Annex 3: Baseline Survey Report <Fish>

1 Survey objectives

The purpose of the survey was to identify important areas for the various fish species in and around the Ayago Hydropower Project area. The results of the survey would indicate the location of the critical areas/habitat types for various resident fish species. Physical water quality would be measured in the field using electronic probes to give a quick indication on habitat quality. A comparison with results of similar surveys on River Nile would be made to gauge the importance of Ayago hydropower project area as habitats for fishery biodiversity.

2 Survey methodology

The fish survey was conducted along the south and north banks of River Nile within the Ayago Hydropower Project area. In particular fish surveys were made in the following zones:

i The south and north banks of the proposed inflow and outflow zones of the hydropower generation tunnel;

ii The zone of convergence of River Ayago and other selected tributaries, with River Nile along the north and south banks.

Six survey points with a total of 17 sites were identified and surveyed. Selection of the survey sites was representative of the major habitat types including river mouths, bays, water flow characteristics notably turbulent waters close to rapid, areas of counter currents, and waters with moderate flow. The handline with a long cable, basket traps and gillnets of various sizes were the most practical sampling gear from the river banks. A castnet was at times deployed. Hand lines were often deployed to less than 30 m offshore due to heavy presence of hippos. Gillnets were set by an experienced fisherman wading in water up to the chest. Physical water quality parameters were measured *in situ*. These were dissolved oxygen (mg L^{-1}), temperature (^{o}C), pH, as well as water conductivity (µs cm^{-1}); measured at 0.5 m below water surface using Multiprobe (Hach HQ40d).

Two fishers with lifelong experience on River Nile were hired for the survey. Effective sampling of 16 sites required more field days than were available. Targeted sampling based on sites with representative habitat types was used. Each habitat type was hence sampled effectively with suitable gear at least once. The experience of the fishermen and the sub consultant were tapped to compile lists of the fishes often caught from the different major habitat types sampled, for comparison with what was caught.

Name	Position	Organization
Dr. Twongo Timothy	Aquatic /Fisheries Specialist	WSS Services (U) Ltd.
Dr. Okello William	Water Quality Specialist	WSS Services (U) Ltd.

Date	Time	Area	Surveyors
21st September – 24th September 2010	6am – 5pm	Survey points	Dr. Twongo Timothy Dr. Okello William
12th October – 15th October 2010	6am – 5pm	Survey points	Dr. Twongo Timothy

3 Results and discussion

3.1 Physical water quality

The physical water quality parameters recorded at four of the survey points fished along the south bank are presented in Table 1. Water depth at the edge of the river where the parameters were measured is strikingly similar. Dissolved oxen and pH did not differ markedly but the latter tended to increase downstream. Water conductivity was erratic but within limited margin. The three water quality parameters reflected the basically pristine natural environment in the Ayago hydropower project area. Physical water quality was not recorded along the northern banks whose tributaries carried water leaden with particularly heavy silt and organic debris. Clearly the stream environment is not pristine possibly due to impacts of human activities in the upper catchment and the apparently high hippo population pressure.

Table 1: Selected physical water quality parameters at the survey points fished along the southern banks of River Nile in the Ayago hydropower project area

Station	GPS coding	Total depth (m)	Temp (°C)	DO (mgL^{-1})	pH	Cond (μScm^{-1})
Inflow South 1	UPSTM1	1.2	26.8	7.35	7.63	187
Inflow South 2	UPSTM2	1.1	26.5	7.14	8.01	219
Inflow South 3	UPSTM3	1.1	26.8	7.45	8.06	167
Outflow South1	OUTF1S		27.9	8.31	7.93	227

3.2 Fishes and habitats

Seven survey points with a total of 17 sites were samples. The survey points and the GPS location of the sites surveyed are listed in Table 2. The sites and their GPS location are listed in Table 2 and plotted in Figure 1. The habitat types at each of the 17 sites are briefly outlined in Table 3 and a series of pictures of some of them are presented in Annex 1.

Table 2 GPS location of the sites surveyed/fished along the southern and northern banks of River Nile in Ayago Hydropower Project area

Survey point and sites	GPS Location Arc 1960		Elevation (m)
	36N	UTM	
Canal inflow sites - South bank			
Site 1	0382014	0259222	855
Site 2 - mouth of tributary	0381723	0259230	852
Site 3 about 150 m up tributary	No record	No record-	
Site 4 - raft of fragments of water hyacinth	No record	No record	
Canal outflow sites - South bank			
Site 5	0374063	0260858	775
Site 6	0373987	0260885	773
Canal inflow sites - North bank			
Site 7	0382400	0259682	861
Site 8	0382293	0259615	860
River Ayago sites - North bank			
9. Ayago bridge (Chobe-Para track)	0380047	0262396	841
10 Ayago downstream of bridge	0379820	0262347	839
11 Ayago River mouth	0379457	0262114	
Canal outflow sites - North bank			
Sites 12	0374161	0261212	
Site 13	0373700	0261679	
Site 14: mouth of tributary	0372868	0262098	
Site 15 upstream of mouth of tributary	0373237	0262323	779
River Kibaa sites - Bridge : Chobe /Para track			
Site 16 Kibaa bridge (Chobe-Para track)	0370170	0263555	
Site 17 Just downstream of bridge	0370070	0263542	

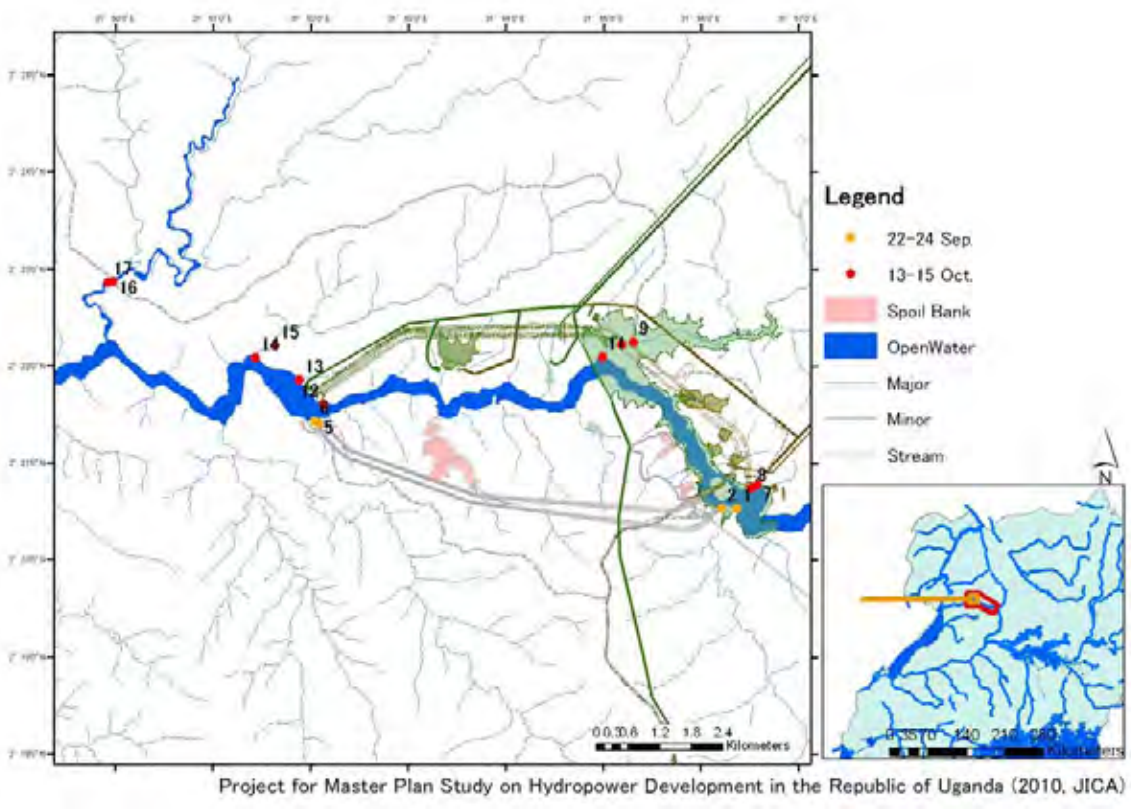

Figure 1 Sites covered by the fishery survey along the north and south banks of River Nile in the Ayago hydropower project area

Table 3 Habitat types at various Survey points and sites sampled along the southern and northern banks of River Nile in the Ayago Hydropower Project area

Canal inflow sites - South bank				
	General habitat description	***Fishes caught***	***Fishes expected***	***Comments***
Site 1	At edge of expansive open-water dotted with small islands (Figure 2a); sandy shore with underwater rocky patches and exposed rocks; moderate water flow - likely fast undersurface; no live aquatic plants found; plenty of water hyacinth debris in water column; family of at least five hippos > 40 m offshore	*Barbus altianalis - one*	*Barbus altianalis, Oreochromis niloticus, Lates niloticus, Bagrus docmac, Mormyrus kannume,* smaller mormyrids	Fish caught in castnet –see Figure 2b; fishing with gillnets ineffective due to clogging by water hyacinth debris - see Figure3
Site 2	**Mouth of small semi-perennial tributary** with relatively wide valley; mostly rocky bottom; water about 1.5 m deep in delta zone with hippo family of five or more; banks covered in various wetland grasses dominated by *Leesier sp* and *Cyperus articulatus*; upstream section constricted by mats of water hyacinth; gentle water flow.	*Lates niloticus - two*	*Barbus altianalis, Oreochromis niloticus, Lates niloticus, Bagrus docmac, Mormyrus kannume,*	Fish caught on handline hook (Figure 4a); much better catches expected with more effective gear deployment
Site 3	**About 150 m upstream tributary at site 2 –** water pool upstream of water hyacinth mats; constantly flushed by the inflow of the tributary; water clean but volume low at time well into rainy season; tributary likely a seasonal one	*Barbus altianalis* – five; *Juvenile Oreochromis niloticus* -one	*Barbus altianalis, Oreochromis niloticus, Oreochromis variabilis, Mormyrus kannume, Claria spp, Protopterus aethiopicus*	Fish caught in two short nets across pool (see Figure 4b) and in basket trap set in water hyacinth; tributary may not be ideal for upstream migrant fish species without perennial source upstream
Site 4	A large organic raft of fragmented water hyacinth anchored just downstream of major rapids (see Figure 5b); raft molded by strong counter current. This site was selected for survey because it was deemed suitable habitat for insectivorous fishes.	*Mormyrus kannume* – 36 in two settings; *Bagrus docmac* - one	*Barbus altianalis, , Lates niloticus, Bagrus docmac, Mormyrus kannume,*	Temporary habitat fished with basket trap was deemed suitable for insectivorous fishes (See Figure 5a).

Canal outflow sites - South bank				
	General habitat description	***Fishes caught***	***Fishes expected***	***Comments***
Site 5	Located within zone of strong counter current generated by water from nearby major rapids; water depth about two metres at ten metres from the shoreline; sandy bottom with a scatter of stones and rocks.	Nil	*Barbus altianalis, , Lates niloticus, Bagrus docmac, Mormyrus kannume,*	Fished with gillnets - ineffective due to clogging by water hyacinth debris; counter current also entangled gillnets
Site 6	Located downstream beyond the counter current. Gentle flow; water depth at least 2.5 m.. Three hours of fishing –handline - yielded three *Lates niloticus* of about 20, 4 and 1.5 kg (Figure 6a;b). Overnight fishing with two pieces of gillnet yielded one *Barbus altianalis*	*Lates niloticus* – three: two large one medium size	*Barbus altianalis, Lates niloticus, Bagrus docmac, Mormyrus kannume, Oreocromis niloticus*	Point was identified as ideal for handline and longline fishing.
Canal inflow sites - North bank				
Site 7 **Site 8**	Extensive bay; relatively shallow water; water plants dominated by water hyacinth fringe the banks; water quality closer to shore poor mainly - decomposing fragmented hyacinth and hippo dung – at least four families of territorial hippos were noted; encountered over 15 buffalos cooling of in the shallow water	Nil	*Barbus altianalis, Oreochromis niloticus, Lates niloticus, Bagrus docmac, Mormyrus kannume,* smaller mormyrids	Fished with handline; Gillnet set at Site 8 was clogged with organic debris.
River Ayago				
Site 9	**Ayago bridge** - full spate at time of survey ; the rocky bottom and rock outcrops now hardly discernible (Figure 7a); very rapid flow; water dark with silt and organic debris	-	*Clarias spp, Protopterus aethiopicus, Oreochromis niloticus, Oreochromis variabilis*	Not fished - water flow too fast for fishing with handline and other available gear
Sit 10	. **Ayago downstream of bridge –** muddy bottom, dark water leaden with silt and organic debris; gentle flow; banks fringed with aquatic macrophytes dominated by water hyacinth (Figure 7b)	-	*Clarias spp, Protopterus aethiopicus, Oreochromis niloticus, Oreochromis variabilis*	Not fished - water too shallow for fishing with handline and other available gear

River Ayago sites – cont'n				
	General habitat description	***Fishes caught***	***Fishes expected***	***Comments***
Site 11	**River Ayago mouth –**dark water heavily laden with salty organic debris pours into the Nile and aquatic macrophytes dominated by water hyacinth mats plus native grasses, herbs and shrubs fringe parts of the banks of a two armed delta. A school of at least 15 hippos were resident at the river mouth Fiigure 8	Lates niloticus Oreochromis niloticus -7, Mormyrus kannume - 2 Bagrus docmac - 1	*Clarias spp, Protopterus aethiopicus, Oreochromis niloticus, Oreochromis variabilis Mormyrus kannume,*	The highest fish species richnes at one site caught by handline (see Figure 9); and gillnets (Figures 10
Canal outflow sites - North bank				
Site 13	Located within zone of strong counter current generated by water from nearby major rapids; water depth about two metres only ten metres from the shoreline; sandy bottom with a scatter of stones and rocks. Flow brisk and water relatively clean with strands of organic debris; fairly steep banks - forested	NIL	*Barbus altianalis, , Lates niloticus, Bagrus docmac, Mormyrus kannume,*	Fished with handline only; NB good fish catches expected in the area if appropriate fishing gears and methods are deployed
Site 14	Just below weak rapids produced by exposed rocks; shallow zone just offshore with two territorial hippo families - water flow brisk; river bank fairly low with some water hyacinth in muddy stretch; water relatively clean with occasional water hyacinth debris			

Canal outflow sites - North bank – cont'n				
	General habitat description	***Fishes caught***	***Fishes expected***	***Comments***
Site 15	Gentle water flow, sandy bottom with rock outcrops; low river bank to forest margin		*Barbus altianalis, , Lates niloticus, Bagrus docmac, Mormyrus kannume, Oreochromis niloticus*	NB good fish catches expected in the area if appropriate fishing gears and methods are deployed
Site 16	Mouth of a tributary; water flow brisk; dark tributary water loaded with silty organic debris pours into the Nile; family of hippos - at least 10 keep watch (Figure 11). River delta fringed by water plants includig water hyacinth (Figure 12a)	*Lates niloticus* Two juveniles; shoals of Oreochromis niloticus`observed at river mouth	*Oreochromis niloticus Barbus altianalis, Lates niloticus, Bagrus docmac, Mormyrus kannume, Oreochromis variabilis*	Good fishing ground especially for *Oreochromis niloticus*
17	**Upstream of tributary of Site 16**– rocky bottom brisk flow of water – considerable volume (Figure 12b)		*Barbus altianalis, Mormyrus kannume, Oreochromis niloticus Oreochromis variabilis*	Not fished; Possibly a-perennial stream; if source is permanent
River Kibaa				
18	Kibaa bridge – rocky with rock mounds and perennial grasses on river bed (Figure 13) water flow and slagish	-	Historical flows data need to determine	Possibly a seasonal river
19	Just below above bridge – rocky with rock mounds and perennial grasses on river bed water flow sluggish			

3.3 Evaluation of habitats

3.3.1 Evaluation in Uganda

In Table 4 lists fish species richness of 12, 13 and 13 species recorded in earlier studies for Karuma Hydropower Project, Jinja Bridge Project.and Bujagali Hydropower Project, respectively. These records are considerably higher in terms of species than the eight expected to occur in the Ayago project area; and significantly higher than the five recorded. Again, the rapid nature of this survey limits firm comparison of Ayago data with the rest making a detailed survey with adequate spatial and seasonal coverage imperative.

Table 4 Commercial fish species richness recorded and expected during Ayago Hydropower project survey and other similar studies at various locations along River Nile

	Ayago Hydropower Project		**Karuma Hydropower Project**	**Bujagali Hydropower Project**	**Jinja Bridge Project**
Sientific names	**Recorded**	**Expected**	**Recorded**		
Lates niloticus	**P**	**P**	**P**	**P**	**P**
Barbus altianalis	**P**	**P**	**P**	**P**	**P**
Mormyrus kannume	**P**	**P**	**P**	**P**	**P**
Bagrus docmac	**P**	**P**	**P**	**P**	**P**
Oreochromis niloticus	**P**	**P**	**P**	**P**	**P**
Oreochromis variabilis		**P**	**P**	**P**	**P**
Clarias gariepinus		**P**	**P**	**P**	**P**
Protopterus aethiopicus		**P**	**P**	**P**	**P**
Synodontis afrofischeri			**P**	**P**	**P**
Synodontis victorie			**P**	**P**	**P**
Intermedius mystus			**P**	**P**	**P**
Tilapia zillii			**P**	**P**	**P**
Rastrineobola argentia				**P**	**P**
Total species	**5**	**8**	**12**	**13**	**13**

3.3.2 Evaluation in the survey area

The rapid fish survey which covered the nearshore environment identified tributaries and their vicinity as important areas for fishes. These areas included the mouths of River Ayago, the unnamed tributary downstream of the outflow of the north bank layout and that just upstream of the inflow of the south bank layout. According to similar fish surveys (Twongo 2009; Twongo 2010; Burnside International Ltd. (2006) the diverse habitat types of River Nile are important areas for a wide variety of commercial fish species (See Table 5). These habitats are founded over a patchwork of rocky, sandy and muddy bottoms; plus a variety water flow patterns including ripple and rapid flows as well as counter currents; fast and gentle flows; and near stationary zones of water masses. Bare and vegetated river banks compared to shallow and deep zones in the middle of

the river also add to habitat diversity. Tributaries are extensions of the main river and their nutrient input is a vital supplement to the River Nile environment and productivity potential. They are also vital habitats in the reproductive biology and ecology of upstream migrant fish species.

The commercial fish species captured at the 16 sampling sites within the Ayago Hydropower Project area are listed in Table 5 alongside those expected to occur based on long term experience on River Nile. Five commercially important fish species were captured out of the eight expected by this sub-consultant and the fishermen to occur in the area surveyed. It is expected that all the eight fish species would be recovered in a more comprehensive survey using appropriate gears and methods. Secondly, during this survey the five fish species *(L. niloticus, B. altianatis , M. kannume, Bagrus docmac* and *Oreochromis niloticus* were more likely to be captured in association with the mouths of the rivers and smaller tributaries to River Nile. This finding is consistent with other experiences on River Nile by this sub-consultant. The finding highlights the ecological importance of tributaries to the fisheries of the rivers they feed. The third observation from this study is the heavy load of silt and fine organic debris visually noted in all the tributaries that were surveyed. The local fishermen attributed the absence of the fishes that make seasonal up-river runs to spawn such as *Synodontis afrofischeri, Synodontis victorie and Intermedius mystus,* and labeo victorianus to the poor water quality. According to the fishermen the 'ecology' of those species is adapted to clean water. This conclusion begs prolonged seasonal and spatial studies for verification.

Table 5 Evaluation of the survey sites

	Sientific names	IUCN Red List status	Habitat preferences	Population in the survey area*																
				Left Bank						North Bank										
				Intake				Outlet		Intake		Ayago River			Outlet				Kibaa	
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Survey result	*Lates niloticus*	Least concern	open water; not very turbulent	E	R		E	E	R	E	E			R		E	E	E	R	
	Barbus altianalis	Least concern	open turbulent waters; upstream migrant	R	E	R	E	E	E	E	E					E	E	E	E	E
	Mormyrus kannume	Least concern	open turbulent/flowing water	E	E	E	R	E	E	E	E			R		E	E	E	E	E
	Bagrus docmac	Least concern	open flowing water	E	E		R	E	E	E	E			R		E	E	E		
	Oreochromis niloticus	Least concern	shallow non-turbulent open	E	E	R			E	E	E	E	E	R				E		E
	Oreochromis variabilis	Least concern	shallow, non-turbulent, open			E						E	E						E	E
	Clarias gariepinus	Least concern	near shore, aquatic vegetation			E						E	E							
	Protopterus aethiopicus	not determined	aquatic vegetation			E						E	E							
	Synodontis afrofischeri	not determined	upstream spawner, clean water																	
	Synodontis victorie	not determined	upstream spawner, clean water																	
	Intermedius mystus	not determined	upstream spawner, clean water																	
	Tilapia zillii	not determined	aquatic vegetation																	
	Rastrineobola argentia	Least concern	pelagic clean water																	
	Labeo victorianus	Threatened	upstream spawner, clean water																	
	Number of species			5	5	6	4	4	5	5	5	4	4	4		4	4	5	4	4
				8				5		5		7			5				5	
Evaluation	Importance of the habitat	**Breeding, nursery, feeding, shelter/refugia**		A				B		B		A			B				B	

* **Detailed survey needed**

R Record

E Expected

4 Impact Assessment

All options to negatively impact drawdown area of the Nile depending on the magnitude of the amenity flow allowed; the dam option impacts would be positive on fisheries in the medium term but aquatic weed menace would be enhanced. More detailed spatial and seasonal information on tributary flows and fishes needed to clarify on magnitude and duration of likely impacts

Table 6 Impact Assessment for each option

Options	Dam	Left Bank	Right Bank
Length of recession	B 6.6 km	C 9.7 km	C 10.0 km
Impact on big basin	Big size basin will be seriously affected.	Middle size basin will be affected.	Big size basin will be affected a bit.
Height of the barrier	C 45m	B 15m	B 15m
Inundation area and facility area	C 470 ha	B 140 ha	B 142 ha
Impact on rare fish fauna	C Big impact on Ayago river	B Middle impact on small tributary	B Middle impact on small tributary
Ranking	C	B	B

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

5 Discussion and recommendation

The effects of the likely environmental impacts in the Ayago Hydropower Project area will be influenced directly by the magnitude of the drawdown on the level of the river after diversion of the water to the power generation channel; as well as by the size of ponding behind the water diversion weir. Decisions on these parameters should take into account the multiple functions and uses of this section of the River Nile and associated tributaries which will be impacted. The fish survey results in this report were limited in intensity and spatial coverage especially with respect to the open waters and tributaries. Data are also limited to one season. Several fish species recorded are known to make seasonal migrations up some tributaries to spawn. It is recommended that planned multiple fish surveys that cover the major seasons are essential for in-depth understanding of the role and significance of the Ayago Hydropower Project area in the biology and ecology of fishes of river Nile. This information would inform the environmental impact assessment process.

6 References

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Annex 1: Pictures - habitats and fishes in Ayago hydropower project area on River Nile

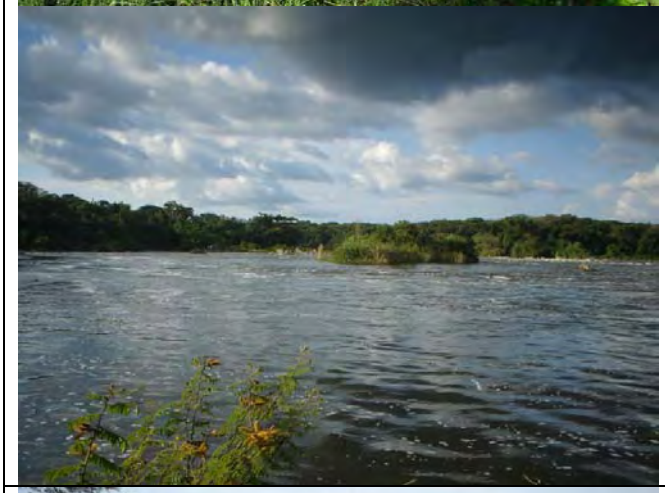


Figure 1: Expansive zone of River Nile with moderate water flow (1a). *Barbus altianalis* was caught here in a castnet (1b).

Figure 2: Use of gillnets in most parts of River Nile was rendered unproductive by the large quantity of floating water hyacinth debris.

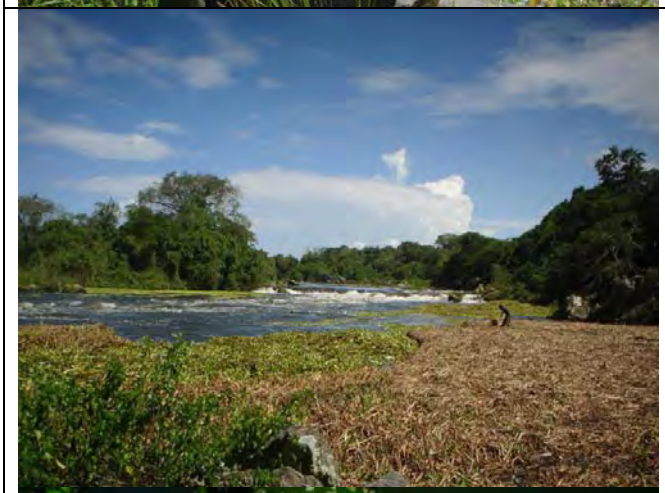
	Figure 3: Use of the handlile to catch *Lates niloticus* was most often successful at the mouth of tributaries (3a) while two short pieces of gillnet caught four *Barbus altianalis* upstream in the same tributary.
 	Figure 4: The small basket trap (Goni) (4a) caught the largest number of *Mormyrus kannume* under the raft of fragmented water hyacinth (3b).

Figure 5: Two handlines was caught the three *Lates niloticus* (5a and 5b) at this canal outflow site within one hour.

Figure 6: Two contrasting habitats of River Ayago (6a and 6b)

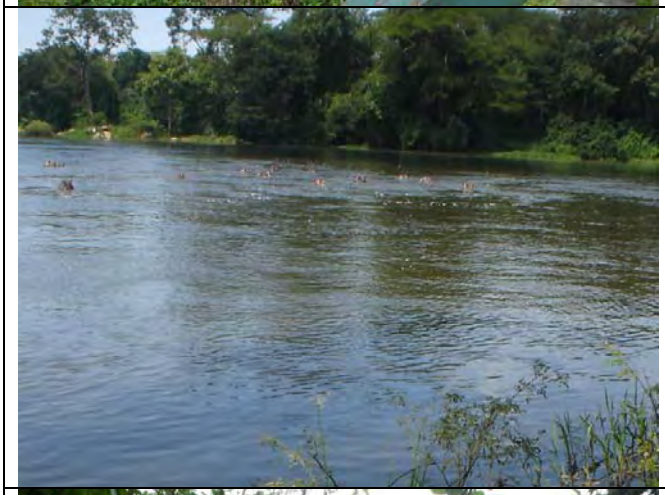
	
	Figure 7: Hippos at the mouth of River Ayago. The largest single aggregations were found in association with the mouth of rivers and springs.
	Figure 8: Young *Bagrus docmac* at the mouth of River Ayago was attracted to bait (young *Protopterus aethiopicus*) about half its length.

	Figure 9: A variety of fish species caught in gillnets and handlines at the mouth of River Ayago.
	Figure 10: Hippos at the mouth of unnamed tributary at the north bank of River Nile downstream of the canal outflow of the Ayago Hydropower Project.
	Figure 11: Habitats at the mouth (11a) and at a forested site (11b) upstream of the unnamed tributary in Figure 10.

Figure 12: River Kibaa – upstream view from the bridge at the Chobe to Para track.

