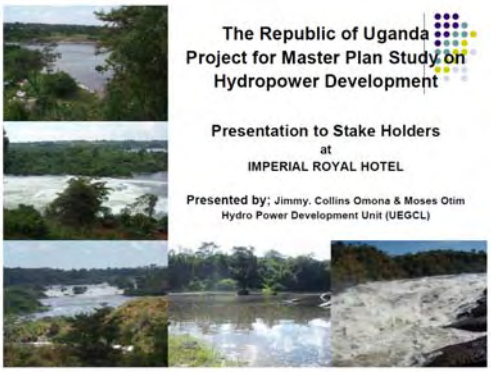
Appendix K-3

Presentation on Third Stake Holder Meeting



The Republic of Uganda
Project for Master Plan Study on
Hydropower Development

Presentation to Stake Holders
at
IMPERIAL ROYAL HOTEL

Presented by; Jimmy. Collins Omona & Moses Otim
Hydro Power Development Unit (UEGCL)

SESSION-1

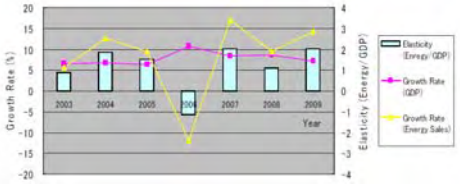
HYDROPOWER MASTER PLAN

Contents

1. Demand Forecast
1.1 Actual Record of Gross Domestic Product and Domestic Energy Sales

Year	Gross Domestic Product (GDP)		Domestic Energy Sales		Elasticity (Energy/GDP)
	Constant currency (billion UGX)	Growth Rate (%)	(GWh)	Growth Rate (%)	
2002	10,709	8.73	1,356		
2003	11,403	6.47	1,433	5.68	0.88
2004	12,179	6.81	1,614	12.65	1.86
2005	12,950	6.33	1,767	9.47	1.50
2006	14,347	10.78	1,554	-12.05	-1.12
2007	15,554	8.41	1,819	17.03	2.02
2008	16,908	8.71	1,993	9.53	1.09
2009	18,103	7.06	2,278	14.32	2.03
Average 2002-2009		7.79		7.69	0.99

1.2 Actual Record of Gross Domestic Product and Domestic Energy Sales



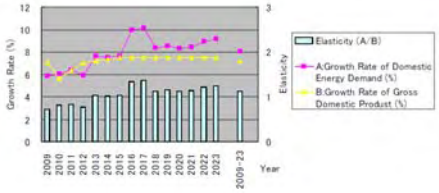
1.3 Comparison of Growth Rate

(Domestic Energy Demand Forecast in GDP2009 and Gross Domestic Product)

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2009-23
A: Growth Rate of Domestic Energy Demand in GDP 2009 (%)	5.86	6.04	6.39	5.93	7.64	7.52	7.63	9.94	10.2	8.37	8.53	8.30	8.43	8.93	9.16	8.06
B: Growth Rate of Gross Domestic Product by IMF (%)	7.06	5.59	6.40	7.00	7.20	7.40	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.22
Elasticity (A/B)	0.73	0.81	0.83	0.77	1.03	1.02	1.03	1.34	1.37	1.13	1.15	1.12	1.14	1.21	1.24	1.12

1.4 Comparison of Growth Rate

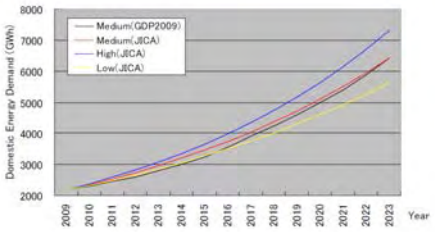
(Domestic Energy Demand Forecast in GDP2009 and Gross Domestic Product)



1.5 Result of Domestic Energy Demand Forecast (GWh)

Year		2009	2010	2011	2012	2013	2014	2015	2016
GDP2009	Medium	2,171	2,302	2,449	2,595	2,793	3,003	3,232	3,354
JICA	Medium	2,171	2,346	2,535	2,740	2,961	3,199	3,457	3,736
	High	2,171	2,368	2,582	2,816	3,072	3,350	3,654	3,985
	Low	2,171	2,324	2,489	2,664	2,852	3,054	3,270	3,500
Year		2017	2018	2019	2020	2021	2022	2023	
GDP2009	Medium	3,915	4,242	4,604	4,986	5,406	5,889	6,428	
JICA	Medium	4,037	4,363	4,714	5,094	5,505	5,949	6,428	
	High	4,346	4,740	5,169	5,637	6,148	6,706	7313	
	Low	3,748	4,012	4,296	4,599	4,924	5,272	5,644	

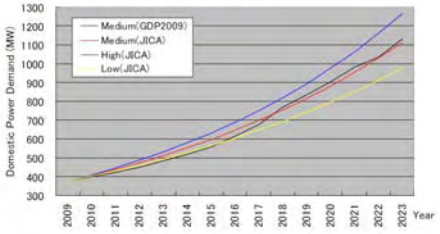
1.6 Result of Domestic Energy Demand Forecast (GWh)



1.7 Result of Domestic Power Demand Forecast (MW)

Year		2009	2010	2011	2012	2013	2014	2015	2016
GDP2009	Medium	375	398	424	449	483	519	559	615
JICA	Medium	375	406	439	474	512	553	598	646
	High	375	410	447	487	531	579	632	689
	Low	375	402	430	461	493	528	566	605
Year		2017	2018	2019	2020	2021	2022	2023	
GDP2009	Medium	677	769	834	903	980	1,034	1,129	
JICA	Medium	698	755	815	881	952	1,029	1,112	
	High	752	820	894	975	1,063	1,160	1,265	
	Low	648	694	743	795	852	912	976	

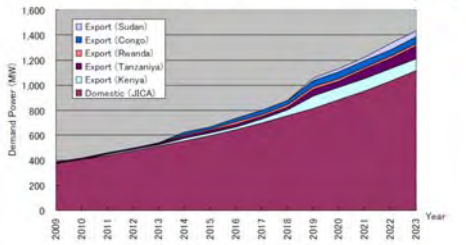
1.8 Result of Domestic Power Demand Forecast (MW)



1.9 Result of Power Demand Forecast incl. Export (MW)

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Domestic (JICA)	375	406	439	474	512	553	598	646	698	755	815	881	952	1029	1112
Domestic (GDP2009)	375	398	424	449	483	519	559	615	677	769	834	903	980	1034	1129
Export (Kenya)	1	1	10	10	10	20	20	20	30	50	100	100	100	100	100
Export (Tanzania)	10	10	11	12	13	20	20	20	20	20	50	50	70	80	100
Export (Rwanda)	1	1	1	1	1	10	10	20	20	20	20	20	20	20	20
Export (Congo)			1	2	3	20	20	30	30	30	50	50	50	50	50
Export (Sudan)										0	20	30	30	50	50
Total (JICA)	387	418	462	499	539	623	668	736	798	875	1055	1131	1222	1329	1432
Total (GDP2009)	387	410	447	474	510	589	629	705	777	889	1074	1153	1250	1334	1449

1.10 Result of Power Demand Forecast incl. Export (MW)



2. System

2.1 Condition

Network to be Simulated
- Based on GDP2009
- 220kV Kawanda—Mutundwe is added to solve overload problem in Kampala Area

2.2 Network Analysis

2.3 Power Flow Analysis Result in 2023

Network to be Simulated
- Based on GDP2009
- 220kV Kawanda—Mutudwe is added to solve overload problem in Kampala area

Maximum power flow

	Line	Max. P. Flow	Comments
400kV	Karuma-Kafu	748MW	Sufficient transmitting capacity is necessary
220kV	Kawanda-Mutundwe	267MW	Listing the line in GDP is necessary

3. Alternative Energy Source

3.1 Economic and Technical Consideration

Evaluation items		Hydro	Geothermal	Diesel Engine (Heavy Oil)	Wind Power	Biomass Thermal Cogeneration	Solar Thermal	Nuclear	Energy import
Cost**	Development cost(USD/kW)	C	C	A	E	E	E	E	A
	Operation & Maintenance cost (USD/kW/year)	A	C	C	A	C	A	E	A
	Unit cost of power generation (USD/MWh)	A	A	E	A	C	E	A	E
Development potential**	Existing potential (MW)	A	C	C	E	B	D	B	D
	Technically feasible potential at present (MW)	A	C	D	-	B	C	E	E
	Availability of Energy Source+	B	A	D	-	D	C	E	E
Construction *	Survey maturity	B	C	A	-	A	A	E	E
	Lead time for construction(years)	C	D	A	-	B	B	E	C
Operation	Initial Starting Time	A	C	B	-	C	C	D	E
	Energy stability	B	A	A	-	C	E	A	C
	Power supply stability	B	A	C	-	D	E	D	D
	Life Span (Year)	A	B	C	B	B	B	B	A
Contribution to national economy*		A	A	E	C	A	C	A	C

