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Interventions for rising lake levels upstream of the Nile – A case of L. Victoria outflow

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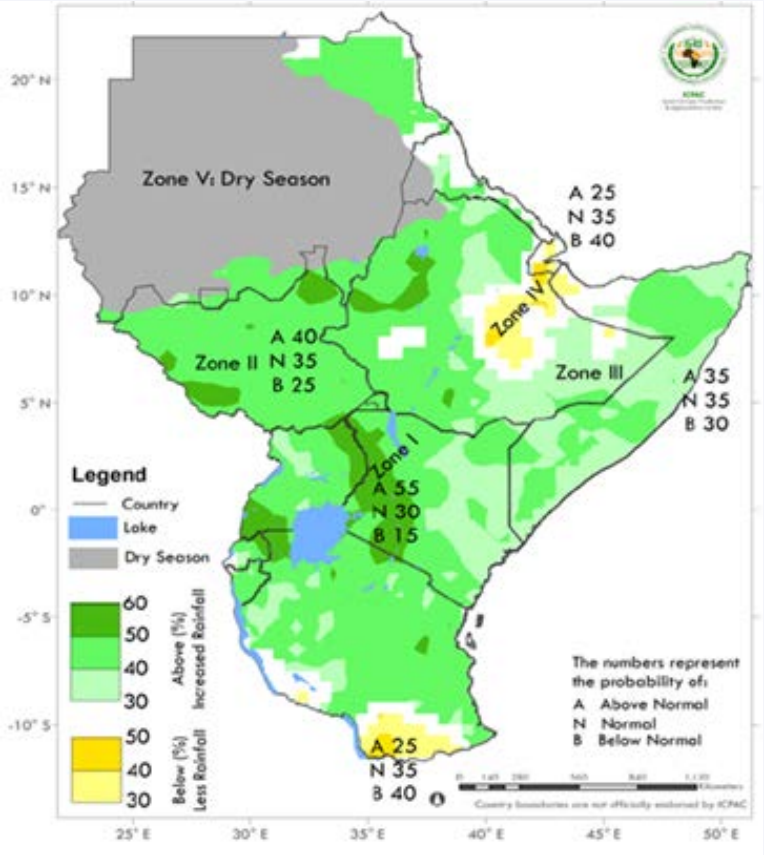
Outline of the Presentation

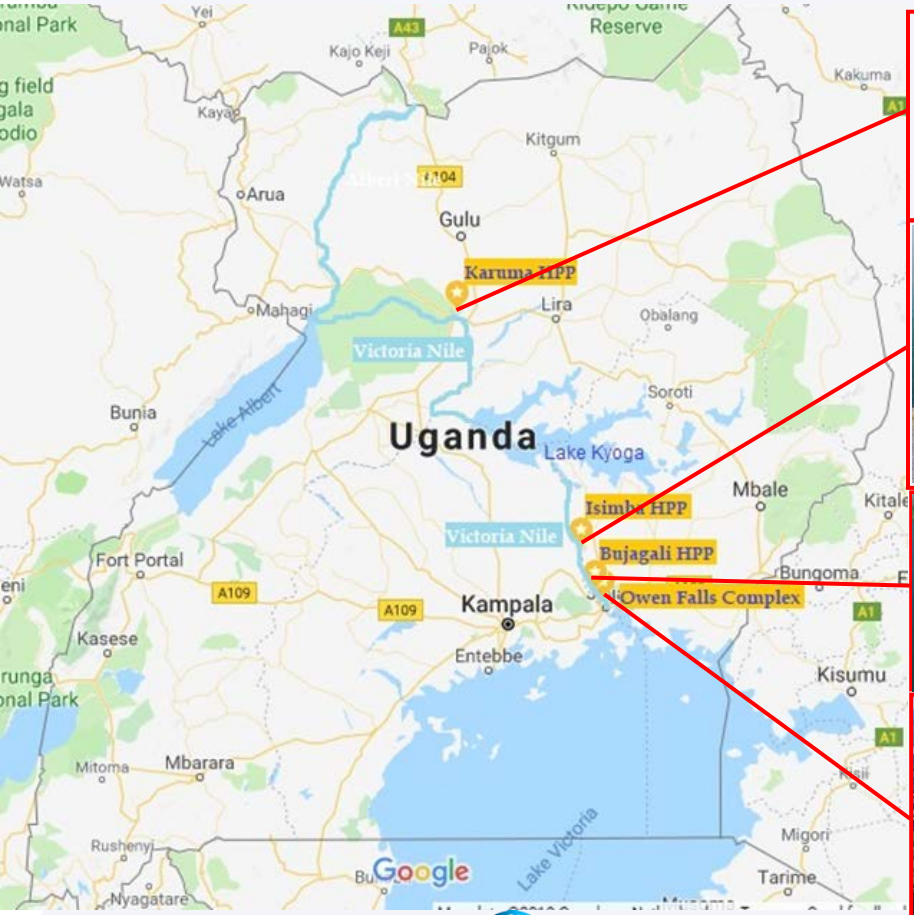
- Introduction to L. Victoria Basin
- Introduction to the White Nile Cascade
- Overview of the Extreme Event
- Generic Interventions made
- Effects, Impacts and Mitigation Measures
- Generic Lessons Learnt
- Specific Lessons Learnt
- Recommendations
- Conclusion