Annex 4: Baseline Survey Report <Land Use>

1. Objectives

- To identify land use patterns such as such as forest, woodland, grassland, bush land, wetland, farmland and residential area in survey area A, B and C.
- To find out land ownership patterns in survey area C.

2. Surveyor

Name	Position	Organization
Mr. Begumisa Anthony	Social Consultant	WSS Services (U) LTD.

3. Survey period and area

Date	Area	Surveyors
12th/7/2010	Masindi Town Masindi District	Mr. Begumisa Anthony
13th/7/2010	Mutunda Sub-county Kiryandongo District	Mr. Begumisa Anthony
14th/7/2010	Purongo Sub-county Anaka Sub-county Nwoya District	Mr. Begumisa Anthony
15th/7/2010	Aber Sub-county Oyam District	Mr. Begumisa Anthony
16th/7/2010	Myene Sub-county Minakulu Sub-county Oyam District	Mr. Begumisa Anthony
17th/7/2010	Koch Goma Sub-county Nwoya District	Mr. Begumisa Anthony

4. Survey methods

- Analysis of aerial photos
- Literature survey
- Data collection and interview with national, district and sub-county officials
- Focus Group Discussion with surrounding communities in Survey Area C
- Direct observation in Survey Area C

5. Survey results

5.1 Land Use

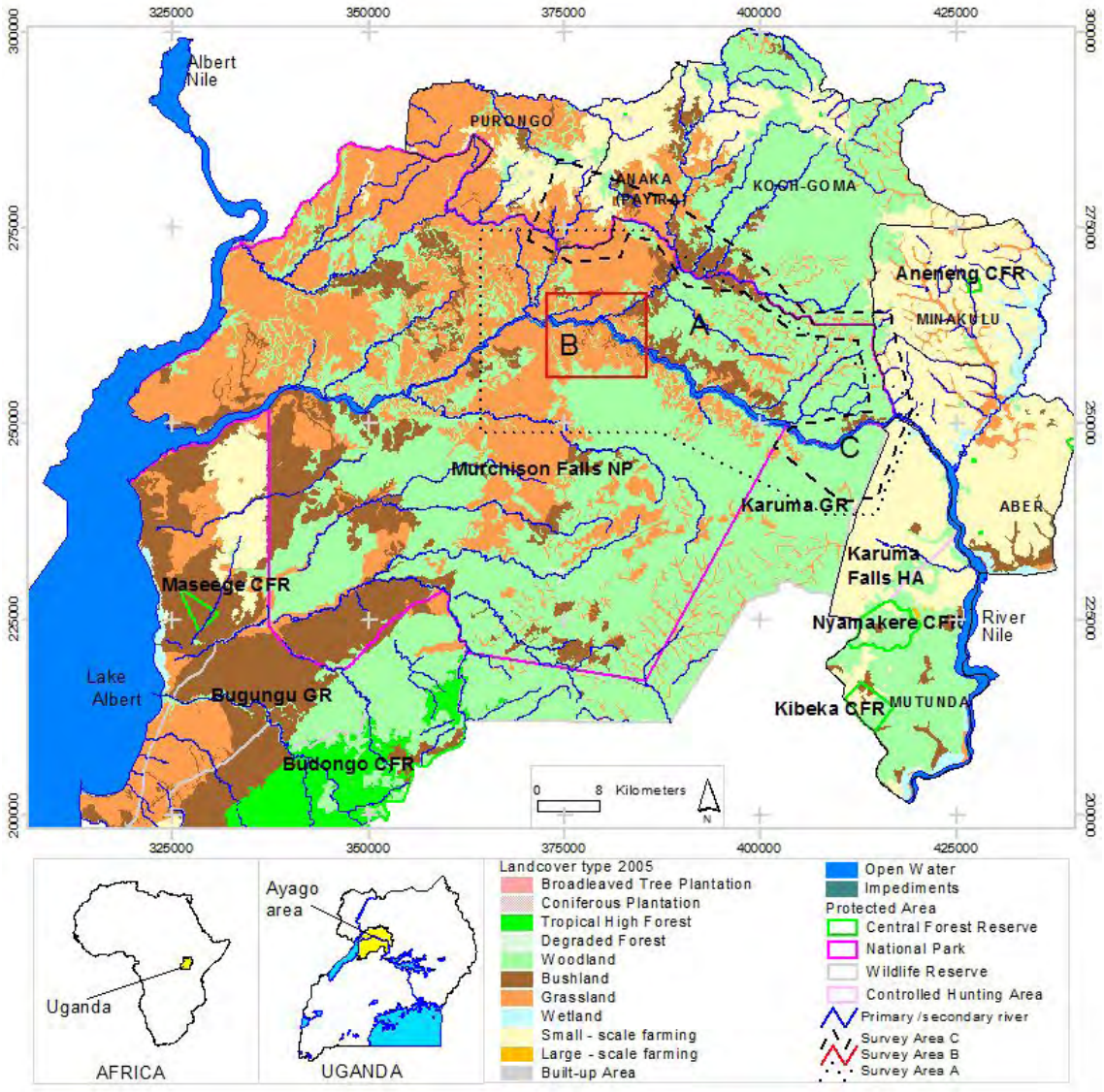


Figure 1 Land Use around Ayago Site, 2005

The vegetation covers in survey area A, B and C consist of grassland, bush land, wood land, forests, wetland and farmland. The North-West area (Anaka and Purongo Sub-counties) is mainly covered by savannah grassland. Most of the Eastern area (Myene/Minakulu, Aber and Mutunda Sub-counties) is characterized by small scale-farmland. A part of Southern area (Mutunda Sub-county) and most of the Northern area (Koch Goma Sub-county) are woodland and forest reserve.

Much of survey area A is occupied by the Murchison Falls National Park, which is government land. It consists of forests, grassland and bush land. In the past, the area had a number of wetlands that were home to a variety of aquatic life (Murchison Falls Protected Area General Management Plan, 2001). The wetlands were a key survival resource for surrounding community since they got water for domestic use, for animals and for small-scale fishing.

Agriculture is the dominant form of land use in survey area C. Table 1 explains the general characteristic of land use by Sub-county.

Table 1 Characteristics of Land Use by Sub-county in Survey Area C

Sub-county	Characteristics
Mutunda	• Some parts of the Sub-county are covered with tall grass and shrubs. It has fairly good vegetation coverage with low ones in heavily population areas. • The vegetation coverage is being constrained by the culture of bush burning which ends up hampering the biodiversity and ecosystem of the living and soil quality. • There are two types of wetland resources; seasonal and permanent. River Nile is the most renounced permanent wetland with many seasonal wetlands including Nanda and Cweje.
Aber	• Savannah grassland is prominent along the Nile shores. • 82% of the land is under crop cultivation, 2% for livestock, 5% under forest, 1% fish farming and 10% for Murchison Falls National Park. • There are two forest reserves at Aber and Atura forest reserves.
Myene/Minakulu	• The area is covered with savannah grassland with scattered thorny buses and swampy vegetation. • 76% of the land is arable. 24 % is covered by water. • Most land is used for agriculture such as cotton, tobacco, maize, millet, sorghum, rice, beans, peas, soya beans, ground nuts, sunflower, sesame, cassava, potatoes and vegetables. • Other land is used for livestock rearing such as cattle, goats, sheep, pigs, and poultry of various species. • Fishing is practiced seasonally along River Tochi and a few swamps, streams by about 1% of the population.
Anaka	• The vegetation is typical savanna grassland with grasses reaching up 2 meters and trees reaching up to 10 meters high. • The trees and grasses have been over exploited for firewood, charcoal and building materials leading to environment degradation.
Purongo	• The sub-county has only thin natural forests. • The vegetation had been affected by elephants. • There are few wetlands in Pawatomero, Pabit and Paromo. • Wetlands are drying up because of people's encroachment through cultivation.

(Source: Sub-county Three Year Development Plan for F/Y 2009/2010 – 2011/2012)

5.2 Land Ownership

Table 2 shows tenure of dwelling units in survey area C.

Table 2 Tenure of Dwelling Units in Survey Area C

Condition	Masindi	Amuru (Gulu)	Oyam (Apac)
Owner Occupied	74.2%	77.4%	94.0%
Free	10.1%	9.0%	3.8%
Rented	14.8%	10.8%	2.1%
Other	0.9%	2.8%	0.1%

(Source: 2002 Population and Housing Census, District Reports of Masindi, Gulu, Apac)

According to the discussion with local community, the majority of people acquire land through inheritance and a few others through purchase. Under customary land tenure, all members of the communities own land. They have usufruct rights that can be passed to the next generation through inheritance.

The land is commonly owned under customary tenure and land rights are vested in the clan elders or chiefs. Customary tenure actually means that the right to use land is regulated by local customs and linked to family inheritance and lineage. In the northern region in general, the system features as communal holdings and also as specific holdings as long as a particular group of individuals use the land. The clan heads have powers regarding access and use rights by the clan members. This means that communally owned land cannot be disposed off or transacted unless there is the general consent of the stakeholders represented by the clan heads. However, due to the emergency of a cash economy, it is possible for individuals to acquire land and secure certificates of titles.

"...land here is owned communally. Those of us with formal titles of registration had to apply for these from the local government. However, acquisition of land requires much more than approaching local government. If one wants to acquire land in this area, one must first talk to the clan leaders who communally own and manage the land that is desired. It is only after this consultation, that an individual contacts the sub-county. After the sub-county confirms that the land in question is within the designated area of the sub-county, one is then able to obtain a title of registration, and begin developing the land". (FGD Anaka sub-county)

In addition to land acquisition through inheritance and buying, some others with little or without land can hire land for agricultural activities. Under this arrangement land is hired on a seasonal basis.

According to the District Rehabilitation Officer in Masindi, normal charge ranges between 50.000-100,000 Uganda shillings for an acre per season. This money is paid at the end of the season. The only challenge with this type of practice is that the one who hires land has to plant crops which mature very fast like maize, so that she/he can harvest between 3 to 4 months.

This practice is more pronounced in Mutunda sub-county than any other place. This is because most settlers in Mutunda sub-county migrated from the North in order to avoid LRA activities and did not have their ancestral land for cultivation.

Women's access and control over land and other household's assets are limited. During the discussion with community in Mutunda sub-county, it was mentioned that women do not usually own land. This is due to traditional culture in Uganda. Women can purchase and own land only when her husband died or she doesn't have one. At the policy level, the legal framework for protecting these rights is weak.

Annex 5: Baseline Survey Report

< Population, Ethnic Group and Settlement Patterns>

1 Objectives

- To find out population and population density in survey area C and along the proposed new roads.
- To identify ethnic composition of the population and their settlement patterns in survey area C.
- To find out the location of IDP (Internally Displaced Persons) camps in survey area C.

2 Surveyor

Name	Position	Organization
Mr. Begumisa Anthony	Social Consultant	WSS Services (U) LTD.

3 Survey period and area

Date	Area	Surveyors
12th/7/2010	Masindi Town Masindi District	Mr. Begumisa Anthony
13th/7/2010	Mutunda Sub-county Kiryandongo District	Mr. Begumisa Anthony
14th/7/2010	Purongo Sub-county Anaka Sub-county Nwoya District	Mr. Begumisa Anthony
15th/7/2010	Aber Sub-county Oyam District	Mr. Begumisa Anthony
16th/7/2010	Myene Sub-county Minakulu Sub-county Oyam District	Mr. Begumisa Anthony
17th/7/2010	Koch Goma Sub-county Nwoya District	Mr. Begumisa Anthony

4 Survey methods

- Literature survey
- Data collection and interview with national, district and sub-county officials
- Focus Group Discussion with surrounding communities in Survey Area C
- Direct observation in Survey Area C

5 Survey results

5.1 Population

Table 1 shows the distribution of population in survey area C. However, it should be noted that the population in the areas has not lived a sedentary life because of the LRA related war and the associated displacements. There have been lots of movements of people due to insecurity. Hence the population figures are projections for 2010, except Masindi District where the community census was carried out.

Table 1 Estimated Population by Parish in Survey Area C, 2010

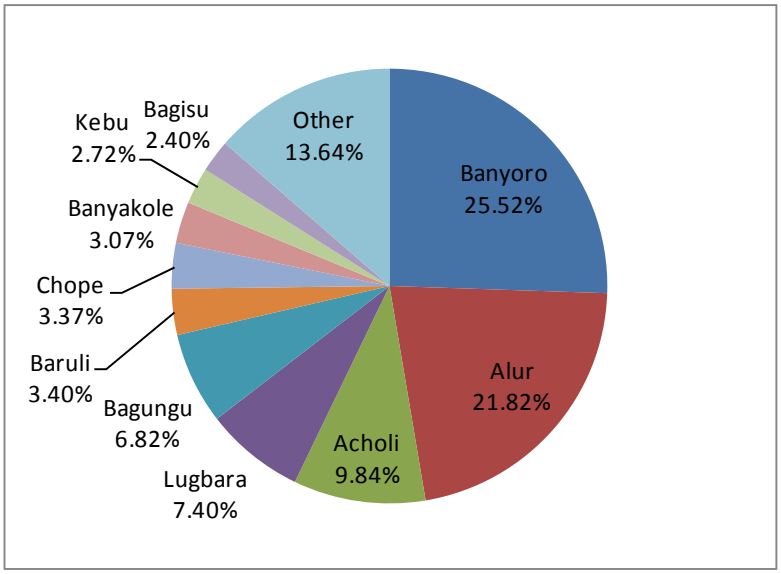
District	Sub-county	Parish	Male	Female	Total
Amuru	Purongo	Latoro	700	700	1,400
		Pabit	1,200	1,200	2,400
		Paromo	600	600	1,200
		Patira	400	400	800
		Pawatomero	1,200	1,300	2,500
	Anaka	Kuluamuka	1,300	1,400	2,700
		Pabali	700	700	1,400
		Paduny	1,700	1,700	3,400
		Pangora	1,100	1,200	2,300
		Tadora	1,600	1,700	3,300
		Ywaya	1,200	1,400	2,600
	Koch Goma	Agonga	600	700	1,300
		Amar	800	900	1,700
		Coorom	800	800	1,600
		Kal	2,000	1,200	3,200
		Lii	400	500	900
		Orum	900	1,000	1,900
Oyam	Myene/ Minakulu	Aceno	4,900	5,200	10,100
		Adel	4,000	3,800	7,800
		Amwa	4,600	4,600	9,200
		Atek	5,000	5,100	10,100
		kaluabura	2,500	2,400	4,900
		Oyoro	5,700	5,800	11,500
	Aber	Adyegi	2,800	2,800	5,600
		Akaka	4,700	4,900	9,600
		Atura	3,100	3,600	6,700
		Kamdini	6,900	7,600	14,500
		Ocini	4,800	5,000	9,800
		Pukica	5,600	5,800	11,400
		Wirao	5,100	5,400	10,500
Masindi	Mutunda	Diima	4,905	5,828	10,733
		Kakwokwo	3,182	3,212	6,394
		Nyamahasa	5,638	6,030	11,668

(Source: Sub National Projections Report Northern Region 2008-2012, Masindi District CIS Analysis 2010)

5.2 Ethnic Group

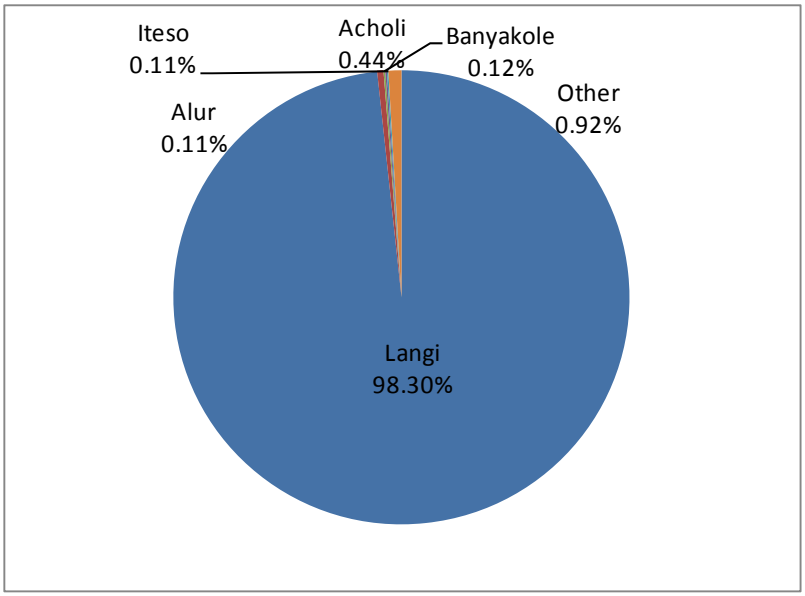
As Figure 1 shows, Banyoro and Alur are dominant in Masindi District. In Mutunda sub-county, many people are of Chope tribe. In Minakulu/Myene and Aber sub-counties in Oyam District, the majority of people are Langi (Figure 2), while in Purongo, Anaka, and Koch Goma sub-counties in

Amuru, people are mainly Acholi settlers (Figure 3). Out of fifteen sub-counties surrounding the park and reserves, nine of them are occupied by mainly Luo speaking tribes.



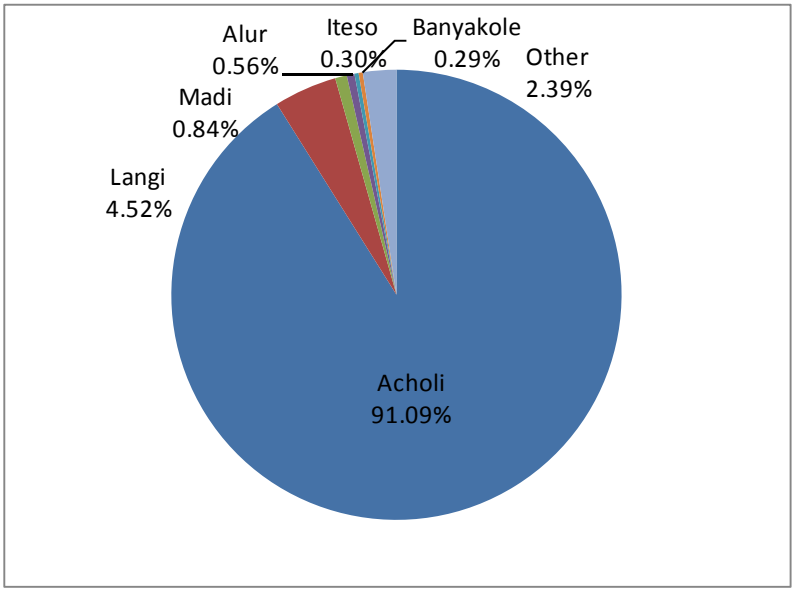
Source: 2002 Population and Housing Census

Figure 1: Distribution of Population by Ethnic Groups in Masindi District, 2002



Source: 2002 Population and Housing Census

Figure 2: Distribution of Population by Ethnic Groups in Oyam (Apac) District, 2002



Source: 2002 Population and Housing Census

Figure 3: Distribution of Population by Ethnic Groups in Amuru (Gulu) District, 2002

5.3 IDP

Due to the LRA activities, the area has experienced insecurity over the last two decades. The IDPs camps were often found along the main roads, trading centres, town centres and its suburbs (Figure 5). Following the end of the insurgency, the IDPs have been returning and resettling on their ancestral lands under the auspices of the peace and recovery program initiated by the government of Uganda and other development partners including JICA.

The resettlement process is however still incomplete. There are settlements in the main camps where especially the vulnerable groups such as the elderly, the orphans and vulnerable children and the perpetually sick are found. There are also settlements in the transit or satellite sites (smaller size settlements than the main camp which hosted the size of a whole sub-county population. Lastly, there are return village settlements (where everyone else originally came from before the war displaced them).

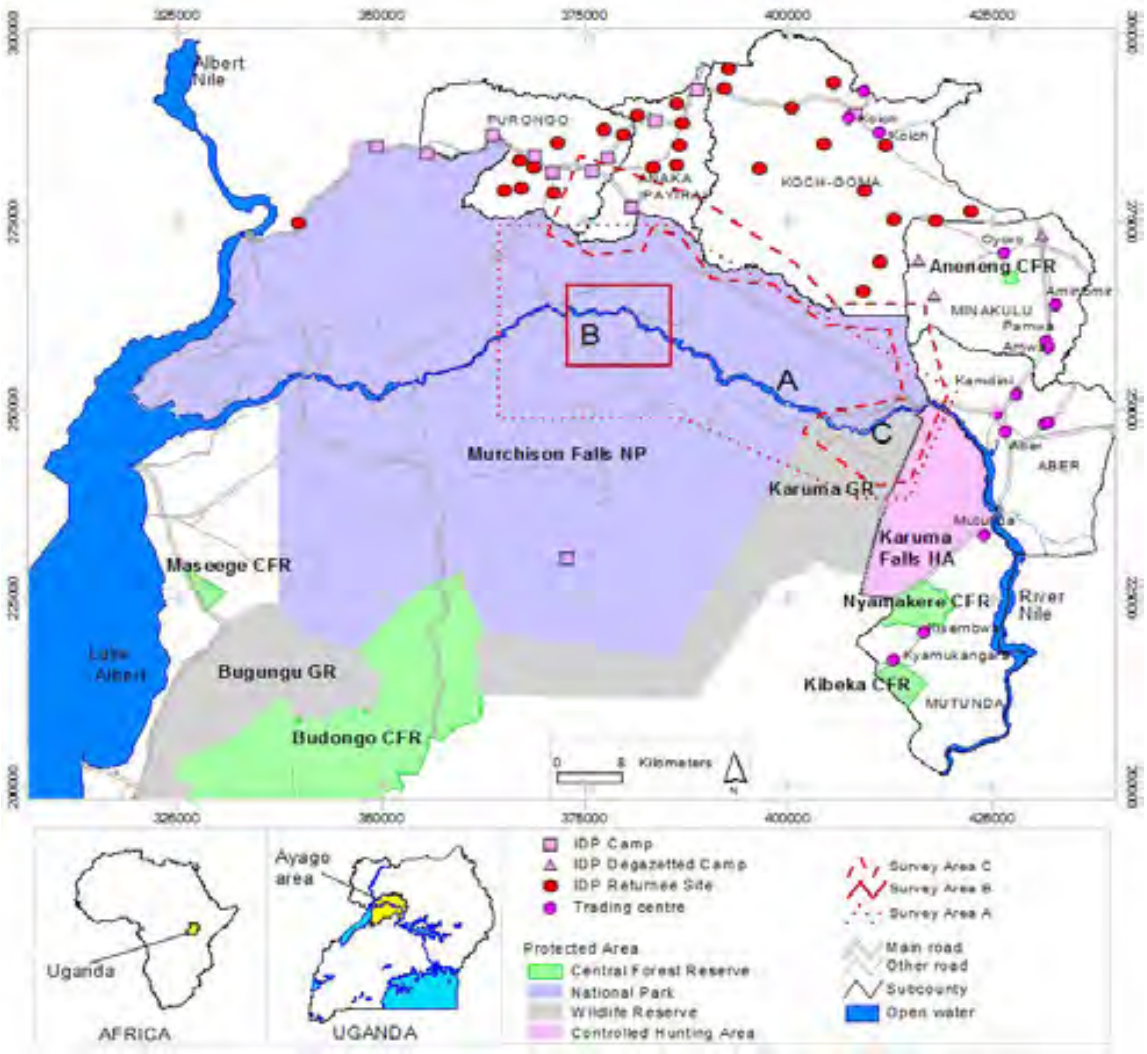


Figure 4: Locations of IDP Camps

Annex 6: Baseline Survey Report <Housing and Infrastructure>

1. Objectives

- To identify types of buildings and houses in residential area in survey area C.
- To identify types, locations and accessibility of roads in survey area C.
- To identify types, locations and accessibility of water sources in survey area C.

2. Surveyor

Name	Position	Organization
Mr. Begumisa Anthony	Social Consultant	WSS Services (U) LTD.

3. Survey period and area

Date	Area	Surveyors
12th/7/2010	Masindi Town Masindi District	Mr. Begumisa Anthony
13th/7/2010	Mutunda Sub-county Kiryandongo District	Mr. Begumisa Anthony
14th/7/2010	Purongo Sub-county Anaka Sub-county Nwoya District	Mr. Begumisa Anthony
15th/7/2010	Aber Sub-county Oyam District	Mr. Begumisa Anthony
16th/7/2010	Myene Sub-county Minakulu Sub-county Oyam District	Mr. Begumisa Anthony
17th/7/2010	Koch Goma Sub-county Nwoya District	Mr. Begumisa Anthony

4. Survey methods

- Analysis of aerial photos
- Literature survey
- Data collection and interview with national, district and sub-county officials
- Focus Group Discussion with surrounding communities
- Direct observation in Area C

5. Survey results

5.1 Buildings and Houses

According to 2002 Population and Housing Census, the type of dwelling units is divided into three categories such as dethatched house, semi-dethatched/flat and tenement (Muzigo). As table 1 shows, more than 75% of people in survey area C live in dethatched house, which means a stand-alone independent residential unit intended for the habitation of a single household. A semi-

dethatched house is one of a pair of single-family houses joined by a common wall and forming a structural unit. Tenement means a low-rent dwelling unit, located in a slum of informal settlement, often ageing and in sub-standard condition, poorly maintained and over-crowded. It is commonly referred to as “Muzigo”.

Table 1 Type of Dwelling Units in Survey Area C

Type	Masindi	Amuru (Gulu)	Oyam (Apac)
Dethatched House	75.1%	77.3%	86.9%
Semi-dethatched/Flat	17.0%	7.0%	11.4%
Tenement (Muzigo)	4.3%	3.8%	0.8%
Other	3.7%	11.9%	0.9%

(Source: 2002 Population and Housing Census, District Reports of Masindi, Gulu, Apac)

The condition of buildings and houses can be categorized as table 2 shows. Permanent means dwelling units built with durable materials that can maintain their stability for at least 15 years. It accounts for only 12.2% in Masindi, 4.4% in Amuru and 2.8% in Oyam. Semi-permanent is referred to as dwelling units built with a combination of durable materials, and require regular maintenance. More than 80% of people live in temporary houses. Temporary means dwelling units built with non-durable wall floor and roof materials that can be maintained for more than 3 years. They require regular replacement. All housing units thatched with untreated natural fibers are classified as temporary irrespective of wall and floor materials.

Table 2 Condition of Dwelling Units by District

	Masindi	Amuru (Gulu)	Oyam (Apac)
Status of dwelling units			
Permanent	12.2%	4.4%	2.8%
Semi-permanent	6.3%	2.3%	2.2%
Temporary	81.5%	93.3%	94.9%
Types of materials			
Roofed with Iron Sheets	30.0%	7.7%	10.8%
Grass Thatched Rood	68.7%	91.3%	88.3%
With Walls made of Mud and Poles	58.1%	21.3%	11.6%
With Floor made of Rammed Earth	83.7%	93.4%	94.7%

(Source: 2002 Population and Housing Census, District Reports of Masindi, Gulu, Apac)

In survey area C, the building types range from, grass thatched mud and wattle, semi permanent and permanent structures (use of cement, iron sheets and burnt bricks/blocks characterize permanent structures). It is in the trading centres, especially along Kampala-Gulu and Karuma-Arua highways that semi and permanent houses/buildings are found. They are mainly individually owned commercial and publicly owned institutions. The former include business buildings such as hotels, restaurants and stores.

The vast majority of the houses are grass thatched huts which are used for residence, kitchen, food stores and animal shelters. The grass thatched huts/houses is a defining characteristic of the nature

of housing in the region. They are cheap to construct considering that most of the building materials are obtained locally for free or cheaply. Due to LRA War-led insurgency in Northern region, the people were relocated from their original villages to IDP camps.