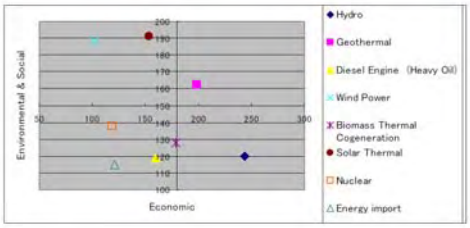
3.2 Environmental Consideration

Evaluation items	Hydro	Geothermal	Diesel Engine (Heavy Oil)	Wind Power	Biomass Thermal Cogeneration	Solar Thermal	Nuclear	Energy import
Air pollution	A	A	E	B	D	B	A	D
Water pollution	C	D	C	A	C	B	D	D
Consumption of natural resource*	A	B	E	A	C	A	C	E
CO2 emission	A	B	E	C	C	D	A	E
Waste	B	C	C	A	D	A	E	D
Water right/ water resource*	D	B	C	A	B	B	C	C
Impact on natural ecology**	E	C	D	B	C	A	C	D

3.3 Social Consideration

Evaluation items	Hydro	Geothermal	Diesel Engine (Heavy Oil)	Wind Power	Biomass Thermal Cogeneration	Solar Thermal	Nuclear	Energy import
Impact on Agriculture	D	A	A	C	E	B	A	A
Resettlement	D	A	A	C	E	A	B	A
Impact on fishery	E	C	D	A	D	A	D	D
Impact on tourism	E	B	A	D	A	C	C	A
Legal aspects	A	C	A	A	A	E	A	A
Human health hazard+	D	D	D	B	D	A	D	D
Risk of accident	D	B	E	A	B	A	D	E

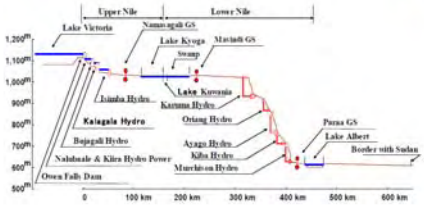
3.4 Summary (Multi Criteria Decision)



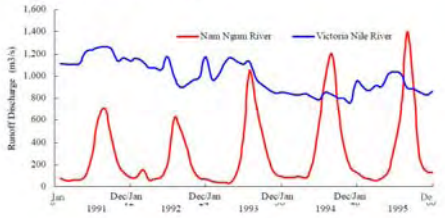
4. Selection of Prospective Site

4.1 Plan

4.2 Profile of Nile River



4.3 Feature of Nile River
- Abundant Water resources and Stable Flow -



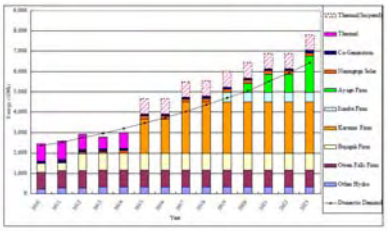
5. Power Development Plan

5.1 Scenarios of Development Plan

	Demand Forecast	Data Source
Scenario I	Middle Case	Study Team
Scenario II	High Case	Study Team
Scenario III	Low Case	Study Team
Scenario IV	Middle + Export to Kenya	Study Team
Scenario V	Vision 2035	PSIP Draft Report Dec.8.2009

(Source: Study Team)

5.2 Scenario I : Energy demand and Supply Balance



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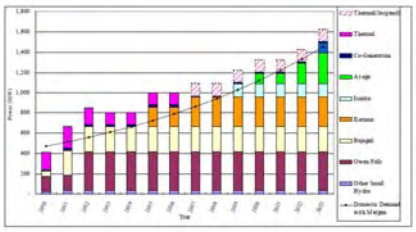
5.3 Scenario II : Power demand and Supply Balance



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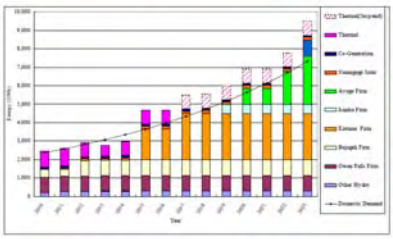
5.4 Scenario II : Energy demand and Supply Balance



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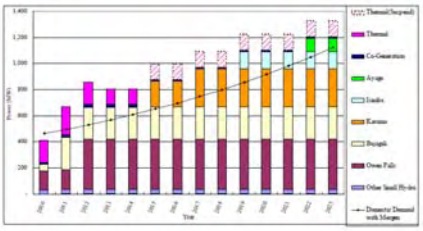
5.5 Scenario III : Power demand and Supply Balance



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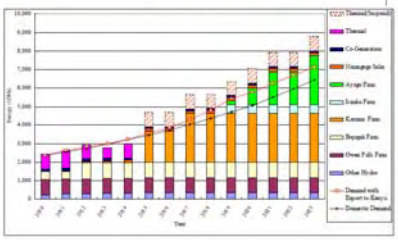
5.6 Scenario IV : Energy demand and Supply Balance



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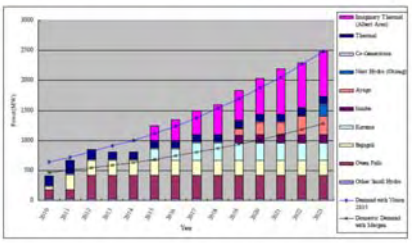
5.7 Scenario V : Power demand and Supply Balance



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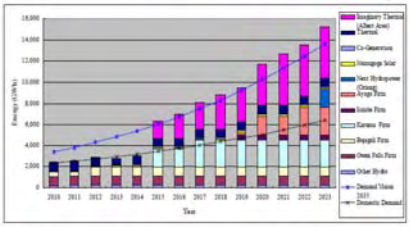
5.8 Scenario V : Energy demand and Supply Balance



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- END OF PRESENTATION

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SESSION-2

PRE-FEASIBILITY STUDIES
FOR THE AYAGO PROJECT

Contents

1. Hydrology

1.1 Introduction

1) The Nile River Network
2) Historical Record of Water Level of L. Victoria
3) Water Balance of Lake Victoria and Lake Kyoga
4) Flow Duration of Lake Victoria and Lake Kyoga
5) Flood Analysis

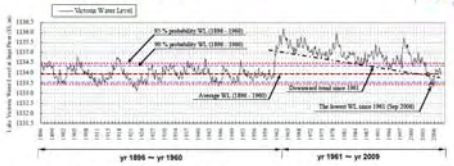
1.2 The Nile River Network

1. The Nile River is originated from Lake Victoria. It flows through Lake Kyoga and Lake Albert, and down to Sudan.
2. The runoff from the Lake Victoria is solely regulated at Owen Falls Dam.

Basic Features of Lake Victoria, Lake Kyoga and Lake Albert

Lakes	Total Area (km^2)	Area in Uganda (km^2)	Mean Elevation (m)	Max. Depth (m)
Victoria	68,457	28,665	1,134	82
Albert	5,335	2,913	621	51
Kyoga and Kwania	2,047	2,047	1,033	7

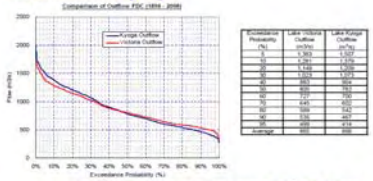
1.3 Historical Record of Water Level at Lake Victoria



Water Level of Lake Victoria (yr 1896 ~ yr 2009)

1. The water level of Lake Victoria varied from EL1134.5m to 1133.41m between year 1896 to year 1960.
2. The water level suddenly rose by 2 meters due to heavy rains in 1961- 1964
   Since 1964, the lake level gradually continued to fall until 2006 when it reached its lowest level and the benefit of high lake level seemed to have been exhausted.
4. The agreement between Uganda and the downstream riparian countries of Sudan and Egypt prescribes the rule curve for releases from the Owen Falls Dam. The rule curve requires the releases to keep the natural flow regime of the river and O.F.P.S generally complies the rule.

1.4 Flow Duration of Lake Victoria and Lake Kyoga



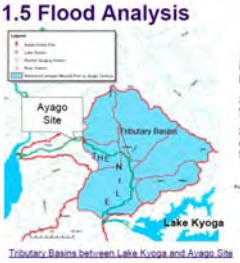
Exceedance Probability (%)	Lake Victoria Outflow (m^3/s)	Lake Kyoga Outflow (m^3/s)
5	1,363	1,327
10	1,261	1,176
20	1,148	1,006
30	1,062	1,073
40	983	964
50	908	781
60	727	700
70	645	602
80	589	542
90	576	497
95	499	414
Average	895	808

Flow Duration Curve of Lake Victoria and Lake Kyoga

- Runoff from Lake Victoria flows into Lake Kyoga which is 120 km downstream from Lake Victoria.
- In the draught season, the evaporation exceeds total inflow in the Lake Kyoga. Therefore the flow is lower than the Victoria runoff in the draught season.
- In general, the flow duration of Lake Kyoga and Lake Victoria is similar.
- Discharges at 95% exceedance probability are 499 m^3/s for the Lake Victoria and 414 m^3/s for the Lake Kyoga.