Introduction to L. Victoria



- Lake Victoria covers a surface area of about 68,800 km2
- Shared across three East African countries; Uganda (45%), Kenya (6%), and Tanzania (49%)
- Has 17 tributaries with a regional basin consisting of five countries namely Uganda, Kenya, Tanzania, Rwanda and Burundi.
- The only outlet is River Nile

Introduction to the White Nile



600MW Karuma HPP

183MW Isimba HPP

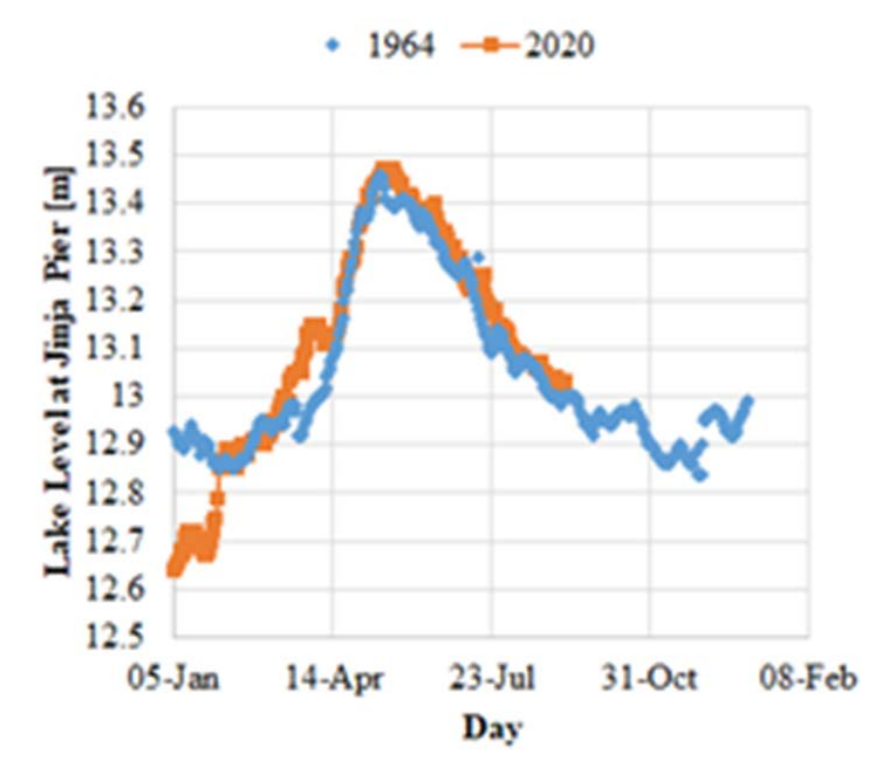
250MW Bujagali HPP

380MW Owen Falls Complex

Introduction to the White Nile

Description	Unit	Parameters				
		Nalubaale PS	Kira PS	Bujagali HPP	Isimba HPP	Karuma HPP
Dam Type		Concrete	Composite	Composite	Composite	Concrete
PMF (10,000 yr)	m^3/s	4,200		4,500	4,500	4,700
Spillway	m^3/s	1,272	1,740	4,500	5,230	4,800
Plant Discharge	m^3/s	1,150	1,120	1,375	1,375	1,224
Dam height	m	30.0	32.0	30.0	26.5	14.0
Dam crest level	m.a.s.l	1136.15	1137.00	1114.54	1057.50	1032.00
Max. flood level	m.a.s.l	1135.00	1135.00	1112.00	1055.00	1030.00
Length of Dam	m	726	380	850	1,599	314

Overview of the Extreme Event



- The first highest recorded lake levels up to 13.41 were encountered in May 1964
- There was a decrease in Lake Levels between 2002 and 2006.
- The Lake Victoria levels recovered in 2012