Temporary house, grass thatched roof with walls made of mud in Masindi

Temporary house, roofed with iron sheets with walls made of mud in Masindi

Permanent house, with iron sheet in Amuru

Permanent Building (Amuru District Headquarters)

5.2 Road Network

The roads that exist in Uganda fall under three major categories: National, District Sub-county and community/feeder roads. The sub county of Myene for instance, has a total of 18 roads belonging to district and community. The map in Figure 1 shows two categories of roads; main and other roads whereby the main roads include the national and district roads while other roads fall under community/feeder roads.

The maintenance of the roads was reported to be a major challenge for the sub-counties and some places/ roads become impassable especially during the rainy seasons. For some roads, the culverts have broken down and need replacement (FGD in sub-counties).

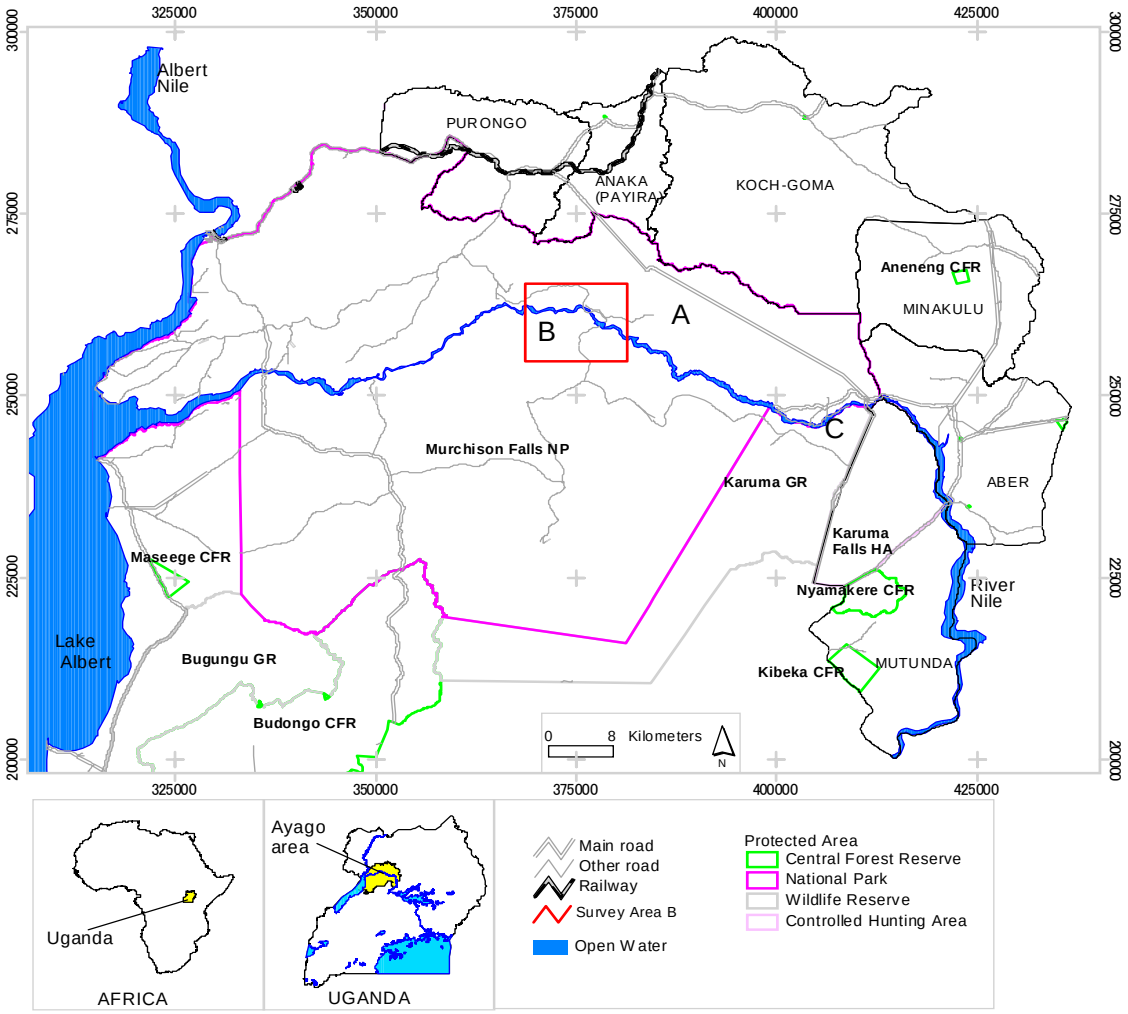


Figure 1 Road Network around Ayago Site, 2010

5.3 Water Use

The major sources of water in survey area C include rivers, boreholes, protected springs, shallow wells, rainwater, and streams. The locations are shown in Figure 2.

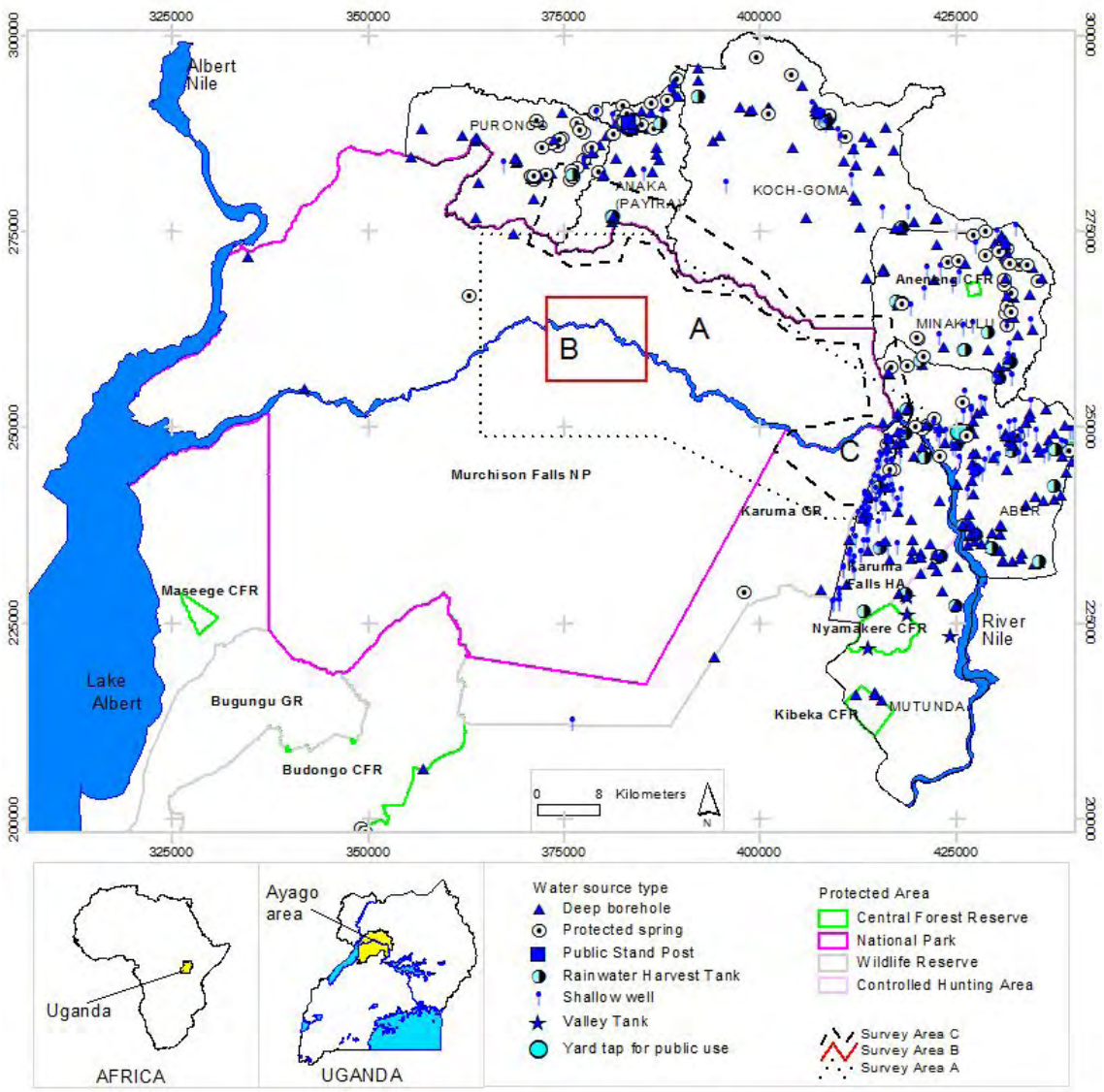


Figure 2 Water Sources around Ayago Site, 2010

Table 3 shows the accessibility of water by district. The majority of people in survey area C do not have water source on premises. The responsibility of fetching water mainly lies with women and children and reduces the time they have available to productively engage in other activities.

Table 3 Distance between Household and Nearest Water Source by Sub County

Sub-county	Water Source		
	On premises	Up to 1km	Over 1km
Aber	163	6,287	3,532
Minakulu	312	7,100	1,056
Anaka	127	2,219	65
Purongo	104	1,419	75
Koch Goma	84	1,786	107
Mutunda	104	5,156	3,660

(Source: 2002 Population and Housing Census, District Reports of Masindi, Gulu, Apac)

Table 4 shows the status of water sources in Masindi District. There are many boreholes which are non functional. On average, 85.2% of water sources are functional.

Table 4 Status of Water Sources by functionality in Masindi District

Category	Functional	Not Functional	% Functional	% Not Functional
Boreholes	345	98	78.4	21.6
Protected Springs	296	9	97.4	2.6
Shallow Wells	436	10	86.8	13.2
Valley Tanks	16	2	88.9	11.1
Total Facilities	**1081**	**119**	**85.2**	**14.8**

(Source: Masindi District, Department of Water March 2009)

Annex 7: Baseline Survey Report < Education and Health>

1 Objective

- To identify locations of health and educational facilities in survey area C.
- To find out issues and concerns in relation to education and health.

2 Surveyor

Name	Position	Organization
Mr. Begumisa Anthony	Social Consultant	WSS Services (U) LTD.

3 Survey period and area

Date	Area	Surveyors
12th/7/2010	Masindi Town Masindi District	Mr. Begumisa Anthony
13th/7/2010	Mutunda Sub-county Kiryandongo District	Mr. Begumisa Anthony
14th/7/2010	Purongo Sub-county Anaka Sub-county Nwoya District	Mr. Begumisa Anthony
15th/7/2010	Aber Sub-county Oyam District	Mr. Begumisa Anthony
16th/7/2010	Myene Sub-county Minakulu Sub-county Oyam District	Mr. Begumisa Anthony
17th/7/2010	Koch Goma Sub-county Nwoya District	Mr. Begumisa Anthony

4 Survey methods

- Literature survey
- Data collection and interview with national, district and sub-county officials
- Focus Group Discussion with surrounding communities in Survey Area C
- Direct observation in Survey Area C

5 Survey results

5.1 Schools and Health Facilities

Public owned buildings observable in the areas are usually schools, health facilities and public administration buildings such as sub-county or district headquarters. The public administration buildings tend to be in one given geographical location while the health facilities and schools are scattered in the sub counties surveyed.

There is a fair distribution of the educational institutions in each of the Sub-counties surveyed (Sub county and district development plans for 2010). The interviews conducted with the local leaders

further corroborated this fact. The institutions in question are mostly primary and a few secondary and vocational schools most of which are government run. The locations of schools and health facilities in survey area C are shown in Table 1 and 2 respectively.

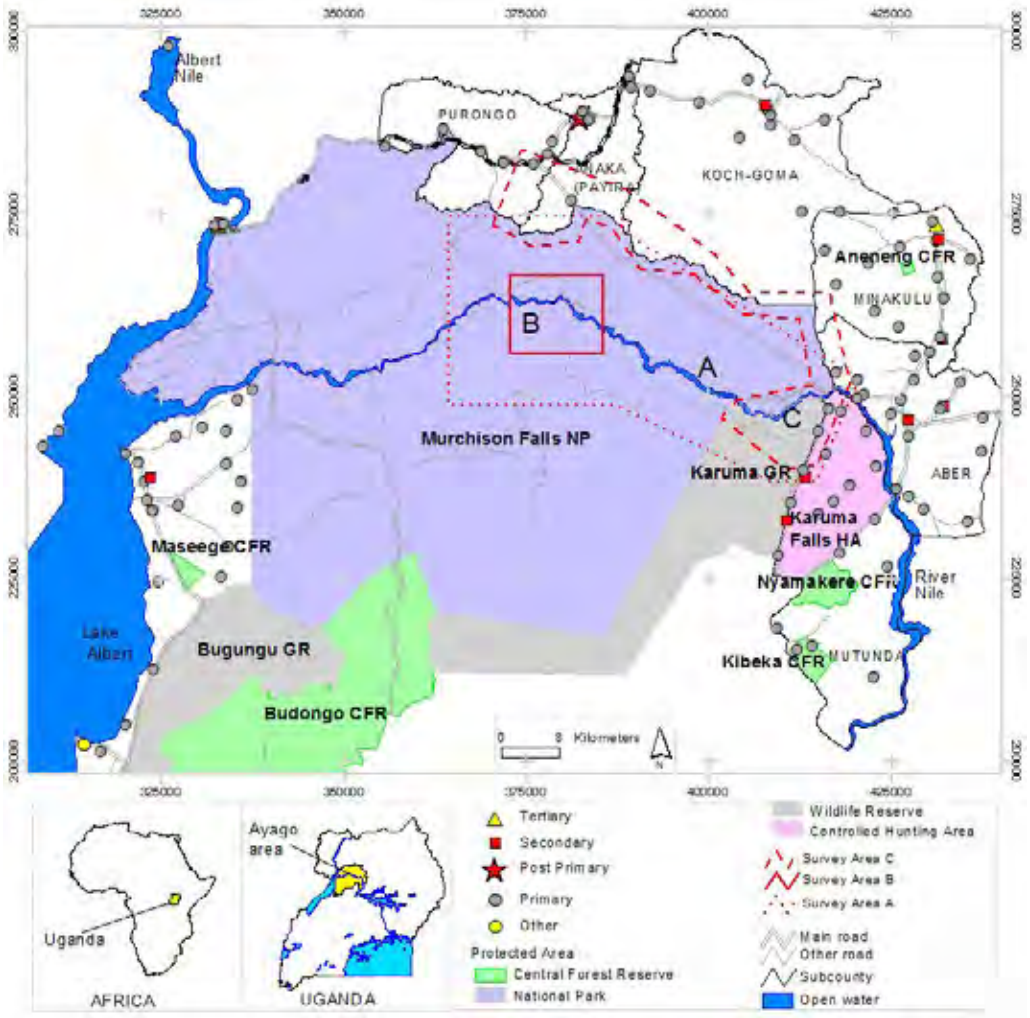


Figure 1 Location of Educational Institution around Ayago Site, 2010

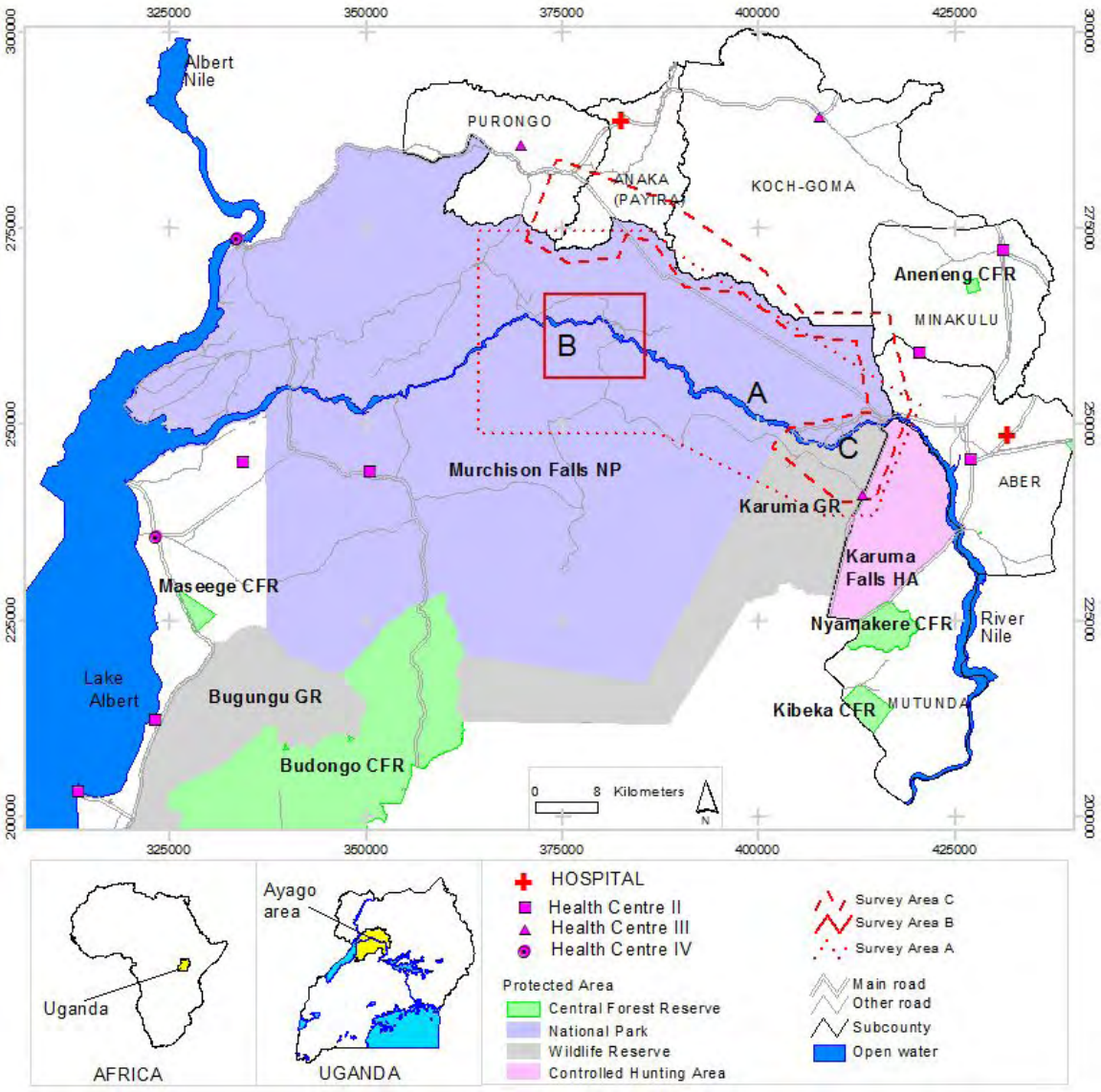


Figure 2 Location of Health Facilities around Ayago Site, 2010

The Government policy provides that there should be HC II from the Parish level, HC III at sub-county and in that order up to the national referral hospital level. The public health facilities in the survey area are mostly HC II and HC III except in Aber and Anaka Sub-counties where there are hospitals.

The health centres including hospitals in the surveyed sub-counties are not only few but also fall short of the expected service standards. The most frequently raised complaint against the health facilities is inadequate drugs and supplies, unqualified health workers and long waiting period before getting the services. The long waiting time at the health centre also means that there are limited health facilities in the sub-counties. As a result some people obtain health care services from private for profit health outlets such as clinics and drug shops.

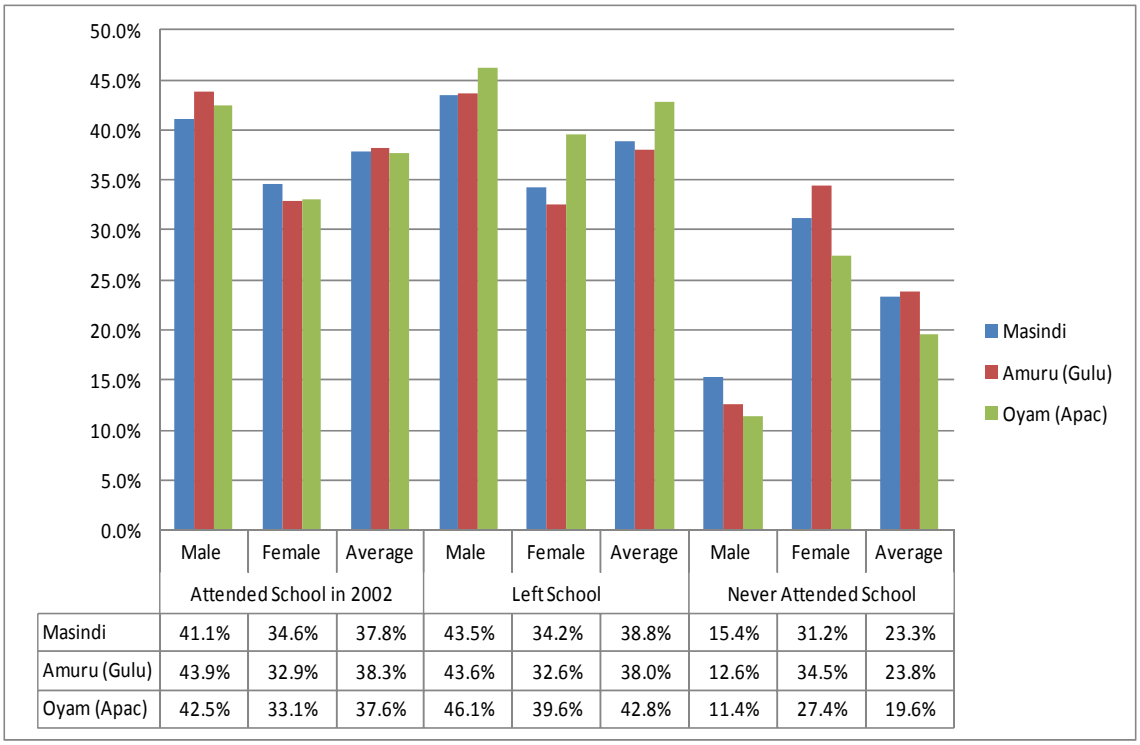
Table 1 shows the accessibility of schools and health institutions by local people.

Table 1 Distance between Households and Nearest School and Health Institutions by Sub-county

Sub-county	Health Facility		Primary School	
	Up to 5 Km	Over 5 Km	Up to 5 Km	Over 5 Km
Aber	3,851	6,131	9,135	847
Minakulu	5,630	2,838	7,982	486
Anaka	1,731	680	2,251	160
Purongo	1,136	462	1,419	179
Koch Goma	1,457	520	1,717	260
Mutunda	4,841	4,079	7,262	1,658

(Source: 2002 Population and Housing Census, District Reports of Masindi, Gulu, Apac)

School attendance by gender by district is shown in figure 3. Compared to male, female attendance is low. More than 25% of female have never been to school.

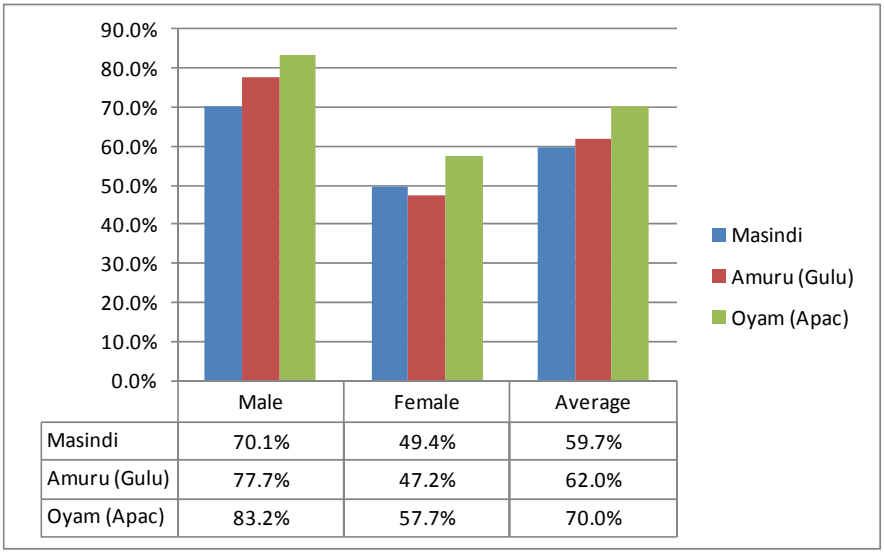


	Attended School in 2002			Left School			Never Attended School		
	Male	Female	Average	Male	Female	Average	Male	Female	Average
Masindi	41.1%	34.6%	37.8%	43.5%	34.2%	38.8%	15.4%	31.2%	23.3%
Amuru (Gulu)	43.9%	32.9%	38.3%	43.6%	32.6%	38.0%	12.6%	34.5%	23.8%
Oyam (Apac)	42.5%	33.1%	37.6%	46.1%	39.6%	42.8%	11.4%	27.4%	19.6%

(Source: 2002 Population and Housing Census, District Reports of Masindi, Gulu, Apac)

Figure 3 School Attendance

Similarly, literacy rate of women is lower than that of men in three districts (figure 4).



	Male	Female	Average
Masindi	70.1%	49.4%	59.7%
Amuru (Gulu)	77.7%	47.2%	62.0%
Oyam (Apac)	83.2%	57.7%	70.0%

(Source: 2002 Population and Housing Census, District Reports of Masindi, Gulu, Apac)

Figure 4 Literacy Rate

Access to health service remains low in Masindi. The District is yet to achieve the government target of a Health Center in every Parish. The existing facilities need extra improvement. There are many health-related problems in the District which are attributed to the inadequate health services and these include malaria, STIs and cholera epidemic among others (Table 4).

Despite some efforts to improve the health situation, the health status of the population is still poor. A high prevalence of infectious and communicable diseases and malnutrition among the general population especially in children under 5 contributes to the heavy burden of disease. The table below portrays the burden of diseases in the District with a focus on the top ten killer diseases.

Table 3 The Top Ten Morbidity Cases in Masindi District 2007/08

Cases	Total	%
1. Malaria	93.886	35%
2. Non Pneumonia Cold/cough	64,950	24%
3. Intestional Worms	14,992	5.6%
4. Skin infection	10,032	3.7%
5. Oral conditions	9,191	3.4%
6. Diahrroheal Diseases	7,696	2.9%
7. Trauma	6,129	2.3%
8. STIs	5,666	2.1%
9. Eye conditions	5,156	1.9%
10. Gastro Intestinal disorders	4,251	1.6%

(Source: District HMIS data 2007/08)

Annex 8: Baseline Survey Report <Local Economy>

1 Objectives

- To identify the types and characteristics of economic activities in survey area C.
- To identify number of workers for each occupation / industry in survey area C.
- To identify locations of trading centres and markets in survey area C.

2 Surveyor

Name	Position	Organization
Mr. Begumisa Anthony	Social Consultant	WSS Services (U) LTD.

3 Survey period and area

Date	Area	Surveyors
12th/7/2010	Masindi Town Masindi District	Mr. Begumisa Anthony
13th/7/2010	Mutunda Sub-county Kiryandongo District	Mr. Begumisa Anthony
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16th/7/2010	Myene Sub-county Minakulu Sub-county Oyam District	Mr. Begumisa Anthony
17th/7/2010	Koch Goma Sub-county Nwoya District	Mr. Begumisa Anthony

4 Survey methods

- Literature survey
- Data collection and interview with national, district and sub-county officials
- Focus Group Discussion with surrounding communities in Survey Area C
- Direct observation in Survey Area C

5 Survey results

5.1 Source of Livelihood

The main source of household livelihood in survey area C is subsistence farming. According to the Census in 2002, subsistence farming is the main source of livelihood for 67.4% of the household in Masindi, 77.4% in Amuru and 94.0% in Apac.

