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Possibilities and challenges of coordinated hydropower reservoir management in the Eastern Nile Basin

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Outline

- Overview of Eastern Nile Developments
- Planned and Proposed Developments
- Unilateral vs. Coordinated Planning
- Unilateral vs. Coordinated Management

Main Nile

White Nile

Victoria/Albert Nile

Lake Victoria

Courtesy of Nile Basin Initiative

Blue Nile

Lake Tana

Sudd Wetland



Modern Historical Development

Egypt

Aswan Dam (1902)

High Aswan Dam (1960-70)

Sudan

Sennar Dam (1925)

Jebel Aulia Dam (1937)

Khashm El Girba (1964)

Rosaries Dam (1967)

Merowe Dam (2009)

Upper Atbara/Setit (2015)

Ethiopia

Tekeze Dam (2009)

Tana Beles HP (2009)

GERD (2017)



Proposed Energy Development

Egypt

Current ~10,000 GWh/year

Sudan

Current ~8,200 GWh/year

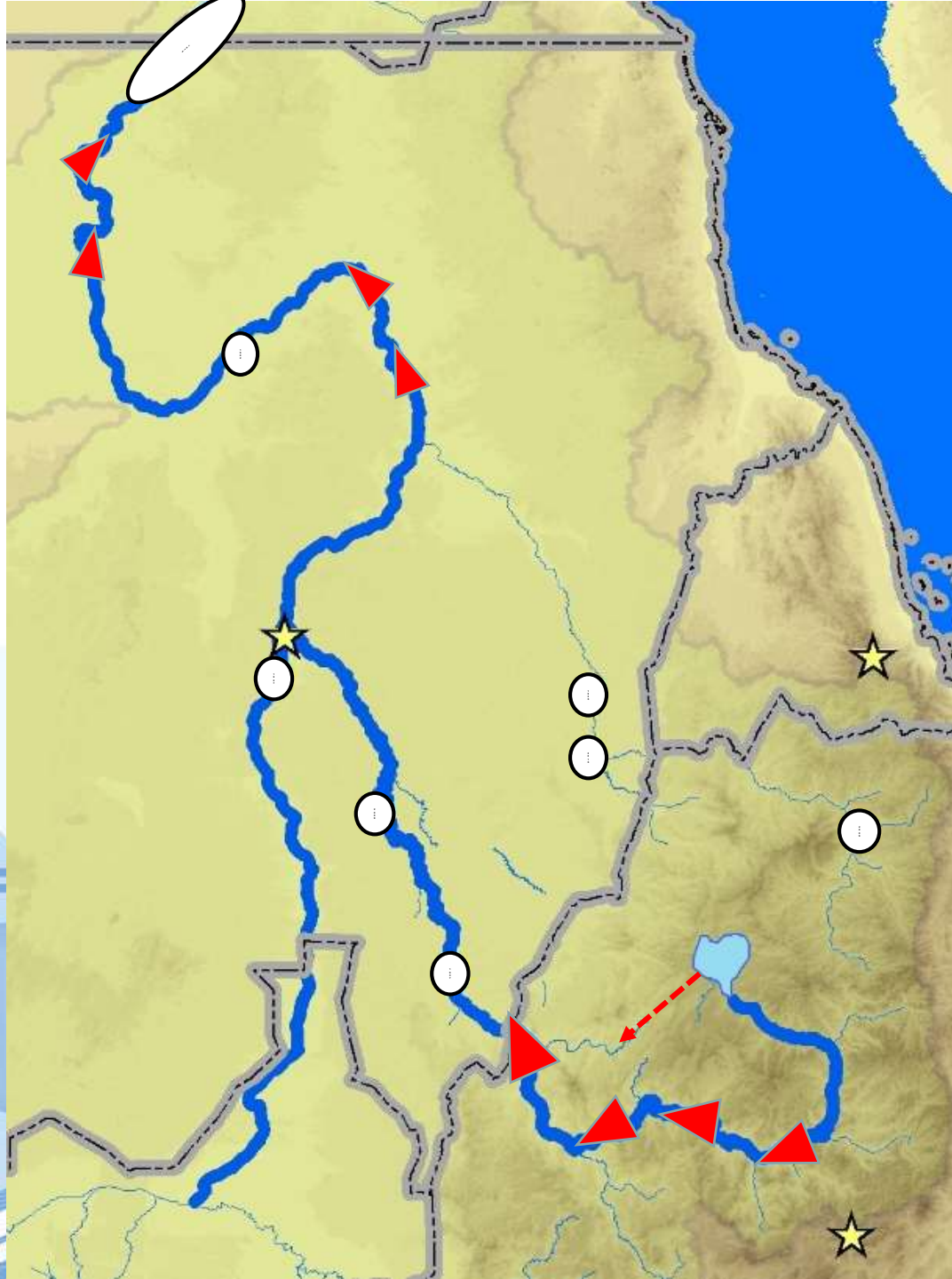
Shereiq	}	6,000 GWh/year
Dagash		
Kagbar		
Low Dal		

