Downstream Upstream Relationship and The Grand Ethiopian Renaissance Dam (GERD) Filling and Operation Agreement Flexibility

Wossenu Abtew, Ph.D., P.E., DWRE,
Principal Civil Engineer, Water and Environment Consulting LLC,
wabtew@gmail.com

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https://waterandenvironmental.com

Outline of Talk

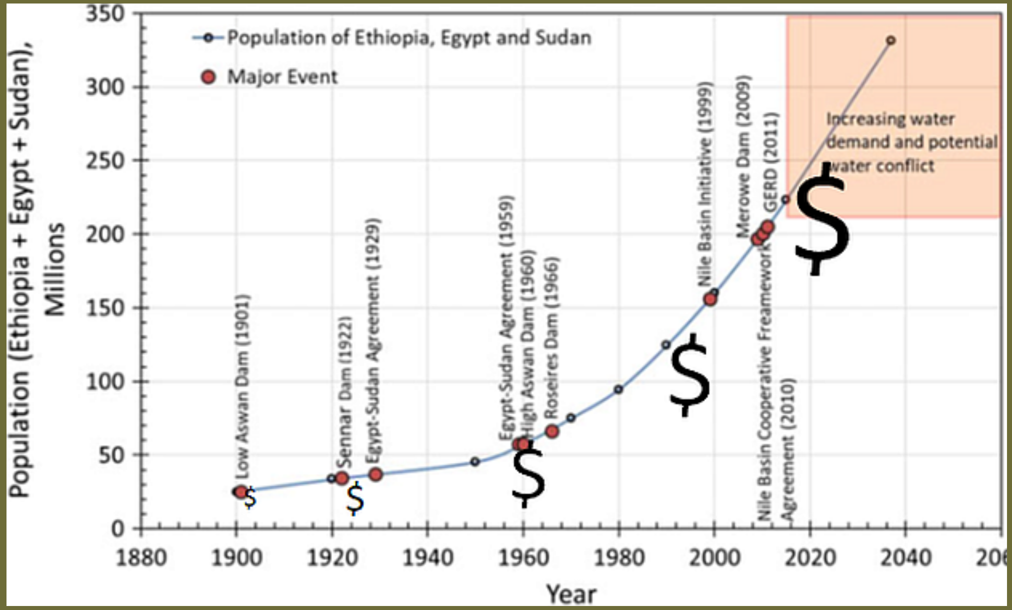
- Global Freshwater Impending Shortage and the Nile Basin
- GERD Negotiations – Washington DC Proposal
- Dam Operation Flexibility and Climate Prediction
- The Future of GERD Negotiations

Eastern Nile Population Growth, Water Value and Water Conflict

The Price of Nile water has increased inviting and global freshwater deficit is projected (40% deficit by 2030)

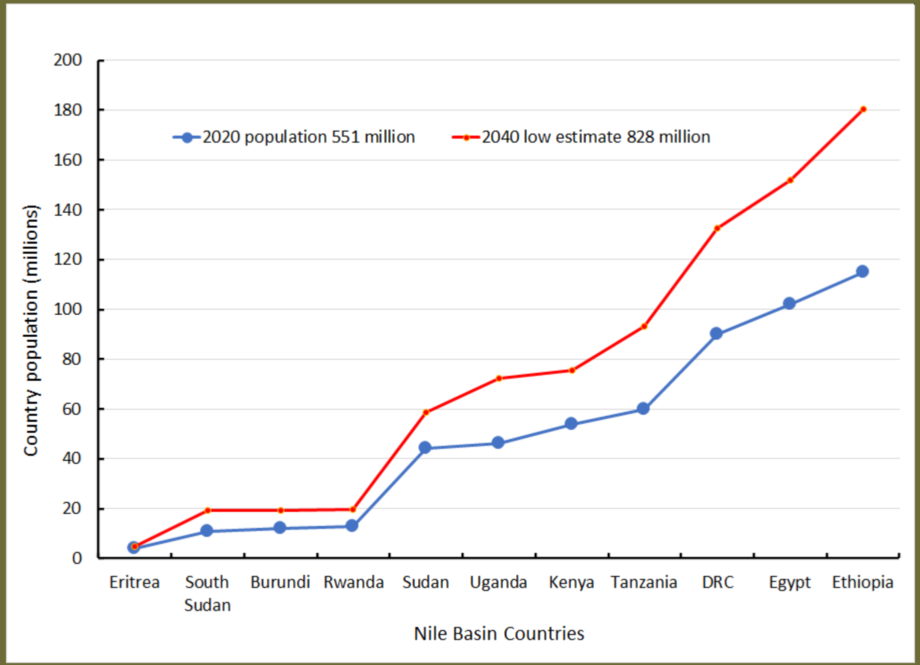
1. Out of basin water transfer/sale (direct or indirect)
2. Political and economic bartering of water and internationalizing Nile water conflict
3. It is drawing speculators attention as now water is a commodity - ((NQH2O) on the Nasdaq Veles California Water Index)
4. Domestic political value of water keeps on increasing
5. Land and water grab are part of water trading – Sudan with the highest potential
6. The Nile flow will decrease due to upstream abstraction