Table 1 Main Source of Household Livelihood in Survey Area C

	Masindi	Amuru (Gulu)	Oyam (Apac)
Subsistence Farming	67.4%	77.4%	94.0%
Earned Income	20.1%	9.0%	3.8%
Property Income	1.7%	10.8%	2.1%
Other	10.7%	2.8%	0.1%

(Source: 2002 Population and Housing Census 2002, District Reports of Masindi, Gulu, Apac)

The table below shows the percentage male and female in different occupations in survey area C. It indicates that the majority are subsistence farmers for crops, livestock and fishery. The percentages of female subsistence farmers are much higher in all three districts.

Table 2 Occupation of Currently Working Persons Aged 14 to 64 Years in Survey Area C

Occupation	Masindi			Amuru (Gulu)			Oyam (Apac)		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Subsistence crop farmers	62.1%	79.8%	69.4%	63.6%	80.4%	70.9%	86.8%	96.2%	91.7%
Subsistence livestock and fishery workers	6.3%	2.6%	4.8%	0.2%	0.1%	0.2%	1.4%	0.2%	0.8%
Associate Professionals	6.0%	3.9%	5.2%	7.6%	4.5%	6.3%	4.7%	1.2%	2.9%
Craft and related workers	5.1%	2.6%	4.0%	5.8%	4.1%	5.0%	2.2%	0.8%	1.5%
Wholesalers and Retailers	2.3%	4.2%	3.1%	2.7%	5.9%	4.1%	1.0%	0.5%	0.7%
Personal/Protective work/sales persons and models	3.1%	2.7%	2.9%	2.4%	2.2%	2.3%	0.9%	0.4%	0.7%
Managers, Senior Officials, Legislators	0.3%	0.1%	0.2%	0.4%	0.2%	0.3%	0.2%	0.0%	0.1%
Professionals	0.5%	0.2%	0.4%	0.9%	0.3%	0.6%	0.3%	0.0%	0.1%
Clerks	0.4%	0.5%	0.5%	0.8%	0.5%	0.7%	0.2%	0.1%	0.1%
Market Oriented Agricultural Workers	1.5%	0.5%	1.1%	0.4%	0.4%	0.4%	0.9%	0.1%	0.5%
Machine operators	2.9%	0.1%	1.7%	12.6%	0.4%	7.3%	0.9%	0.0%	0.5%
Elementary occupations	9.3%	2.9%	6.7%	2.5%	1.0%	1.8%	0.6%	0.5%	0.5%

(Source: 2002 Population and Housing Census 2002, District Reports of Masindi, Gulu, Apac)

5.2 Characteristics of Local Economy

The population in the survey area C derives their livelihood from agricultural activities. The cash and food crops include ground nuts, sesame, millet, sorghum, sweet potatoes, peas, sunflower, beans, maize and cassava. Being largely peasant farmers they consume domestically what they

produce and sell the surplus in local markets for cash. Other activities include petty businesses such as operating small kiosk grocery shops in the village and trading centres, brick making, charcoal burning and selling, and road side sale of farm products.

Animal rearing is also a key economic activity in the survey area C, although small numbers of cattle goats, pigs, sheep, pigs, duck and turkey are kept. It was reported by the community that the LRA related war that lasted for twenty years in the areas, made large scale animal rearing difficult since most of the population during the war time were in the IDP (internally displaced people) camps.

During the field survey it was observed that peripheral communities carry out fishing activities on River Nile outside the park area, in the vast swamps and wetlands, small rivers and streams which act as breeding places for the fish. Fishing is on a small scale and what is caught is locally consumed. The common market is readily available in the nearby markets such as Bweyale along the Kampala-Gulu highway. No fish exports from the national park water bodies were reported.

Table 3 shows the characteristics of local economy by Sub-county.

Table 3 Characteristics of Local Economy in Survey Area C

District	Sub-county	Economic activity	Characteristics
Masindi	Mutunda	Subsistence farming and major crops	• Small scale farming both food and cash crop is the major source of income. • 98% of the crop farmers use traditional methods of farming.
		Other activities	• Market vending, local beer brewing, charcoal burning, small scale shop keeping, food vending and eating houses.
Oyam	Aber	Subsistence farming and major crops	• Over 85% of the populations are engaged in subsistence farming. • The major crops include cotton, tobacco, sunflower, sesame, cassava, millet, maize, groundnuts, beans and soya beans.
	Myene/Minakulu	Subsistence farming and major crops	• 98% of the populations are engaged in subsistence farming while 2% are in employed service. • Cotton, tobacco, maize, millet, sorghum, rice, beans, peas, soya beans, ground nuts, sunflower, sesame, cassava, potatoes and vegetables.
		Livestock	• The livestock reared are cattle, goats, sheep, pigs, and poultry of various species.
		Fishing	• Fishing is practiced seasonally along River Tochi and a few swamps, streams by about 1% of the population.
		Other activities	• Brick making, sand and stone quarrying are also practiced along swamps. • Charcoal burning and crafts from forest products are on the rise threatening the

District	Sub-county	Economic activity	Characteristics
			natural vegetation.
Amuru	Purongo	Subsistence / commercial farming and major crops	• Over 90% of the populations are engaged in subsistence and commercial farming. • The major crops include rice, maize, beans, millet, sesame, cassava, sweet potatoes, ground nuts and peas.
		Livestock	• Cattle, sheep, goats, pigs, duck and turkey
	Anaka	Subsistence farming and major crops	• Crop production is a major activity which employs about 95% of the population. • Traditional cash crops include cotton and tobacco. • Other crops include rice, groundnuts, sorghum, millet, cassava, potatoes and pigeon peas.

(Source: Sub-county Three Year Development Plan for F/Y 2009/2010 − 2011/2012)

In Mutunda Sub-county, where the transmission line may cross, the distribution of workers by industry is shown in table 4.

Table 4 Number of Workers by Industry in Mutunda Sub-county

Parish	Agriculture	Trade	Manufacturing	Services	Other services
Diima	3912	560	32	47	386
Kakwokwo	2245	121	43	45	620
Nyamahasa	5115	530	78	566	811

(Source: Masindi District CIS Analysis 2010)

Table 5 shows the number of household for livestock production in Mutunda Sub-county.

Table 5 Number of Household by Livestock in Mutunda Sub-county

Parish	Cattle	Goats	Pigs	Chicken
Diima	72	788	241	1303
Kakwokwo	840	528	123	969
Nyamahasa	180	978	201	1432

(Source: Masindi District CIS Analysis 2010)

Table 6 shows the number of household for crop productions in Mutunda Sub-county.

Table 6 Number of Households by Main Crops in Mutunda Sub-county

Parish	Coffee	Beans	Cassava	Sweet Potato	Banana	Maize	Millet	Sorghum	Potato	Rice
Diima	1	1939	1781	854	26	2377	1009	353	5	4
Kakwokwo	7	856	694	445	92	747	301	38	5	0
Nyamahasa	12	1441	1229	480	42	1619	235	143	3	9

(Source: Masindi District CIS Analysis 2010)

5.3 Trading Centre and Local Markets

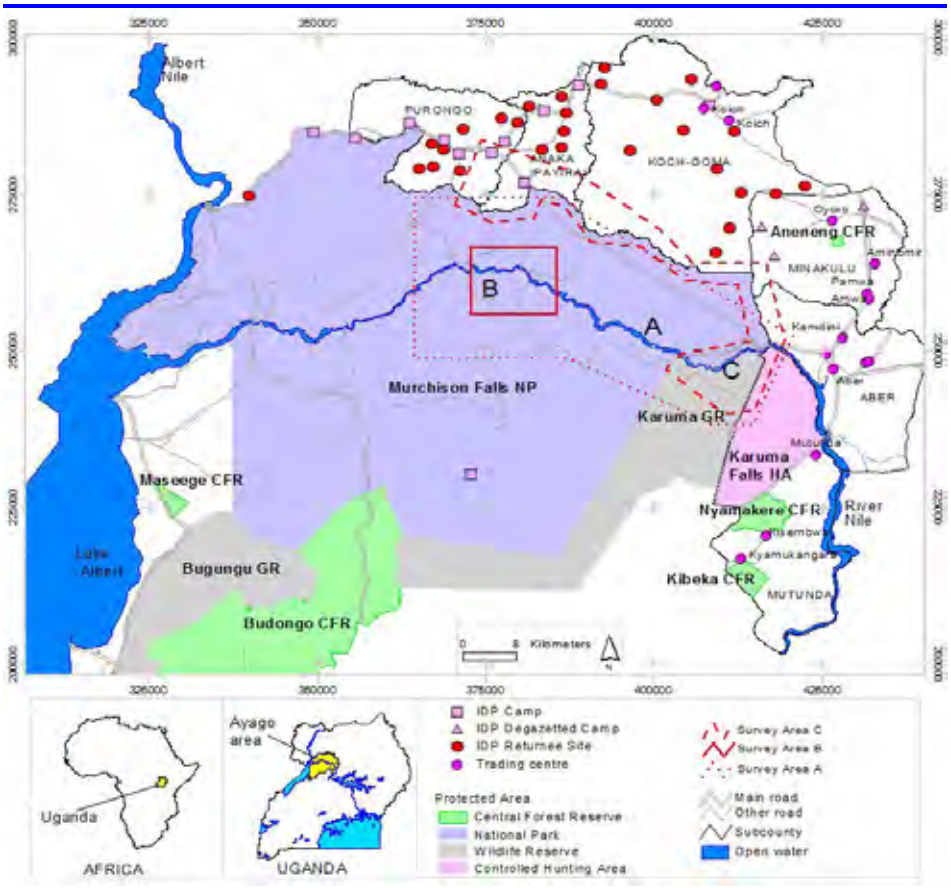


Figure 1 Locations of Trading Centres and Local Market near IDP camp, 2010

Cassava production in Mutunda Sub-county

Millet in Mutunda Sub-county

Annex 9: Baseline Survey Report <Tourism>

1 Objective

- To identify types, locations and revenue of tourism activities in Murchison Falls Protected Area
- To find out the potential for tourism development in Murchison Falls Protected Area

2 Surveyor

Name	Position	Organization
Ms. Edith Kafubire	Social Consultant	WSS Services (U) LTD.
Mr. Begumisa Anthony	Social Consultant	WSS Services (U) LTD.
Mr. Pius Kahangirwe	Environment and Natural Resource Specialist	WSS Services (U) LTD.

3 Survey period and area

Date	Area	Surveyors
23th/6/2010	UWA Masindi station Murchison Falls Protected Area	Ms. Edith Kafubire
16th/7/2010	UWA Karuma station Murchison Falls Protected Area	Mr. Begumisa Anthony
29th/7/2010	UWA headquarter, Kampala	Mr. Begumisa Anthony
20th/10/2010	UWA headquarter, Kampala	Mr. Pius Kahangirwe

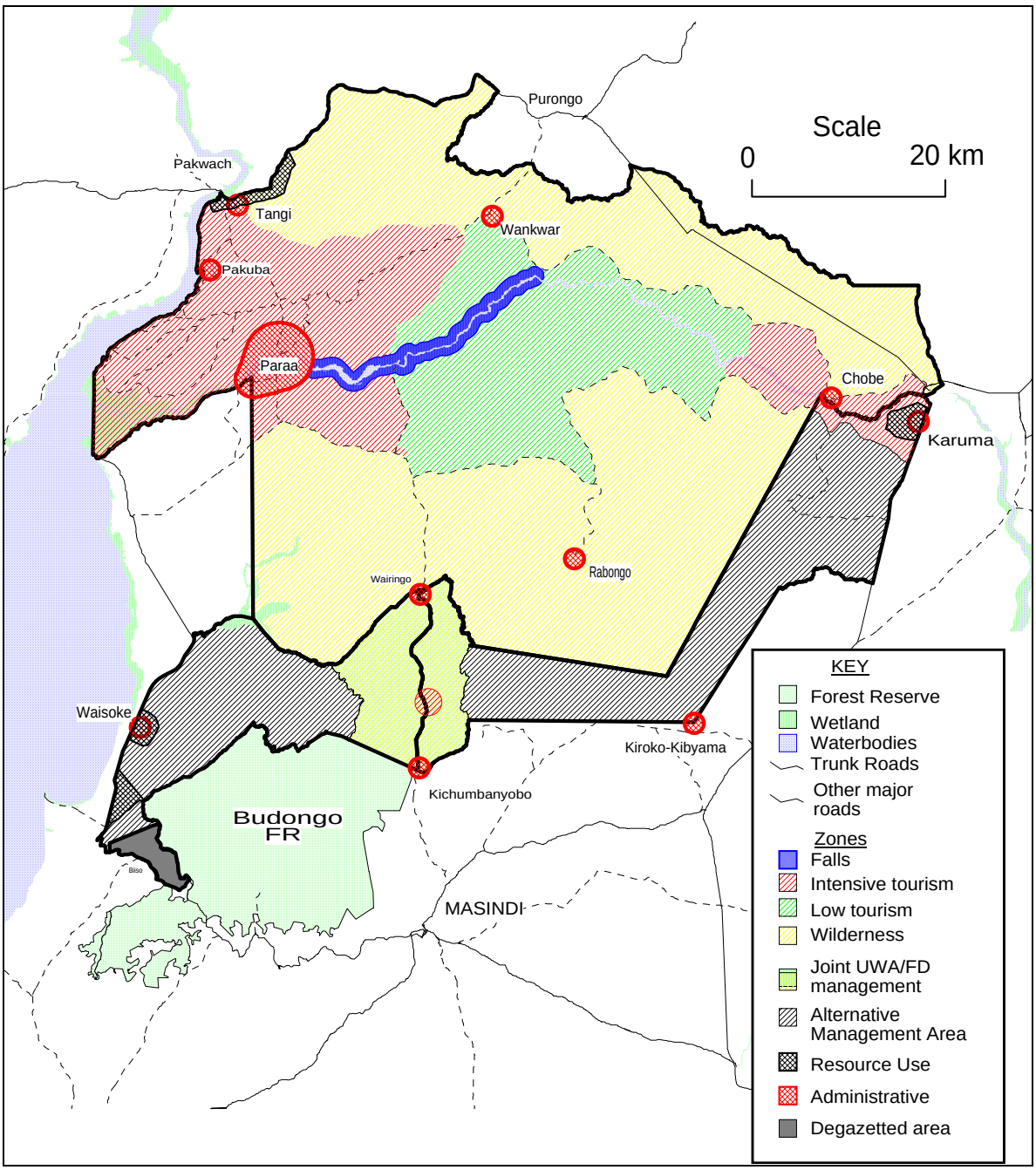
4 Survey methods

- Literature survey
- Data collection and interview with UWA
- Focus Group Discussion with surrounding communities in Survey Area C
- Direct observation in Murchison Falls Protected Area

5 Survey results

5.1 Tourism Zone

The Murchison Falls Protected Area (MFPA) includes Murchison Falls National Park, Bugungu Wildlife Reserve and Karuma Wildlife Reserve. It is one of the most important tourism resources in Uganda. The area has been divided into several zones to clarify tourism development and to protect important and sensitive resources. Figure 1 shows the location of the zones.



(Source: Murchison Falls Protected Area General Management Plan for 2001-2011)

Figure 1 Management Zones of Murchison Falls Protected Area

According to the MFPA General Management Plan 2001-2011, the management zones are briefly described below.

The Falls Zone is proposed for inscription on the World Heritage Site list. Tourism activities will mainly be walking safaris, fly camping and sport fishing.

The Intensive Tourism Zone comprises two parts: The Western Tourism Area, will offer boat trips into the Nile Delta from Delta Point, walking safaris along Tangi and Nyamsika rivers and the traditional game drives in the Buligi circuit. The second area, the Chobe Tourism Area will

accommodate a campsite to be set up on the south bank of the Nile within Karuma WR, close to the proposed Gwara Gate and the Chobe Safari Lodge. The main tourism opportunities will be non-concession sport fishing.

The Low Tourism Zone mostly falls between the Wangkwar-Chobe road and the Rabongo-Nanda road to the north and south as well as the Kibaa River and midway between Chobe lodge and Ayago River to the East and West. Concessionaires may design and set up fly camps for accommodation during walking safaris. Upstream of the mouth of the Kibaa River, and in the central part of Murchison Falls National Park (the 'Heart of MFPA') is a unique habitat to almost half of the large mammals of the entire conservation area. Use and activities will be confined to game viewing, walking safaris, and sport fishing by concession.

The Wilderness Zone is characterised by dense bushland and thicket, low wildlife numbers, tsetse flies infestation, and does not appeal to tourists. This zone will have minimal disturbance, though tourism activities suggested by operators may be allowed.

The Integrated Resource Use Zone is designated to allow for possible collection of selected resources in specified parts of the MFPA by local communities, following UWA resource utilisation guidelines.

Administrative Zones contain the developed areas of the PA that cater for PA operations and visitor accommodation. The zone includes areas around Paraa, Mubako, Rabongo, Waisoke and Karuma. Outposts will also be constructed and/or maintained at Kiroko, Wairingo, Kichumbanyobo, Pakuba, Tangi, Bugungu gate, Wangkwar, Top of the Falls and Chobe.

Alternative Management Areas are large areas of Bugungu and Karuma WRs that will be offered for long-term (10-15 year) management by NGOs or other concessionaires so as to enable revenue generation. Sport hunting may be permitted, based on UWA guidelines. The concessionaire will meet all capital investments costs (e.g. road construction and administrative offices).

The table below shows the calcification of the zones from the viewpoint of tourism development, natural resource management and community collaboration.

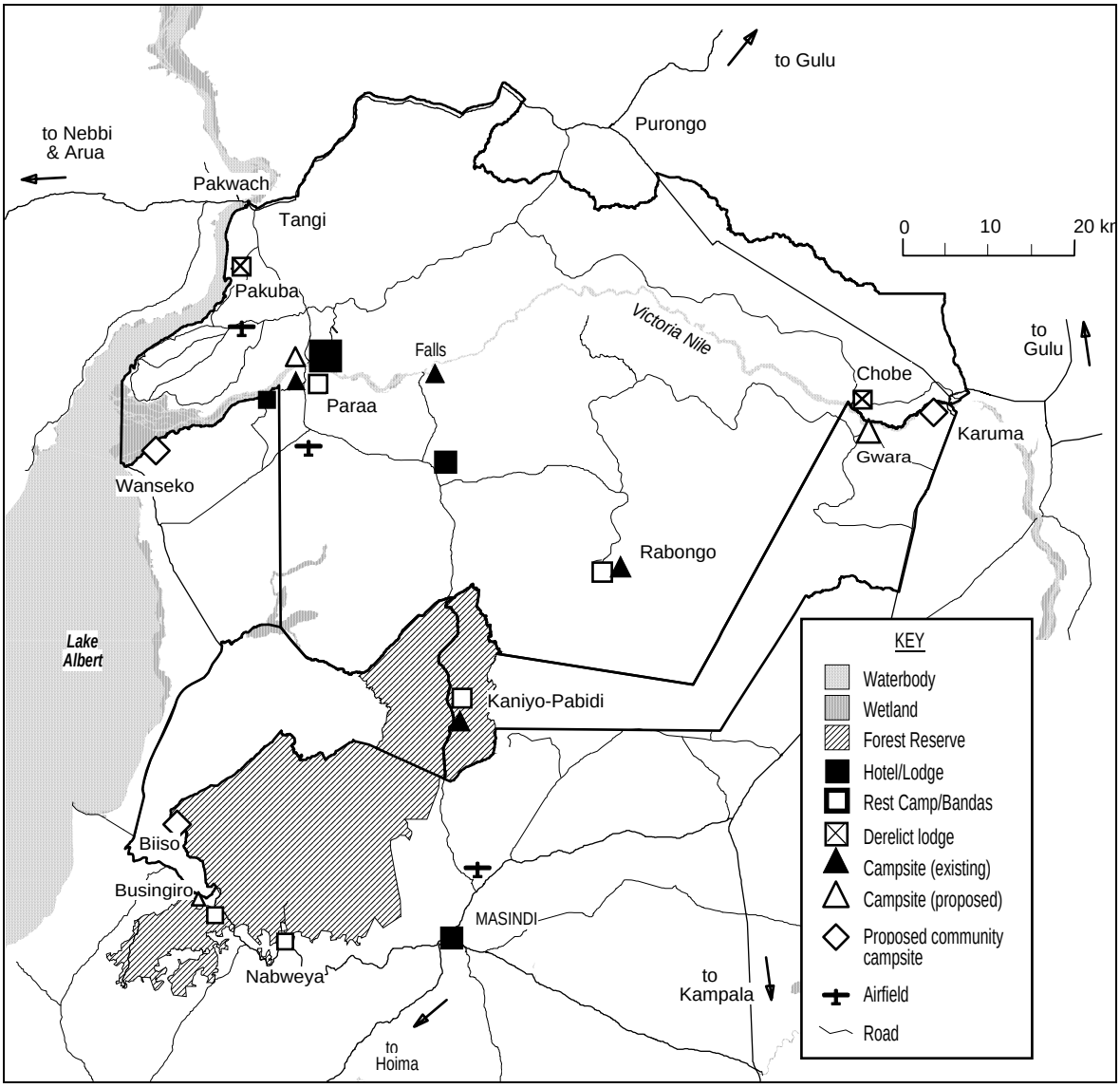
Table 1 Calcification of Management Zones of Murchison Falls Protected Area

Management Zones	Tourism Development	Natural Resource Management	Community Collaboration
The Falls Zone	It was proposed for nomination for the World heritage Site list. All developments are carefully designed to give the visitor the fullest exposure to the spectacular landscape of the Falls.	It is the main breeding are for Nile Crocodiles. There is the unique spray forest around the Falls.	None
The Intensive Tourism Zone	It comprises the launch trip to the Falls, the drive to the Falls, the drive to the Falls, game drive, walking safari, bird watching and sport fishing. Activities will continue to be promoted with a diversification of visitor experience.	None	None
The Low Tourism Zone	It is confined to game drive, walking safari and sport fishing by concession. Development is conducted in a particularly sensitive way.	The central part of this area is a unique habitat to almost half of the large mammals of the entire conservation area.	None
The Wilderness Zone	Although tourism activities suggested by operators may be allowed, the area does not appeal to tourist.	It comprises dense bushland and thicket with low wildlife numbers. Tsetse flies are abundant. Wildlife and habitats will remain undisturbed.	None
The Integrated Resource Use Zone	None	None	Local community may use resources such as firewood and thatching materials in a sustainable manner under MoUs.
Administrative Zones	It contains the developed areas where resources are allocated for operations and visitor accommodation.	Environment in this zone is kept as natural as possible.	None
Alternative Management Area	It will be offered for long-term management by concessionaries. Sport hunting may be permitted.	Wildlife populations are low. The vegetation is thick, infested with tsetse flies.	None

(Source: JICA Study Team)

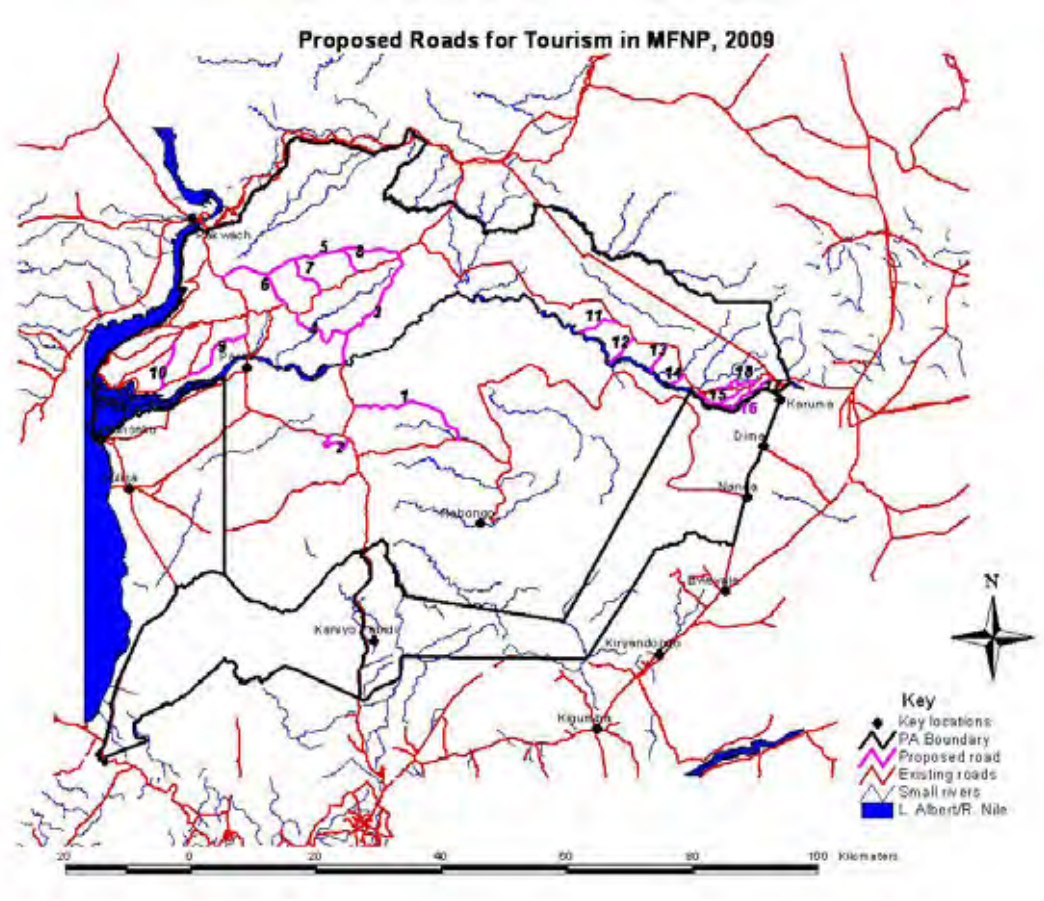
5.2 Tourism Facilities

The Murchison Falls Protected Area General Management Plan for 2001-2011 highlights the existing and potential for tourism development. Figure 2 shows the existing tourism facilities.



(Source: Murchison Falls Protected Area General Management Plan for 2001-2011)

Figure 2 Existing Tourism Facilities in Murchison Falls Protected Area



(Source: Uganda Wildlife Authority)

Figure 3 Existing and Future Road Networks in Murchison Falls Protected Area

The Park offers a wide range of accommodation from camping and traditional bandas at Paraa Rest Camp to the luxury of Paraa Safari Lodge, Nile Safari Camp and Sambiya River Lodge. The list is shown in the table below.