Ethiopia

Current ~ 3,300 GWh/year

+ GERD 15,000 GWh/year

+ Karadobi	}	~20,000 - 25,000 GWh
+ Beko Abo (Low/High)		
+ Mendaya (upper)		



Aligning Interests

- Coordinated **Planning**
 - What to build?
 - Where to build it?
 - When to build?

- Coordinated **Management**
 - How to operate multiple dams?
 - Unilateral vs. joint-operations
 - Single-purpose dam vs. multi-purpose network

Coordinated Infrastructure Planning

- Long-term viability
 - Avoid stranded assets
 - Avoid path dependency
 - Short-term thinking = long-term problems
- Developing parallel projects
 - New developments
- Invest in projects
- Invest in energy

Avoid the risk of...



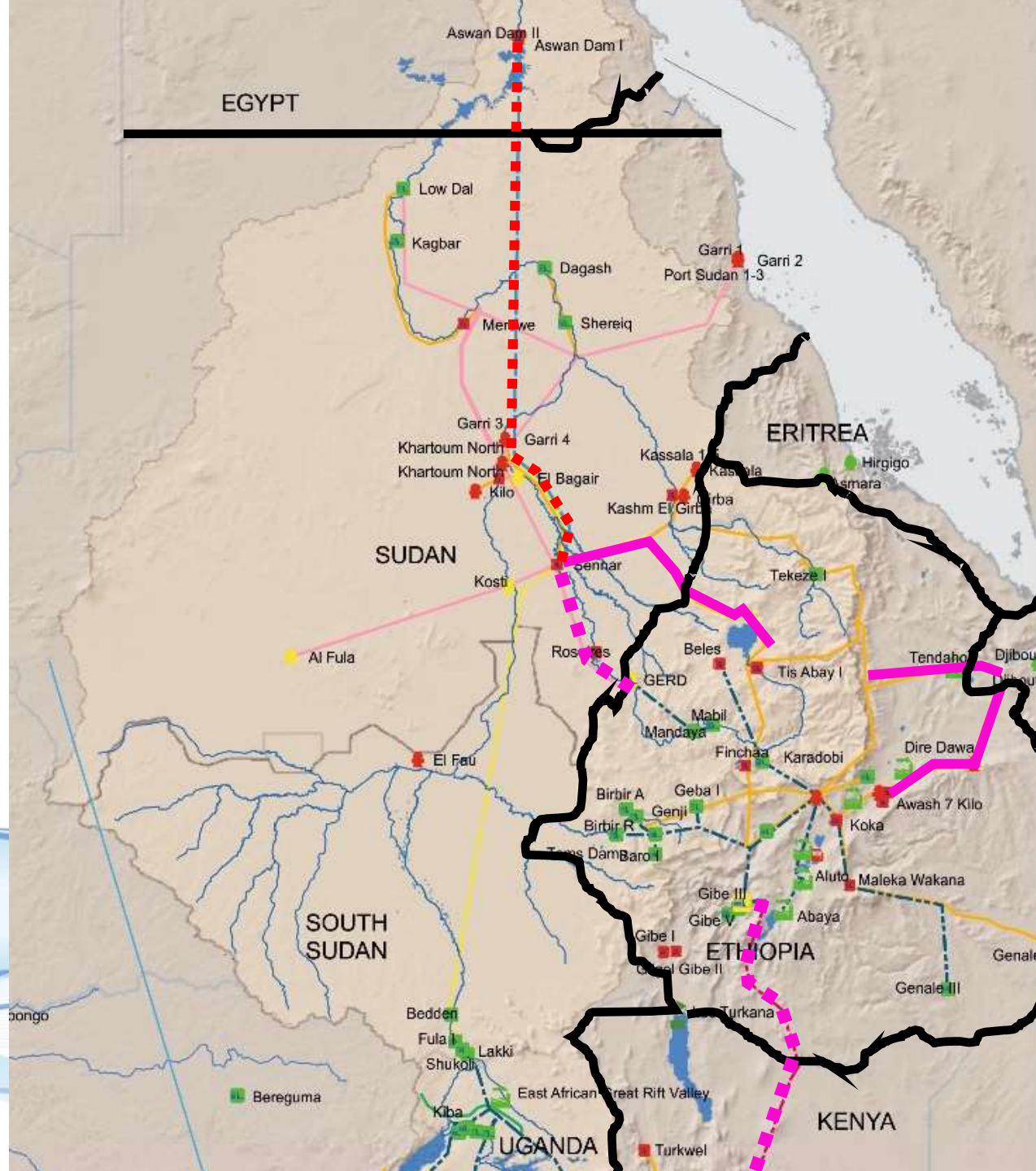
Coordinated Planning Example

Avoid the race to the edge of the cliff...



- With Ethiopian dams, are new main-stem Sudanese reservoirs necessary?
 - + Need for Sudan irrigation development
 - +/- Sudan vs. Ethiopian hydropower