Eastern Nile Countries

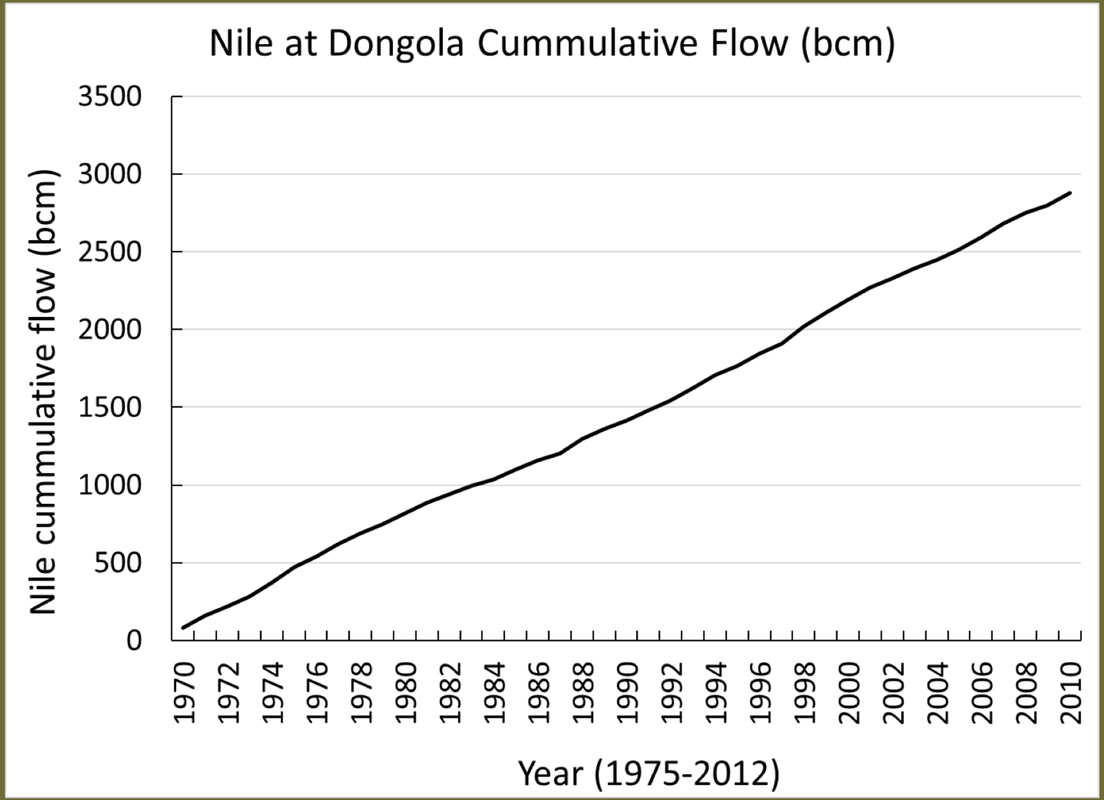


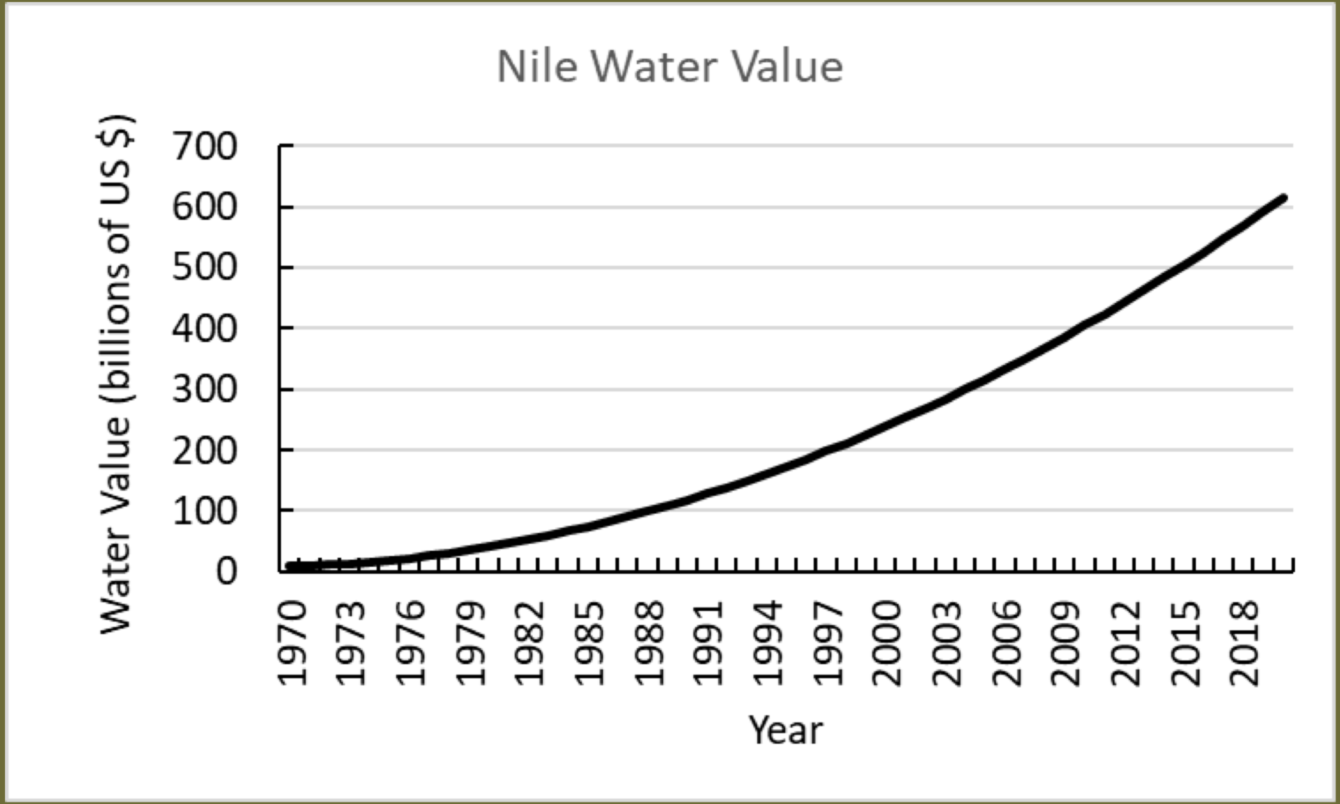
Abtew, W, Dessu S. 2018. *The Grand Ethiopian Renaissance Dam on the Blue Nile River*. Springer (https://www.springer.com/la/book/9783319970936)

Nile Countries



Water Has Become a Market Commodity and Worth Fighting for - Upstream view it as issue of Water Sharing but downstream and International Capital view it as $





1 to 27cents for a cubic meter of Nile water

From 1970 to 2020

GERD Filling and Operation Plan Negotiations

- Who sets the agenda?

The Washington D.C. GERD Negotiation (Nov 2019 – Feb 2020)
A Lesson in Water Negotiations

- Guaranteed flow, dam filling and dam operation plan

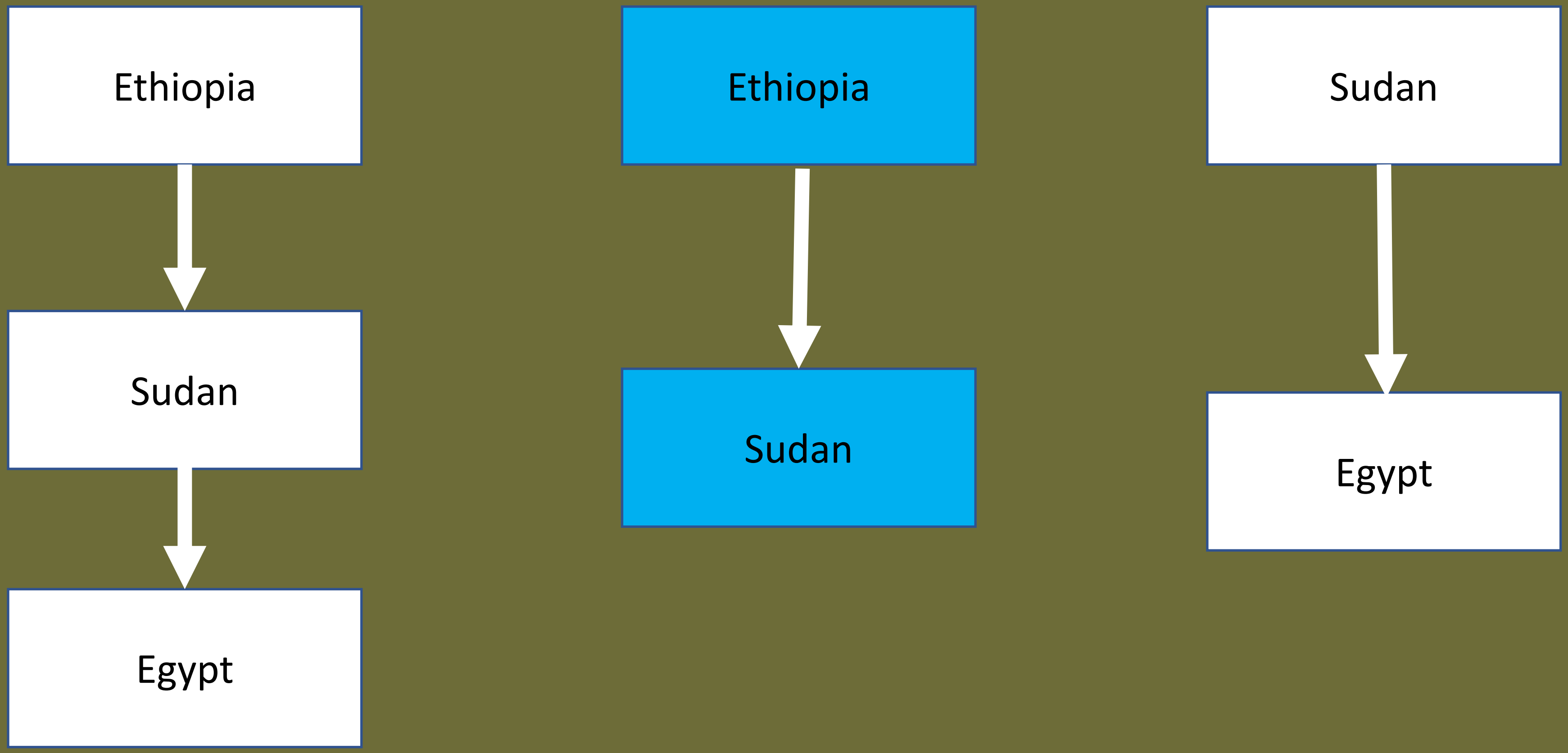
- Annex A, B, C, D

- Reference – Egypt's 19 June 2020 Letter to UNSC
  (https://www.securitycouncilreport.org/atf/cf/%7B65BFCF9B-6D27-4E9C-8CD3-CF6E4FF96FF9%7D/S_2020_566%20Egypt%20letter%20of%2019%20June.pdf)

Nile Basin Countries – Hydrologic Status

Country	Relative Location in Basin	Percentage of Country Area in Nile Basin (FAO 2000)
Burundi	Upstream	46
Democratic Republic of Congo	Upstream	1
Egypt	Downstream	33
Eritrea	Upstream	21
Ethiopia	Upstream	32
Kenya	Upstream	9
Rwanda	Upstream	83
South Sudan	Upstream/Downstream	78
Sudan	Upstream/Downstream	
Tanzania	Upstream	13
Uganda	Upstream	98

Eastern Nile Countries Transboundary River Relationship



Downstream Upstream or Upstream Downstream Relationship Models for Transboundary Basins

Downstream Upstream Relationship Models

Hostility

- Undermine upstream security
- Block access to the sea
- Undermine upstream development by blocking fund etc.
- Covert and overt military engagement
- Propaganda war
- Diplomatic war

- No water sharing
- Race for water use expansion
- Undermine upstream water needs
- Stick to colonial treaties
- Internationalize water use and water conflict