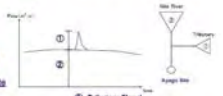
2011/1/20

1.5 Flood Analysis



Tributary Basins between Lake Kyoga and Ayago Site

1. Flood analysis is carried out at intake and outlet location for the planned Ayago site.
2. Return period of 100 years, 200 years, and 1000 years are examined.
3. Flood discharge is derived by combination of the Nile and tributary flood.



① Tributary Flood:
Flood duration = Several days

② Nile River Flood:
Flood duration = Several months to years

Concept of Combination of Floods

Probable Flood Discharge

	Return Period		
	100 years	200 years	1,000 year
Ayago Intake	2,800 m^3/s	3,200 m^3/s	4,100 m^3/s
Ayago Outlet	3,000 m^3/s	3,300 m^3/s	4,200 m^3/s

2. Topography and Geology

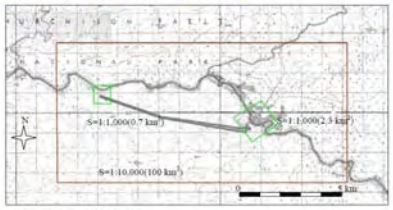
2.1 General

Rating on Geological Condition

Location	Kalagala, Isimba	Karuma, Ortung, Ayago, Kibo Murchisons Falls
geology	Granitic gneiss/mafic gneiss	Biotite gneiss
Evaluation	B : good	C: fair

Base map: 1:1,500,000 Geological Map, Department of Geological Survey and Mines, Uganda, 1966

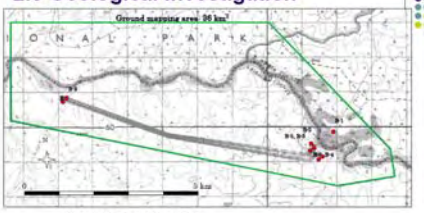
2.2 Topographic Survey



Survey Items and Quantity

- Topographic maps covering the whole project area, scale 1:10,000 (5m contour interval)
- Topographic maps for main structures such as inlet weir, power station and outlet, scale 1:1,000 (1 m contour interval)
- Cross-section survey

2.3 Geological Investigation

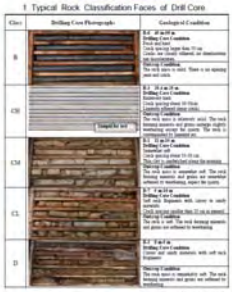


Survey Items and Quantities

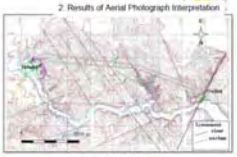
- Ground Mapping : 36 km2
- Aerial Photograph Interpretation: 100 km2
- Core Drilling : 8 holes total 350m in length
- Permeability tests : 46 nos.
- Laboratory tests and Construction Material Survey

2.4 Core Boring and Laboratory Test Results

1 Typical Rock Classification Faces of Drill Core



2 Results of Aerial Photograph Interpretation



3 Results of Laboratory tests

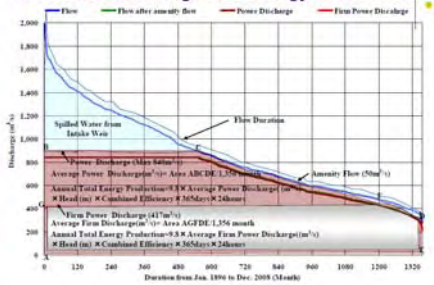
Laboratory test	Unit	No. of Sample	Average	Max.	Min.
Water absorption	%	20	0.34	0.61	0.05
Bulk density	g/cm³	3	2.64	2.88	2.75
UCS	MPa	20	31.7	36.59	10.61
Soundness	%	1	1.3		
Abrasion	%	1	40		
Alkali Reactivity		1	nonreactive		

2.5 Results of Geological Investigation

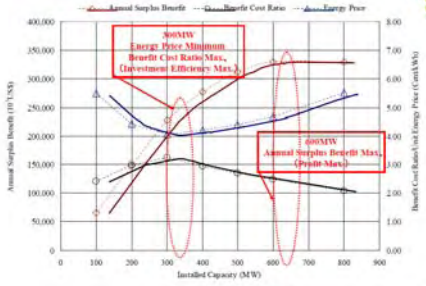
- Ayago site is underlain mainly by hard gneiss rocks, which will be suitable in terms of strength and water tightness.
- No serious problems were found in rock foundations of the structures such as intake weir, underground powerhouse and tunnels.
- A NE-SW lineament near the outlet site indicates a weak zone. Rock condition seems to be more preferable by shifting the layout of the outlet slightly to the upstream.
- Development of quarry site is essential for construction material. Use of rock materials obtained by tunnel excavation will be preferable from the viewpoint of nature conservation.
- Additional geological investigations including core drilling with testing are necessary during the F/S to confirm the distribution of sound rock and availability of construction material source.

3. Optimum Scale of Ayago Project

3.1 Power Discharge and Energy Production

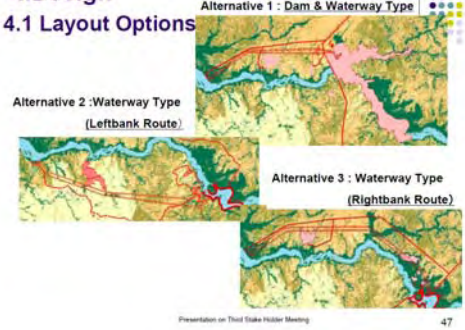


3.2 Selection of Optimum Size



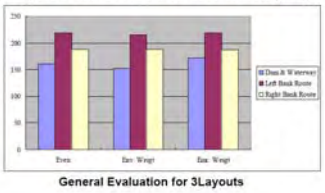
4.Design

4.1 Layout Options



4.2 General Evaluation of Optimal Layout

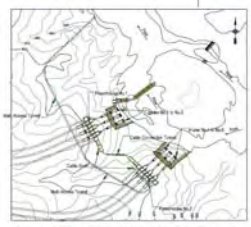
- Current evaluation shows that Left Bank Route has relatively higher score than the other layouts for Even Case, Environment Weighting Case, and Economic & Technical Weighting Case.



General Evaluation for 3Layouts

4.3 General Layout of Intake and Powerhouse

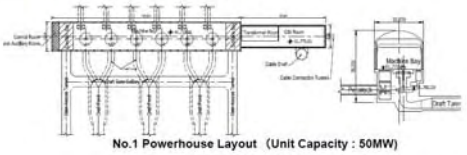
- The intake and powerhouse structures were divided into two ridges due to limitation of the ridge area.
- Two powerhouses are connected by one access tunnel and one cable connection tunnel. Two powerhouses
- The high voltage cable will be led out from the GIS room to the transmission line via cable shaft. The transmission line will be connected to the steel tower located on the ground surface.



Layout Plan from Intake to Powerhouse

4.4 Powerhouse Layout

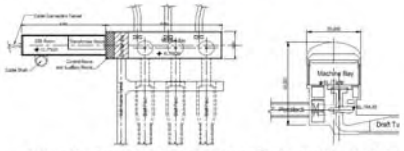
- A 50 MW generating unit capacity was adopted so as to avoid damage of the power grid system in Uganda.
- There are six numbers of turbines and generators, which unit capacity is 50 MW, in each powerhouse cavern.
- Two erection bays were planned to be located at both sides of the powerhouse machine bay, so as to shorten the installation period.
- Transformer and GIS caverns were proposed to be located at the immediate vicinity of the powerhouse cavern.