Table 2 Existing Accommodation Facilities in Murchison Falls Protected Area

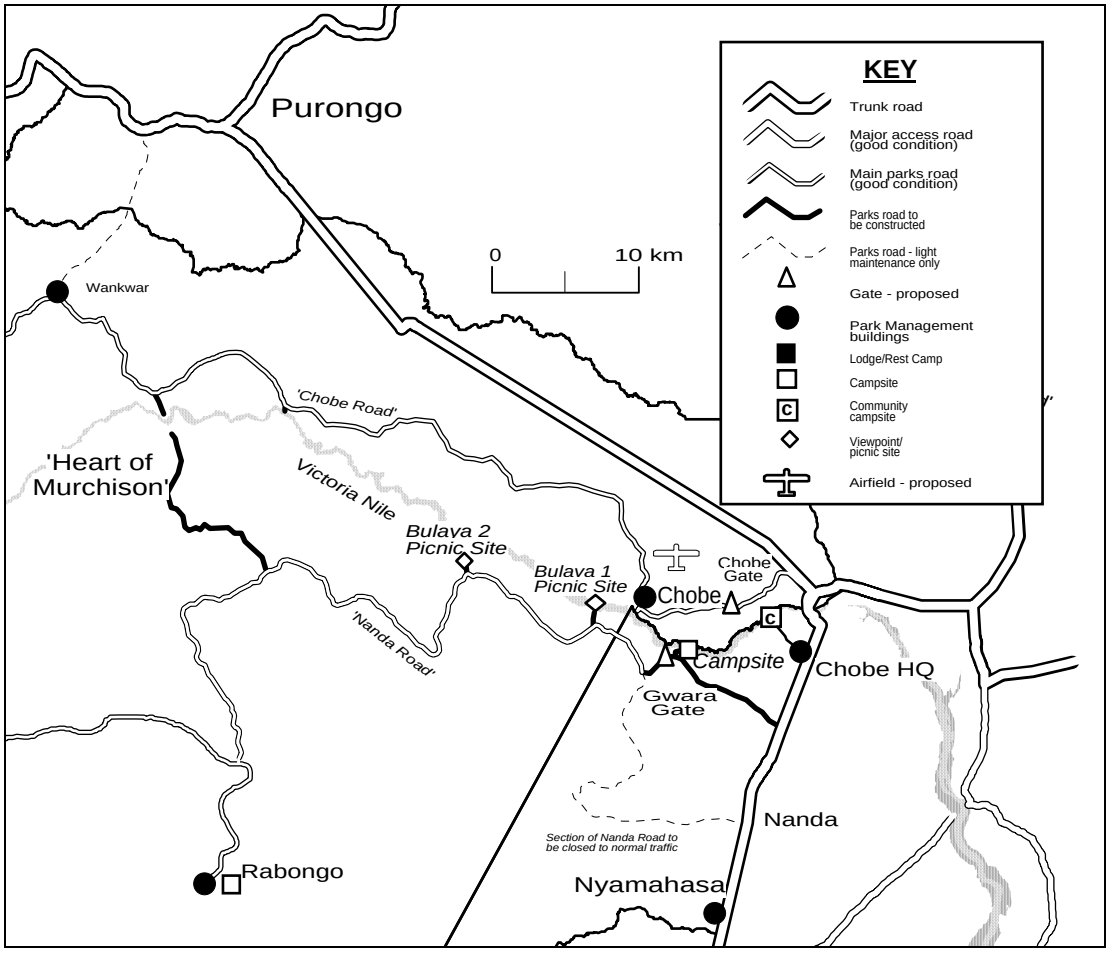
Facility	Type	Condition	Target market	Visitor Experience
Paraa Safari Lodge	Hotel	Good	High budget	High quality hotel facilities; average river views
Paraa Rest Camp	Self contained bandas	Average	Medium budget	Medium-low quality facilities; poor views
Paraa Rest Camp	'traditional' bandas	Poor	Low budget	Poor facilities; poor views
Paraa Campsite	Campsite	Poor	Low budget	Poor facilities; no view
Rabongo	Cottages	Very Poor	Medium budget	Poor facilities; pleasant forest setting
Rabongo	Campsite	Poor	Low-Medium budget	Poor facilities; pleasant forest setting
Top of the Falls	Campsite	Poor	Low-Medium budget	Poor facilities; superb location

Facility	Type	Condition	Target market	Visitor Experience
Budongo Forest (FD-operated)	Campsite	Poor	Low-Medium budget	Poor facilities; pleasant forest setting
Budongo Forest (FD-operated)	Bandas	Average	Low-Medium budget	Average facilities; pleasant forest setting
Sambiya River Lodge	Lodge cottages	Good	Medium-High budget	Good medium-high quality; average setting
Nile Safari Camp (outside MFPA)	Tented camp/ cottages	Good	High Budget	Expensive high quality 'national park' accommodation; good Nile view

(Source: Murchison Falls Protected Area General Management Plan for 2001-2011)

Apart from the above facilities, the Chobe Safari Lodge was newly opened in September 2010. The surrounding area has been rehabilitated. It used to be a high tourism area. However, it had been destroyed by LRA activities during the last two decades. UWA officials expect that the area will attract tourists again since it is an excellent location for tourism activities.

There is also a plan for new accommodation near the Falls at the south bank, according to the UWA officials. If the plan is approved, it will encourage the development of Top of the Falls.



(Source: Murchison Falls Protected Area General Management Plan for 2001-2011)

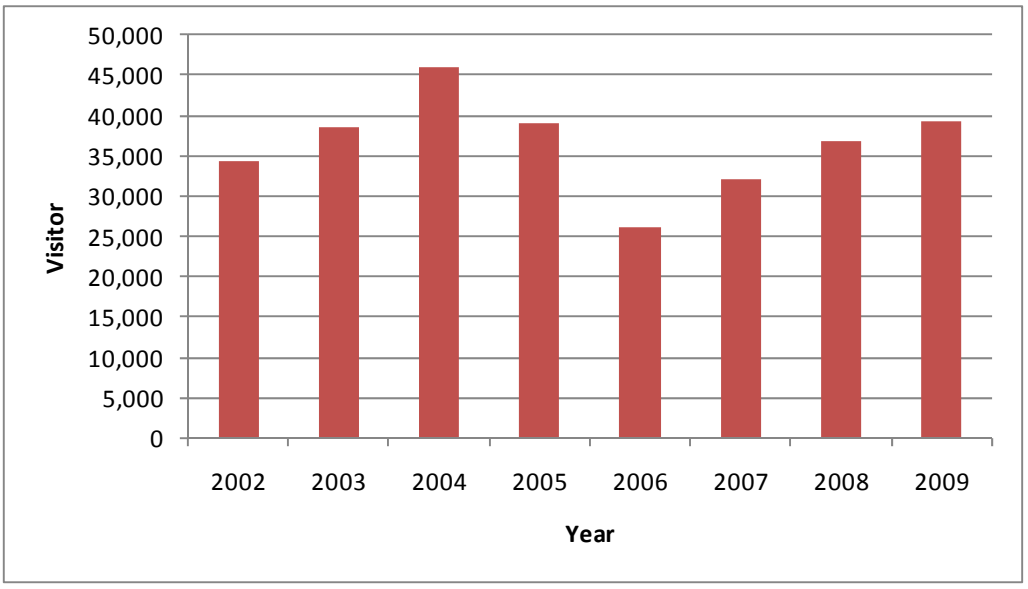
Figure 4 Tourism Development in Central and Eastern Murchison Falls Protected Area

Newly opened Chobe Safari Lodge

The war-devastated facilities in Chobe

5.3 Visitors to Murchison Falls National Park

The tourism industry in the Murchison Falls National Park has not been fully developed. The annual number of tourists has been less than 50,000 as indicated in the figure below. The factors for small number of visitors include rebel activities in Northern Uganda that posed a security threat and failure to adapt to tourism needs and expectations. According to the interviews with UWA officials, the current number of visitors accounts for only 30 to 40% of carrying capacity of the Park.



(Source: Uganda Wildlife Authority)

Figure 5 Number of Visitors to Murchison Falls National Park

5.4 Tourism Activities and Revenue

Tourism activities in Murchison Falls National Park are generally limited to the boat/launch trip to view wild animals and the falls, a visit to the falls and a Buligi circuit game drive. The list of tourism activities and the corresponding fees are shown in Table 3.

Table 3 Tourism Activity Fees in Murchison Falls National Park

Activities	Age/Class	Foreign Residents /Non-Residents	East African Residents
Entrance	Adult	US$30/day	Ush 5,000/day
	Children (5-15 years old)	US$15/day	Ush 2,500/day
Game drives	Day time drive	US$20/guide	US$15/guide
	Night time drives (7.00-11.00pm)	US$15/guide	Ush 5,000/guide
Guided Nature Walk	Day Nature Walk (up to 4 hours)	US$10/person	Ush 5,000/person
	Day Nature Walk (Over 4 hours)	US$15/person	Ush 10,000/person
	Night Nature Walk (up to 4 hours)	US$25/person	Ush 20,000/person
	Murchison Falls Experience	US$10/person	Ush 5,000/person
	Students guided walk	Ush 10,000/6 persons	Ush 10,000/6 persons
Sport Fishing	Day permit	US$50/person	US$50/person
	Up to 4 days	US$100/person	US$100/person
	Annual Permit	US$300/person	US$300/person
Personal Fishing Boats	Adult/Children (5-15 years old)	Ush 50,000/day	Ush 50,000/day
Boat / Launch Trip	Adult/Children (5-15 years old)	US$15/trip	Ush 20,000 (Ugandan Citizens)

(Source: Uganda Wildlife Authority)

Table 4 shows the tourism revenue of Murchison Falls National Park in 2009. It indicates that most revenue was collected through the entrance fees. Tourism activities such as boat ride, nature walk game drive and fishing are not major sources of the revenue. It means that currently, many of the visitors are on self-drive and they do not pay anything except entrance fee to see all beautiful wildlife in the Park (Performance Evaluation of the Murchison Falls Protected Area General Management Plan Report, 2007).

Table 4 Murchison Falls National Park Tourism Revenue in 2009

Tourism Activity	Annual Revenue in Ush.	%
Entrance fees (visitors)	1,649,033,319	63.7
Entrance fees (vehicles)	192,906,513	7.4
Canping fees	40,526,570	1.6
Landing fees	10,775,951	0.4
Photographic fees	29,938,677	1.2
Ranger Guide Fees	51,735,529	2.0
Ferry Crossing	301,849,052	11.7
Fishing Permits	39,960,836	1.5
Nature Walk fees	71,325,277	2.8
Lauch Hire	71,768,241	2.8
Vehicle Hire	3,941,737	0.2
Accomodation Bandas	16,452,950	0.6
Accomodation Ugandan Students	31,449,980	1.2
Boat rides	78,722,312	3.0
Total	2,590,386,944	100.0

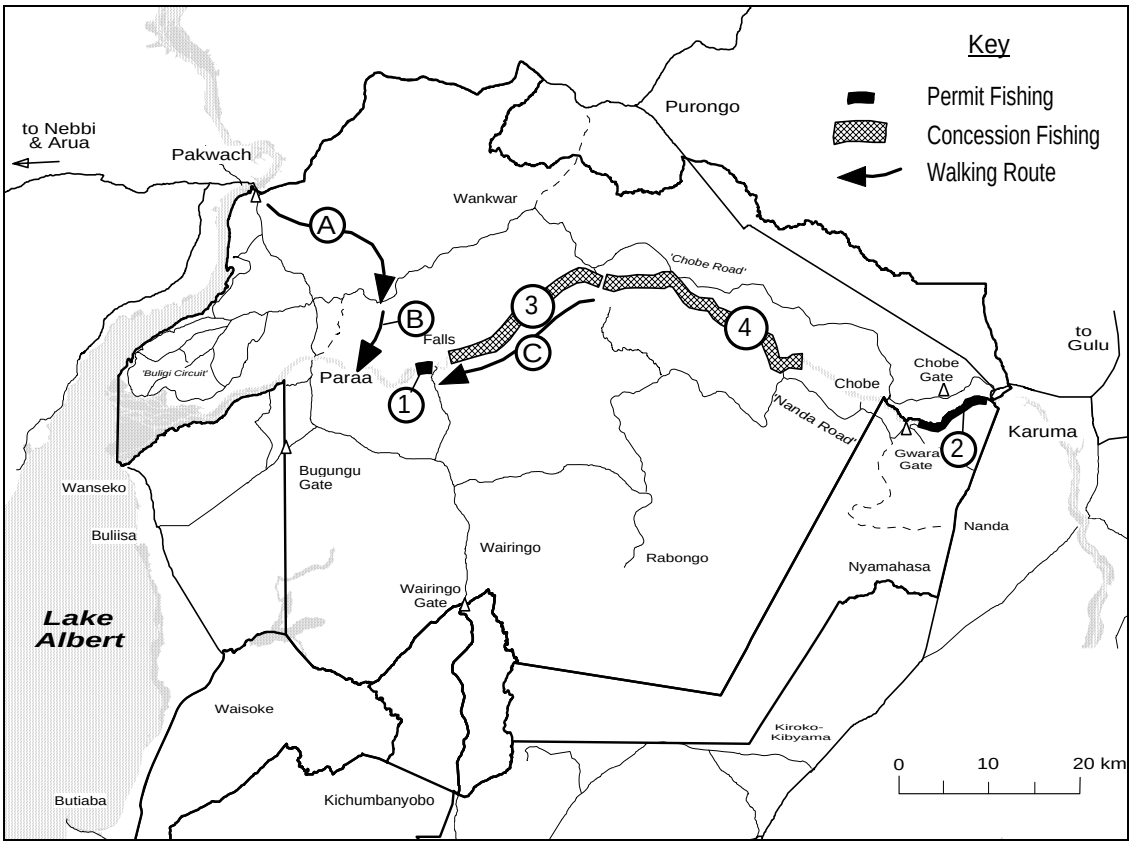
(Source: Uganda Wildlife Authority)

Therefore, the report proposed that a visitor should clearly specify activities he/she intends to carry out in the park and should be given the necessary advice including payments for such activities at the time of park entry.

5.5 Potential for Diversifying Tourism Opportunities

The need for diversification of tourism opportunities is emphasized in the MFPA plan and during the interview with UWA officials. The diversification strategies include opening up new areas such as “Heart of Murchison“and Chobe, so that there is no more confinement of tourism activities to Paraa.

Walking Safaris, sport fishing and white water rafting are described as potentials, and a proposal for long term fishing concessions are key strategies in the plan. The locations are indicated the figure below.



1: Falls Permit Fishing Area

2: Karuma Permit Fishing Area

3: Kibaa Concession Fishing Area

4: Ayago Concession Fishing Area

A: Tangi Walk

B: Nyamsika Walk

C: Nile Walk

(Source: Murchison Falls Protected Area General Management Plan for 2001-2011)

Figure 5 Fishing Concession and Walking Safari Areas in Murchison Falls Protected Area

5.5.1 Walking Safari

Walking safaris provide visitors with the opportunity to experience MFPA's landscapes and wildlife at close quarters. Walking safaris will be conducted along the following routes:

A and B: Along Tangi river to Te Bito (possible vehicle pickup), then along Nyamsika river and down to the Victoria Nile for pickup by boat. Currently, the starting point is Nyamsika Cliff about 20km North East of Paraa Safari Lodge. It takes six to eight hours to reach the Nile. The distance is 12km.

C: From a central drop-off point on the south bank of the Nile, near 'Kisangani Falls', following the river to the Top of the Falls.

5.5.2 Sport Fishing

MFPA offers some of the finest sport fishing possibilities. According to the guidebook published by UWA in 2002, fishing sites are located along the 40km stretch of the Nile between the foot of the Falls and Chobe. Fishing for Nile perch is the major attraction in the park. The most exciting place to fish is the fast flowing waters above the Falls and just below the Falls. The recorded fish taken from the bank below the Falls is 108kg.

UWA will auction off two fish concessions; Kibaa and Ayago as provisionally defined in Figure 5. These concessions will guarantee the winner of each exclusive fishing and camping rights within the defined 3-10 km stretch of the river. It is important to note that walking safaris will be permitted through these fishing concession areas.

MFPA will also retain a number of fishing sites for use by fishermen who buy a daily fishing permit from UWA. The most prominent permit-fishing site is the foot of the Falls (Figure 5). Another permit-fishing site will be at Karuma, between the new Gwara Gate and Karuma Falls. Different fees will be set for each site taking into consideration quality of site and possibility of making record catches.

5.5.3 White Water Rafting

The MFPA plan considers rafting as a high-risk activity with the potential to injure or lead to death of participants, since there are many crocodiles and hippopotami in the river. However, UWA will study proposals for rafting in MFPA if a suitable qualified and experienced company withes to conduct an exploratory expedition.

Annex 10: Baseline Survey Report <MFNP and Community>

1 Objective

- To find out UWA's strategy for collaborative management of Murchison Falls Protected Area.with local communities
- To grasp the situation of resource use in the Murchison Falls Protected Area by local communities including illegal activities

2 Surveyor

Name	Position	Organization
Mr. Begumisa Anthony	Social Consultant	WSS Services (U) LTD.
Mr. Pius Kahangirwe	Environment and Natural Resource Specialist	WSS Services (U) LTD.

3 Survey period and area

Date	Area	Surveyors
12th/7/2010	Masindi Town Masindi District	Mr. Begumisa Anthony
13th/7/2010	Mutunda Sub-county Kiryandongo District	Mr. Begumisa Anthony
14th/7/2010	Purongo Sub-county Anaka Sub-county Nwoya District	Mr. Begumisa Anthony
15th/7/2010	Aber Sub-county Oyam District	Mr. Begumisa Anthony
16th/7/2010	UWA Karuma station Murchison Falls Protected Area Myene Sub-county Minakulu Sub-county Oyam District	Mr. Begumisa Anthony
17th/7/2010	Koch Goma Sub-county Nwoya District	Mr. Begumisa Anthony
29th/7/2010	UWA headquarter, Kampala	Mr. Begumisa Anthony
20th/10/2010	UWA headquarter, Kampala	Mr. Pius Kahangirwe

4 Survey methods

- Literature survey
- Data collection and interview with national, district, sub-county officials and UWA
- Focus Group Discussion with surrounding communities in Survey Area C
- Direct observation in Survey Area C

5 Survey results

5.1 Community Collaboration Strategy

According to the Murchison Falls Protected Area General Management Plan 2001-2011, UWA has promoted better relationships with local communities. The objectives of community collaboration are the followings.

- To conserve and protect resources in MFPA, in collaboration with adjacent communities
- To minimize the impact of problem animals and vermin on local communities
- To support local communities in implementing benefit-sharing programmes
- To develop programmes to enable local communities to use MFPA resources in a sustainable manner

Under the community collaboration programme, community conservation wardens and rangers explain MFPA management policies to the communities bordering the protected area through group discussions, informal village meetings and workshops.

In addition, the Community Protected Areas Institutions (CPI) was established to increase awareness of the various environmental issues particularly related to the conservation of the MFPA ecosystem. CPIs are integrated within Local Environment Committees, and report to local councils. They are expected to address community issues in PA management, to act as intermediaries facilitating communication, and to plan and implement revenue sharing projects. According to UWA officials, the institutions have been functioning well to link with the communities.

5.2 Problem Animal Control

In adjacent communities to MFPA, the rapidly growing human population and changes in land use have led to increased conflicts between people and wildlife. As there is no policy on compensation for crop damage or injury, local people feel their livelihoods are undermined as the PA economy thrives when their crops or animals are destroyed. Similarly, there are strong complaints that the MFPA management is not sufficiently staffed or equipped to respond when communities need help in controlling problem animals (Murchison Falls Protected Area General Management Plan 2001-2011).

5.3 Revenue Sharing

The Wildlife Statute 1996 provides that 20% of gate entrance fees are given to local communities to be used in funding development projects. The park has disbursed USh.896,396,296 (nearly equal to US$487,453) from July 2002 to June 2009.

The beneficiary communities have undertaken development projects upon consultation with the local leaders. The verbatim quote below illustrates how the communities have benefited.

"20% of the revenue generated by the National Park is given to Purongo sub-county, which is then divided equally among the 45 parishes directly bordering the park. We have benefited greatly from this revenue sharing, for from this revenue we were able to construct Purongo Primary School and Purongo Vocation Technical School, though both of these schools are not yet functional. For example, out of the money that we have received from this revenue sharing, we have been able to put up Lamoki Primary School" (Interview with Purongo sub county officials)

" There is some slight revenue sharing from gate collections which is shared in the communities and for Mutunda sub-county specifically, that money has helped to construct some classrooms like at Nanda primary school and some Maternity ward but now the emphasis has been put on development projects. Each parish gets 8 millions but for the whole of Mutunda only two parishes benefited that is Nyamahasa and Diima because they are neighbouring the park." (Key informant interview Mutunda Sub-county)

5.4 Resource Utilization by Local Communities

The Wildlife Statute 1996 clearly indicates that no resources should be taken from a protected area without the permission of UWA Executive Director. At the same time, UWA considers local community incentives as powerful tools for encouraging and promoting wildlife conservation. One of such incentives is the access to resources within PAs. The challenge for UWA is to meet the ever-increasing needs of expanding local populations for biological resources, and to regulate this resource use with an under-strength workforce. To meet this challenge, Under collaborative management strategy, PA managers may prepare Memoranda of Understanding (MoUs) with communities specifying which resources may be used in what quantities, control mechanisms for resource use, and penalties for violation of the agreement (Murchison Falls Protected Area General Management Plan 2001-2011).

For example, it was noted during interviews with UWA officials that fishing within the national park area whether on River Nile or swamps and streams is an illicit activity that was stopped by the park management in mid 1990's. However, the park management planned to allow sport fishing on sections of the river and has some fishing concessions to some communities so far that spell out in the MoUs "the do's and don'ts". The MoU allows the groups to carry out sport fishing in designated areas and on designated days. Karuma United Fishing Group with 100 members is one example of the groups. One of the key clauses of the MoU is that the fishing groups will work as watch dogs for UWA to prevent others from carrying out illegal fishing within the park and other restricted areas.

The MoUs have clauses which spell out the neighboring communities' roles in conservation of the flora and fauna in the park and what benefits accrue to them. These community groups have the overall responsibility of jointly protecting the park from any illegal activity. In turn the groups are allowed free entry into the park on request from game warden; they also receive 20% revenue from the gate collections. They are given access to fuel wood, grass, medicinal plants, water, green

vegetables, white ants, toad stools and mushrooms and building poles. Despite the concessions to the communities, the park management holds exclusive rights over the park property. This means that any development project near or within the park would require prior consultation and approval from the park management.

It was gathered from the community meetings and interviews with district and sub-county officials that as a result of implementing the collaborative park management policy, the communities have played an instrumental role in protecting and conserving the environment within the park.

5.5 Poaching and Encroachment

According to the baseline survey in 1994 on communities living around the park , hunting for survival on game meat takes place albeit illegally. The Luo were great hunters and they derived most of their livelihood from hunting wild animals especially for food and other animal products like horns, hides and skins. Game meat is a delicacy in the area and is both for domestic consumption and commercial purposes. Some of it is prepared and served in the local restaurants. It was however noted that with the creation of the National Park, hunting especially among the Luo people has gone down in scale since most of the wild game are now protected by the Government and anyone who goes there on hunting expedition does so illegally.

Annex11: Baseline Survey Report <Cultural and Historical Property>

1 Objectives

- To grasp the legal regime on cultural heritage
- To identify the locations of cultural sites that exist in survey area C
- To capture issues concerning ethnicity and culture in survey area C

2 Surveyors

Name	Position	Organization
Mr. Ongwen Dismas	Archaeologist	WSS Services (U) LTD/ Uganda Museum
Mr. Paul Asodio	Assistant Archaeologist	WSS Services (U) LTD.

3 Survey date and area

Date	Area	Surveyors
12th/7/2010	Masindi town Masindi District	Mr. Ongwen Dismas and Mr. Paul Asodio
13th/7/2010	Mutunda Sub-county Kiryandongo District	Mr. Ongwen Dismas and Mr. Paul Asodio
14th/7/2010	Purongo Sub-county Anaka Sub-county Nwoya District	Mr. Ongwen Dismas and Mr. Paul Asodio
15th/7/2010	Aber Sub-county Oyam District	Mr. Ongwen Dismas and Mr. Paul Asodio
16th/7/2010	Myene Sub-county Minakulu Sub-county Oyam District	Mr. Ongwen Dismas and Mr. Paul Asodio
17th/7/2010	Koch Goma Sub-county Nwoya District	Mr. Ongwen Dismas and Mr. Paul Asodio

4 Survey Methods

- Literature Survey
- Interviews and FGD(focus group discussions) with Districts and Sub-counties officers, and communities
- Filed Survey in Area C

5 Survey results

5.1 Distribution map of cultural sites

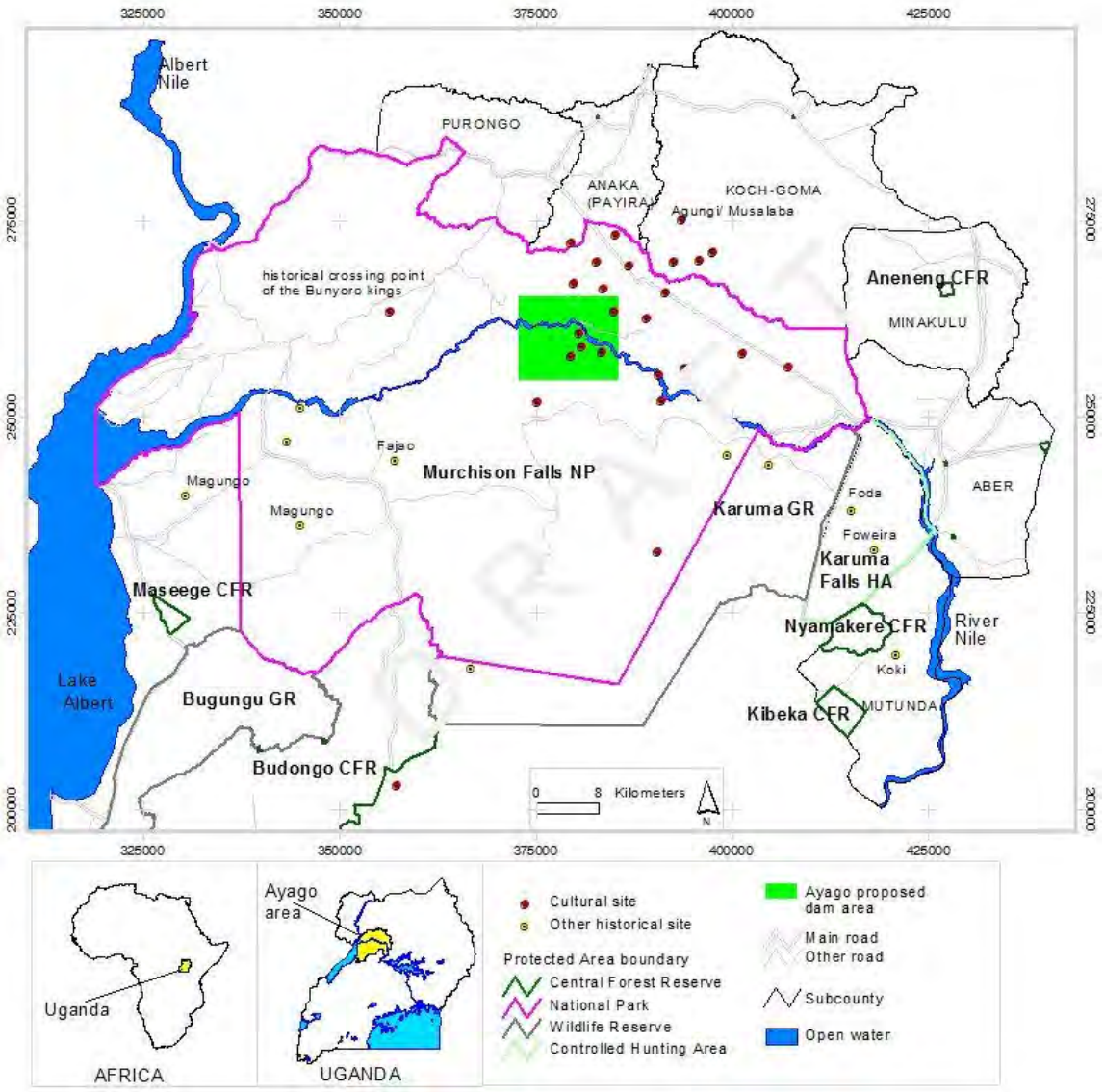


Figure 1 Location of Cultural and Historical Sites around Ayago Site, 2010

5.2 Literature survey results

5.2.1 Ethnic group

The people living within the Murchison Falls National Park and the Karuma -Bugungu Game Reserves are from two major ethnic groups of Luo and the Bantu. The Luo dominate the North and South West while the Bantu occupy the south East and the rest of the areas. The Luo are said to have settled in the area around the 16th century and settled first at the southern bank of the river Nile and later crossed the Nile to Acholi land while the others continued to Bunyoro and formed the Babito dynasty (Richard 1998).