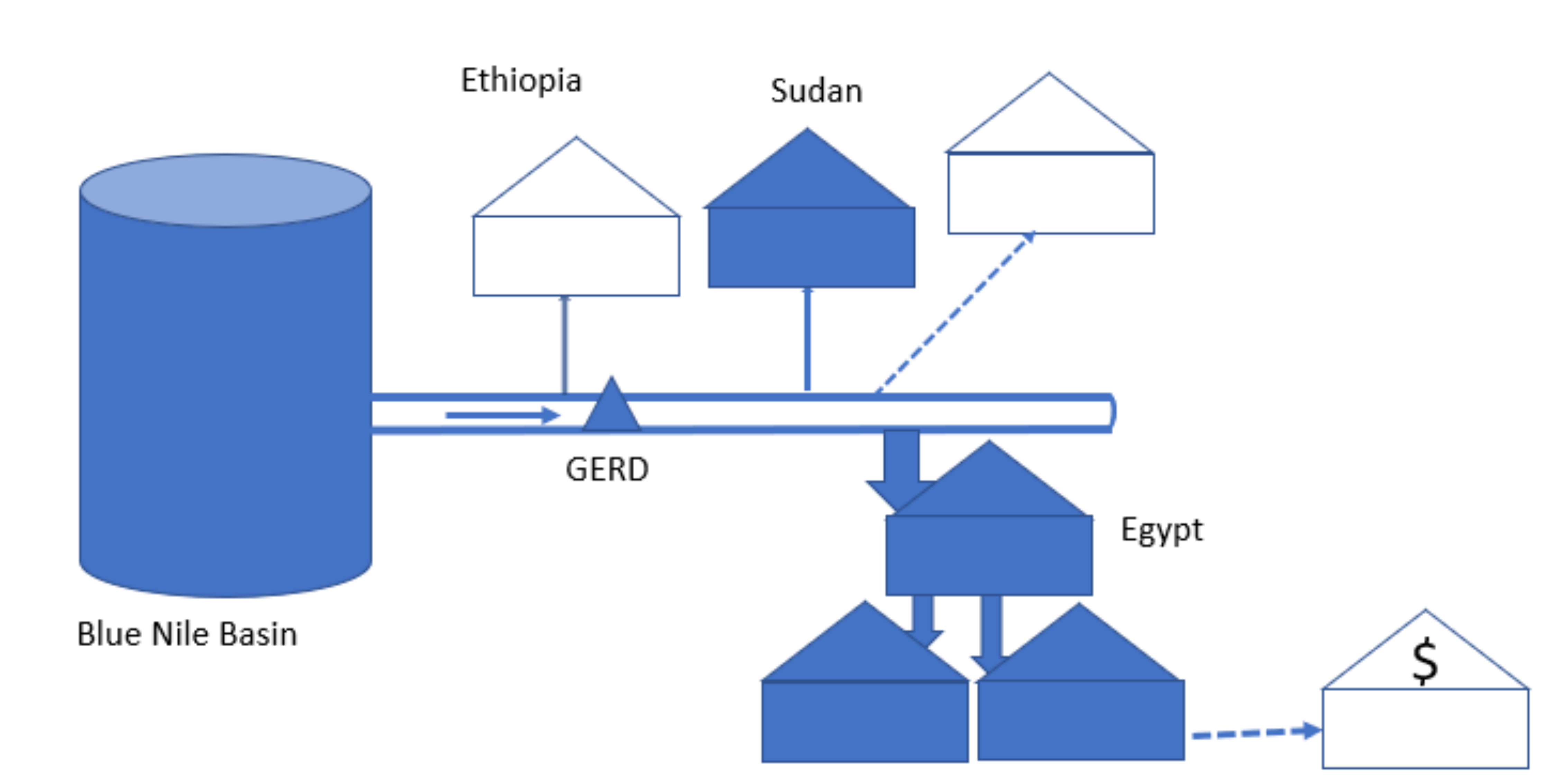
Cooperation

- Fair water sharing agreement
- Watershed management
- Economic cooperation
- Trust and data sharing
- Peace in the region

UN Resolution of 1997 "Affirming the importance of international cooperation and good neighbourliness in this field"

Finite Volume of Water and Expanding Allocation in the Nile Basin

Drought Definition and Water Use/Water Policy and Water Shortage



Washington D.C. Negotiations – Guaranteed Flow Mitigation Mechanism for Drought, Prolonged Drought and Prolonged Periods of Dry Years (Annex A)

Drought	Filling		Long-Term Operation	
	Inflow (Q_i)	Minimum Release (Q_r)	Inflow (Qi)	Minimum Release (Q_r)
Drought (Annual)	$Q_i < 37$ bcm	$Q_r = Q_i$ + From Reservoir (Annex A)	$Q_i < 37$ bcm	$Q_r = Q_i$ + From Reservoir (Annex A)
Prolonged Drought (4-yr Average)	Q_i (4-yr Avg.) < 37 bcm	$Q_r = Q_i$ + 62.5% of Storage Above 603 m a.s.l.), the Following 4 years*	Q_i (4-yr Avg.) < 39 bcm	$Q_r = Q_i$ + 100% of Storage Above 603 m a.s.l)., the Following 4 years*
Prolonged Period of Dry Years	Q_i (4-yr Avg.) < 40 bcm	$Q_r = Q_i$ + 50% of Storage Above 603 m a.s.l.), the Following 4 years	Q_i (5-yr Avg.) < 40 bcm	$Q_r = Q_i$ + 100% of Storage Above 603 m a.s.l.), the Following 5 years**

Q_i = inflow into reservoir and Q_r is Reservoir release in a year (July 1 to June 30)

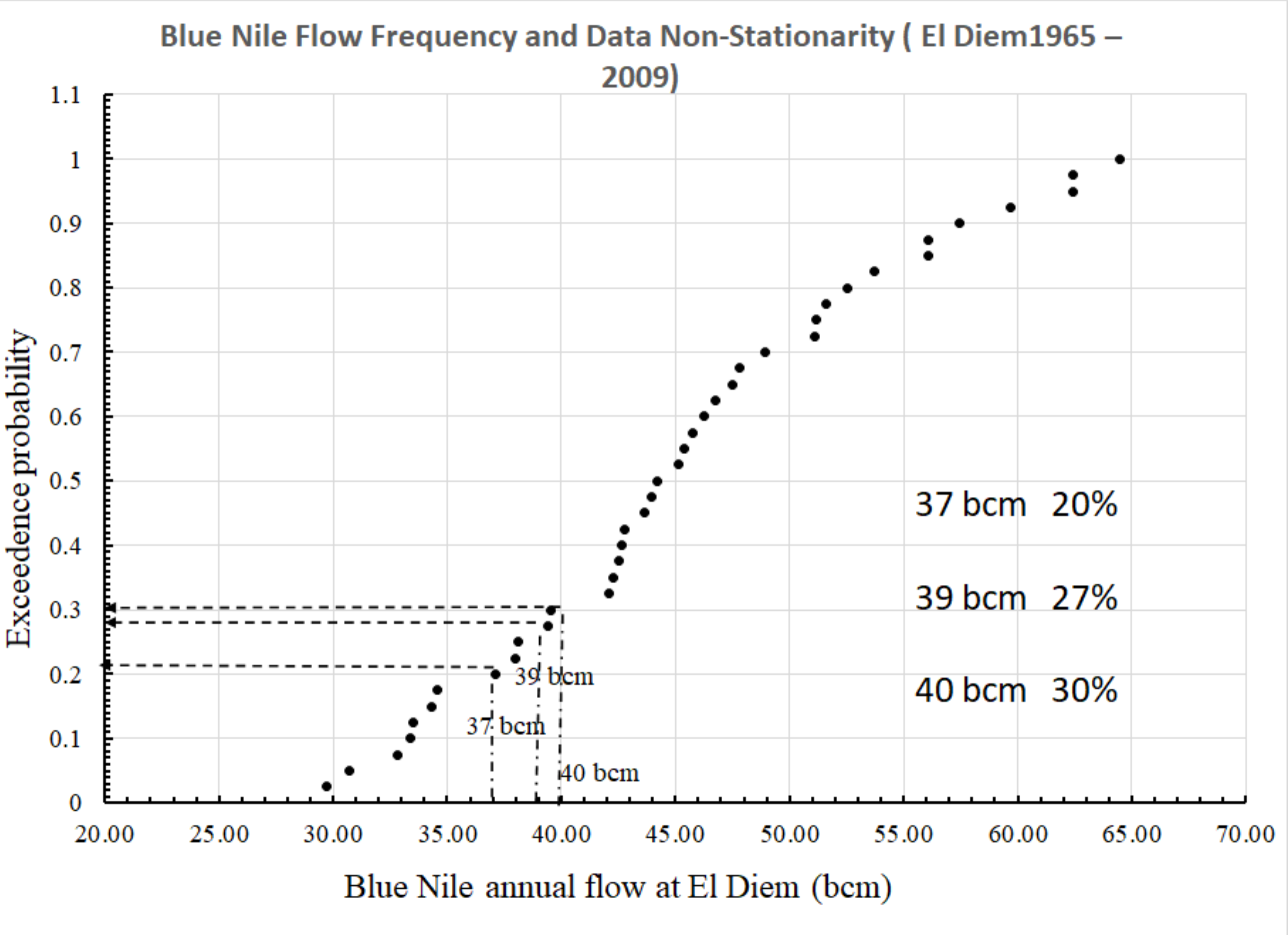
*** minimum annual release in a year from reservoir is 1/8 of total**