 - Evaporation Losses
 - Human displacement
 - Cultural losses

Electricity Distribution Network



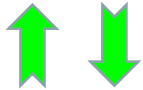
Coordinated Management?

- Releases to meet downstream needs
 - Agreed Daily/Monthly/Annual Releases
 - Releases by Orders/Requests
 - Improved Drought Planning
 - Improved Flood Planning
- Releases to meet energy needs
 - Turbines directly connected to demands
 - Baseload vs. peak load
 - Power Purchase Agreements (PPA)

Optimization vs. Reality

What are the objectives

- Hydropower
- Agriculture
- Municipal
- Environment
- Flood Control



“What is possible”
Optimization

Idealized World

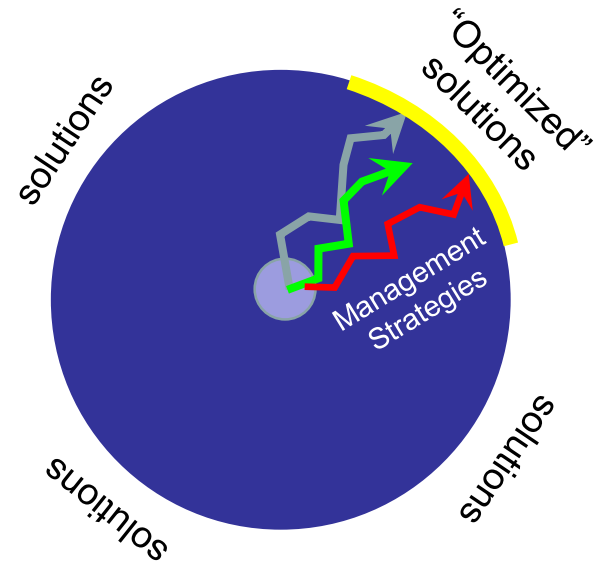
- “Objective Function”
 - Maximize Generation
 - Minimize Shortages
- A world without borders



How to make it
actually happen

Face Reality

- Develop priorities among uses
- Sovereignty
- Rights
- “Implementable” rules, laws and procedures



Why Coordinate?