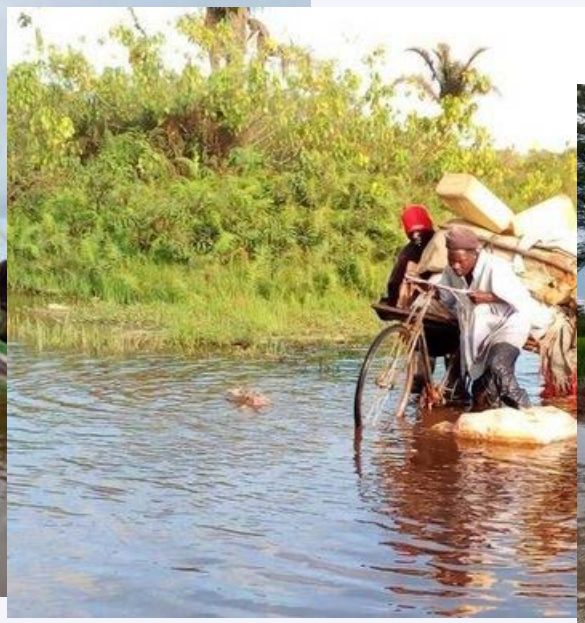
- In May 2020, the lake level surpassed the 1964 record, peaking at 13.47 m towards the end of May

Generic Interventions made

- DWRM permitted a gradual increase in the Nile Discharges
- It was done in incremental steps of 1200, 1300, 1350, 1400, 1450, 1500,1700,1850, 2000, 2200, 2400
- This was done to minimize shock to the ecosystem and allow the public time to adjust to the high discharges
- An integrated multi-sectoral framework that was adopted to assess and mitigate the risks
- Emergency Preparedness Awareness Campaign were rolled out
- Dam Break Drills were undertaken to prepare the public
- The frequency of dam surveillance was increased

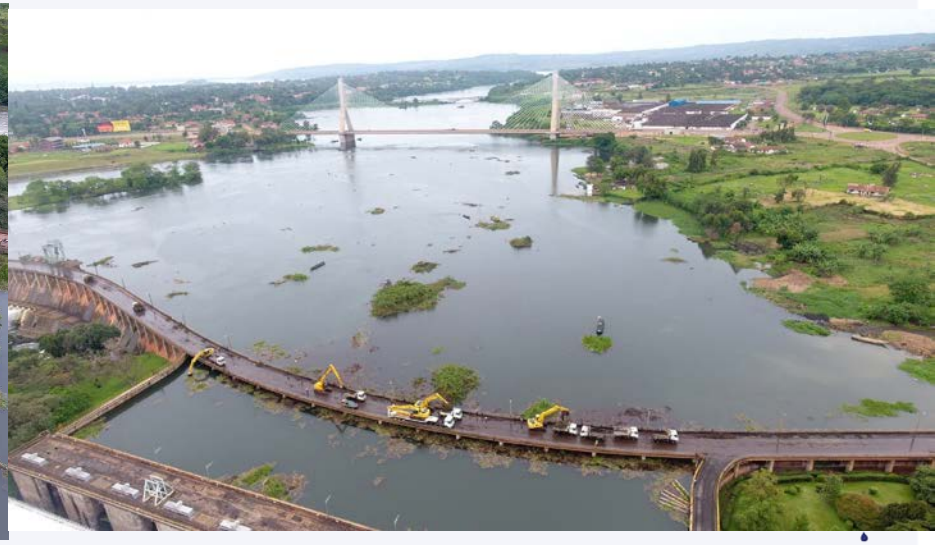
Effects, Impacts & Interventions

Effect	*Flooding of communities living around the L. Victoria & Kyoga*
Impact	Displacement of people, damage to property, Water quality issues and increased spread of water-borne diseases
Intervention	Relocation of affected communities, Increased permitted discharge, Emergency preparedness and Public safety awareness, National Taskforce



Effects, Impacts & Interventions

Effect	*Accelerated heavy influx of Floating Islands*
Impact	National blackouts, Head loses, high maintenance costs
Intervention	Disintegration & removal of the Islands was a combined and coordinated multi-sectoral effort involving the usage of excavators, dump trucks, tag boats and wheel loaders to remove all the debris and transport it



Effects, Impacts & Interventions

Effect	*Accelerated heavy influx of Floating Islands*
Impact	National blackouts, Head loses, high maintenance costs
Mitigation Measures	Regular reservoir inspection; Disintegrate the island when still upstream and removal of debris; Installation of a large boom structure upstream of the Nile