**** minimum annual release in a year from reservoir is 1/10 of total**

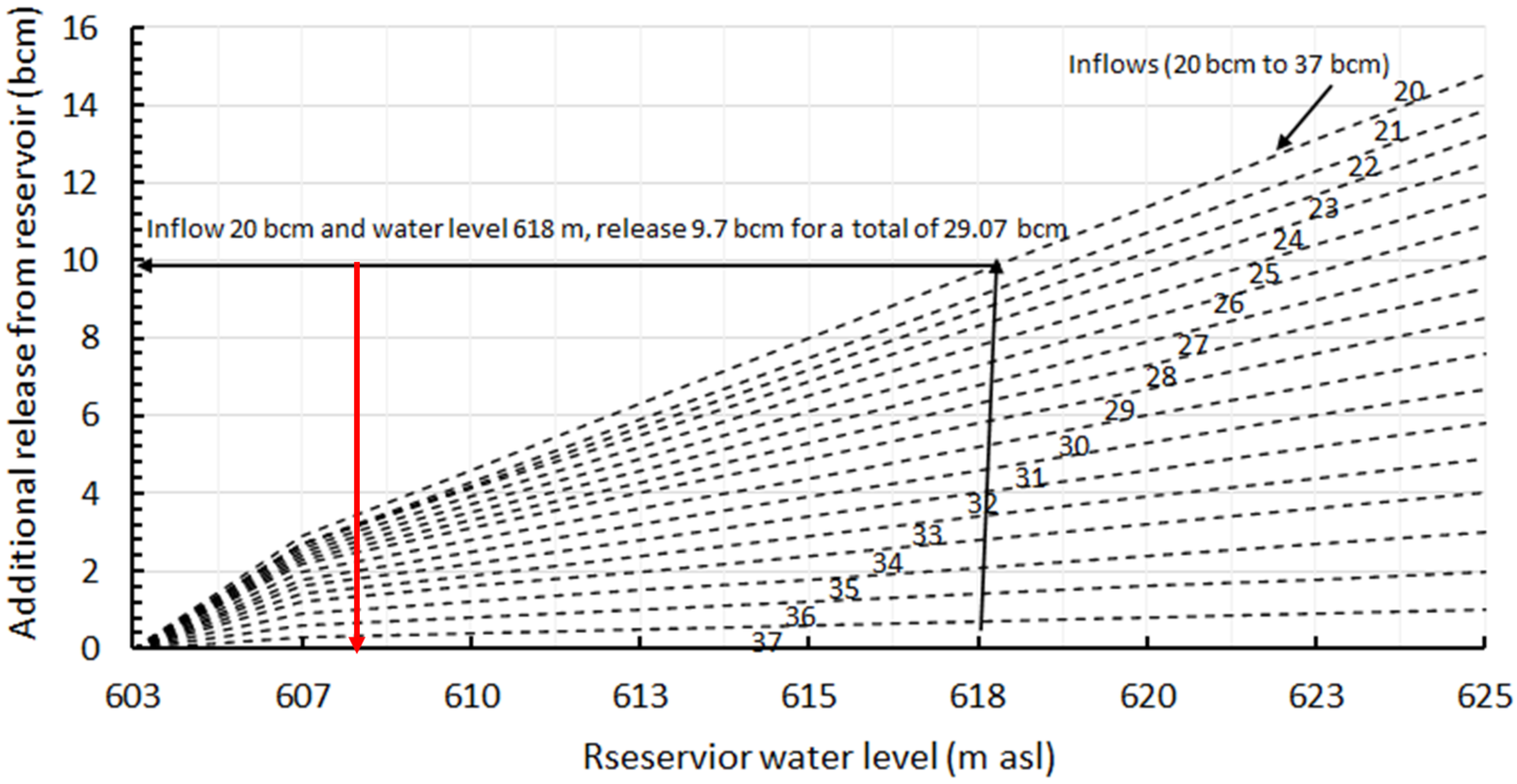
Releases from reservoir are obligated even if year is wet

Releases from drought, prolonged drought and prolonged dry periods are additive

Annex A (Figure 20.6)



Annex A (Exhibit A)– Drought Conditions Release Matrix



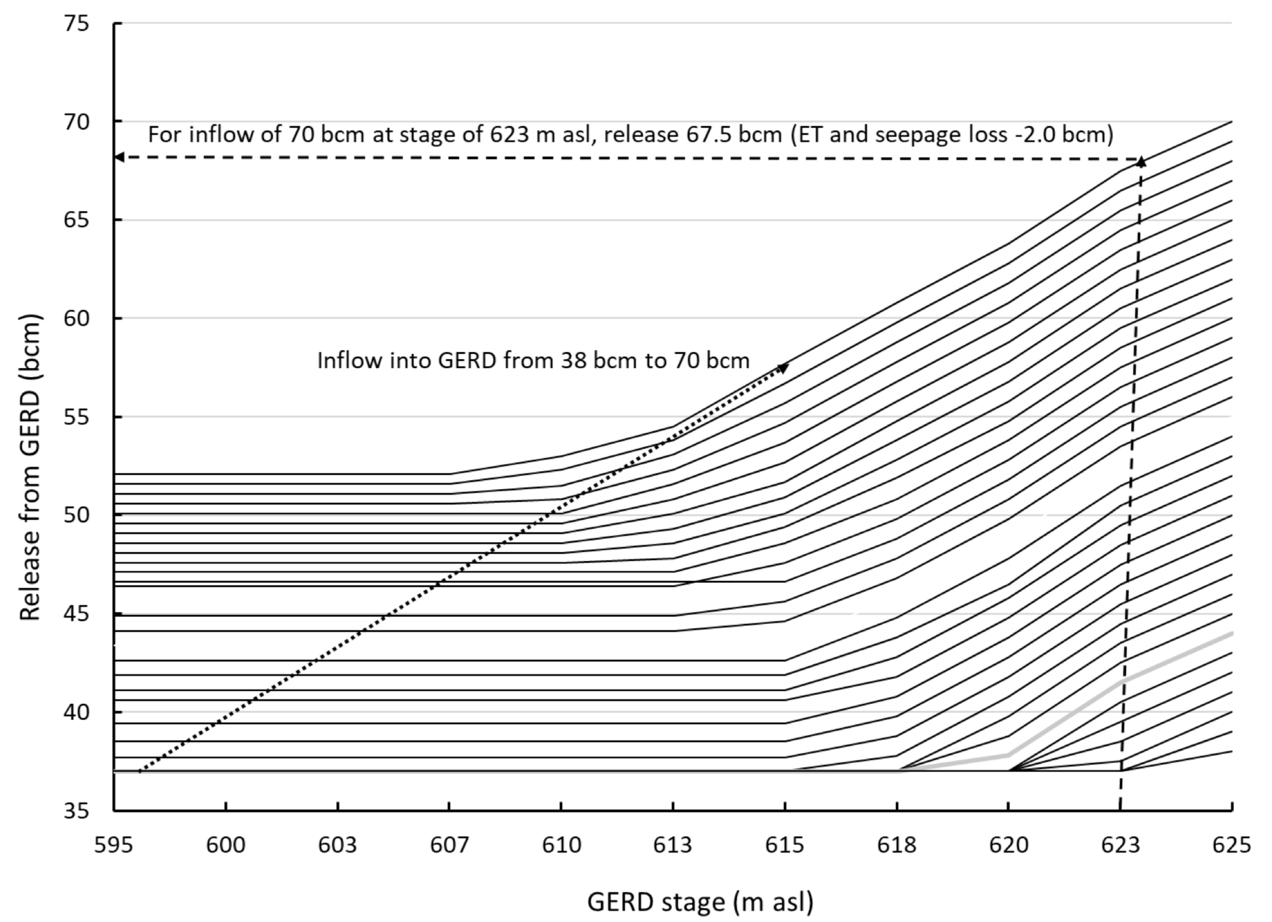
Annex B - GERD Stage I Filling

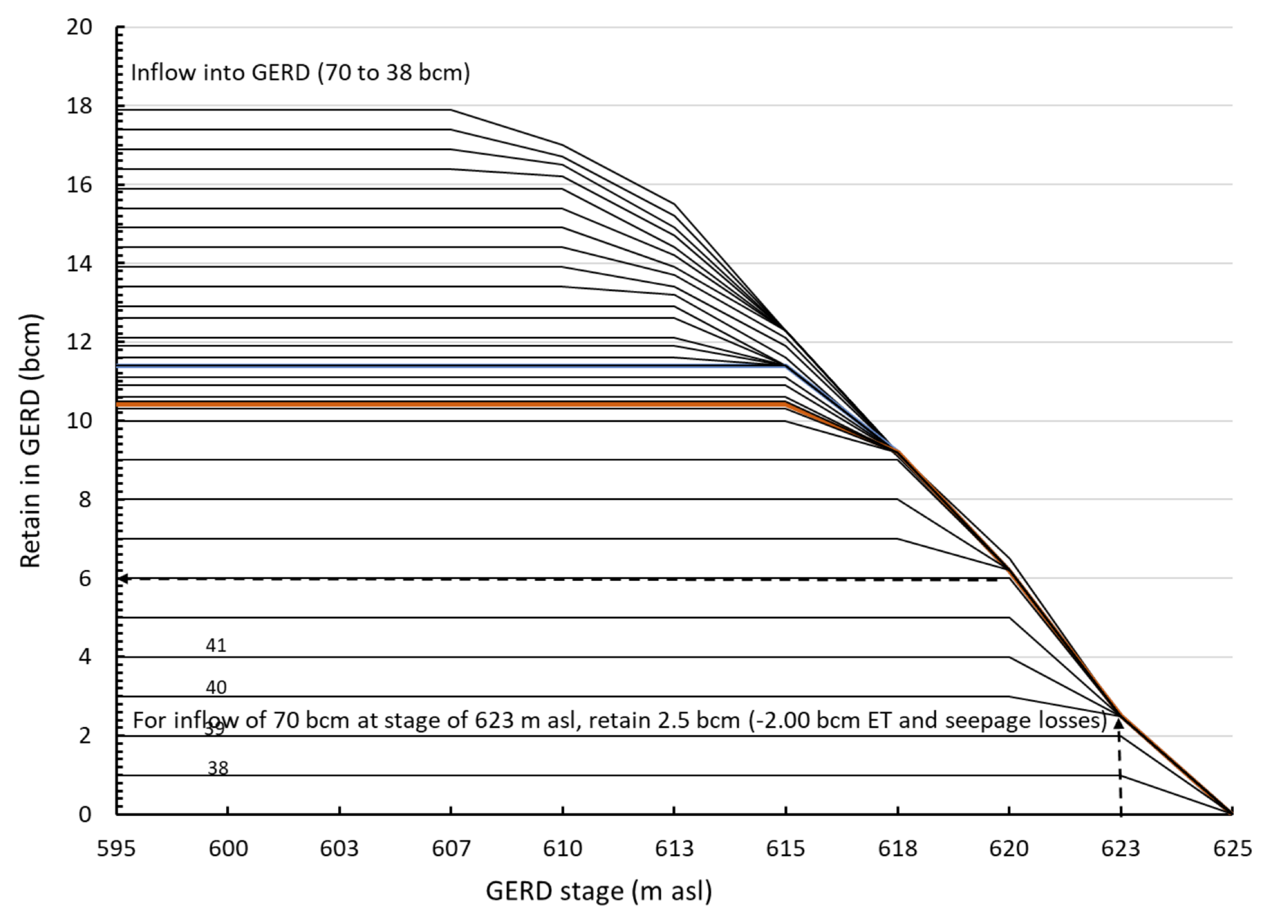
Stage I Filling (to 595 m a.s.l level of GERD	Incremental Retention
Hydrological Year 1	4.9 bcm
Hydrological Year 2	13.5 bcm (18.5 bcm total)
Definition of Drought	31 bcm
Release Rule	Lower of 31 bcm or Flow
Postponement of Stage I	If Flow less than 31 bcm, Stage I will be postponed