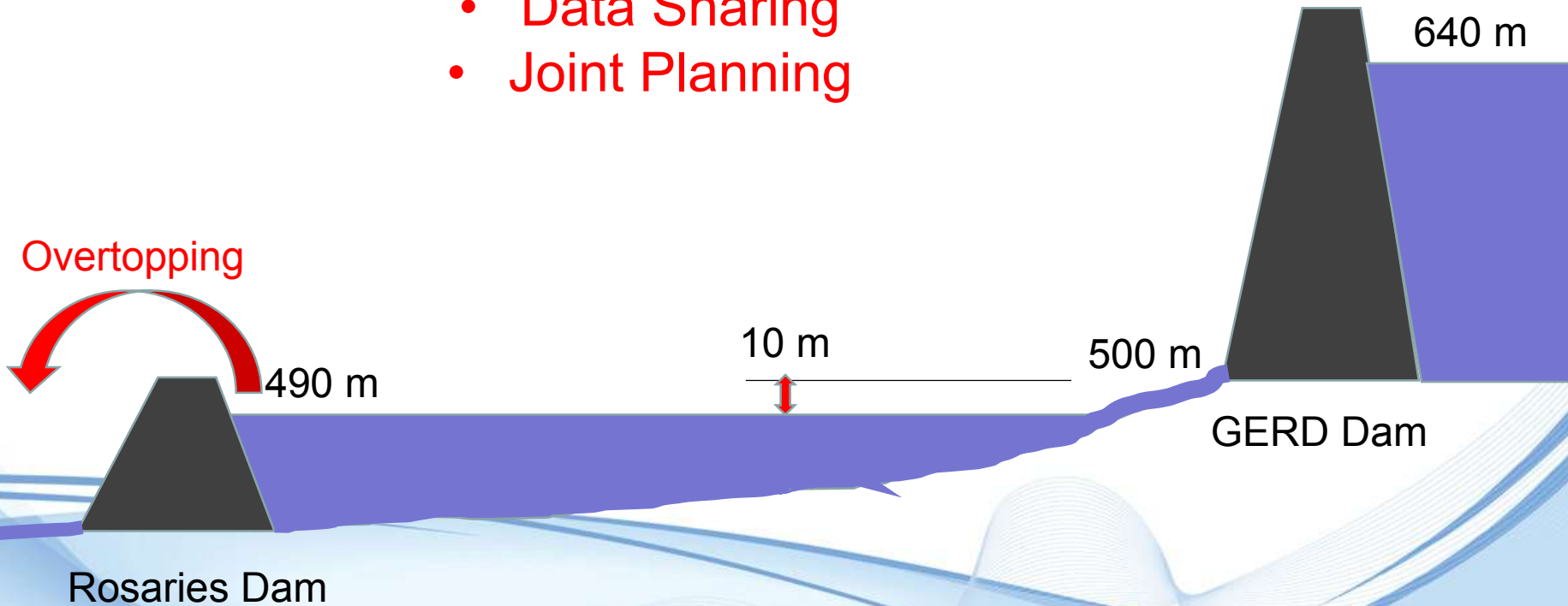
Coordination vs. non-coordination

	Benefits			Costs		
	Ethiopia	Sudan	Egypt	Ethiopia	Sudan	Egypt
Coordination						
Non-Coordination						