No.1 Powerhouse Layout (Unit Capacity : 50MW)

4.5 Case Study for Unit Capacity

- In case the grid system will be developed to more than expected, 100 MW unit capacity can be adopted for the Project.
- A reduction of 15% in the volume of excavation for the cavern and a 50% decrease in the quantity of the generating units can be achieved by adopting a 100 MW unit capacity



Alternative Layout of No.2 Powerhouse (Unit Capacity : 100MW)

4.6 Electrical Equipment

Appropriate Unit Capacity

Condition

- Peak load 900MW
- Off-peak load 440MW
- Constant characteristics 5%
- Minimum frequency 48.5Hz
- No connection to Kenya

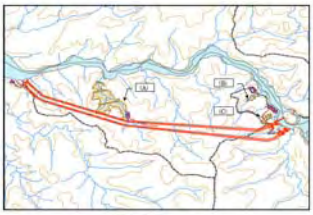
4.7 Transmission Line Route

5. Construction Planning

5.1 Access Road

- Project site: South of Nile River
- Length: approx. 75km(south), 40km(north), 20km(site)
- Use of existing path to minimize environmental impact

5.2 Spoil Bank

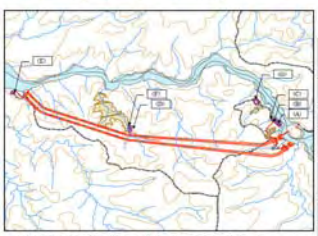


No	Estimated Area (m²)	Estimated Volume (m³)
(A)	318,000	5,088,000
(B)	52,000	298,000
(C)	61,000	536,000
Total	431,000	5,922,000

(A) Exit of tailrace work adit
(B) Exit of powerhouse access tunnel
(C) Downstream of weir
※Further investigation is required

- Volume: over 5mil m3 except concrete aggregate
- Consider accessibility and less environmental impact
- Detailed survey and environmental evaluation are required

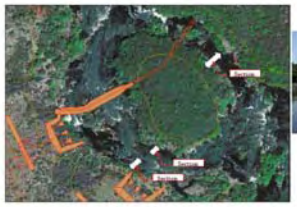
5.3 Temporary Facility Area



No	Expected Area (m²)	Purpose for
(A)	2,600	Weir Intake
(B)	3,500	Headrace Penstock
(C)	3,300	Powerhouse Tailrace
(D)	3,200	Tailrace
(E)	3,200	Tailrace Outlet
(F)	11,000	Concrete Facility
(G)	45,000	Building Camp

- Temporary facilities will be demolished later
- Building and camp will be remained for operation

5.4 Weir and Intake



Weir
Excavation: 11,000m3
Concrete: 83,000m3

- Weir location is determined in consideration of river diversion
- Easy to divert river flow utilizing 2 small islands in the river
- Closure work is conducted in 3 stages

5.5 Underground Powerhouse

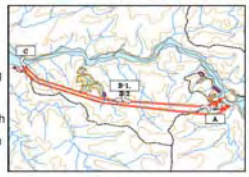
Bullet Type
23m wide 40m high
150m long

- Arch excavation
- Cavern excavation
- Foundation concrete
- Installation of Draft tube
- Reinforcing bar and Concrete Casting
- Installation of the electrical equipment

Excavation: 15 month
Concrete & Electromechanical : 27 month
Others : 10 month

5.6 Tailrace Tunnel

- Reinforcement of Tunnel Portal
- Drill and Blasting
- Carry out muck from tunnel to outside
- Reinforce the excavated area by shotcrete and rockbolt
- Installation of sliding form
- Casting of Lining Concrete



- 6 lines with 8.4m dia. 7500m long
- Blasting method
- Excavation: 80m/monthx24month
- Concrete: 110m/monthx18month
- Driven simultaneously from 4 tunnel faces

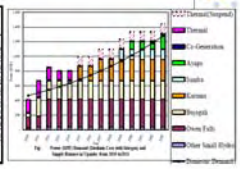
6. Cost Estimates
6.1 Total Cost for 600MW

Item	Cost (x10^{3}US$)	Note
1. Preparation and Land acquisition	36,030	
(1) Access road	13,500	100x10^{3}US$/km × 135 km
(2) Compensation & Resettlement	5,000	
(3) Camp & Facilities	17,530	(3. Civil work)× 3%
2. Environmental mitigation cost	43,825	(3. Civil work)× 5%
3. Civil work	876,494	
(1) Weir	28,013	
(2) Intake	19,531	
(3) Headrace	21,053	
(4) Penstock	5,060	
(5) Access tunnel	13,018	
(6) Powerhouse	78,520	
(7) Draft Pond	23,712	
(8) Tailrace tunnel	601,881	
(9) Outlet	5,444	
(10) Miscellaneous	79,681	
4. Hydraulic equipment	38,886	
5. Electro-mechanical equipment	235,200	Installed Capacity 610 MW
6. Transmission line	29,000	Ayago-Karuma 58 km
Direct cost	1,279,434	
7. Administration and Engineering service	191,915	Direct cost × 15%
8. Contingency	127,943	Direct cost × 10%
Total cost	1,599,293	

6.2 Disbursement Schedule

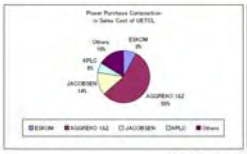
SCENARIO- 1 : Middle Demand Case

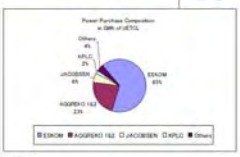
year	Installed Capacity	Cost (x1000 USD)			
	/MW	100MW	200MW	300MW	Total
2015		43,625			43,625
2016		87,249			87,249
2017		130,874			130,874
2018		130,874			130,874
2019		43,625			43,625
2020	100		63,982		63,982
2021	100		85,309	63,991	149,300
2022	100		63,982	85,321	149,303
2023	200			63,991	63,991
2024	300				



- Disburse schedule is based on the stage development
- First 100MW starts construction in 2015 and operates in 2020
- Second 100MW starts construction in 2020 and operates in 2023
- Third 100MW starts construction in 2021 and operates in 2024

7.Economic & Financial Evaluation
7.1 Power Purchase Composition





Source: UETCL Annual Report 2008

UGX390,051 million (US$200 million) for 2,095 GWh →

(for simplicity the exchange rate: US$1=UGX2,000)

Average purchase cost: US 9.3 ¢ /kWh
Eskom: US 1.2 ¢ /kWh
Aggreko: US 22.7 ¢ /kWh
Jacobsen: US 23.4 ¢ /kWh
KPLC: US 29.8 ¢ /kWh

7.2. Result of Economic Evaluation (Scenario I)

Scenario I on Base Case

The construction cost of Ayago hydropower=100%
The construction cost of the alternative thermal power=100%
The fuel price=US$50 cents/liter
Discount rate=10%

Criteria	Evaluation	Index	Judgement
EIRR	24.36%	> 10%	Passed
NPV	US$ 1,134 million	>0	Passed
B/C	2.98	>1	Passed

Scenario I on Severer Case

The construction cost of Ayago hydropower=150%
The construction cost of the alternative thermal power=50%
The fuel price=US$25 cents/liter
Discount rate=10%

Criteria	Evaluation	Index	Judgement
EIRR	10.65%	> 10%	Passed
NPV	US$ 60million	> 0	Passed
B/C	1.07	>1	Passed

7.3. Result of Economic Evaluation (Scenario IV)

Scenario IV on Base Case

The construction cost of Ayago hydropower=100%
The construction cost of the alternative thermal power=100%
The fuel price=US$50 cents/liter
Export tariff=US$11.5cents/kWh
Discount rate=10%

Criteria	Evaluation	Index	Judgement
EIRR	24.44%	> 10%	Passed
NPV	US$ 1,156 million	> 0	Passed
B/C	2.88	>1	Passed

Scenario IV on Severer Case

The construction cost of Ayago hydropower=150%
The construction cost of the alternative thermal power=50%
The fuel price=US$25 cents/liter
Export tariff=US$6cents/kWh
Discount rate=10%

Criteria	Evaluation	Index	Judgement
EIRR	10.19%	> 10%	Passed
NPV	US$ 18million	> 0	Passed
B/C	1.02	>1	Passed

7.4 Result of Financial Evaluation (Scenario I)

Scenario I on Base Case

The construction cost of Ayago hydropower=100%
The power price=US$6 cents/kWh
Discount rate=10%

Criteria	Evaluation	Index	Judgement
FIRR	12.83%	> 10%	Passed
NPV	US$ 192 million	> 0	Passed
B/C	1.33	>1	Passed

Scenario I on Severer Case

The construction cost of Ayago hydropower=120%
The power price=US$5.5 cents/kWh
Discount rate=10%

Criteria	Evaluation	Index	Judgement
FIRR	10.18%	> 10%	Passed
NPV	US$ 14million	> 0	Passed
B/C	1.02	>1	Passed

7.5 Result of Financial Evaluation (Scenario IV)

Scenario IV on Base Case

The construction cost of Ayago hydropower=100%
The power price=US$6 cents/kWh
Export tariff=US$11.5 cents/kWh
Discount rate=10%

Criteria	Evaluation	Index	Judgement
FIRR	18.46%	> 10%	Passed
NPV	US$ 639 million	> 0	Passed
B/C	2.04	>1	Passed