5.2.2 Legal Regime on Cultural Heritage

The umbrella of legislation that exists in the protection of cultural heritage in Uganda is both national and international. The national legal regime stems from the Constitutional provision that specifically provides for the protection of cultural heritage.

- According to the constitution of the Republic of Uganda, under Article 37 every person has a right to belong to, enjoy, practice and profess, maintain and promote any culture, cultural institution or tradition in community with others. Under the National Objectives and Directive Principles of State Policy, the State is obliged under objective XXIV and XXVII to promote protect and preserve cultural values and practices which enhance the dignity and wellbeing of Ugandans.
- Under objective XXV the State is obliged to preserve, promote and generally promote the culture of preservation of public property and Uganda's heritage. The state is also obliged under the objective to promote and implement energy policies that will ensure that people's basic needs and those of environmental protection are met.
- The national legislation pertinent to this work includes The National Environment Act 1995.
- The Historical Monument Act of 1967 and several government policies. This scope of legal network is supplemented by various international treaties where Uganda is signatory.
- The National Environments Act under section 49 defines cultural heritage to include elements, objects and sites in the natural environment which are of cultural importance to the people of Uganda. The Act further specifies the projects that warrant the need to have an impact assessment categorized under the Third schedule to the Act.
- The historic monuments Act is the principle legislation that provides for the conservation and protection of historical monuments or objects archaeological, paleontological, ethnographical and traditional interest. The existing legal regime establishes the requirement to have impact assessment carried out on projects to be undertaken within the country with the objective of protecting the existing cultural heritage.
- This is specifically provided for under the National Environment (Environment Impact Assessment) Regulations, 1998.
- In the international arena, the legal regime basically emanates from the UNESCO World Heritage Convention, 1972) the convention concerning the protection of the world cultural and natural heritage. This convention gives the basis of recommendations developed by experts to conserve cultural heritage. Uganda is member of UNESCO and as such is bound by the recommendation made by the convention in the protection of cultural heritage.

5.3 Interview and Focus Group Discussion results

5.3.1 Interview with Masindi District headquarters

The area is predominantly occupied by the Banyoro and part of the large Bunyoro kingdom. As of the month of June 2010, the population was rated at 72, 000.

The ethnic composition of the area is comprised of about 56 tribes, the predominant are the Bantu and the Luo, The majority of the Luo speaking people are immigrants from the North. The land tenure is a customary tenure system; there is also lease hold tenure system but only subject to restriction on the crops grown. The socio-economic activities carried out in the area are farming, fishing and commerce in urban centers. There is also pastoralism especially among the Barolo.

5.3.2 Interview with Kiryandongo District

The ethnic cultural composition is made up of the Baruli, Chope as the majority tribes while the Baruli , Acholi, Langi, Bagisu form the other score of the various immigrant tribes in the district. This fact suggests that there is lack of cultural homogeneity within the people living in the area.

According to the district officials, each tribe in the area has a distinct cultural tradition and practice this is particularly true for the Acholi people who have resuscitated their traditional folk dances and lore only particular to themselves. Some of these dances include apiti dance, bwola court dance, ding-ding, ladongo after hunting and the lakaraka dances.

It was also stressed by the interviewees that most of the cultural practices and beliefs have been eroded following the advent of religion. They also pointed out that traditionally, burial sites were never cemented or marked as such save for a pillage of stone on the grave yards.

5.3.3 FGD in Mutunda Sub-county

The meeting session at Mutunda involved several members of the community in Mutunda sub-county and the villages in the neighborhood of Mutunda sub-county headquarters. The members in this meeting were women, youth and elders who were consulted on several issues pertaining to their cultural heritage, economic activity.

The people in Mutunda are predominantly agriculturalist practicing peasantry farming and animal husbandry. Traditionally they practiced hunting, pottery and wood crafting especially the making of pounding motors. During the meeting it was pointed out that pottery was mainly practiced at the Juma site. They indulged in making animal snares and traps and had demarcated areas for hunting like the Gwar Wii in Nyamahasa parish and Ayegwe site near Pany dol hill. It was also pointed out that there used to be traditional dances like obwere and the opera dance. The first settlers in the area are the pa luo but there are other tribes like the Acholi langi, teso and the baruli.

The pa luo have three outstanding clans (kaka) that is, pa wi, awora, pajab. the three major clans are further subdivided into over 49 other clans and to include, lubito, lukeno, lubim, okweche, and gaya to mention but a few.

The area was attacked by an epidemic (sleeping sickness) between 1921-23, forcing the people to migrate out of the park into areas of Acholi and Langi. Others, settled around the Karuma area settling along the river up to Masindi Port at River Kafu. The ancestral home of the Paluo was later gazetted as game park and reserve in the 1950s.

Traditionally, the Luo tribesmen (Alur) who settled in this area were proud hunters and cerebrated fishermen. Hunting and fishing was a major source of livelihood. They practiced hunting as an art, made remarkable animal snaring tools and techniques only peculiar to them and aided by divine spiritual intervention. They also practiced farming and hand craft activities to a lesser extent. However the traditional activity of hunting has since dwindled if not completely faded following government policy that outlawed poaching around the game park and reserve.

5.3.4 FGD in Purongo Sub-county

Community meeting was held at Purongo sub-county headquarters that comprised sub-county employees, village chairmen and representatives, teachers, elders and the sub county leadership.

In the opinion of the sub- chief, the area is predominantly Acholi with population of over 70%. All the attendants were born and settlers at Purongo, their economic activities include farming, business, hunting, charcoal burning, blacksmithing, carpentry, construction, weaving, pottery and animal rearing, all the above are done on a subsistence level. Places of cultural significance the Musalaba site at Agungu right from the river Nile bank to Agungu is a historical route where the evangelist and Christian missionaries passed to reach the north. The word Agungu literally means to kneel to pray. It was also learnt that the church of Uganda and the community within the area advocate for the construction of a church at the said site.

The activity of pottery is carried out at Tangi, Kibaa and at Wang Okwot The community benefits from the park thru the shared revenue scheme from which they have managed to build a school. The cultural values of the people include traditional dances like olele and the rak raka dances, traditional practices of rainmaking and stopping of floods known as talo kot. They still practice traditional marriages, they also the practice of tomo kii which is cleansing ritual. The traditional institutions one headed by a clan chief, there are over 56 clans within the Acholi tribe and there burials sites are at a homestead level. The people interviewed admit to having stayed in the park before they were forced out by the authorities following the establishment of the area as a game park, they maintain the notion that their ancestry is traceable within the park area.

5.3.5 5.3.5 FGD in Anaka Sub-county

A community group meeting was held at Anaka Sub County. The majority of the attendants were men hailing from the parishes of Todora, Pudiny, Pangora, Pabiti and Pabulu.

The attendants attested to the fact that they first settled in the park before relocating out of it in the 1950s they used to farm and practiced a lot of hunting the park they had specific hunting zones for both fishing and hunting animals like at on the Ayago River and the Aswa river, at Doc ceke akago and Lagu respectively. They also used to make spears and other rudimentary tools out iron and dumping iron slag commonly known as Cet nyony but have now resorted to the use of scrap materials.

5.3.6 Interview with Minakulu Sub-county chief

Sub-county chief raised the following concerns; there is a need for power in the area as it will lead to the development of the area. He also talked of limited health facilities and schools. There is a need for community sensitization in order to equip the local people with knowledge of what the coming work force may introduce to the area. The LCIII of the area talked of old hunting grounds called 'tim' in the local language, which included; tim omide in Oyoro parish, time obero in Kulu Abora parish, tim Adit in Opuke parish.

5.3.7 Interview with Myene Sub-county officer

The officer pointed out that there is a lot of poverty in the area and the coming of power would be very helpful to the development of the area. The land in the area is customary owned and some of the cultural activities which used to take place are things like hunting but this was brought to an end when the place was turned into a park.

5.3.8 5.3.8 Interview with Aber Sub-county officer and chief

The assistant community development officer mentioned that the area is mainly occupied by langi people and hunting was the major traditional activity practiced by the people. He also pointed out hunting grounds like 'tim' ogole, 'tim' oboro near the park in a place called Pukitia and they used to hunt with spears, nets and trained dogs. The Sub-county chief raised the following questions. How will the project take care of the wild life?, how will the water level be maintained?, how will the project benefit local people in term of jobs. He also talked of site called Tyen Olum at the hill called obuje. The site is characterized by a foot mark of a dog and a person.

5.3.9 5.3.9 Interview with village chief in Kochi Goma Sub-county

The chief in Kal village talked of hunting which used to take place before the area turned into a National park, and local shrines like Tel Awal shrine in Kal parish. The major cultural site in the

area is the home of wrot Lagong France. The home was built by NUSF near his former home which was destroyed by termites.

5.4 Field survey results

The detail information on each cultural site can be found in Field Survey Sheet 1-4. The following points are some of the findings.

Traditionally, the pa luo were spiritual people and had a great attachment to the river, most communities that settled along the river had particular spots at the river bank that were sacred sites where certain rituals were carried out. The river was and still is so important to the locals since it was the prime source of water for domestic use and fish to supplement their food diet. The cultural rituals included ousting evil spirits, thanks giving and attainment of blessings.

This is especially true for communities on the southern bank with such spots located at manana, musurubene, pataka, bedmot, amenya, panymeda and at okweche. In the past all the clan had shrines referred to as abila. Like any other society, people have lost loved ones who were buried in different parts of the project area. It was noted that almost every homestead had at least one burial.

For the purposes of this report, traditional sites comprise palaces and living culture. One should note that palaces may be included in the living culture as they were re-instituted by the 1993 reinstitution of traditional assets. Living culture meaning traditional beliefs and practices that are living and can be passed on to future generation. Cultural trees and cultural rocks were therefore placed under living culture.

The royal burials within the site also justify the cultural significance as a burial ground for previous princes and princesses. It's also an important site for rainmaking rituals in the area. The rainmaking shrine within the site justifies the practice which is still living and need to be carried on to the future generation.

Burials are sensitive sites normally treated with extreme care and respect not only in the local cultures, but world over. It is very important to note the general background of the Northern and west Nile region. For over 20 years, the region was characterized by so many deaths during the rebel activities. This means that some people were buried very close to the road and in some cases others were actually not given a decent burial. There is a general belief that the dead are very much part of the living and that if they are not treated well, they come back to haunt the living, this is true in most parts of the country as people attach too much value to the spiritual world.

Annex 12: Baseline Survey Report <Archaeology>

1 Objectives

- To identify the locations of archaeological sites that exist in survey area B
- To examine the level of importance of each site

2 Surveyor

Name	Position	Organization
Mr. Ongwen Dismas	Archaeologist	WSS Services (U) LTD/ Uganda Museum
Mr. Paul Asodio	Assistant Archaeologist	WSS Services (U) LTD.

3 Survey period and area

Date	Area	Surveyors
26th/7 - 3rd /8 /2010	Survey area B	Mr. Ongwen Dismas and Mr. Paul Asodio

4 Survey Methods:

- Literature review
- Interview with Murchison Falls National Park Community Conservation Liaison Office Masindi and Uganda wildlife offices
- Archaeological survey (Field survey): Field personnel walked across the study area which is the proposed project area collecting data. The method of data collection included; observations, recording, photographing, and documenting all identified cultural materials, and other environmental features.
- Ethno-archaeological study through FGD: meeting and interviews with the local people was the major source of information about the impact of the project on the current socio-cultural lives of the people living in and around the area.
- Data analysis; The team will sort out and study the types of diagnostic cultural materials e.g. ceramics, fossils, stone tools etc, in numbers and types.

5 Survey Results

5.1 Distribution map of archaeological sites

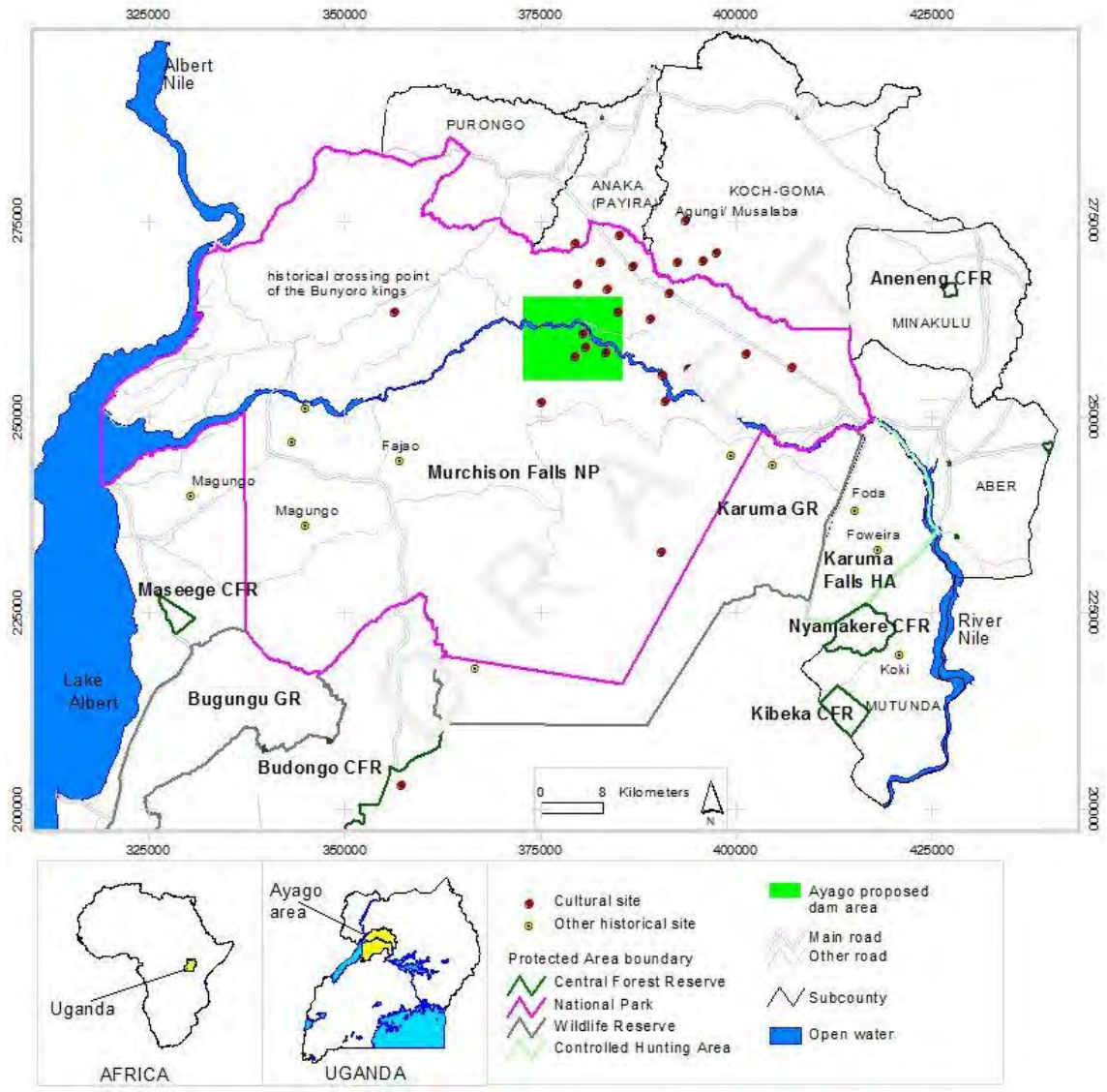


Figure 1 Location of Cultural/Historical and Archaeological Sites around Ayago Site, 2010

5.2 Literature survey results

The Luo are part of the people from the southern Sudan. The migration brought changes during the 15th century with the Acholi people and with intermarriage. The Langi lost their Ateker language and migrated closer to the Lake Kyogo in the 18th century after living more than two hundred years in the Acholi region. They lost the system of pastoralism and began to speak Luo. Their origins were not the Luo but rather the Nilo-Hamites.

The Luo marked the last influence on the already settled population in the region in the West Nile and in northern and eastern Uganda. They introduced their language, culture and some animals and crops. The concept of the empaako name is of Luo origin, hence is the system of centralized states.

They founded the Bunyoro-Kitara kingdom that was established after the collapse of the Bachwezi dynasty (Connah, 1996) (Mbaga, 1998) (Dundar, 1968). Some of the major traditional activities include pot making, iron production, hunting, and fishing.

5.3 Interview results

5.3.1 1 Interview with Murchison Falls National Park Community Conservation Liaison Office

According to the officer, there are several historical sites within the park area and these include:-

- Gulu site,
- Pakuba,
- Wang Kwa
- Lebito Escarpment
- Bbisso
- Kakonko of the Chwezi
- Musalaba at Purongo
- Chobe site the old stone age site near ayago
- Swingiri belonging to the Aria clan who are the descendants of king Awichi.
- The Pabidi site

All the above mentioned sites profess a great deal of cultural heritage worth of protection and conservation

5.4 5.4 Archaeological survey results

The detailed information on each archaeological site can be found in Field Survey Sheet 5-34. The following points are some of the findings.

The evidence of time and the contributions of all periods should be respected in conservation. The material of a particular period may be obscured or removed if assessment shows that this would not diminish the archaeology or cultural heritage value of the place. In these circumstances such material should be documented before it is obscured or removed. The area of interest has missed on out on recent research which other region without war enjoyed, which means that we have to get archaeological information from whatever evidence we can get. The surface pottery scatters are common feature in the area, however not much information could be analyzed since they were not excavated to find the profile depth. It is very hard to relay on surface find to determine the significance of the site, however one can say that some sites have potential for further studies based on the fact of high density finds.

There were no features recovered or seen by the assessment team indicating the existence of paleontological sites in project area, however this does not mean non-existence of paleontology in the area.

5.5 Ethno-archaeological study results

Surface iron slag is localized to few places. The local people interviewed could not point out the time iron smelting was done in the area, which points to loss of information which can only be recovered through archaeological work. They were, however, aware of the activities of black smiths which were more recent. The local people gave so much attention to blacksmith activity with a mythology of health problems associated with it, the community pointed out that such problems could be removed after rituals are made. The main products in the blacksmithing are spears, knives and other home tools.

Reference:

Connah, G. (1996). Kibiro"The salt of Bunyoro, past and present. London: BIEA.

Dundar, A. (1968). A History of Bunyoro- Kitara. Nairobi: Oxford University press.

Mbaga, R. N. (1998). People and Cultures of Uganda. Kampala

Field Survey Sheet <Culture and Archaeology> 1

Name of the place: Kajura Monument

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) MTC (Parish) Western Ward
Survey date	12 / July / 2010
Survey time	Morning
GPS Coordination	N 01˚41'55.9'', E 031˚42'26.9'
Number in Map	CL site 1
Description of place	The Kajura monument is where Sir Samuel Baker met with Kabalega the omukama of Bunyoro in the late 19th century.
Picture	
Heritage status/ Importance of the place	This is not a national heritage. However, it is worth protection and conservation.
Category	Needs to be preserved.

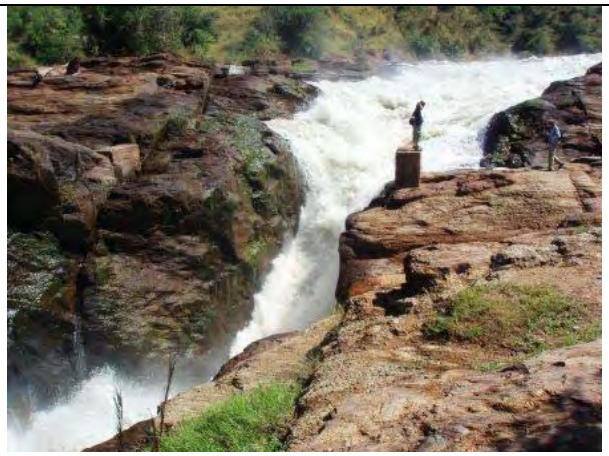
Field Survey Sheet <Culture and Archaeology> 2

Name of the place: Manana Spiritual Site

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Mutunda (Parish) Diima
Survey date	27 / May / 2010
Survey time	Afternoon
GPS Coordination	N 02˚ 14’ 69.8”; E 032˚ 15’11.2
Number in Map	CL site 2
Description of place	Traditionally, the pa luo were spiritual people and had a great attachment to the river, most communities that settled along the river had particular spots at the river bank that were sacred sites where certain rituals were carried out. The cultural rituals included ousting evil spirits, thanks giving and attainment of blessings.
Picture	
Heritage status / Importance of the place	This is not a national heritage. However, The river was and still is important to the locals since it is the prime source of water for domestic use and fish to supplement their food diet. The site is no longer in use on regular basis.
Category	Need to be preserved.

Field Survey Sheet <Culture and Archaeology> 3

Name of the place: Top of the Falls

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	February / 2010
Survey time	Afternoon
GPS Coordination	N 02˚16'42.0'', E 031˚41'09.3''
Number in Map	His 1
Description of place	The historical crossing point of the Bunyoro kings. The crossing point is located at a narrow point just above the Murchison falls called "top of the falls" by the local people. It is the most attractive place for tourists.
Picture	
Heritage status / Importance of the place	It is a site recognized by Bunyoro Kingdom and the park management, but not by the Government of Uganda.
Category	Needs to be preserved.

Field Survey Sheet <Culture and Archaeology> 4

Name of the place: Agungi/ Musalaba

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Amuru (Sub-county) Purungo (Parish)Pabali
Survey date	26 / July / 2010
Survey time	Afternoon
GPS Coordination	N 02˚29’01.8’’, E 031˚55’45.6’’
Number in Map	His 2
Description of place	According to information from FGD, it is the location where the first missionaries in the region prayed in 1903. The site is characterized by a Christian cross with the bass made out of cement and a metallic cross on the top.
Picture	
Heritage status / Importance of the place	Not gazzetted by the Government but recognized by the local people.
Category	Needs to be preserved

Field Survey Sheet <Culture and Archaeology> 5

Name of the place: Park site 1

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	30 / July / 2010
Survey time	8:30am
GPS Coordination	N:02˚19’15.1’’, E:031˚55’03.1’’
Number in Map	Pk site 1
Description of place	It is in an open grass land type of vegetation .The site is characterized by pottery scatters of KPR decoration type.
Picture	
Heritage status / Importance of the place	Not known
Category	Needs to be investigated.

Field Survey Sheet <Culture and Archaeology> 6

Name of the place: Park site 2

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	30 / July / 2010
Survey time	8:50 am
GPS Coordination	N: 02˚18’58.3’’, E: 031˚55’00.1’’
Number in Map	Pk site 2
Description of place	An open area which looks like a watering point for the wild life, the site is characterized by a very high density pottery scatters of different types some seen 40cm below the surface.
Picture	
Heritage status / Importance of the place	Not known
Category	Needs to be investigated

Field Survey Sheet <Culture and Archaeology> 7

Name of the place: Park site 3

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	30 / July / 2010
Survey time	9:50 am
GPS Coordination	N:02˚17’56.4’’, E: 031˚ 55’42.4’’
Number in Map	Pk site 3
Description of place	Located by the road side in an open area. The site is characterized by pottery exposure of mostly roulette decoration types.
Picture	
Heritage status / Importance of the place	May not be important as the pottery type is common
Category	Can be ignored

Field Survey Sheet <Culture and Archaeology> 8

Name of the place: Park site 4

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	30 / July / 2010
Survey time	10:25 am
GPS Coordination	N: 02˚5’00.3’’, E: 031˚52’01.0’’.
Number in Map	Pk site 4
Description of place	This archaeological site is found by the animal watering point evidenced by pottery and lithics scatters.
Picture	
Heritage status / Importance of the place	May not be important as the pottery type is of un diagnostic type.
Category	Can be ignored

Field Survey Sheet <Culture and Archaeology> 9

Name of the place: Park site 5

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	30 / July / 2010
Survey time	11:04am
GPS Coordination	N: 02˚ 15 ’10.0’’, E: 031˚52’03.8’’
Number in Map	Pk site 5
Description of place	A few pottery scatters in an open ground with no vegetation cover.
Picture	
Heritage status / Importance of the place	May not be important as the pottery finds were not that many.
Category	Can be ignored.