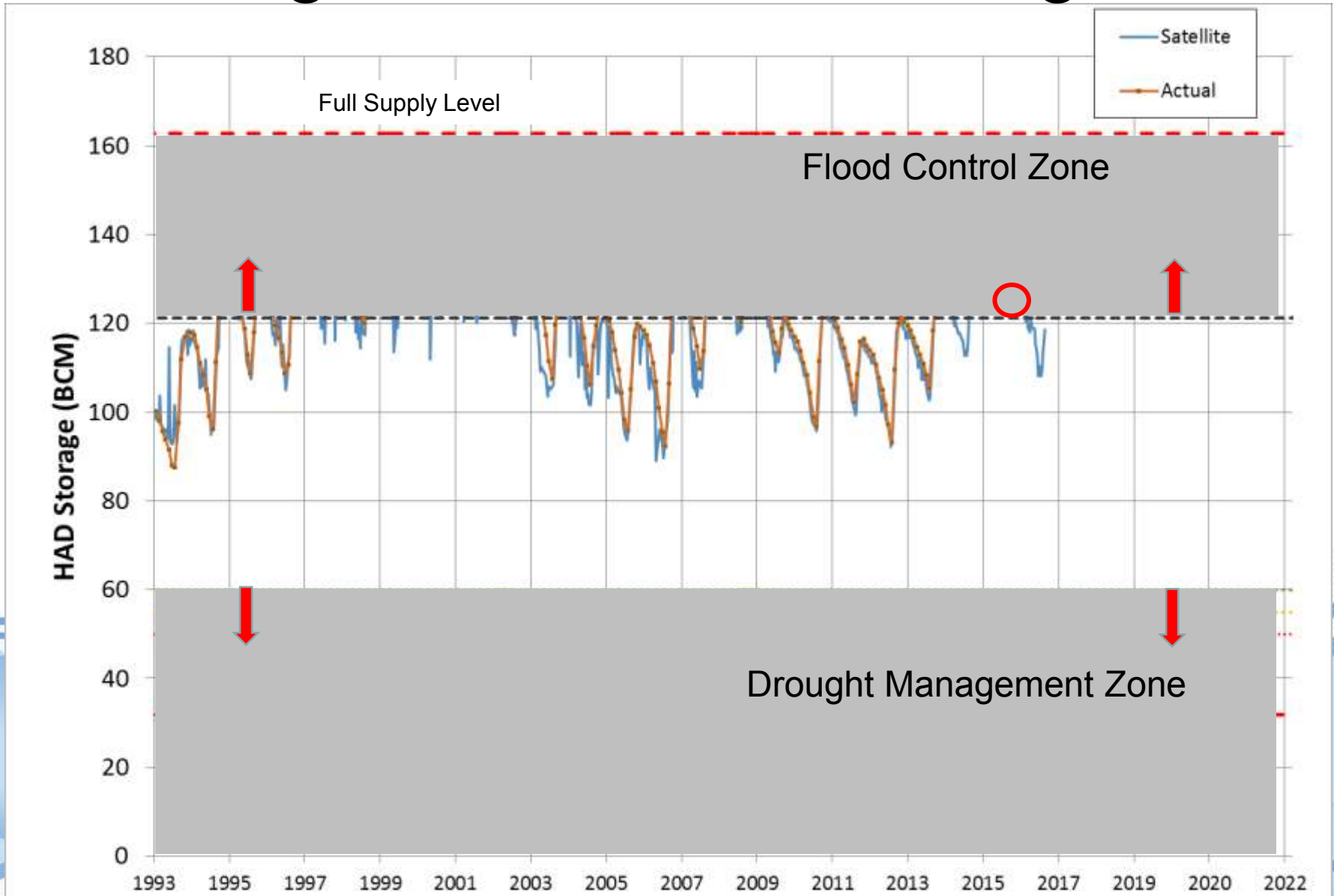
Sudan - Ethiopia

Constant Coordination Necessary for Safety

- Data Sharing
- Joint Planning



High Aswan Dam Storage



Ethiopian Storage – High Aswan Dam Coordination

- More reliable annual inflow to HAD
- GERD can provide a “safety net” for Egypt during extended droughts
 - ~1 additional year
- Protect HAD Minimum generation level
- Higher lower annual “flood storage space”
- Energy generation = Releasing water