Scenario IV on Severer Case

The construction cost of Ayago hydropower=120%
The power price=US$4.5 cents/kWh
Export tariff=US$6 cents/kWh
Discount rate=10%

Criteria	Evaluation	Index	Judgement
FIRR	10.19%	> 10%	Passed
NPV	US$ 15million	> 0	Passed
B/C	1.02	>1	Passed

7.6 Result of Cashflow Analysis (Scenario I)

Scenario I on Base Case

The construction cost of Ayago hydropower=100%
The power price=US$6 cents/kWh
Interest rate=7%

Criteria	Evaluation	Index	Judgement
IRR on Project	9.41%	> 7%	Passed
IRR on Equity	12.32%	> 7%	Passed
LLCR	2.95	> 1.5	Passed
DSCR Average	4.19	> 1.5	Passed
DSCR Minimum	2.68	> 1.0	Passed

Scenario I on Severer Case

The construction cost of Ayago hydropower=120%
The power price=US$5.5 cents/kWh
Interest rate=10%

Criteria	Evaluation	Index	Judgement
IRR on Project	7.34%	> 7%	Passed
IRR on Equity	8.03%	> 7%	Passed
LLCR	1.72	> 1.5	Passed
DSCR Average	2.84	> 1.5	Passed
DSCR Minimum	1.71	> 1.0	Passed

7.7 Result of Cashflow Analysis (Scenario IV)

Scenario IV on Base Case

The construction cost of Ayago hydropower=100%
The power price=US$6 cents/kWh
Export tariff=US$11.5 cents/kWh
Interest rate=7%

Criteria	Evaluation	Index	Judgement
IRR on Project	13.36%	> 7%	Passed
IRR on Equity	18.64%	> 7%	Passed
LLCR	4.22	> 1.5	Passed
DSCR Average	5.95	> 1.5	Passed
DSCR Minimum	3.75	> 1.0	Passed

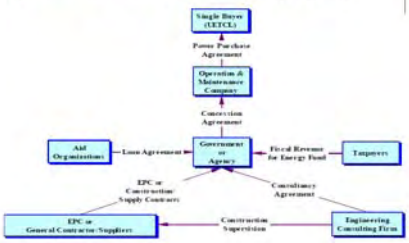
Scenario IV on Severer Case

The construction cost of Ayago hydropower=120%
The power price=US$4.5 cents/kWh
Export tariff=US$6 cents/kWh
Interest rate=10%

Criteria	Evaluation	Index	Judgement
IRR on Project	7.19%	> 7%	Passed
IRR on Equity	7.50%	> 7%	Passed
LLCR	1.64	> 1.5	Passed
DSCR Average	2.67	> 1.5	Passed
DSCR Minimum	1.61	> 1.0	Passed

8. Project Execution Plan
8.1 Scheme of Implementation
(IPP/PPP with government equity participation)

8.2 Scheme of Implementation
(Public works as government project)



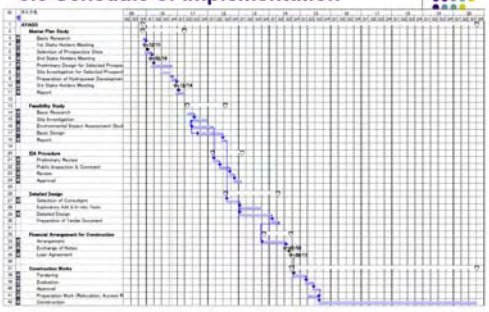
8.3 Mode of Implementation

Viewed from the government	Advantages	Disadvantages
IPP/PPP with government equity participation	• Possible to utilize funds and knowhow of the private sector • Possible to reduce financial burden on the government • Possible to reduce input of human resources of the government	• Complicated financial/contractual scheme • Time consuming for coordination between a numerous parties concerned • Uncertain about the timing of financial close • Required to provide government guarantees as conditions for private sector participation (contingent liabilities) • Less management transparency • Less likely to accumulate project management capability
Public works as government project	• Possible shortening of development period • Possible to accumulate project management capability • Enhanced management transparency	• Full funding responsibility on the government • Necessary to secure project management staff • Vulnerable to government intervention in autonomy as power utility

8.4 Type of Execution

Viewed from the government	Advantages	Disadvantages
EPC	• Being called as fast track, possible to reduce the period of detail design and construction • Responsibility for design and construction solely on EPC contractor • Possible to reduce input of human resources of the government	• Higher markup on the contract price for risk hedge • Fast track may not be kept if differing conditions from tendering conditions set at the level of F/S are encountered • Necessary to have the ability to properly prepare EPC tender documents and evaluate the submitted tenders • Necessary to have the ability to check the quality and the quantity of the works performed
CM at risk	• Construction quality, cost and time guaranteed by CM consultant • Possible to reduce input of human resources of the government • Design responsibility on CM consultant if they make detail design	• Consultant's fee raised for risk hedge against guarantee of quality, cost and time • Less likely to be able to accumulate experience in project management
Joint S/V	• Possible to make impartial judgment on allocation of responsibility • Reasonable consultant fee • Possible to accumulate project management capability • Design responsibility on CM consultant if they make detail design	• Construction quality, cost and time not guaranteed by S/V consultant

8.5 Schedule of Implementation

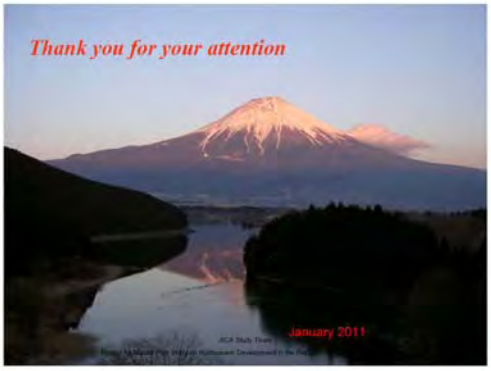


- END OF PRESENTATION

Discussion

Conclusions

- **Hydropower M/P**
  - **Ayago Site selected as Prospective Site**
  - **Stage Development plan of Ayago Project**
- **Pre F/S**
  - **Salient Feature of Ayago Project**
    Installed Capacity: 50MW X 12 units
    Suitable Layout for Stage Development by 100MW
  - **Feasible Project in terms of Economic and financial**



SESSION-3

HYDROPOWER MASTER PLAN STUDY

Items of Session-3

1. Result of Strategic Environmental Assessment study
   - Stage 1: Dec. 2009 – Jan. 2010
   - Stage 2: Dec. 2009 – Feb. 2010
   - Stage 3: Jul. – Oct. 2010
2. Mitigation Strategy and Next Study

Three Strategic Environmental Assessments

Alternatives	Methods
1st Stage: Hydropower, Geothermal, Diesel Engine, Solar thermal, Wind Power, Biomass Cogeneration, Nuclear, Energy Import	Literature Survey
2nd stage: Kalagara, Isimba, Karuma, Oriang, Ayago, Kiba, and Murchison	Literature Survey
3rd stage: Dam option, Left bank option, Right bank option	Site Survey

1. Result of Strategic Environmental Assessment study

1.1 Stage 1

1.1 Stage 1
General Rating

Hydro	High impact on natural Ecology Low unit cost high availability of energy	A
Geothermal	Totally better, but survey maturity is necessary	B
Diesel Engine (Heavy Oil)	High unit cost High impact on air pollution and global warming	C
Wind Power	Low impact on environment Low potential	C
Biomass Thermal Cogeneration	Totally good Availability of energy is low	C
Solar Thermal	Low impact on Environment High development cost	B
Nuclear	Long initial starting time	C
Energy import	Uncertainly of supply High risk of accident	C

1.1 Stage 1
Conclusion

- High Score Sources are Hydro, Geothermal, and Solar.
- Geothermal has low survey maturity.
- Energy potential of solar is low.
- Hydro would be the most suitable energy source to fulfill the demand until 2023.