Effects, Impacts & Interventions

Effect	*Excessive erosion of tailrace slopes due to wave action*
Impact	Reduced stability of the dam due to erosion around the dam toe; Sedimentation of the reservoirs
Intervention	Interim slope protection measures were sought; Grouting works o-going

Effects, Impacts & Interventions

Effect	*Excessive erosion of tailrace slopes due to wave action*
Impact	Reduced stability of the dam due to erosion of the foundation; Sedimentation of the reservoirs
Mitigation Measures	Regular reservoir inspection; Survey the slopes and stabilize the collapsed slopes; Should be captured in the Civil O&M Manual, Cascade coordination

Effects, Impacts & Interventions

Effect	*Excessive erosion of tailrace slopes due to wave action*
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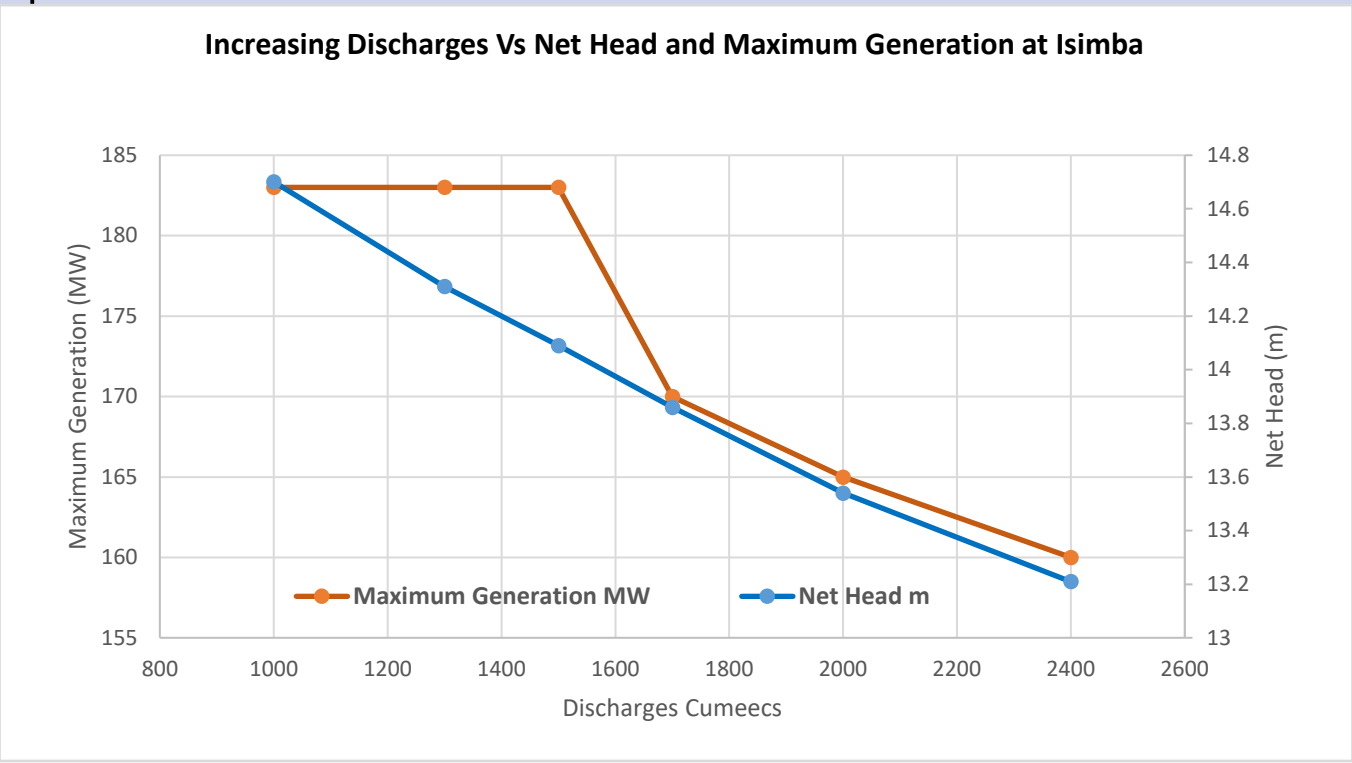
Effects, Impacts & Interventions

Effect	*Collapse of reservoir and river bank slope*
Impact	Sedimentation of the reservoirs, Uptake of uncompensated land
Mitigation Measures	Regular reservoir inspection; Survey the slopes and stabilize the collapsed slopes; Should be captured in the Civil O&M Manual, Cascade coordination