**SHARED BENEFITS REQUIRES
COORDINATION**

Coordination vs. non-coordination

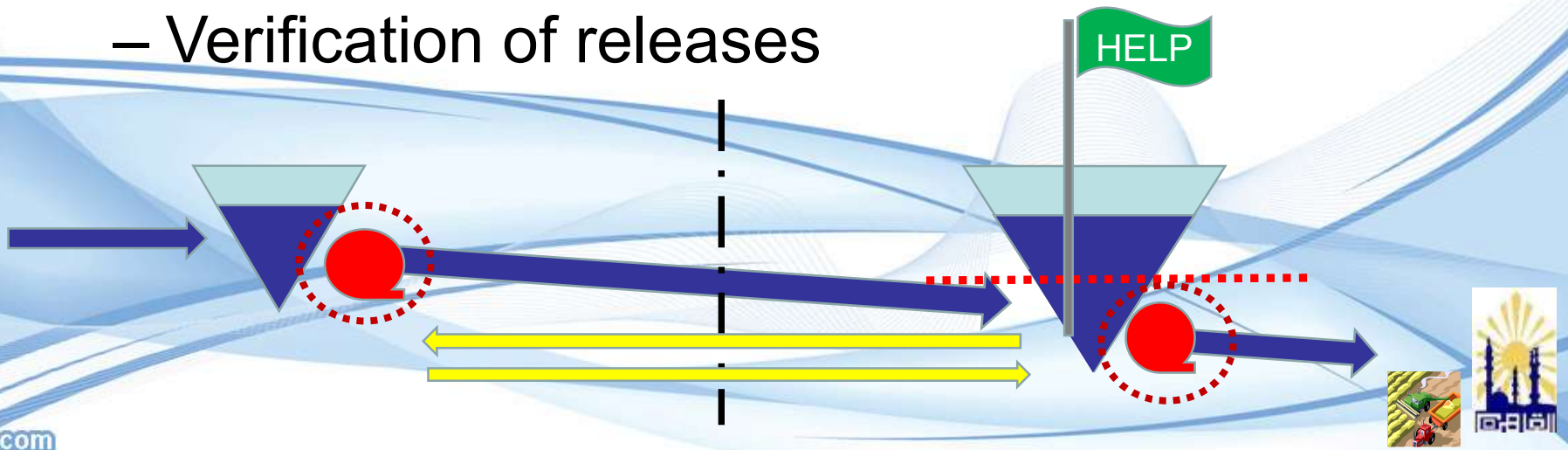
	Benefits			Costs		
	Ethiopia	Sudan	Egypt	Ethiopia	Sudan	Egypt
Coordination	<ul style="list-style-type: none"> ❖ Increase hydropower revenue ❖ Regional Development ❖ Demonstrate responsible leadership 	<ul style="list-style-type: none"> ❖ Increase reliability of irrigation ❖ Increase reliability of electricity ❖ Decreased risk of flooding 	<ul style="list-style-type: none"> ❖ Increase drought resilience ❖ Increase reliability of electricity 	<ul style="list-style-type: none"> ❖ Decreased independence of decisions 	<ul style="list-style-type: none"> ❖ ??? 	<ul style="list-style-type: none"> ❖ Acceptance of new joint-management paradigm
Non-Coordination	<ul style="list-style-type: none"> ❖ Promote internal development ❖ Maximise autonomy and flexibility 	<ul style="list-style-type: none"> ❖ ??? 	<ul style="list-style-type: none"> ❖ ??? 	<ul style="list-style-type: none"> ❖ Distrust of power buyers ❖ Increase regional tensions ❖ Spill of flood waters 	<ul style="list-style-type: none"> ❖ Catastrophic damage to lives and property ❖ Unpredictable Shortages 	<ul style="list-style-type: none"> ❖ Increased risk and uncertainty during droughts ❖ Lost opportunity for energy sharing

Sharing Knowledge = Gain Knowledge



Data Sharing is the Key to Coordination

- Planning
 - Allow accurate historical analyses
 - All sides can explore creative solutions
- Management
 - Daily/monthly/seasonal operating plans
 - Verification of releases



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Recent Publication

Cooperative filling approaches for the Grand Ethiopian Renaissance Dam

Kevin G. Wheeler, Mohammed Basheer, Zelalem T. Mekonnen, Sami O. Eltoum, Azeb Mersha, Gamal M. Abdo, Edith A. Zagona, Jim W. Hall, Simon J. Dadson

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