Stage Based Filling of GERD (Annex C, Table 1)

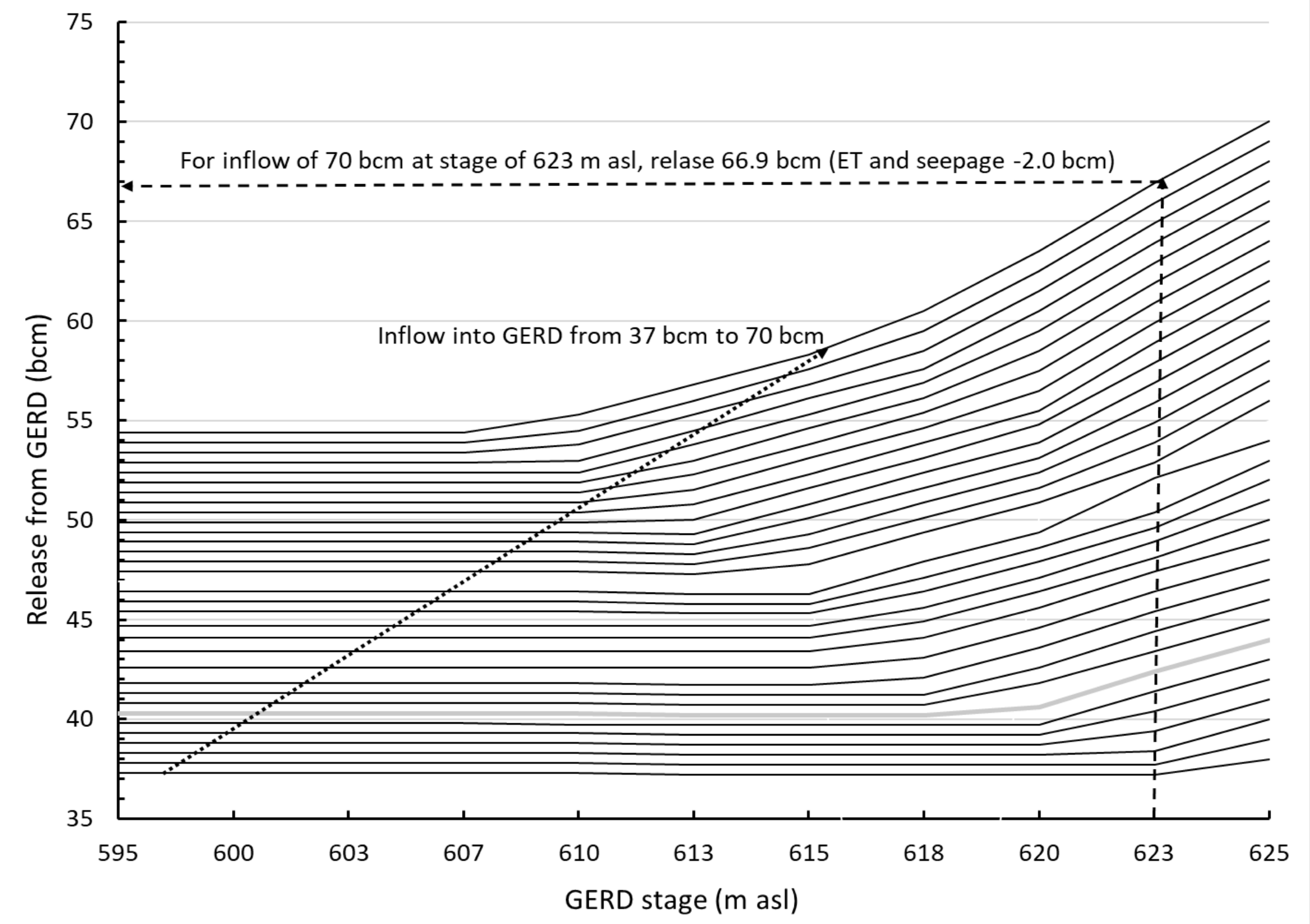
Stage	Target Level of Stage in GERD (m)	Incremental Retained Water at the end of June (BCM)	Cumulative Retained Water at the end of June (BCM)
1	565	4.9	4.9
	595	13.5	18.4
2	608	10.5	28.9
3	617	10.4	39.3
4	625	10	49.3

GERD Inflows and Prescribed Releases and Retentions during Filling at Given Water Levels (Annex C, Table 2)





GERD Inflows and Prescribed Releases during Normal Operation and Refilling at Given Water Levels (Annex D for flows from 37 to 70 bcm)



GERD Filling Simulation with D.C. Plan (18 years)

Year	Inflow	4-yr inflow avg.	5-yr inflow avg.	Rain-ET	Release	Release from Reservoir	Retained	Cumulative storage	Stage	Area	Release Decision
	BCM	BCM	BCM	BCM	BCM	BCM	BCM	BCM	m a.s.l.	km^2	
1979	38.13			0.19	33.23	0.00	4.90	4.71	571	260	Annex B
1980	42.50			0.47	31.00	0.00	11.50	16.21	597	650	Annex B
1981	42.77			0.38	40.76	0.00	2.00	18.21	590	522	Annex B
1982	34.33	39.43		0.51	34.23	0.00	0.10	18.31	600	700	Annex B
1983	39.53	39.78	39.45	0.57	37.00	0.00	2.53	20.84	604	781	Annex C
1984	29.73	36.59	37.77	0.60	28.60	0.00	1.13	21.98	606	823	Annex C
1985	45.11	37.18	38.29	0.75	37.00	0.00	8.11	30.08	615	1030	Annex C
1986	34.58	37.24	36.66	0.75	35.40	0.00	0.00	29.27	615	1030	Annex C
1987	33.41	35.71	36.47	0.70	34.80	0.00	0.00	27.87	612	954	Annex A
1988	64.48	44.39	41.46	0.95	49.70	1.45	14.78	42.65	625	1304	Annex A
1989	32.83	41.32	42.08	0.87	36.20	1.45	0.00	37.83	621	1192	Annex A
1990	37.99	42.18	40.66	0.79	37.00	1.45	0.99	32.33	617	1082	Annex A
1991	45.38	45.17	42.82	0.79	38.80	1.45	6.58	32.41	617	1082	Annex C
1992	44.21	40.10	44.98	0.89	37.80	0.00	6.41	32.31	622	1220	Annex C
1993	56.10	45.92	43.30	0.87	53.00	0.00	3.10	30.36	621	1190	Annex C
1994	52.51	49.55	47.24	0.95	46.00	0.00	6.51	36.87	625	1304	Annex C
1995	37.13	47.49	47.06	0.97	37.00	0.00	0.13	37.00	626	1333	Annex C
1996	56.06	50.45	49.20	0.97	56.00	0.00	0.06	37.06	626	1333	Annex C

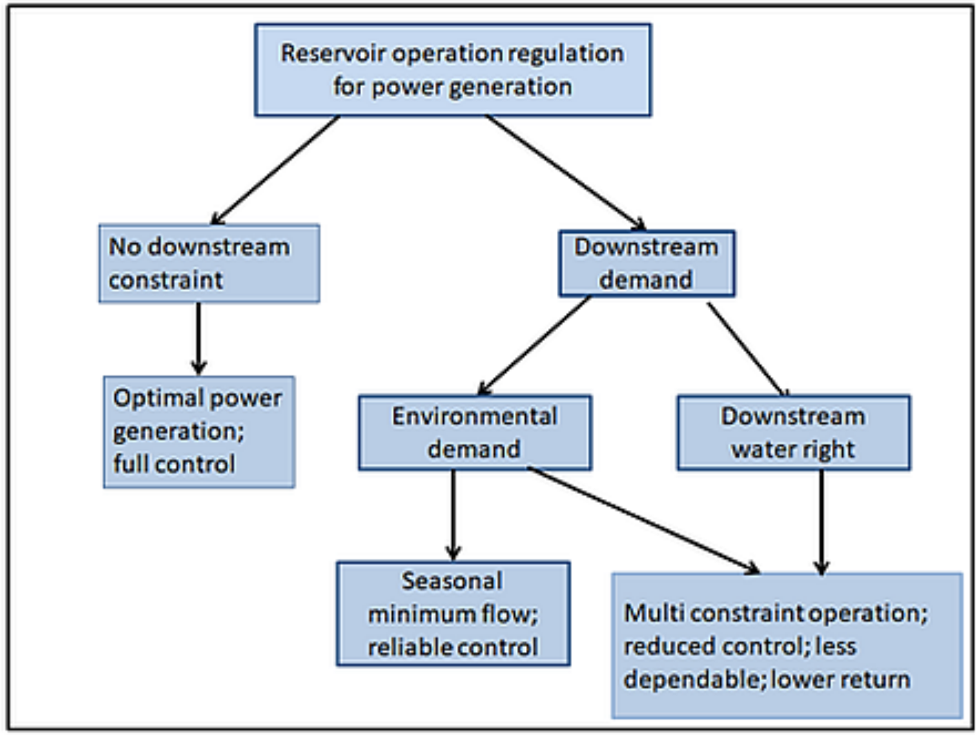
GERD Normal Operation with the D.C. Plan (9 years)