Effects, Impacts & Interventions

Effect	*High flows, requiring increased discharges and resulting into extensive fluctuation of HWL & TWL*
Impact	Head losses and reduced energy output
Intervention	Adopting optimum reservoir operation procedures, Creation of cascade data sharing platform and Cascade discharge tests to configure optimal operations



Effects, Impacts & Interventions

Effect	*Prolonged operation of Spillways due to exceptional flood*
Impact	Scouring of the stilling basin and buffer blocks, Abrasion and erosion of the tailrace river bed, Public safety concerns
Intervention	Monitoring & maintenance; coordinated operation of the cascade; routine testing of gates; Implementation of EPP, Development and implementation of Public Safety Plan

Effects, Impacts & Interventions

Effect	*Disruption of ferry operations, bridge construction and other economic activities along the Nile*
Impact	Delays in construction, Ferry operations were temporarily suspended, where as other economic activities like fishing, sand mining and recreation activities were regulated
Intervention	Coordination between the ferry operators, bridge construction and the Plant operators; Closing monitoring and keeping the tailrace at the appropriate level; Use of siren to warn the downstream on any operational outflow that would threaten downstream activities; EP Awareness, and Public Safety Education

Generic Lessons Learnt

- Dam operators need to address public safety around their dams.
- Floating booms should always be considered most especially in project areas prone to floating debris
- For dam safety regulatory programs, it is important to have a reserve source of funding identified for responding to any emergency.

Generic Lessons Learnt

- Conducting Potential Failure Mode Analyses, Risk Analysis and periodic assessments of high and significant hazard dams are effective methods that can keep the dams safe.
- Emergency alarm/warning system can be an effective means of providing warning to downstream water users and residents in close proximity to the dam.

Generic Lessons Learnt

- Regular monitoring, inspections and maintenance is important to the early detection of dam safety related problems
- Appropriate reservoir operation and inspection is not only important for optimization of power production but also for mitigating dam failure related risks and early detection of public safety related incidents
- Failure of upstream dams/reservoirs should be considered in design and dam break analysis of closely spaced dams

Specific Lessons Learnt

- When confronted with disasters, the Government of Uganda has the capacity to mobilize resources (equipment and manpower) and respond quickly to emergencies.
- Power system stability associated with frequency and voltage fluctuations is of great concern.
- The hydraulic structures of hydropower plants are exposed to serious dam safety and revenue generation loss without a robust log boom in place to contain not only floating debris, but the emerging threat of floating islands.

Specific Lessons Learnt

- There is need for adapt Nalubaale Dam operations to the inter-annual variation of precipitation patterns and lake levels as a result of climate change.
- Future hydrological studies should cover longer historical and future projections for 150 years from 1950 to 2100 to minimize inherent model uncertainties.
- The Nalubaale-Kiira complex is a strategic asset for the Government not only for hydropower generation, but flood control.

Specific Lessons Learnt

- There is need to investigate whether erosion of the river banks, reduce the stability of natural slopes and floating islands are within current dam design criteria and the implications on downstream activities.
- There is need to regulate the Lake Victoria outflow and efficiently utilize water resources to mitigate against seasonal changes.

Specific Lessons Learnt

- Stability analysis of the dam should be undertaken during operation using parameters derived from existing conditions especially during extreme events.
- There is urgent need to build on UCOLD initiatives and strengthen the nation's dam safety regulatory framework.

Recommendations

- *There is need for **undertake studies regarding impacts of climate change** on the Lake Victoria basin and hydropower generation to inform adaptation measures for the Dam operations.*
- *There is need to **develop, build and implement a real-time flood forecasting and early warning system** for the Victoria Nile catchment*
- *NBI should consider initiating and supporting a **"Young Nile Professionals Forum"**, mentor them and build their capacity to champion Nile Cooperation today and in the future*

Conclusion

- *The climatic extreme events have tested the current principles of flood and dam safety management along the White Nile Cascade, revealing opportunities for further improvements in processes and procedures.*
- *To better manage such risks, a risk informed strategy should be adopted cognizant of certain critical factors surrounding such extreme events.*

Conclusion

- *At the pinnacle of all this is the need to create dam safety legislation in Uganda to regulate operations of dams of all sizes, with an objective of protecting downstream population, enforcing operational guidelines, ensuring accountability in the event of failure.*
- *This along with improved cascade cooperation shall go a long way in averting future risks and impacts of changing climatic conditions.*

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600MW Karuma Hydropower Project

183MW Isimba Hydropower Project

380MW Nalubaale-Kiira Hydro Power complex

VISION

To be one of the leading power producers in the Great Lakes Region

MISSION

To sustainably ***generate*** reliable, quality and affordable electricity for socio-economic development

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Accountability

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