1.2 Stage 2

1.2 Stage 2
Economic

Evaluation items		Kalagala	Isimba	Karuma	Oriang	Ayago	Kiba	Murchiso
Cost**	Construction Cost (MUSD)	A	A	C	C	C	D	B
	Generation Cost (cent/kWh)	A	D	B	C	A	E	B
Effectiveness*	Maximum Power (MW)	C	E	B	C	A	D	A
	Construction time (year)	A	A	B	B	B	B	A
	Head (m)	E	E	B	C	A	D	A
	Distance to load center or existing grid(km)	B	D	A	C	D	D	E
	Length of Waterway	A	A	D	D	C	E	B
	Geological Condition	B	B	C	C	C	C	C
	Excavation Volume	B	A	D	C	C	E	B
	Construction material (availability)	A	A	B	B	B	C	A
	Accessibility	A	A	A	B	C	D	B
	Loss of transmission	A	A	A	B	A	B	B
Development progress	Lead Time	D	D	A	C	B	C	C
	Financial Negotiation and close	E	C	C	C	C	C	E

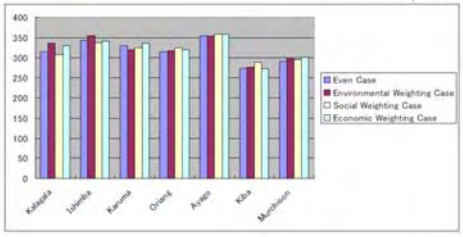
1.2 Stage 2
Environment

Evaluation items	Kalagala	Isimba	Karuma	Oriang	Ayago	Murchison
Length of water recession (km)	A	A	D	D	C	B
Rate of recession (%)	A	A	D	D	D	D
Impact on Protected area	C	C	B	D	D	E
Impact on wetland	A	A	C	A	A	A
Impact on protected species	A	A	E	E	E	E
Degradation of underground water	A	A	D	D	C	A
CO2 emission from the reservoir	D	E	A	A	A	C

1.2 Stage 2
Social

Evaluation items	Kalagala	Isimba	Karuma	Oriang	Ayago	Kiba	Murchison
Land acquisition	E	E	B	C	C	C	D
Flooding area*	D	E	A	A	A	A	C
Number of affected people	D	E	D	A	A	A	A
Impact on ethnic minority and indigenous people	C	C	D	B	B	B	B
Impact on fish breading and/or fishing	A	A	B	A	A	A	A
Impact on Agriculture	C	D	D	A	A	A	A
Impact on cultural property	E	A	D	A	A	A	C
Impact on potential tourism	E	B	C	D	D	D	E
Impact on current tourism	E	A	B	B	B	B	E
Impact on existing infrastructure	C	C	D	A	A	A	B
Impact on landscape	E	A	D	C	C	C	E
Human health hazard	C	C	D	A	A	A	A

1.2 Stage 2
Total Scores



1.2 Stage 2
Cumulative Impact Assessment

Items	Impacts	Significance
Length of Recession	50.2 km	Serious
Impact Area	1,075 km2	Middle
Impact on protected area	6.0 % of total protected area in the country	Serious
Impact on Hippopotamus	34.2 % of the total Hippopotamus population in the country	Serious
Poaching and Encroachment	Expansion of the poaching is anxious	Middle
Impact on tourism	Impact will be long and seriously.	Serious

1. Result of Strategic Environmental Assessment study

1.2 Stage 3

1.3 Stage 3
Survey Items (Site Survey Period)

- Topography (6/1-12/20)
- Geology (6/1-10/13)
- Flora (7/29-8/2)
- Terrestrial Fauna (8/9-15)
- Fish (9/21-24, 10/12-15)
- Social (6/22-23, 7/12-17)
- Archeology (7/12-17, 7/26-8/3)

1.3 Stage 3
EIA process

- 19 March 2010: MEMD submitted **"Project Brief of Pre-Feasibility Study of Ayago Hydro Electric Power Project"** to NEMA.
- 11 May 2010: NEMA issued **Approval to proceed the Pre-Feasibility Study**. (No need IEE/EIA)

1.3 Stage 3 - Survey Results1
Flora and Vegetation

- 244 vascular plant species were recorded.
- IUCN redlisted (VU)
  - *Milicia excelsa*
  - *Khaya anthotheca*
- Vegetations:
  - Riverine vegetation
  - Combretum dominated grassland,
  - Acacia dominated wooded grassland
  - Piliostigma-Acacia wooded grassland

1.3 Stage 3 - Survey Results 1
Vegetation Map

1.3 Stage 3 - Survey Results 1
Photos of main Vegetations


Riverine vegetation


Piliostigma-Acacia wooded grassland


Combretum dominated grassland

1.3 Stage 3 - Survey Results 2

Mammals

- 26 mammals are recorded.
- 4 IUCN red list species are recorded.
  - Hippopotamus (VU-Vulnerable)
  - Leopard (NT-Near Threatened)
  - Spotted Hyena (NT)
  - African Elephant (NT)

1.3 Stage 3 - Survey Results 1

Photos of Mammal vestige

Prints (Leopard)

Route (Elephant)

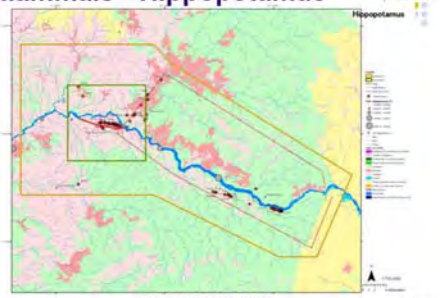
Giraffe

Trail (Hippopotamus)

Prints (Marsh Mongoose)

1.3 Stage 3 - Survey Results 2

Mammals - Hippopotamus



1.3 Stage 3 - Survey Results 2

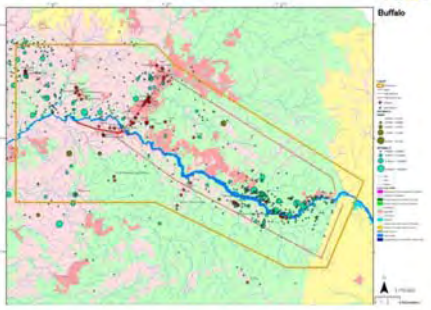
Mammals - Elephant

1.3 Stage 3 - Survey Results 2

Mammals - Giraffe

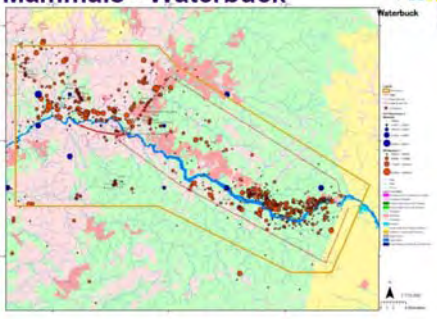
1.3 Stage 3 - Survey Results 2

Mammals - Buffalo



1.3 Stage 3 - Survey Results 2

Mammals - Waterbuck



1.3 Stage 3 - Survey Results 3

Birds

- 119 species are recorded.
- 9 conservation concern species are recorded.

Purple Heron	LC
Brown Snake Eagle	LC
Western Banded Snake Eagle	LC
Swallow-tailed Bee-eater	LC
Ring-necked Francolin	NT
Rock Pratincole	LC
Spot-flanked Barbet	LC
White-headed Saw-wing	LC
Sharpe's Starling	LC

Ground Hornbill

Swallow-tailed Bee-eater LC (© Wiki)

1.3 Stage 3 - Survey results 4

Amphibians and Reptiles

- 12 amphibian species are recorded.
  - *Amietophrynus maculates* LC
  - *Amietophrynus regularis* LC
  - *Amietophrynus vittatus* DD
  - *Afrixalus osorioi* LC
  - *Hyperolius viridiflavus* LC
  - *Kassina senegalensis* LC
  - *Amietia angolensis* LC
  - *Phrynobatrachus acridoides* LC
  - *Phrynobatrachus natalensis* LC
  - *Ptychadena anchiateae* LC
  - *Ptychadena chrysogaster* LC
  - *Ptychadena mascareniensis* LC
- 16 reptiles species are recorded.
  - *Crocodylus niloticus* LC


Amietophrynus regularis (©Wiki)


Amietia angolensis (©Wiki)


Hyperolius viridiflavus (©Wiki)


Phrynobatrachus acridoides (©Wiki)


Ptychadena mascareniensis (©Wiki)


Crocodylus niloticus


Phrynobatrachus natalensis (©Wiki)

1.3 Stage 3 - Survey Results 5

Butterflies

- 66 species of butterflies are confirmed at the site survey.
- None of them are listed in the IUCN red list.