Year	Inflow	Release	4-yr avg. inflow	5-yr avg. inflow	Rain-ET	From reservoir	Cum. Storge	Stage	Assumed operation start at 625 m a.s.l.
	BCM	BCM	BCM	BCM	BCM	BCM	BCM	m a.s.l.	Annual operational release (BCM)
1979	38.13	38.00			0.95		42.20	625	Annex D
1980	42.50	42.50			0.95		41.25	625	Annex D
1981	42.77	42.77			0.93		40.32	624	Annex D
1982	34.33	37.00	39.43		0.87	2.67	34.10	619	Annex D
1983	39.53	37.70	39.78	39.45	0.81		35.13	619	Annex D
1984	29.73	32.61	36.59	37.77	0.75	2.88	28.62	613	5-yr drought (< 40 bcm)
1985	45.11	47.99	37.18	38.29	0.70	2.88	22.16	606	5-yr drought (< 40 bcm)
1986	34.58	37.46	37.24	36.66	0.65	2.88	15.75	597	5-yr drought (< 40 bcm)
1987	33.41	36.29	35.71	36.47	0.64	2.88	9.35	585	5-yr drought (< 40 bcm)

GERD Storage Loss during Maximum Inflow of 70 bcm (Annex D) Loosing Storage/Stage during Extreme High Flow

Stage m a.s.l.	Inflow (bcm)	Release (bcm)	Area (km^2)	Evap. (bcm)	Seepage (bcm)	Change in storage (bcm)
625	70	70	1304	0.95	1.01	-1.97

Downstream Demand Impact on Hydropower Reservoir Operation



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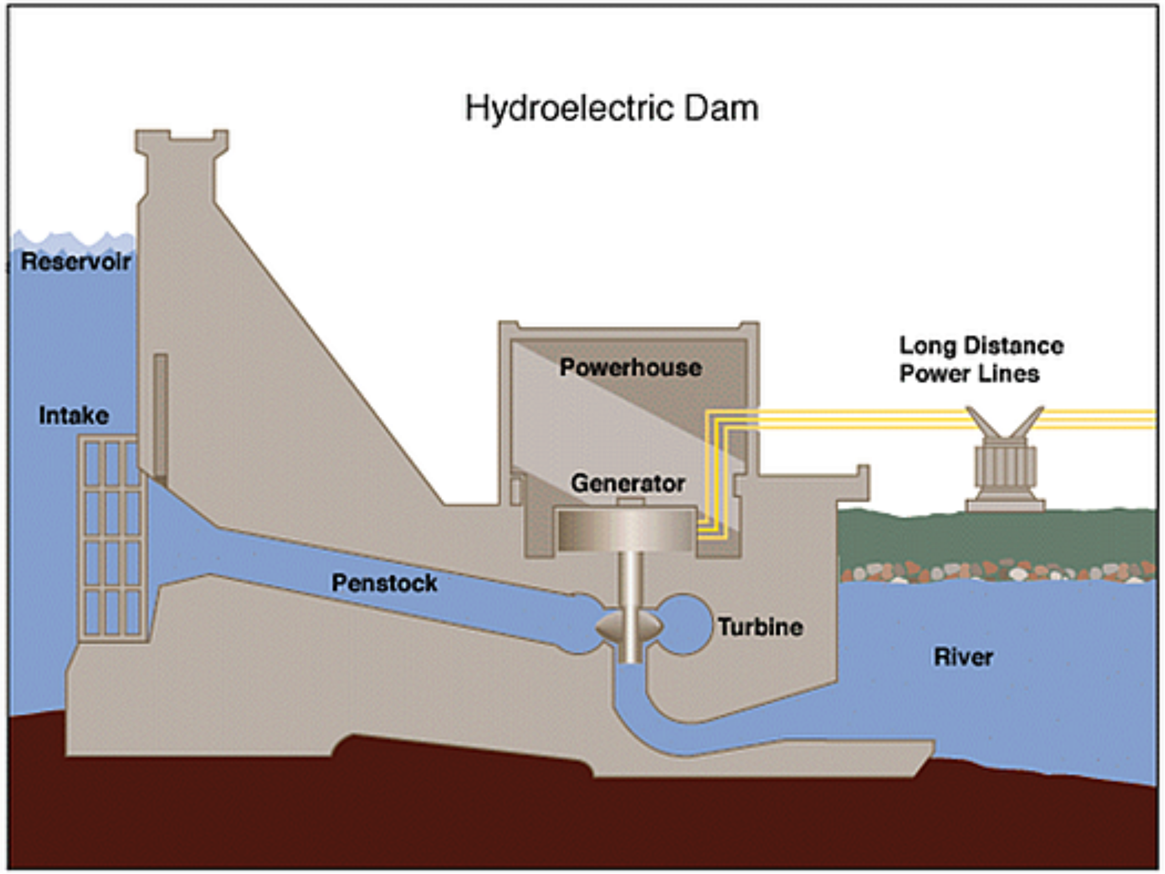
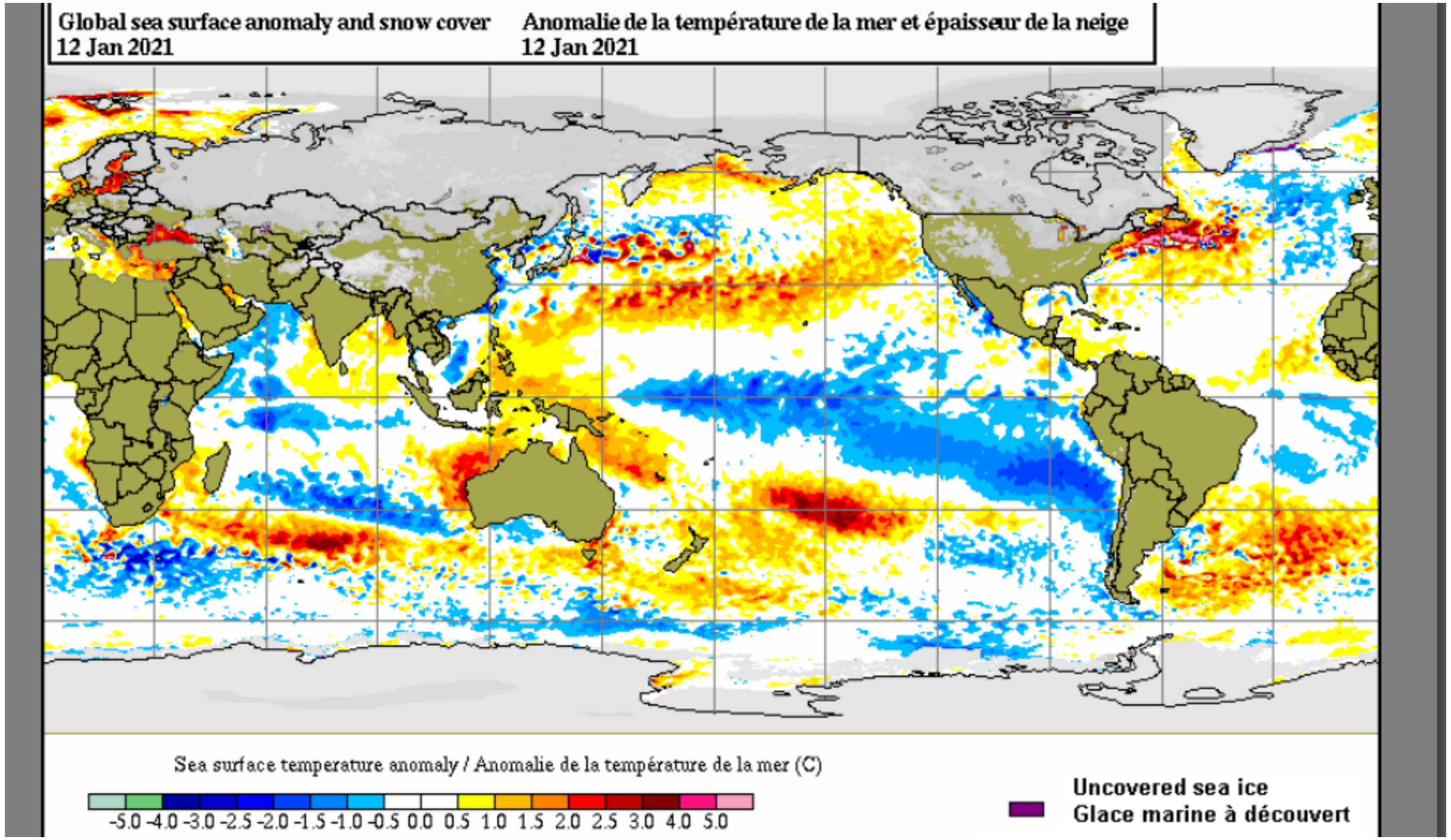