Field Survey Sheet <Culture and Archaeology> 10

Name of the place: Park site 6

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	30 / July / 2010
Survey time	11:23am
GPS Coordination	N: 02˚15’21.7’’, E: 031˚51’59.9’’
Number in Map	Pk site 6
Description of place	It is characterized by a mixture of decorated pottery types but in low density located.
Picture	
Heritage status / Importance of the place	Not in the Government registry and not much is known about the site.
Category	Needs to be investigated

Field Survey Sheet <Culture and Archaeology> 11

Name of the place: Park site 7

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	30 / July / 2010
Survey time	am
GPS Coordination	N: 02˚51'30.4'', E: 031˚52'08.4''.
Number in Map	Pk site 7
Description of place	Evidenced by pottery and a polished stone tool , found near a small river and exposed by animal activities.
Picture	
Heritage status / Importance of the place	Not registered by the Government department but the site could be useful to archaeological research.
Category	Needs to be investigated

Field Survey Sheet <Culture and Archaeology> 12

Name of the place: Park site 8

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	30 / July / 2010
Survey time	12:25pm
GPS Coordination	N: 02˚15’11.1’’, E: 031˚52’55.4’’
Number in Map	Pk site 8
Description of place	Located just by the road side and the site is characterized archaeological pottery scatters of different types , with some lithics
Picture	
Heritage status / Importance of the place	Not registered by the Government department but the site could be useful to archaeological research.
Category	Needs to be investigated

Field Survey Sheet <Culture and Archaeology> 13

Name of the place: Park site 9

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	30/ July / 2010
Survey time	1:45pm
GPS Coordination	N: 02˚19'07.1'', E: 031˚55'12.8''
Number in Map	Pk site 9
Description of place	It is characterized by fairly high density pottery scatters.
Picture	
Heritage status / Importance of the place	Not registered by the Government department but the site could be useful to archaeological research.
Category	Needs to be investigated

Field Survey Sheet <Culture and Archaeology> 14

Name of the place: Park site 10

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	30 / July / 2010
Survey time	2:30 pm
GPS Coordination	N: 02˚18’51.2’’, E:031˚54’58.9’’
Number in Map	Pk site 10
Description of place	It covers about 200/100m2 and is characterized by different pottery types and blocks of iron slag.
Picture	
Heritage status / Importance of the place	Not registered by the Government department but the site could be useful to archaeological research.
Remarks	Needs to be investigated

Field Survey Sheet <Culture and Archaeology> 15

Name of the place: Park site 11

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	30 / July / 2010
Survey time	2:49 pm
GPS Coordination	N: 02˚18’41.3’’, E:031˚55’01.0’’.
Number in Map	Pk site 11
Description of place	The site is evidenced by lots of archaeological materials in pottery and a piece of smocking pipe spread in an area of about 100m2.
Picture	
Heritage status / Importance of the place	Not registered by the Government department but the site could be useful to archaeological research.
Category	Needs to be investigated

Field Survey Sheet <Culture and Archaeology> 16

Name of the place: Park site 12

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	30 / July / 2010
Survey time	Afternoon
GPS Coordination	N: 02˚19’00.2’’, E: 031˚54’52.8’’.
Number in Map	Pk site 12
Description of place	The site is demonstrated by pottery find mixed with a few lithic scatters.
Picture	No picture of the site or finds was taken.
Heritage status / Importance of the place	Not registered by the Government department. The site has low density finds.
Category	Can be ignored

Field Survey Sheet <Culture and Archaeology> 17

Name of the place: Park site 13

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	30 / July / 2010
Survey time	Afternoon
GPS Coordination	N: 02˚18’48.9’’, E: 031˚54’29.6’’.
Number in Map	Pk site 13
Description of place	Two pieces of pottery are found in an over grazed part of the park.
Picture	No picture of the site or finds was taken.
Heritage status / Importance of the place	Not registered by the Government department.
Category	Can be ignored

Field Survey Sheet <Culture and Archaeology> 18

Name of the place: Park site 14

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	30 / July / 2010
Survey time	3:59pm
GPS Coordination	N: 02˚19’05.4’’, E: 031˚55’00.0’’.
Number in Map	Pk site 14
Description of place	The site is characterized by pottery finds, quarts, and lithics scatters.
Picture	
Heritage status / Importance of the place	Not registered by the Government department and not much information could be got from the surface collection.
Category	Needs to be investigated

Field Survey Sheet <Culture and Archaeology> 19

Name of the place: Park site 15

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	30 / July / 2010
Survey time	4:20pm
GPS Coordination	N: 02˚20’27.5’’, E: 031˚55’13.2’’.
Number in Map	Pk site 15
Description of place	The site is evidenced by a few scatters of pottery and a grinding stone.
Picture	
Heritage status / Importance of the place	Not registered by the Government department and not much information could be got from the surface collection.
Category	Needs to be investigated

Field Survey Sheet <Culture and Archaeology> 20

Name of the place: Park site 16

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	30 / July / 2010
Survey time	Afternoon
GPS Coordination	N: 02˚20’42.5’’, E: 031˚55’58.1’’.
Number in Map	Pk site 16
Description of place	Is demonstrated by a low density scatters of pottery at the slope towards the river.
Picture	No picture of the site or finds was taken.
Heritage status / Importance of the place	Not registered by the Government department and not much information could be got from the surface collection.
Category	Needs to investigated

Field Survey Sheet <Culture and Archaeology> 21

Name of the place: Park site 17

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	30 / July / 2010
Survey time	Afternoon
GPS Coordination	N: 02˚20’38.4’’, E: 031˚56’04.6’’.
Number in Map	Pk site 17
Description of place	It is characterized by a few shell fish remains by the river side most of which are stark on the rocks.
Picture	
Heritage status / Importance of the place	Not registered by the Government department and not much information could be got from the surface collection.
Category	Needs to be investigated

Field Survey Sheet <Culture and Archaeology> 22

Name of the place: Park site 18

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	31/ July / 2010
Survey time	8:08 am
GPS Coordination	N: 02˚19’09.2’’, E: 031˚55’04.3’’.
Number in Map	Pk site 18
Description of place	It is characterized by pottery finds exposed by soil erosion.
Picture	
Heritage status / Importance of the place	Not registered by the Government department and not much information could be got from the surface collection.
Category	Needs to be investigated

Field Survey Sheet <Culture and Archaeology> 23

Name of the place: Park site 19

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Masindi (Sub-county) Murchison Falls National Park (Parish)None
Survey date	31/ July / 2010
Survey time	8:55am
GPS Coordination	N: 02˚16'39.2'', E: 031˚55'31.1''.
Number in Map	Pk site 19
Description of place	Located by the road side in a pit formally used as a source of marram for the road works (borrow pit). The site is characterized by different pottery types mixed with gravels at the banks of the borrow pit.
Picture	
Heritage status / Importance of the place	Not registered by the Government department and not much information could be got from the surface collection.
Category	Need to be investigated

Field Survey Sheet <Culture and Archaeology> 24

Name of the place: Northern Bank 1

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Amuru (Sub-county) Koch Goma (Parish)Lii
Survey date	31/ July / 2010
Survey time	9:36am
GPS Coordination	N: 02˚14'31.1'',E: 032˚08'11.8''
Number in Map	NB site 1
Description of place	The site is spread and exposed at the air strip constructed by the Chobe lodge management. This archaeological site is one of the sites worked on in the region by a number of researchers which led to the naming of pottery type called chobe ware. The site is characterized by pottery scatters.
Picture	
Heritage status / Importance of the place	Not registered by the Government department and not much information could be got from the surface collection.
Category	Need to be investigated

Field Survey Sheet <Culture and Archaeology> 25

Name of the place: Northern Bank 2

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Amuru (Sub-county) Murchison Falls National Park (Parish)None
Survey date	1/ August / 2010
Survey time	Morning
GPS Coordination	N: 02˚19'06.6'', E:032˚06'04.4''
Number in Map	NB site 2
Description of place	Low density scatter of pottery exposed by the road works along the road.
Picture	No picture of the site or finds was taken.
Heritage status / Importance of the place	Not registered by the Government department and not much information could be got from the surface collection.
Category	Can be ignored

Field Survey Sheet <Culture and Archaeology> 26

Name of the place: Northern Bank 3

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Amuru (Sub-county) Murchison Falls National Park (Parish)None
Survey date	1/ August / 2010
Survey time	Morning
GPS Coordination	N: 00˚05'18.8'', E: 033˚45'00.5''.
Number in Map	NB site 3
Description of place	It is characterized by very think pottery pieces mixed with marram dag during the road excavation works. (Borrow pit).
Picture	No picture of the site or finds was taken.
Heritage status / Importance of the place	Not registered by the Government department and not much information could be got from the surface collection
Category	Need to be investigated

Field Survey Sheet <Culture and Archaeology> 27

Name of the place: Northern Bank 4

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Amuru (Sub-county) Murchison Falls National Park (Parish)None
Survey date	1/ August / 2010
Survey time	Morning
GPS Coordination	N: 02˚21'19.9'', E: 031˚57'26.8''
Number in Map	NB site 4
Description of place	The site is evidenced by different pottery types covering over 250m2 with high concentrations in some points and red orca.
Picture	No picture of the site or finds was taken.
Heritage status / Importance of the place	Not registered by the Government department but the site has high potential for research hence, an important site.
Category	Need to be investigated

Field Survey Sheet <Culture and Archaeology> 28

Name of the place: Northern Bank 5

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Amuru (Sub-county) Murchison Falls National Park (Parish)None
Survey date	1/ August / 2010
Survey time	Morning
GPS Coordination	N: 02˚22'38.0'', E: 031˚55'18.3''
Number in Map	NB site 5
Description of place	Located in a savannah kind of grassland Pottery finds exposed by soil erosion, a few grinding stones were also seen at the same location.
Picture	No picture of the site or finds was taken.
Heritage status / Importance of the place	Not registered by the Government department but the site has low potential for research hence, not important site.
Remarks	Can be ignored

Field Survey Sheet <Culture and Archaeology> 29

Name of the place: Northern Bank 6

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Amuru (Sub-county) Murchison Falls National Park (Parish)None
Survey date	1/ August / 2010
Survey time	Morning
GPS Coordination	N:02˚ 23’20.1’’, E: 031˚51’59.7’’.
Number in Map	NB site 6
Description of place	Very low density scatter of pottery finds located at the top of the hill, mostly non diagnostic types.
Picture	No picture of the site or finds was taken.
Heritage status / Importance of the place	Not registered by the Government department but the site has low potential for research hence, not important site
Category	Can be ignored

Field Survey Sheet <Culture and Archaeology> 30

Name of the place: Northern Bank 7

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Amuru (Sub-county) Murchison Falls National Park (Parish)None
Survey date	1/ August / 2010
Survey time	Afternoon
GPS Coordination:	N: 02˚ 21'11.7'', E: 031˚ 57'05.9''.
Number in Map	NB site 7
Description of place	The site is characterized by wide spread of pottery finds with possible stone tools.
Picture	No picture of the site or finds was taken.
Heritage status / Importance of the place	Not registered by the Government department but the site has potential for research.
Category	Need to be investigated

Field Survey Sheet <Culture and Archaeology> 31

Name of the place: Northern Bank 8

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Amuru (Sub-county) Murchison Falls National Park (Parish)None
Survey date	1/ August / 2010
Survey time	Afternoon
GPS Coordination	N: 02˚20'38.4'', E: 031˚57'02.6''
Number in Map	NB site 8
Description of place	It is located in the forested part of the river side. The pottery finds seem to have been exposed by soil erosion.
Picture	No picture of the site or finds was taken.
Heritage status / Importance of the place	Not registered by the Government department but the site has low potential for research.
Category	Can be ignored.

Field Survey Sheet <Culture and Archaeology> 32

Name of the place: Northern Bank 9

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Amuru (Sub-county) Murchison Falls National Park (Parish)None
Survey date	1/ August / 2010
Survey time	Afternoon
GPS Coordination	N: 02˚20’32.1’’, E: 031˚56’58.1’’
Number in Map	NB site 9
Description of place	In the forest, just after a steep slope above river Achoro, the team recorded a pottery site exposed by soil erosion activity.
Picture	No picture of the site or finds was taken.
Heritage status / Importance of the place	Not registered by the Government department but the site has potential for research.
Category	Need to be investigated

Field Survey Sheet <Culture and Archaeology> 33

Name of the place: Northern Bank 10

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Amuru (Sub-county) Murchison Falls National Park (Parish)None
Survey date	2/ August / 2010
Survey time	1:42pm
GPS Coordination	N: 02˚23’49.4’’, E: 031˚53’20.7’’
Number in Map	NB site 10
Description of place	Just off the road, we recorded an iron smelting site with some pottery scatters. Others finds include pieces of iron slag, tuyere and possible furnace pieces.
Picture	
Heritage status / Importance of the place	Not registered by the Government department but the site has potential for research.
Category	Need to be investigated

Field Survey Sheet <Culture and Archaeology> 34

Name of the place: Northern Bank 11

Surveyors	Mr. Ongwen Dismas and Mr. Paul Asodio
Survey area	(District) Amuru (Sub-county) Murchison Falls National Park (Parish)None
Survey date	1/ August / 2010
Survey time	Afternoon
GPS Coordination	N: 02˚24’43.3’’, E: 031˚49’04.2’’
Number in Map	NB site 11
Description of place	The site characterized by different pottery types, and iron slag pieces, near a marram borrow pit.
Picture	No picture of the site or finds was taken.
Heritage status / Importance of the place	Not registered by the Government department but the site has potential for research.
Category	Need to be investigated

Appendix E

Guideline for Stakeholders Meeting and Information Disclosure & Instruction for Environmental Database

LIST OF CONTENTS

Appendix E-1:
Guideline for Stakeholders Meeting and Information Disclosure

1. Objective and Target of Guideline

1.1 Objective

This guideline shows necessary procedures for stakeholders meeting and information disclosure on hydropower development project in Uganda.

1.2 Users

The users of the guideline are the persons in charge of environment and social consideration at MEMD (Ministry of Energy and Mineral Development).

1.3 Target Project

The target projects of the guideline are hydropower development and its related projects. They include the construction of power plants and transmission lines and the extension of power plants which require EIA process.

1.4 Target Period

The guideline can be applied at several stages such as EIA（Environmental Impact Assessment）, RAP (Resettlement Action Plan). EMP（Environmental Management Plan）, during construction and operation.

2. Basic Conditions for Stakeholders Meeting

2.1 Timing for Stakeholders Meeting

Stakeholders meetings should be conducted at all stages from F/S to operation. NEMA (National Environment Management Authority) established the EIA Public Hearing Guidelines in 1999, which provide when and how to conduct stakeholders meetings. Although it is not legally enforced, stakeholders meetings are usually conducted during RAP, EMP and EMS.

Table E-1 Timing for Stakeholders Meetings

Stage	Environment Consideration	Objective	Conditions in Uganda	Conditions by JICA		
				Category A	Category B	Category C
F/S	EIA	Explanation of draft EIA/ TOR and public hearing	Necessary	Necessary	If necessary	Not necessary
F/S	EIA	Explanation of survey results	Necessary	If necessary	If necessary	Not necessary
F/S	EIA	Explanation of draft EIA report and public hearing	Necessary	Necessary	If necessary	Not necessary
D/D	RAP	Explanation of draft RAP				
D/D	EMP	Explanation of draft EMP				
Construction	EMS	Explanation of monitoring results and measures taken	Necessary			
Operation	EMS	Explanation of monitoring results and measures taken	Necessary			

2.2 Different Objectives of Stakeholders Meetings at Different Stages

Stakeholders meetings have different objectives at different timing. The objectives of each stage are described below.

2.2.1 Draft EIA/TOR

Objectives

There are four objectives for stakeholders meeting when draft EIA/TOR is formulated.

1) To make stakeholders understand the project plan
2) To add more items to research plan by hearing stakeholders' opinions
3) To add more items to impact assessment y hearing stakeholders' opinions
4) To identify to what extent can stakeholder accept the possible impacts

Target Stakeholders

Target stakeholders are any people or groups who may be affected by the project and who are interested in the project. For example, people who may be affected by resettlement or land acquisition, NGOs which are working for environment and the representative of ethnic group in the affected area are the possible stakeholders.

E,g,) Stakeholders of Ayago hydropower development project

Related authorities (National Environment Management Authority, Uganda Wildlife Authority, Electricity Regulatory Authority, National Forest Authority), Ministries (Ministry of Local Government, Ministry of Tourism, Trade and Industry, Ministry of Water, Lands and Environment), Public Energy Corporation (UETCL, UEGCL), Public Water Corporation (National Water and Sewerage Corporation), Local Governments (District, Sub-county, Municipality, Parish, Village), NGO(Uganda Wildlife Society, Africa Institute of Energy

Governance), the representative of kingdoms, the representative of neighboring countries, donors, media (New Vision, Monitor, The Reporter, Red pepper, EB/TV, TV)

Materials to be prepared

PowerPoint materials, handouts, a questionnaire and reference materials should be prepared. Handouts include project plan, research plan, items for impact assessment, and schedule of F/S and EIA. Reference materials include draft EIA/TOR and big maps which show inundation area and location of facilities.

Features of questions and answers

In some cases, local people show some concern about the impacts which are not related to the project. However, if many people are worried about the same impacts, it is better to include them into assessment items. Also, it is necessary to ask the reasons why they are concerned. If there is an assessment items which will be highly affected by the project without clear environment criteria, it is better to ask stakeholder “to what extent can you accept the impacts ?”

2.2.2 EIA Survey Result

Objectives

There are four objectives of stakeholders meeting which is held after the baseline survey.

1) To inform stakeholders the result of the baseline survey
2) To add more items to impact assessment by hearing stakeholders’ opinions
3) To remove items from impact assessment by hearing stakeholders’ opinions
4) To identify mitigation measures by hearing stakeholders’ opinions

Materials to be prepared

PowerPoint materials, handouts, a questionnaire and reference materials should be prepared. Handouts have to show the results of all survey items. Reference materials include big maps or computers which shows the results of the survey results easily.

Features of questions and answers

If there are new concerns after the survey results are informed, it is better to add them into assessment items through the discussion with the stakeholders.

2.2.3 Draft EIA Report

Objectives

The objectives of stakeholders meeting at the formulation stage of draft EIA report are shown bellow.

1) To make stakeholders understand the area, degree and period of possible impacts
2) To make stakeholders understand the area, degree and period of mitigation measures

3) To let stakeholders judge whether the final impacts can be within acceptable degree or not
4) To identify the contents which are necessary to be changed or added by hearing stakeholders' opinions

Target Stakeholders

Target stakeholders are any people or groups who may be affected by the project and who are interested in the project. For example, people who may be affected by resettlement or land acquisition, NGOs who are working for environment and the representative of ethnic group in the affected area are the possible target stakeholders.

Materials to be prepared

PowerPoint materials, handouts, a questionnaire and reference materials should be prepared. Handouts include summary of draft EIA. Reference materials include big maps which show the areas and extent of possible impacts.

Features of questions and answers

If the final impacts are beyond acceptable degree by stakeholders, it is necessary to identify its reasons and to discuss new mitigation plan within the acceptable degree. Also, it is possible to take stakeholders for site visit at project area or other on-going project.

2.2.4 Draft RAP

Objectives

The objectives of stakeholders meeting at the formulation stage of draft RAP are shown bellow.

1) To make stakeholders understand the compensation plan
2) To get the consensus on the compensation plan through the discussion with stakeholders

Target Stakeholders

Affected people who may get compensation from the project

Materials to be prepared

PowerPoint materials, handouts, a questionnaire and reference materials should be prepared. It is better to prepare several copies of draft RAP for reference, so that stakeholders can easily look at it.

Features of questions and answers

It is rare that stakeholders agree to the contents of RAP at the first meeting. Usually, the meetings are hold over and over again to get the final consensus.

2.2.5 Draft EMP

Objectives

The objectives of stakeholders meeting at the formulation stage of draft EMP are shown bellow.

1) To make stakeholders understand the summary of draft EMP
2) To make stakeholders understand their roles and responsibilities
3) To hear stakeholders' opinion about monitoring items, roles and responsibilities

Target Stakeholders

Target stakeholders are the representatives of affected people and groups, and the persons in charge of monitoring and evaluation. For example, project implementers, NEMA, UWA, NFA, Directorate of Water Development and the representatives of Districts are the possible stakeholders.

Materials to be prepared

PowerPoint materials, handouts, a questionnaire and reference materials should be prepared.

Features of questions and answers

The stakeholders' opinions should be reflected to EMP. The meetings are hold over and over again to get the final consensus. It is better to take all participants for the site visit to project area, if necessary.

2.2.6 During Construction

Objectives

The objectives of stakeholders meeting during construction are shown bellow.

1) To make stakeholders understand the monitoring results
2) To hear stakeholders' suggestions on the mitigation plan

Target Stakeholders

Target stakeholders are the representatives of affected people and groups, and the persons in charge of monitoring and evaluation of EMS. For example, project implementers, NEMA, UWA, NFA, Directorate of Water Development and the representatives of Districts are the possible stakeholders.

E.g.) Stakeholders who participated the monitoring committee of Bujagali hydropower development project:
NEMA、UWA、NFA、Ministry of Water and Environment、Ministry of Gender, Labour and Social Welfare、Ministry of Tourism, Trade and Industry 、UEGCL、UETCL、District Environment Office

Materials to be prepared

PowerPoint materials, handouts, EIA report, EMP, monitoring report should be prepared. It is better to prepare the past monitoring reports and questionnaires for monitoring.

Features of questions and answers

The stakeholders' opinions should be reflected to the revised EMP. If necessary, the site visit can be held to check the environmental conditions and the progress of mitigation.

2.2.7 During Operation

Objectives

The objectives of stakeholders meeting during operation are shown bellow.

1) To make stakeholders understand the monitoring results
2) To hear stakeholders' suggestions on the mitigation

Target Stakeholders

Target stakeholders are the representatives of affected people and groups, and the persons in charge of monitoring and evaluation of EMS. For example, project implementers, NEMA, UWA, NFA, Directorate of Water Development and the representatives of Districts are the possible stakeholders.

Materials to be prepared

PowerPoint materials, handouts, EIA report, EMP, monitoring report should be prepared. It is better to prepare the past monitoring reports and questionnaires for monitoring.

Features of questions and answers

The stakeholders' opinions should be reflected to the revised EMP. If necessary, the site visit can be held to check the environmental conditions and the progress of mitigation.

2.3 Proper Response to Stakeholders

- Language: It is better to use local language as much as possible. Both English and local language can be used at stakeholders meeting.
- Ways to get more opinions: Some stakeholders cannot talk in front of many people. Also, there is a tendency that it is difficult to express their opinions in front of their boss, elders or anyone who has a power. Therefore, it is better to ask the participants to write their opinions or talk individually during free discussion time, in order to get more opinions from them.

2.4 Information Disclosure and Advertisement

Basically, all information at stakeholders meeting should be disclosed.

2.4.1 Information Disclosure through Website

It is recommended that the project should establish its website to provide information at all stages from EIA to operation. Information to be disclosed includes the followings.

- Advertisement for stakeholders meetings
- Records of stakeholders meetings including handouts
- TOR/EIA, EIA report, RAP, EMP, monitoring reports
- Progress of the project

2.4.2 Advertisement through Media

To those who cannot access to internet, it is better to advertise for stakeholders meeting through media such as radio and newspapers as well as invitation letters.

2.4.3 Establishment of Information Centre

To those who cannot participate in stakeholders meetings or cannot get information timely through media, it is better to establish an information centre. The centre can be located at MEMD during F/S and D/D and can be at project site during construction and operation.

3. Procedures for Stakeholders Meeting

3.1 Preparation of Presentation Materials

It is recommended that the preparation of presentation materials should start around one and a half months before the stakeholders meeting. It is better to include some pictures, drawings, tables and charts to avoid technical terms, so that local people can easily understand the contents.

3.2 Selection of Venue

The venue should be selected around one month before the meetings. It is important to consider the access of participants from their residence to the venue. If necessary, the meetings can be divided into several times at parish or village levels.

3.3 Set Date and Time

It is recommended to set date and time around one month before the meeting. It is better to consider national holidays, religious events and working time in Uganda.

3.4 Selection of Participants

The participants should be selected around one month before the meeting. It is important to consider the participation of ethnic groups, women, elderly and persons with disabilities.

3.5 Advertisement

The advertisement should be started around three weeks before the meeting. The information should be reached to all participants through website, newspapers, radio and posters.

3.6 Invitation Letters

The invitation letters should be sent to the participants around three weeks before the meeting. A sample letter is shown in Annex 1.

3.7 Review of Presentation Materials

It is recommended to review and revise the presentation materials according to the characteristics of the participants around two weeks before the meeting. If necessary, the materials should be translated to local language.

3.8 Preparation of Handouts, Questionnaire and Reference Materials

It is recommended that handouts, a questionnaire and reference materials are prepared around two weeks before the meeting. A sample of questionnaire is shown in Annex 2.

3.9 Conduct of Stakeholders Meeting

A sample agenda for the meeting is shown in Annex 3. It is better to record the discussion through memo, camera and video during the meeting.

3.10 Minutes of Meeting

It is recommended that minutes of meeting is prepared just after the meeting. If possible, the draft of the minutes should be checked by some stakeholders.

3.11 Reflection to Project

The information and stakeholders' suggestions acquired during the meeting should be reflected to the reports or the implementation of the project.

3.12 Information Disclosure on Results

The handouts, minutes of meetings, the revised reports and the suggestions which were implemented by the project should be disclosed through website and at information centre.

Annex 1 Sample Invitation Letter of Stakeholders Meeting

Reference No.……
Date…….
Address……..

RE: **HY DROPOWER DEVELOPMENT MASTER PLAN STUDY BY JICA**

The Government of Uganda with technical assistance from the Government of Japan through JICA is carrying out a Hydropower Development Master Plan Study in Uganda that will articulate development plans of the selected Hydropower projects for the period of 15 years within the framework of Energy Sector Development Strategy.

The Study Team is in the country to carry out further studies on the sites and also hold the Second Stakeholders Meeting. During this meeting, the stakeholders will be given an update the progress of the planned developments and activities and solicit their input in to the process.

The purpose of this letter therefore is to inform you of the developments and to invite you to this Stakeholders Meeting. For more information please contact……

Name …….. …….
Position …….. ……
Signature…….. ……

Annex 2 Sample Questionnaire for Stakeholders Meeting

Questionnaire

Please tick and fill in the form. After you finish, please put into the collection box.

1. Which is your organization? Please select one from the followings.

☐Relevant Ministry / ☐University / ☐NGO / ☐Coordinator of Natural Resource of District / ☐Cultural leader / ☐Media / ☐Institution / ☐Consultant / ☐Donor / ☐Private Sector / ☐ others ( )

2. Which items in the evaluation framework are more important for you to prioritize power sources and project sites? Please select three items from the following list in each stage.

Stage 1:

☐Cost / ☐Power Potential / ☐Construction difficulty / ☐Operation difficulty /
☐Contribution to national economy / ☐Air pollution / ☐Water pollution / ☐Consumption of natural resource / ☐CO2 emission / ☐Waste Management / ☐Water right and water resource / ☐Impact on natural ecology /
☐Impact on Agriculture / ☐Resettlement / ☐Impact on fishery / ☐Impact on tourism / ☐ Legal aspects /
☐Risk of accident / ☐others ( )

Stage 2-1 (long list):

☐Cost / ☐Effectiveness / ☐Development Progress / ☐Length of water recession / ☐Rate of recession /
☐Cover on natural protection area / ☐Wetland / ☐Protected species / ☐Land acquisition / ☐Flooding area /
☐Number of resettlement / ☐Tourism / ☐Cultural property / ☐Ethnic minority and indigenous people /
☐Fish breading and/or fishing / ☐Agriculture / ☐others ( )

Stage 2-2 (short list):

☐Cost / ☐Effectiveness / ☐Development Progress / ☐Length of water recession / ☐Rate of water recession / ☐Cover on natural protection area / ☐Protected species / ☐Wetland ecosystem / ☐Degradation of underground water / ☐Land acquisition / ☐Existing infrastructure / ☐Flood area / ☐Loss of agricultural land / ☐Tourism / ☐Number of resettlement / ☐Landscape / ☐Ethnic minority and indigenous people / ☐Fishery /
☐Cultural property / ☐Archeology / ☐others ( )

3. If any items above are to be eliminated from the evaluation framework, what should they be?

_____

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4. If you have any useful data or information for our study, please write it down or send e-mail to us.

_____

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_____

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5. Do you have any suggestion and comments on the evaluation methods or data sources? If any, please suggest us.

_____

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_____

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Annex 3 Sample Agenda for Stakeholders Meeting

The Master Plan Study of Hydropower Development in the Republic of UGANDA
Program flow of 1st Stakeholders Meeting

Date: _____

Venue: _____

No.	Time	Program	Person / Organization in Charge
1	9:00-9:30	Registration	HPDU
2	9:30-10:00	Preliminaries ➢ Introduction of Participants and Guest ➢ Opening Remarks	Director of MEMD Chief Representative of JICA
3	10:00-11:00	Presentation ➢ Overview of the Project ➢ Strategic Environmental Assessments ➢ Explanation on Stage 1 and Stage 2	HPDU
4	11:00-11:30	Break	
5	11:30-13:00	Question and Answer Discussion on Evaluation Framework (Stage 1 and Stage 2)	
6	13:00-13:30	Closing Remarks	MEMD NEMA

Appendix E-2:
Instruction for Environmental Database

4. Introduction

Environmental GIS data base is made for environmental analysis in MEMD. All the information is collected from various information sources. The data is made especially for GIS software.

5. Feature of the data

5.1 Copyright

MEMD has not copyright of the data. The data can be used internal only in MEMD. Copy and distribution to outside is restricted.

5.2 Spatial Information

All of the data is transformed into WGS_1984_UTM_Zone_36N. Detail information is as follws.

Table E-2 Unified spatial information

Horizontal coordinate system	*Projected coordinate system name:* WGS_1984_UTM_Zone_36N *Geographic coordinate system name:* GCS_WGS_1984
Map Projection Name:	Transverse Mercator *Scale Factor at Central Meridian:* 0.999600 *Longitude of Central Meridian:* 33.000000 *Latitude of Projection Origin:* 0.000000 *False Easting:* 500000.000000 *False Northing:* 200000.000000
Planar Coordinate Information	*Planar Distance Units:* meters *Coordinate Encoding Method:* coordinate pair
Coordinate Representation	*Abscissa Resolution:* 0.000000 *Ordinate Resolution:* 0.000000
Geodetic Model	*Horizontal Datum Name:* D_WGS_1984 *Ellipsoid Name:* WGS_1984 *Semi-major Axis:* 6378137.000000 *Denominator of Flattening Ratio:* 298.257224
Altitude System Definition	*Resolution:* 0.000100 *Encoding Method:* Explicit elevation coordinate included with horizontal coordinates

5.3 Metadata

All of the data has information of metadata. Metadata is written in http files and stored in the same holder as the data. Metadata includes information source, Description, Abstract, Data storage and

access information, and Constraints on accessing and using the data.

Figure E-1 Sample of metadata

6. Contents of the database

There are more than 60 files in the database. The file names and stored folder is as follows.

