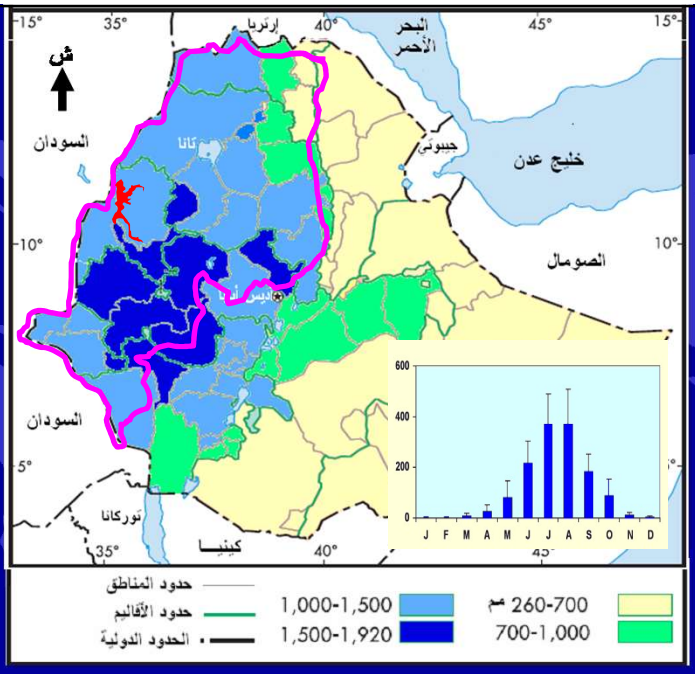
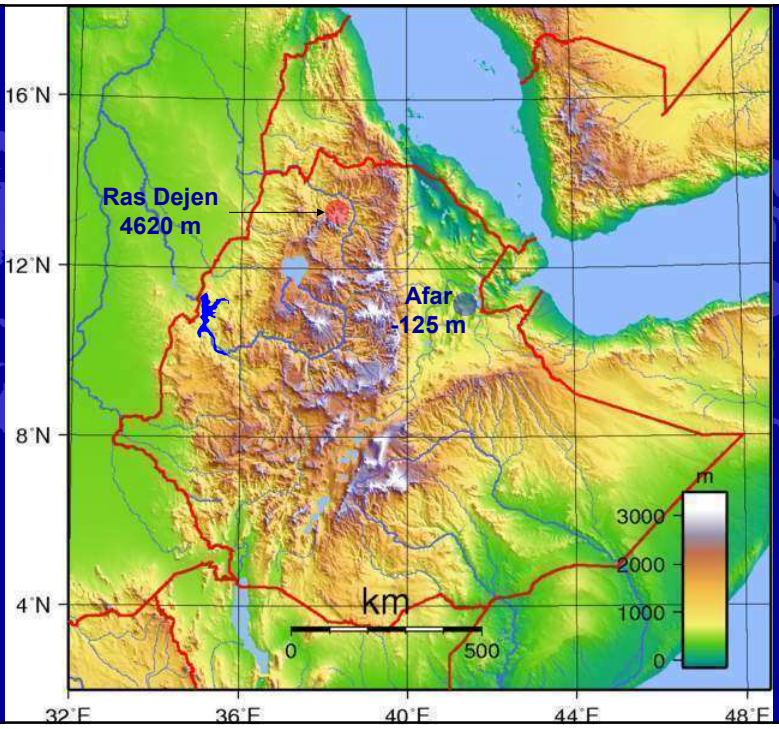
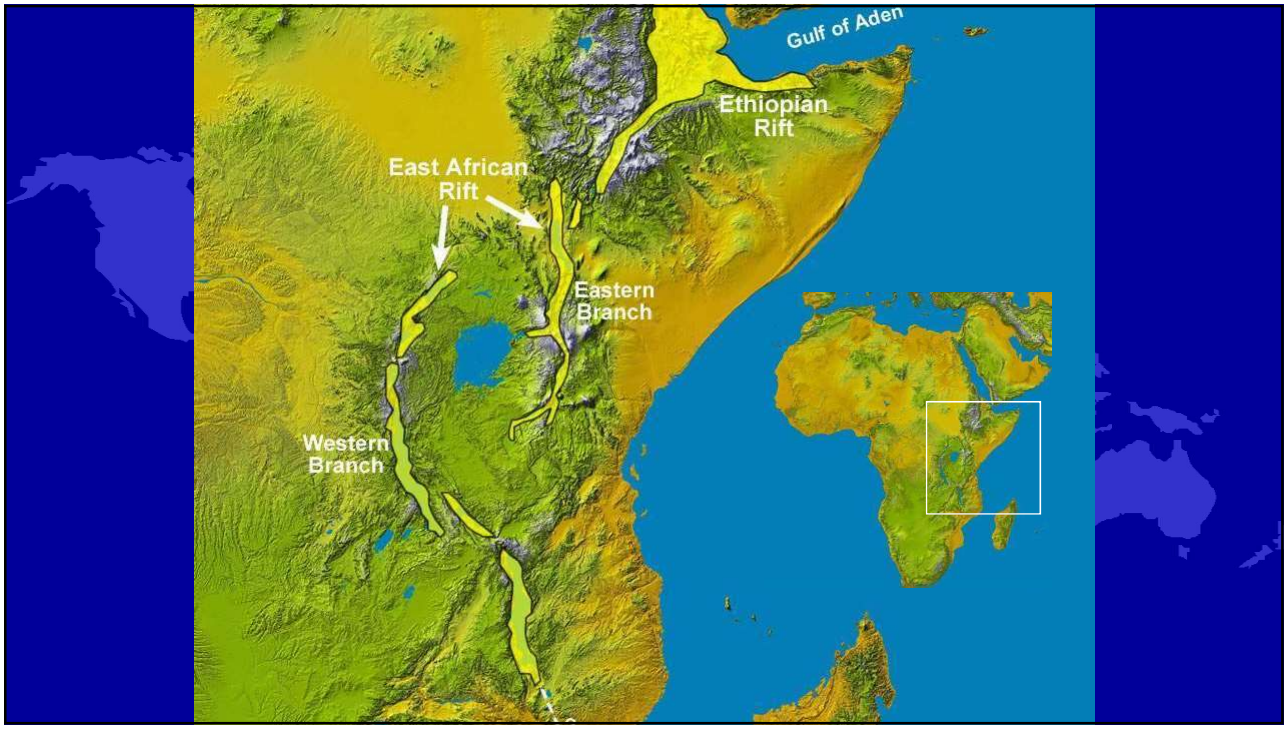
11. Loss of annual water (Evaporation 3 km^3, infiltration ??, agriculture??).
12. Low power generation in the High Dam (10-20%).
13. Decreasing soil fertility in Sudan.
14. Partial control of Ethiopia to water flowing to Sudan & Egypt.
15. Dam safety at high risk (Tsunami-like flooding).



Average of rainfall in Ethiopia 1985-2005. World Bank, 2006




Gulf of Aden
Ethiopian Rift
East African Rift
Eastern Branch
Western Branch