US Energy Information Administration

Flexibility in Dam Operation and Operation Plan

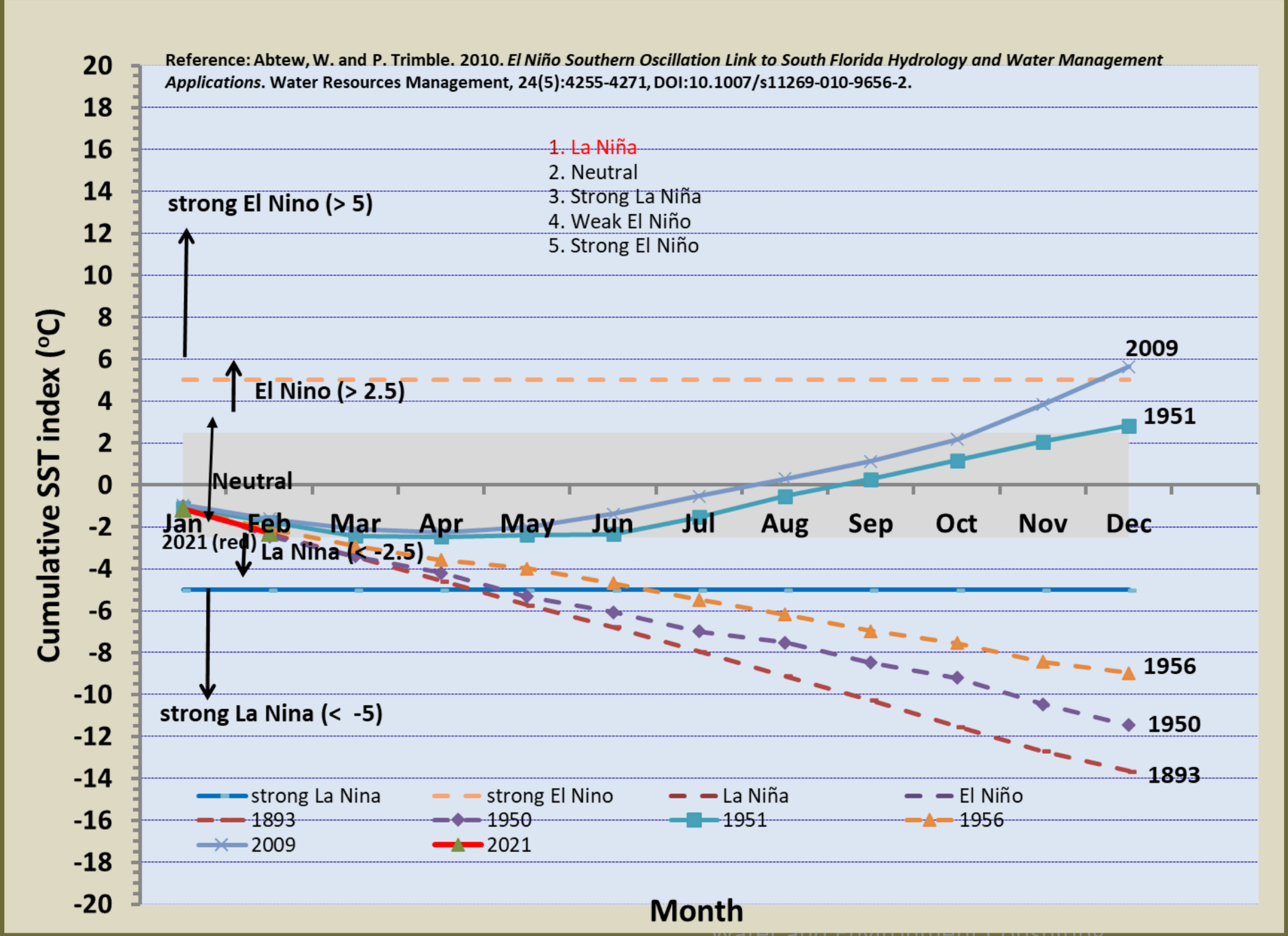
- Dam Safety and Emergency Operation
- Dam Maintenance
- Climate Prediction and Dam Operation
- Power Demand and Dam Operation
- Irrigation Needs and Dam Operation

Climate Teleconnection, Climate Prediction, and Dam Operation



- El Nino Southern Oscillation (ENSO)
- Inter Tropical Convergence Zone (ITCZ)
- Indian Ocean Dipole (IOD)

El Nino and La Nina Tracking for Reservoir Operation Decision Making



Water and Environment Consulting

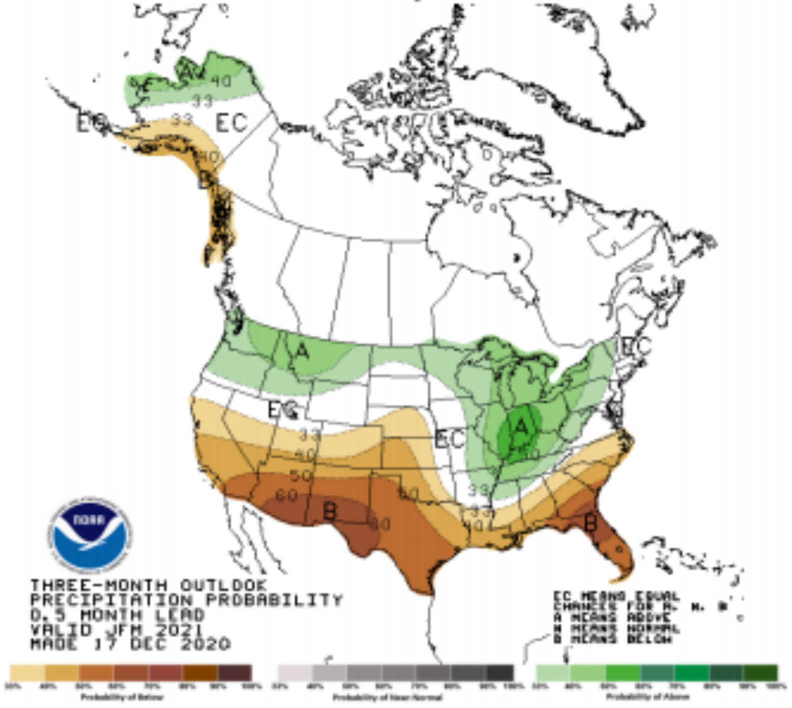
U.S. 3-Month Precipitation and Temperature Outlook Used For Dam Operation in South Florida

U. S. Seasonal Outlooks

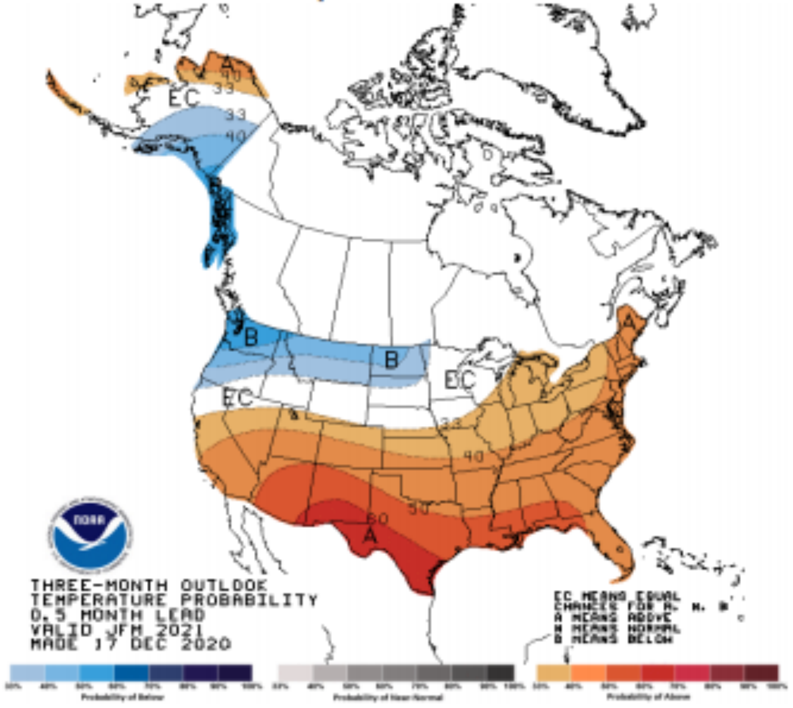
January - March 2021

The seasonal outlooks combine the effects of long-term trends, soil moisture, and, when appropriate, ENSO.