1.3 Stage 3 - Survey Results 6

Fish

- 5 kinds of fishes are confirmed.
  - *Lates niloticus* LC
  - *Barbus altianalis* LC
  - *Mormyrus kannume* LC
  - *Bagrus docmac* LC
  - *Oreochromis niloticus* LC

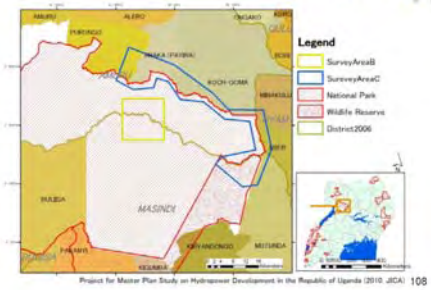

Barbus altianalis


Bagrus docmac


Mormyrus kannume

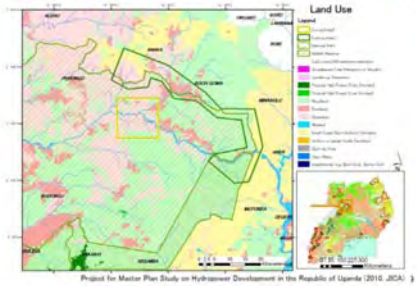
1.3 Stage 3 - Survey results 7

Administrative Boundaries near Survey Areas



1.3 Stage 3 - Survey Results 8

Land Use



1.3 Stage 3 - Survey Results 9

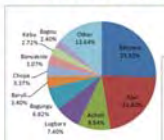
Population by gender, 2010

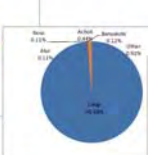
Sub-county	Male	Female	Total
Aber	33,000	35,100	**68,100**
Anaka	7,600	8,100	**15,700**
Purongo	4,100	4,200	**8,300**
Mutunda	35,200	36,900	**72,100**
Myene/ Minakulu	26,700	26,900	**53,600**
Koch Goma	5,500	5,100	**10,600**

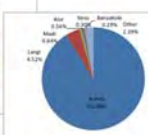
Source: Sub National Projections Report Northern, Western Region 2008-2012

1.3 Stage 3 - Survey Results 10

Ethnic Groups

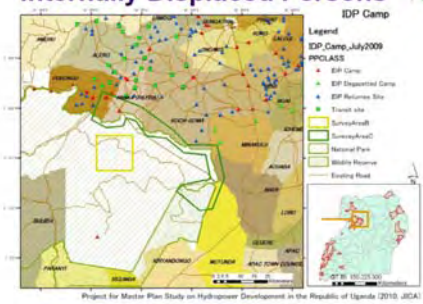

Masindi District, 2002 (Mutunda Sub-county)


Oyam (Apac) District, 2002 (Minakulu/Myene and Aber Sub-county)


Amuru (Gulu) District, 2002 (Purongo, Anaka, and Koch Goma Sub-county)

1.3 Stage 3 - Survey Results 11

Internally Displaced Persons

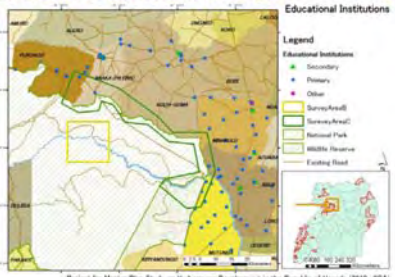


1.3 Stage 3 - Survey Results 11
Internally Displaced Persons

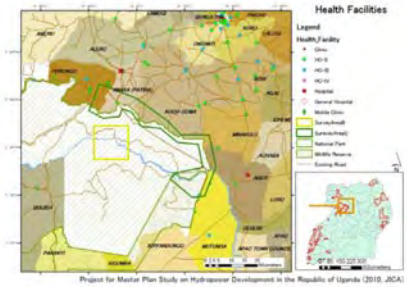
Typical grass thatched houses in IDP camp

A typical IDP satellite camp setting in Koch Goma Sub-county

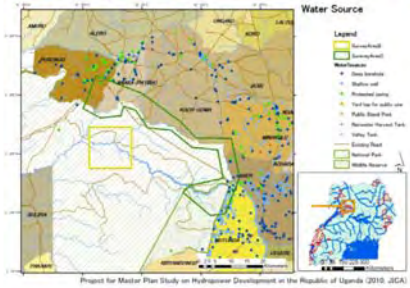
1.3 Stage 3 - Survey Results 12
Educational Institutions



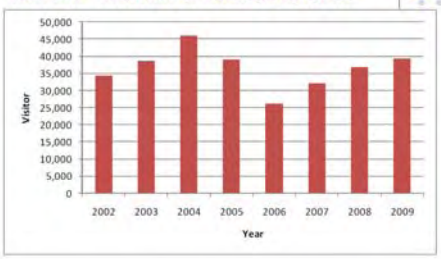
1.3 Stage 3 - Survey Results 13
Health Facilities



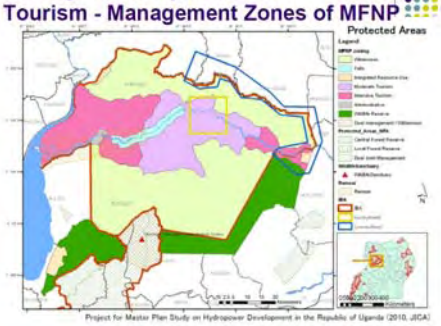
1.3 Stage 3 - Survey Results 14
Water Source



1.3 Stage 3 - Survey Results 15
Tourism – Number of Tourists to MFNP



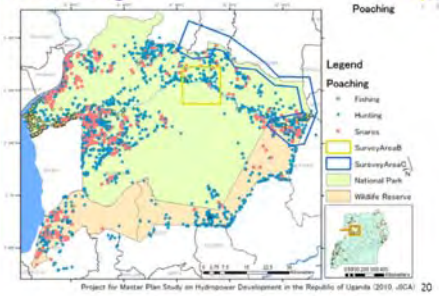
1.3 Stage 3 - Survey results 16
Tourism - Management Zones of MFNP



1.3 Stage 3: Survey Results 17
MFNP and the Community

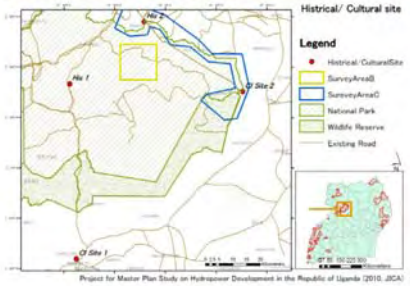
- UWA has promoted collaborative management with local community.
- 20% of the revenue has been shared with communities for development project.
- Based on MoU with UWA, communities are allowed to access park resources such as grass, firewood and local herbs.

1.3 Stage 3: Survey results 18
Poaching



1.3 Stage 3: Survey Results 19

Historical/ Cultural site



1.3 Stage 3: Survey Results 19

Historical/ Cultural site


Top of the Falls

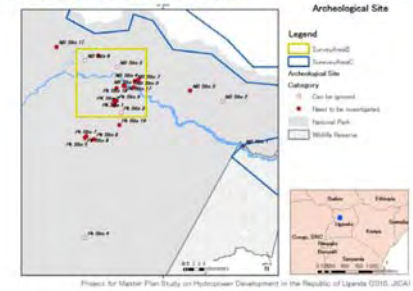

Kajura Monument


Agungi/ Musalaba


Manana Spiritual Site

1.3 Stage 3: Survey Results 20

Archeological Site



1.3 Stage 3: Survey Results 20

Archeological Site


A very high density pottery scatters of different types

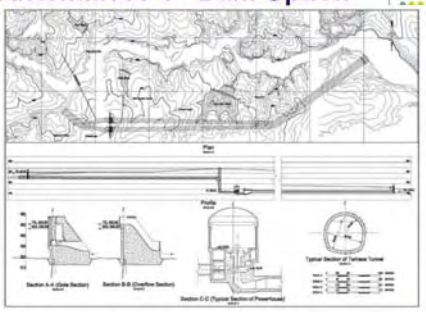

A few shell fish, most of which are stark on the rocks

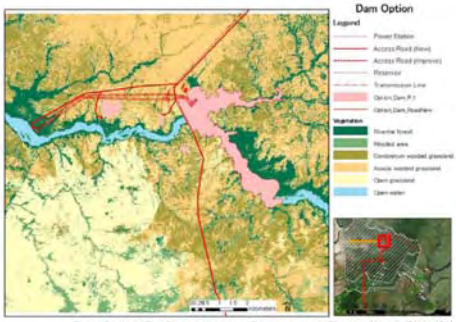

A polished stone tool


Pottery finds, quarts, and lithics scatters

1.3 Stage 3:

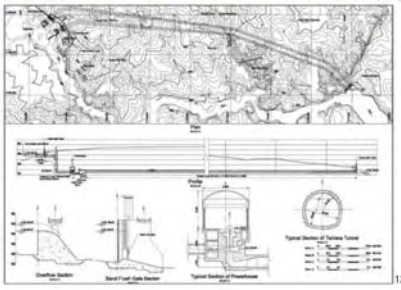
Alternatives 1 - Dam Option

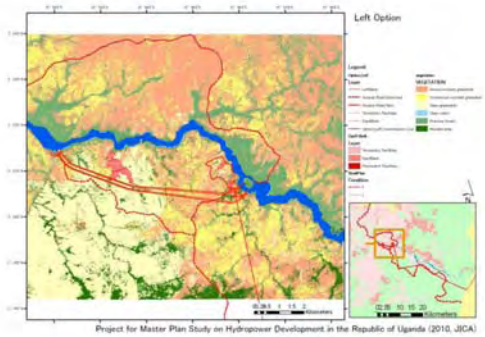




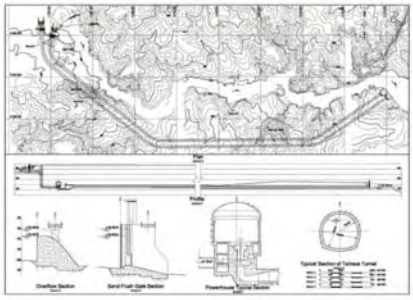
1.3 Stage 3:

Alternative 2 – Left Bank Option

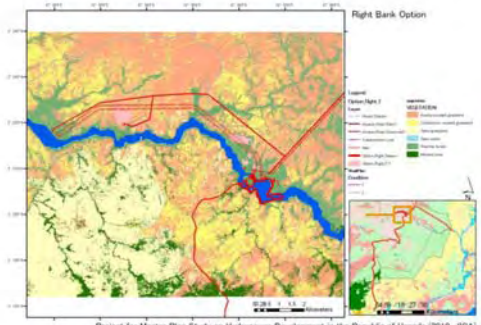




1.3 Stage 3:
Alternatives 3 – Right Bank Option



9



Project for Master Plan Study on Hydropower Development in the Republic of Uganda (2010, JICA)

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1.3 Stage 3: Impact Assessment 1
Economic and technical Aspects

	Dam Option	Left Bank Option	Right Bank Option
Construction Cost (100 x 10^3 USD)	1,704,071 C	1,599,293 A	1,973,557 E
Disposal Volume (m3)	5,102,136 A	6,140,682 C	7,579,766 E
Concrete Aggregate Volume (m3)	170,000 E	Negligible A	Negligible A
Rock Classification Rate	E	A	C
Peak Power Generation Control	Available A	Not Available E	Not Available E
Construction Term (Month)	70 A	70 A	70 A
Construction Risk (Tunnel Length: m/line)	6,100 A	7,900 B	9,900 C

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1.3 Stage 3: Impact Assessment 2
Natural Aspects

	Dam Option	Left Bank option	Right Bank option
Flora and vegetation	C	A	B
Middle and large mammals	C	B	C
Birds	C	B	B
Amphibians and reptiles	C	B	B
Butterflies	C	B	B
Fishes	C	B	B

A: Smaller impact B: Middle impact C: Bigger impact

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1.3 Stage 3: Impact Assessment 3
Social Aspects

	Dam Option	Left Bank option	Right Bank option
Land acquisition	B	C	B
Flooding area	C	B	B
Number of resettlement/ affected people	B	C	B
Impact on agriculture	B	A	C
Impact on historical/cultural property	C	B	A
Impact on poaching activities	B	C	B
Impact on tourism	C	B	B

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1.3 Stage 3: Impact Assessment 4
General Evaluation

	Dam Option	Left Bank option	Right Bank option
Even Case	161	218	188
Environment weighting case	152	215	188
Economic Weighting Case	172	218	187

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2. Mitigation Strategy and Next Study

2.1 Mitigation Strategy 1

- Facility siting
  - Enlarge underground facilities (Control room, management room)
  - Minimize aboveground facilities (Stock yard, Intake, maintenance road, Rock Disposal)
  - Minimize temporally Facilities (Crasher plant, Butcher plant, Temporally Roads)

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2.2 Mitigation Strategy 2

- Access roads planning
  - Minimum vegetation cut
  - Route selection for minimum road kill
  - Animal crossing bridge or tunnel
  - Minimum impact on safari (transport and landscape)
  - Minimize noise, vibration, dust

2.3 Mitigation Strategy 3

- Water use planning
  - Keep environmental flow
- Barrage designing
  - Fit for Natural Landscape
  - Corridor for wildlife
- Transmission line planning
  - Minimize impact on landscape

2.4 Mitigation Strategy 4

- Support UWA's park management
  - Vegetation control (wild fire, invasion plants)
  - Patrol for illegal activities (poaching, encroachment)
  - Wildlife monitoring (survey system, training, sample management)
  - Coexistence of the development project with tourism

2.5 Scoping for EIA 1

Items	Impact	Task in EIA		
		Survey	Impact Assessment	Mitigation
Air pollution	C: Exhaust gas by trucks	-	Need	Need
Water pollution	C: Turbid water during construction	Need	Need	Need
Soil pollution	C: Small risk of contamination by oil	-	-	Need
Waste	**A: Rock disposal**	**Need**	**Need**	**Need**
Noise and vibrations	**A: Noise from blasting, construction machines and trucks**	**Need**	**Need**	**Need**
Ground subsidence	-	-	-	-
Offensive odors	C: Small risk from garbage	-	-	Need

A: Bigger impact B: Medium impact C: Smaller impact

2.6 Scoping for EIA 2

Items	Impact	Task in EIA		
		Survey	Impact Assessment	Mitigation
Bottom sediment	-	-	-	-
Biota and ecosystems	**A: Habitat loss, human disturbance,**	**Need**	**Need**	**Need**
Water usage	B: During construction and operation	Need	Need	Need
Accidents	**A: Car accident, Blasting etc.**	**Need**	**Need**	**Need**
Global warming	-	-	-	-
Involuntary resettlement	C: It might happen near transmission line	Need	Need	Need

2.7 Scoping for EIA 3

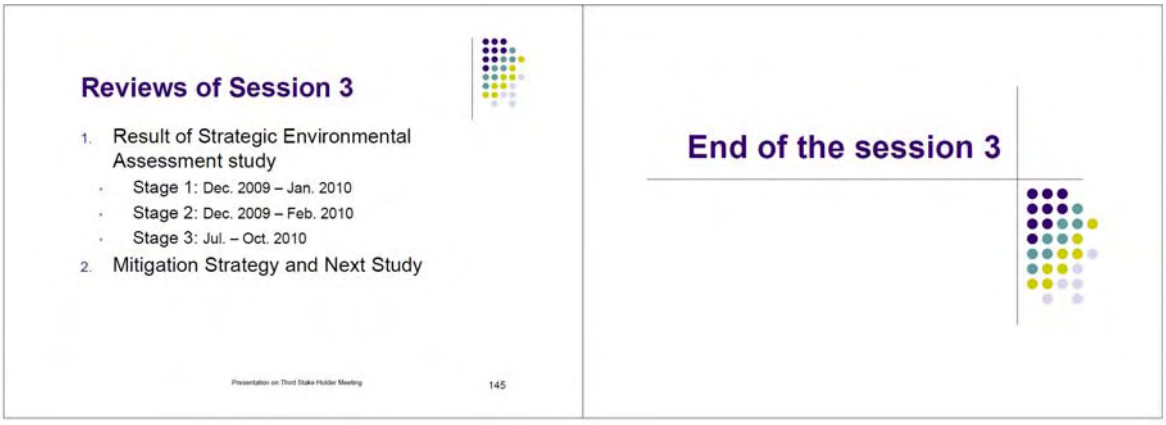
Items	Impact	Task in EIA		
		Survey	Impact Assessment	Mitigation
Land use and utilization of local resources	C: Private land or farm land might be acquired for transmission line.	Need	Need	Need
Social institutions such as social infrastructure and local decision-making institutions	-	Need	Need	Need
Existing social infrastructures and services	C: Community usage of MFNP might be affected.	-	-	-
Poor, indigenous, or ethnic people	C: They might affected by land acquisition.	Need	Need	Need
Misdistribution of benefits and damages	B: Benefits for whole Unandan and damage for the neighbors	Need	Need	Need

2.8 Scoping for EIA 4

Items	Impact	Task in EIA		
		Survey	Impact Assessment	Mitigation
Local conflicts of interest	**A: Conflicts with hunting and tourism**	**Need**	**Need**	**Need**
Limitation of accessibility to information, meetings, etc. for a specific person or group	B: Their mother language is not English and some of them are illiterate.	-	-	Need
Gender	C: Information disclosure should be considered.	-	-	Need
Children's rights	-	-	-	-

2.9 Scoping for EIA 5

Items	Impact	Task in EIA		
		Survey	Impact Assessment	Mitigation
Cultural heritage	B: Some cultural assets might be found in the project site.	Need	Need	Need
Infectious diseases such as HIV/AIDS	**A: Infection diseases might be spread by workers.**	-	-	**Need**
Cultural and spiritual believes	B: Spirit sites might be affected.	Need	Need	Need


Reviews of Session 3
1. Result of Strategic Environmental Assessment study
Stage 1: Dec. 2009 – Jan. 2010
Stage 2: Dec. 2009 – Feb. 2010
Stage 3: Jul. – Oct. 2010
2. Mitigation Strategy and Next Study
Presentation on Third Stake Holder Meeting
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End of the session 3