Precipitation

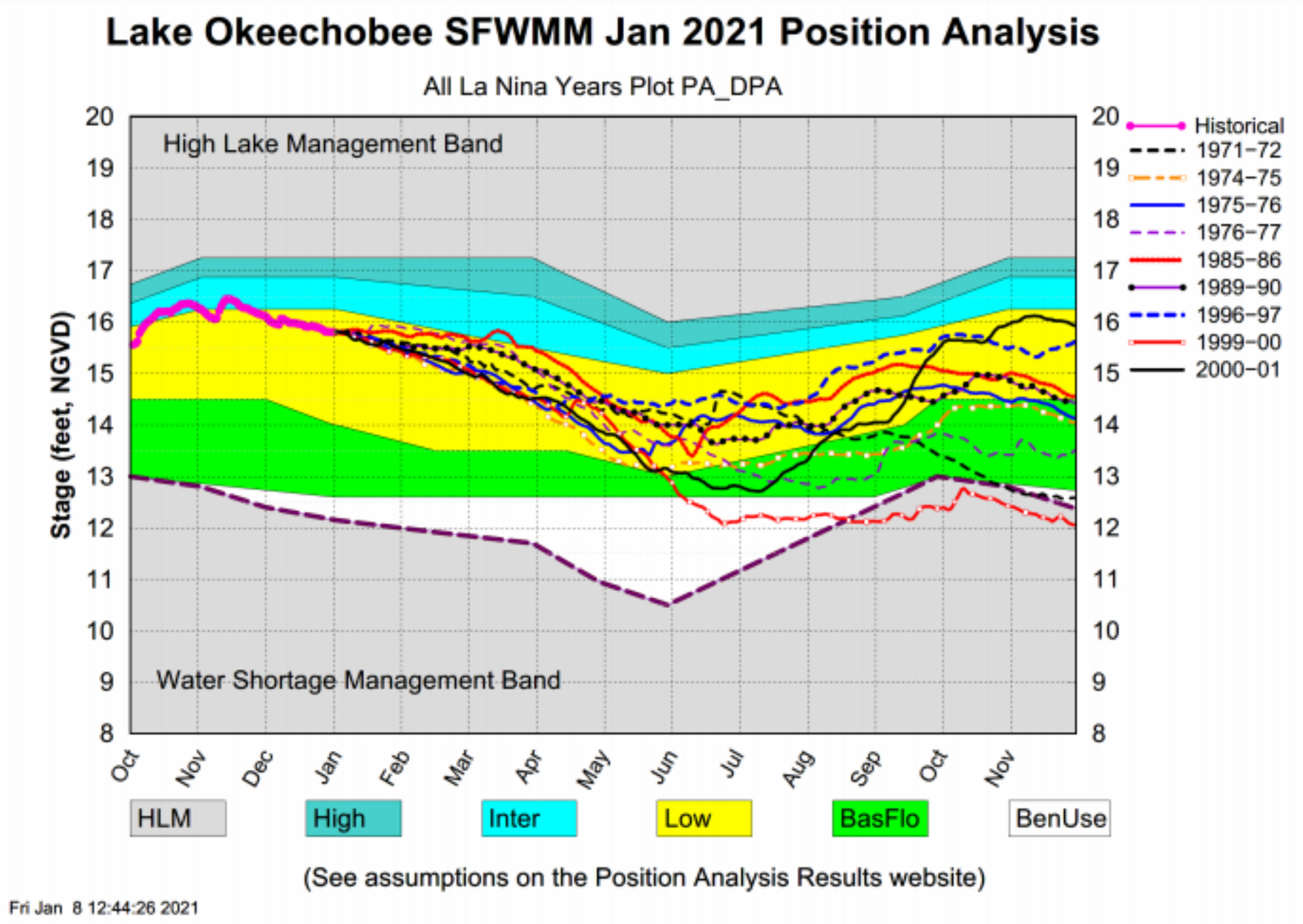


Temperature



Climate Prediction Application to Reservoir Operation

SFWMD Empirical Method[2]		Sub-sampling of La Nina ENSO Years[3]		Sub-sampling of AMO Warm + La Nina ENSO Years[4]	
Value (ft)	Condition	Value (ft)	Condition	Value (ft)	Condition
0.41	Dry	-0.17	Dry	0.13	Dry
2.93	Wet	2.18	Normal	2.08	Normal



What is the Future of GERD Negotiations

- Negotiations will drag and may not end
- Insertion of binding legal clause that indirectly limits Ethiopia from using its water share for irrigation upstream of GERD and guaranteed downstream flow will remain main reasons of disagreement
- AU mediation/moderations in 2021
  - African Union Chairperson for the Year February 2021 to January 2022
  - President Félix Antoine Tshisekedi Tshilombo
  - Congo announces its support towards Egypt on GERD issue (https://egyptindependent.com/congo-announces-its-support-towards-egypt-on-gerd issue, /), 20 September 2020, Egypt Independent

  - Such stated position makes neutrality questionable
  - Why does Sudan insist on the expansion of the role of AU technical staff
  - Cornerstone of current negotiations should be no direct or implied water share right acquisition or denial
  - GERD filling and operation plan that meets the objectives of the dam accommodating reasonable downstream concerns should be the subject of negotiation

What Should A GERD Filling and Operation Plan Agreement Contain?

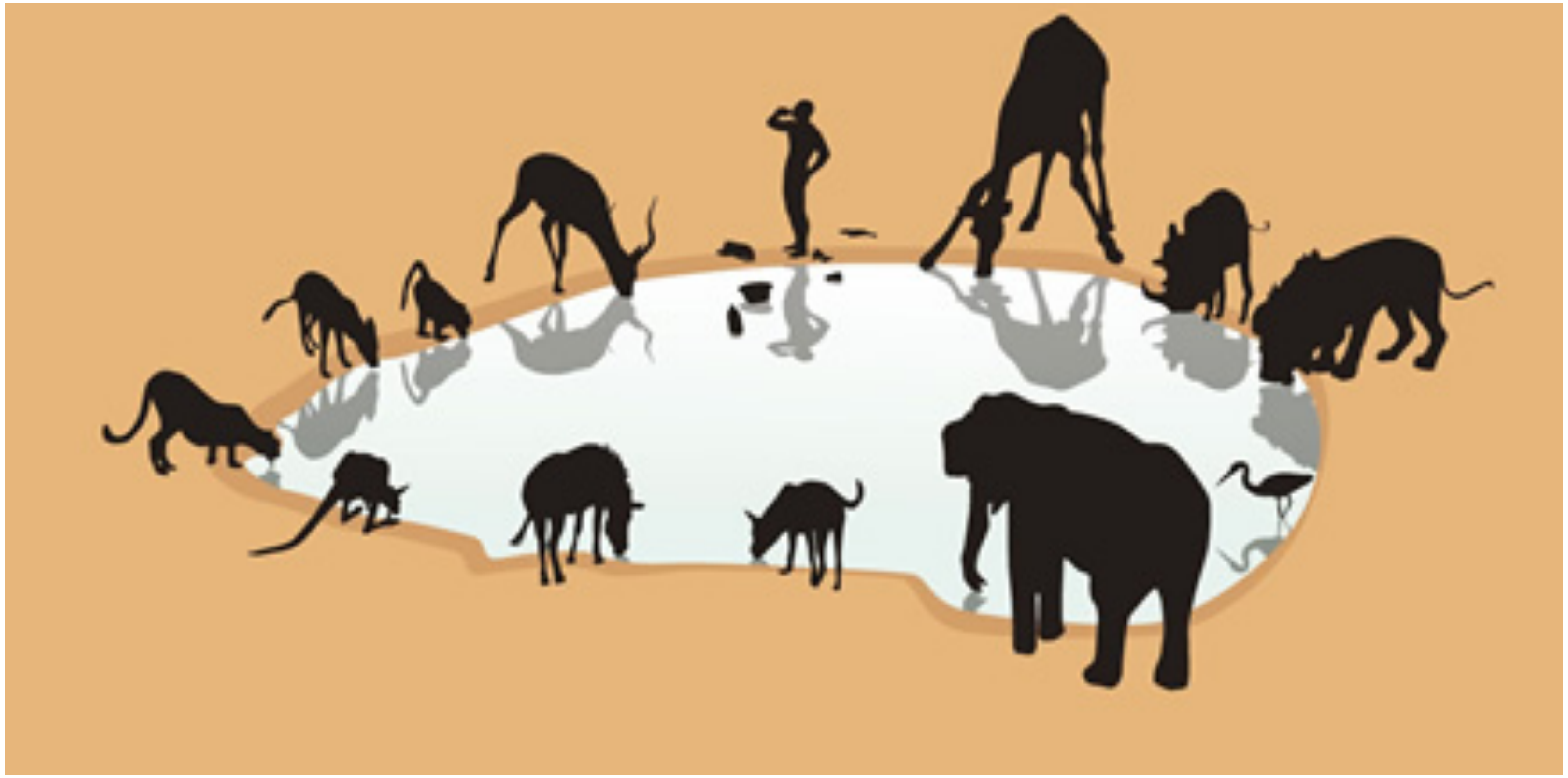
- The GERD shall be operated to generate optimal power as determined by the dam owner Reservoir operation guideline should be developed with maximum flexibility
- Climate forecast is essential to introduce in dam operation knowing uncertainty in prediction
- Mutual cooperation in dam safety, data sharing, and management of extreme conditions is beneficial
- Minimum environmental releases can be accommodated
- The agreement shouldn't directly or indirectly set water share for any country as Nile water and benefit sharing should be determined through a basin wide agreement with all riparian countries
- Water share question should be raised every time legally binding GERD operation agreement is demanded
- Proposal for Nile Basin water sharing should be initiated by Cooperative Framework Agreement signing members of Nile raparian countries
- Avoid legally binding energy production and delivery agreements as it converts energy to flow volume indirectly

Finally: What is the Long-term outcome of Downstream Countries Hostility to Upstream Countries with Current Population Explosion?

- Pakistan pins big hopes on small dams to help farmers beat drought (Reuters 1/25/2021)

- Population pressure will increase upstream abstraction

Questions



UN Water – World Water Day 2013 – International Year of Water Cooperation