Table E-3 File list

Folder Name 1	Folder Name 2	Folder Name 3	File Name
B070_Stellite Image			B070_WorldView_2nd
B071_Contour			B0711_Contour
B072_Water			B0721_MainRivers_Paul B0722_Secondly_USGS B0723_ThirdlyRivers_Paul B0724_FourthRivers_MEMD B0725_Lakes_Paul B0726_Lakes_USGS B0727_N_UG_LakesRiver2005_UNOCHA B0728_OpenWater_NFA B0729_Wetlands_Paul
B073_Soil			B0731_Soil
B074_LandCover			B0741_LandCover2005_NFA B0742_LandCover_1995

Folder Name 1	Folder Name 2	Folder Name 3	File Name
B075_PoliticalBoundary	B0750_Country		B07501_cntry08_ESRI
			B07502_Uganda_UBOS
	B0751_District		B07511_District_2002
			B07512_District_2005
			B07513_A_UG_District2006_UBOS
			B07514_Uganda_district_centres2006
			B07515_District_2007
	B0752_Coounty		B07521_Uganda_county_centres2002
	B0753_Subcounty		B07531_A_UG_SubCounty2006_UBOS
			B07532_Subcounty2006
	B0754_Parish		B07541_A_UG_Parish2006_UBOS
	B0755_Villages		B07551_A_UG_VillageCenter2010_JST
			B07552_Uganda_villages_27Jan09
B076_Transport			B0761_R_UG_RoadCL2009_FAO
			B0762_roads_29Dec08_OCHA
			B0763_Road_MEMD
			B0764_Road_NFA
			B0765_MFNP_RoadPlan
B077_TownAndCities			B0771_cities_ESRI
			B0772_gaz_selection
			B0773_MajorTown
B078_Biological	B0780_WildLife		
	B0781_Protected Area		B07811_ProtectArea_UWA
			B07812_ProtectArea_NFA
			B07813_WildlifeSanctuary
			B07814_IBA
			B07815_Ramsar
			B07816_MurchisonFallsNP
			B07817_MFNP_Zoning
			B07818_ForestReserve_Budongo
			B07819_ForestReserve_Mabira
B079_Social	B0791_National		B07911_CensusAtlas2002_AgriCrop
			B07912_CensusAtlas2002_AgriFish
			B07913_CensusAtlas2002_AgriLivestock
			B07914_CensusAtlas2002_Children
			B07915_CensusAtlas2002_Economy
			B07916_CensusAtlas2002_Education
			B07917_CensusAtlas2002_Population
			B07918_MapAtlas_TourismSite
			B07919_SAP
	B0792_Ayago	B07921_Camp	B079211_North_Uganda_IDP_Camp_July2009
			B079212_PF_Amuru_CampsTransitSites2009
		B07922_HealthFacility	B079221_PF_UGNorth_HealthFacilities200908
			B079222_Uganda_North_Uganda_Health_Facility_Sep2009
		B07923_MFNP	B079231_Encroachment
			B079232_Encroachment_sign
			B079233_Fire
			B079234_PlantHarvesting

Folder Name 1	Folder Name 2	Folder Name 3	File Name
			B079235_PlantHarvesting_sign B079236_Poaching B079237_Poaching_sign B079238_UWA_RangerPosts
		B07924_Population	B079241_A_UG_SubCountyPop200903_UBOS
		B07925_School	B079251_Uganda_North_Uganda_Schools_Sep2009
		B07926_Tourism	B079261_ExploitedPotentialAttractionsReport_TourismPotentialSite
		B07927_WaterSource	B079271_Uganda_Acholi_water_sources_Sep2009 B079272_Uganda_Karamoja_water_sources_30Dec2009

7. Management rule

7.1 Incoming

When new data is obtained, following procedures should be followd.

(1) Confirm the data is not illegal one.

If the data is obtained through illegal route, the data must not be added in the database.

(2) Transform the data into WGS_1984_UTM_Zone_36N.

Confirm the special information. If the data Projected coordinate system is not "WGS_1984_UTM_Zone_36N" or Geographic coordinate system is not "GCS_WGS_1984", convert to the WGS 1984 using GIS software.

(3) Confirm or add the metadata.

Confirm the metadata of the information and add needed information. If ArcMap is used, ArcCatalog would be better for the editing.

(4) Revise the file list

Give new ID number to the data and revise the file list.

7.2 Outgoing

Distribution of the information is restricted. The data in only for internal use.

7.3 Updating

When the information gets old, contact the information source and obtain the latest information. If the data is obtained, follow the procedure of incoming.

7.4 Replacing

If the data is broken, obtain the data from source. When get the new file follow the incoming

procedure.

7.5 Storage

Identify one computer which always has latest version of the data. Only the person who manage the database can access the computer.

7.6 Back up

In order to avoid losing data back up data must be prepared. The back up media can be hard disk or DVD. Every time the data is changed, delete the old file and save new data.

Appendix F

Checklist for Environment and Social Considerations

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Appendix F
Checklist for Environment and Social Considerations

1. Objective This checklist aims to support EIA scoping for hydropower development projects in Uganda

2. Period During draft TOR/EIA. The checklist can be used when project outline is decided based on the conditions of the area.

3. User MEMD and NEMA

4. Process

1) Check the checklist from A, B to C
2) Make a long-list of possible impacts or unclear impacts from checklist C.
3) Make a short-list of relatively high impacts through the discussion among stakeholders.
4) Use the short-list as the assessment items and decide survey items, survey method and impact assessment method.

5. Remarks This checklist is applicable to only hydropower development projects.

6. Checklist A(Confirmation of Project Outline)

Stage	Project Activity	Location	Scale	Period
Construction	Construction of new roads			
	Renovation of existing roads			
	Temporary facility (switchyard, stockyard, concrete plants, crusher plants, accommodation)			
	Barrage and inundation area			
	Waterway			
	Quarry site			
	Dumping site			
	Blast			
	Operation of heavy equipment			
	Traffic of work vehicle			
	Generation of waste			
	Generation of waste water			
	Flow of workers from other regions			
	Transmission line and its tower			
	Electric power substation			
	Mitigation			
Operation	Traffic of maintenance vehicle			
	Generation of water recession			
	Power generation for peak time			
	Water Use aside from power generation(irrigation and domestic use)			
	Mitigation			

7. Checklist B(Confirmation of local conditions)

Category	Item	Existence of Map	Scale	Level
Social	Housing			
	Infrastructure (water system, electricity, roads, gas, drainage)			
	Well			
	Agriculture (farmland, irrigation facility, food processing factory)			
	Livestock			
	Fishery			
	Forestry			
	Mining			
	Tourism (fishing, water rafting, game drive, trekking, bird watching)			
	Public facility (government facility, school, hospital, health centre)			
	Cultural properties(historical, cultural and archaeological site, religious monument, festival site）			
	Administrative boundaries (District, Sub-county, Parish, Village）			
	Ethnicity, language, religion			
	Poverty area			
	Development Plan			
	Hunting and collecting			
Natural environment	Location of river and wetland			
	National treasure/monument (topography, geology, biology)			
	Protected area (national park, forest reserve, wildlife sanctuary etc.)			
	Vulnerable species (IUCN Red list spp.)			

8. Checklist C (Extraction of possible impacts)

Stage	Project Activity	Affected people/ animals	Contents of Impact	Possibility of Impact	Size
Construction	Construction of access roads (new and existing)	Residents	• Damage on lifestyle by noise, vibration and dust • Resettlement of houses and loss of farmland, existing infrastructure, archaeological site and cultural properties by land acquisition for access roads		
		Wildlife	• Damage on habitat by noise, vibration and dust • Loss of habitat by land acquisition for access roads • Increase in illegal hunting and cutting of forest • Separation of habitat		
	Temporary facility (switchyard, stockyard, concrete plants, crusher plants, accommodation)	Residents	• Resettlement of houses and loss of farmland, existing infrastructure, archaeological site and cultural properties by land acquisition		
		Wildlife	• Loss of habitat by land acquisition		
	Mining at Quarry site	Residents	• Resettlement of houses and loss of farmland, existing infrastructure, archaeological site and cultural properties by land acquisition		
		Wildlife	• Loss of habitat by land acquisition		
	Traffic of work vehicle (transport from quarry site to power station, transport of equipment, commuter bus)	Residents	• Air pollution by gas emission • Traffic noise and vibration • Increased traffic accident		
		Wildlife	• Abandoned habitat by noise and vibration • Decreased population by road kill		
	Blasting at construction site and quarry site	Residents	• Noise and damage by stones • Interruption of work and life by escaping from danger		
		Wildlife	• Abandoned habitat and feeding ground by noise		
	Barrage construction	Residents	• Damage on fishery and tourism		
		Wildlife	• Separation of movement route in river		
	Operation of heavy equipment at construction site	Residents	• Air pollution by gas emission • Traffic noise and vibration • Damage on lifestyle by noise and vibration		
		Wildlife	• Air pollution by gas emission • Abandoned habitat by noise and vibration		
	Generation of industrial waste and waste water with hazardous chemicals	Residents	• Domestic water pollution • Contaminated land • Damage on fishery and tourism		
		Wildlife	• Damage on aquatic biodiversity		
	Generation of waste from construction site and workers' camp	Residents	• Vermination • Bad smell		
		Wildlife	• Attraction of wildlife		
	Generation of waste water from construction site and workers' camp	Residents	• Damage on fishery		
		Wildlife	• Damage on wildlife by contaminated water		

Stage	Project Activity	Affected people/ animals	Contents of Impact	Possibility of Impact	Size
Construction	Reclamation of rock at dumping site	Residents	• Resettlement of houses and loss of farmland, existing infrastructure, archaeological site and cultural properties by land acquisition		
		Wildlife	• Loss of habitat • Separation of movement route		
	Generation of muddy water from construction site	Residents	• Damage on fishery and tourism		
		Wildlife	• Damage on aquatic biodiversity		
	Flow of workers from other regions	Residents	• Invasion and expansion of infectious disease from other regions		
		Wildlife	• Increased illegal hunting and collecting		
	Employment of workers	Residents	• Enforcement of child labour		
	Mitigation	Residents	• Conflict of interest		
	Establishment of power station and other facilities	Residents	• Damage on tourism by changing the landscape		
Operation	Generation of inundation area	Residents	• Increased risk of flooding at downstream of inundation area		
		Wildlife	• Flooding at protected area • Damage on vulnerable species		
	Generation of water recession	Residents	• Change in fishing • Change of fish species		
		Wildlife	• Separation of moving route in river • Decreased population of vulnerable species		
	Establishment of power station and other facilities	Residents	• Damage on tourism by changing the landscape		
	Traffic of maintenance vehicle	Residents	• Increased traffic accidents		
		Wildlife	• Occurrence of road kill		
	Power generation for peak time	Residents	• Occurrence of discharge accident		
		Wildlife	• Occurrence of discharge accident		
	Water Use aside from power generation(irrigation and domestic use)	Residents	• Shortage of water in downstream		
		Wildlife	• Change of ecosystem in downstream		

Appendix G

Design

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Appendix G
Design

1 Loss Head Calculation

1.1 Pressure Flow Section (From Intake to Draft Tunnel)

(1) Outline of Pressure Flow Section

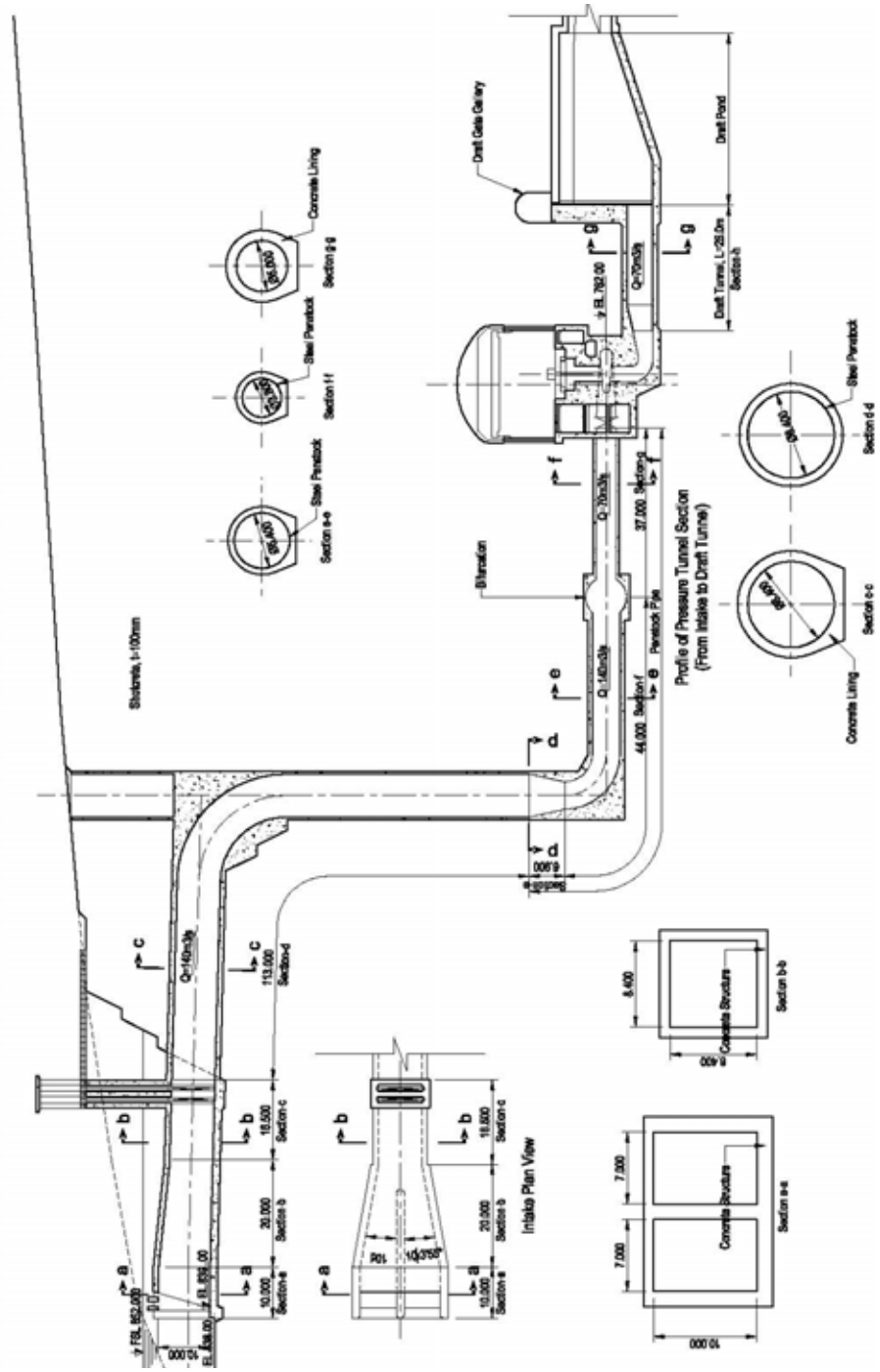


Figure G1-1 Profile and Cross Section of Pressure Flow Section (From Intake to Draft Tunnel)

(2) Entrance Loss

$$h_e = f_e \cdot \frac{V_2^2}{2g}$$

Where, h_e : Entrance loss (m)

f_e : Entrance loss coefficient (See following Figure)

V_2 : Flow velocity after entrance (m/s)

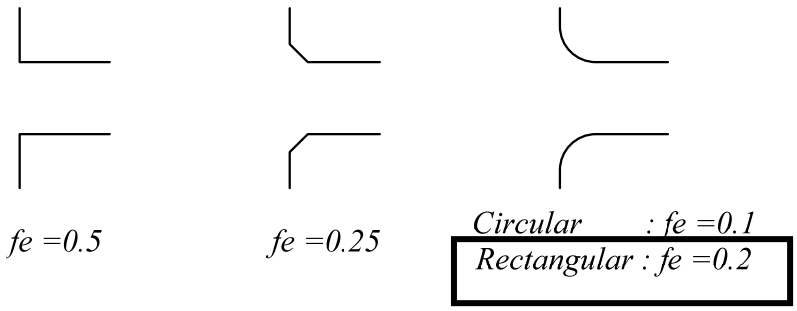


Figure G1-2 Entrance Loss Coefficient

Table G1-1 Entrance Energy Loss at Intake

Items	Mark	Unit		Note
Discharge	Q	m3/s	140	
Cross Section Area of Intake	A	m2	140	7mx10m x 2sections
Velocity at Entrance of Intake	V	m/s	1.000	
Entrance Loss Coefficient	fe		0.2	Rectangular with circular corner
Entrance Loss Head	he	m	**0.010**	$fe*V^2/2g$

(3) Loss of Head at Screen

$$h_r = \frac{1}{\gamma} \cdot f_r \cdot \frac{V_1^2}{2g}$$

$$f_e = \beta \cdot \sin\theta \cdot \left(\frac{t}{b}\right)^{\frac{4}{3}}$$

Where, h_r : Loss of head at screen (m)

f_e : Screen loss coefficient

V_1 : Flow velocity upstream of screen (m/s)

γ : Screen opening reduction rate.

β : Screen-bar shape coefficient (See following figure)

t : Thickness of screen-bar (mm)

b : Clearance of screen bar (mm)

θ : Vertical angle of screen (degree)

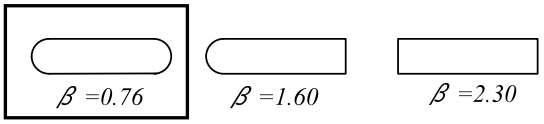


Figure G1-3 Screen-bar Shape Coefficient

Table G1-2 Screen Energy Loss at Intake

Items	Mark	Unit		Note
Velocity at Upstream of Screen	V	m/s	1.000	
Screen-bar shape coefficient	β		0.76	
Thickness of Screen-bar	t	mm	50	
Vertical Angle of Screen-bar	θ	degree	73	
Clearance of Screen-bar	b	mm	100	
Area Reduction Rate	γ	%	25.0%	
Screen Loss Coefficient	fr		0.288	$\beta*\sin\theta*(t/b)^{4/3}$
Loss of Head at Screen	hr		**0.059**	$1/\gamma$ x fr x $V^2/2g$

(4) Loss of Head at Gradual Reduction of Cross Section

$$h_{gc} = f_{gc} \cdot \frac{V_2^2}{2g}$$

Where, h_{gc} : Loss of head at gradual reduction of cross section (m)

f_{gc} : Loss coefficient at gradual reduction of cross section

V_2 : Flow velocity at downstream cross section (m/s)

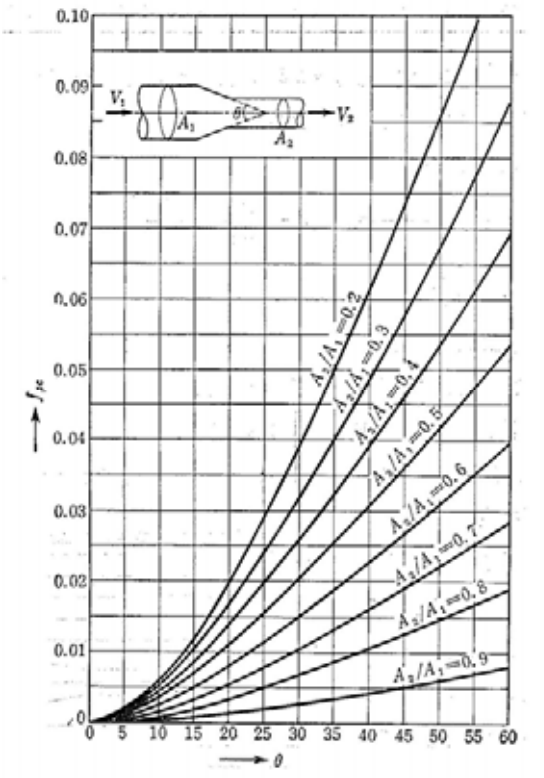


Figure G1-4 Loss Coefficient at Gradual Reduction of Cross Section

Table G1-3 Cross Section Area Reduction Energy Loss at Intake

Items	Mark	Unit		Note
Cross Section Area at Upstream Section	A1	m2	140.000	7mx10m x 2sections
Cross Section Area at Downstream Section	A2	m2	70.560	8.4x8.4m
Velocity at Downstream Section	V2	m/s	1.984	
Section Reduction Angle	θ	degree	20	
	A1/A2		1.984	
Gradual Reduction Loss Coefficient	fge		0.02	
Loss of Head at Gradual Reduction	hgc		**0.004**	fgc x $V2^2/2g$

Table G1-4 Cross Section Area Reduction Energy Loss at Penstock

Items	Mark	Unit		Note
Cross Section Area at Upstream Section	A1	m2	55.418	D=8.4m
Cross Section Area at Downstream Section	A2	m2	22.902	D=5.4m
Velocity at Downstream Section	V2	m/s	6.113	
Section Reduction Angle	θ	degree	25	
	A1/A2		2.420	
Gradual Reduction Loss Coefficient	fge		0.03	
Loss of Head at Gradual Reduction	hgc		**0.057**	fgc x $V2^2/2g$

(4) Friction Energy Loss

Circular Section : $h_f = f \cdot \frac{L}{D} \cdot \frac{V^2}{2g}, f = \frac{124.5 \cdot n^2}{D^{\frac{1}{3}}}$

General Geometry Section : $h_f = f' \cdot \frac{L}{R} \cdot \frac{V^2}{2g}, f' = \frac{2g \cdot n^2}{R^{\frac{1}{3}}}$

Where, h_f : Friction loss (m)

f, f' : Friction loss coefficient

L : Length of waterway (m)

D : Diameter of waterway (m)

V : Flow velocity in the waterway (m/s)

n : Coefficient of roughness (Concrete : 0.014, Steel :0.012)

R : Hydraulic mean depth (m)

Table G1-5 Friction Energy Loss at Pressure Flow Section (From Intake to Draft Tunnel)

Items	Mark	Unit		Note
4.1 Section -a (7.0x 10.0 x 2-sections)				
1) Cross Section Area	Aa	m2	140	
2) Wetted Perimeter of Cross Section	Sa	m	560	
3) Hydraulic Mean Depth	Ra	m	0.250	
4) Roughness Coefficient	n		0.014	Concrete
5) Friction Loss Coefficient	f'a		0.0061	$2gn^2/R^{1/3}$
6) Velocity at Cross Section-a	Va	m/s	1.000	Q/Aa
7) Length of Cross Section -a	La	m	10	
8) Friction Loss at Section-a	hfa	m	0.012	$f'xL/R*V^2/2g$
4.2 Section -b (7.0x 10.0 x 2-sections t0 8.4x8.4m)				
1) Average Cross Section Area	Ab	m2	105.28	
2) Average Wetted Perimeter of Cross Section	Sb	m	296.8	
3) Hydraulic Mean Depth	Rb	m	0.355	
4) Roughness Coefficient	n		0.014	Concrete
5) Friction Loss Coefficient	f'b		0.0054	$2gn^2/R^{1/3}$
6) Average Velocity at Cross Section-b	Vb	m/s	1.330	Q/Ab
7) Length of Cross Section -b	Lb	m	20	
8) Friction Loss at Section-b	hfb	m	0.028	$f'xL/R*V^2/2g$
4.3 Section -C (8.4m 8.4m)				
1) Cross Section Area	Ac	m2	16.8	
2)Wetted Perimeter of Cross Section	Sc	m	33.6	
3) Hydraulic Mean Depth	Rc	m	0.500	
4) Roughness Coefficient	n		0.014	
5) Friction Loss Coefficient	f'c		0.0048	$2gn^2/R^{1/3}$
6) Velocity at Cross Section-c	Vc	m/s	8.333	Q/Aa
7) Length of Cross Section -c	Lc	m	16.5	
8) Friction Loss at Section-c	hfc	m	0.566	$f'xL/R*V^2/2g$
4.4 Section -d (D=8.4m)				
1) Diameter	Dd	m	8.4	
2) Roughness Coefficient	n		0.014	Concrete
3) Friction Loss Coefficient	fd		0.0120	$124.5*n^2/D^{1/3}$
4) Velocity at Section-d	Vd	m/s	2.526	$Q/(\pi*D^2/4)$
5) Length of Cross Section -d	Ld	m	113.000	
6) Friction Loss at Section -d	hfd	m	0.053	$f*L/D*V^2/2g$
4.5 Section -e (D=8.4 to 5.4m)				
1) Average Diameter	De	m	13.8	
2) Roughness Coefficient	n		0.012	Steel
3) Friction Loss Coefficient	fe		0.0075	$124.5*n^2/D^{1/3}$
4) Velocity at Section-e	Ve	m/s	0.936	$Q/(\pi*D^2/4)$
5) Length of Cross Section -e	Le	m	6.900	
6) Friction Loss at Section -e	hfe	m	0.001	$f*L/D*V^2/2g$
4.6 Section -f (D=5.4m)				
1) Average Diameter	Df	m	5.4	
2) Roughness Coefficient	n		0.012	Steel
3) Friction Loss Coefficient	ff		0.0102	$124.5*n^2/D^{1/3}$
4) Velocity at Section-f	Vf	m/s	6.113	$Q/(\pi*D^2/4)$
5) Length of Cross Section -f	Lf	m	44.000	
6) Friction Loss at Section -f	hff	m	0.159	$f*L/D*V^2/2g$
4.7 Section -g (D=3.8m)				
1) Average Diameter	Dg	m	3.8	
2) Roughness Coefficient	n		0.012	Steel
3) Friction Loss Coefficient	fg		0.0115	$124.5*n^2/D^{1/3}$
4) Velocity at Section-g	Vg	m/s	6.172	$Q/(\pi*D^2/4)/2$
5) Length of Cross Section -g	Lg	m	37.000	
6) Friction Loss at Section -g	hfg	m	0.218	$f*L/D*V^2/2g$
4.8 Section -f (D=5m)				
1) Average Diameter	Dh	m	5	
2) Roughness Coefficient	n		0.014	Concrete
3) Friction Loss Coefficient	fh		0.0143	$124.5*n^2/D^{1/3}$
4) Velocity at Section-h	Vh	m/s	3.565	$Q/(\pi*D^2/4)/2$
5) Length of Cross Section -h	Lh	m	26.000	
6) Friction Loss at Section -h	hfh	m	0.049	$f*L/D*V^2/2g$
4.9 Total of Friction Loss	hf		**1.086**	

(5) Loss of Head at Bifurcation

$$h_B = f_B \cdot \frac{V_0^2}{2g}$$

Where, h_B : Loss of head at bifurcation (m)

f_B : Loss coefficient at bifurcation (See following figure)

V_0 : Flow velocity at upstream of bifurcation (m/s)

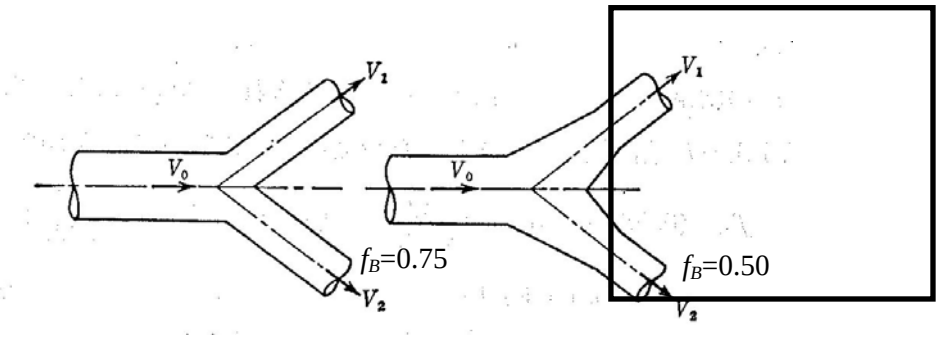


Figure G1-5 Loss Coefficient at Bifurcation

Table G1-6 Loss of Head at Penstock Bifurcation

Items	Mark	Unit		Note
Cross Section Area upstream of Bifurcation	A	m2	22.902	D=5.4m
Velocity upstream of Bifurcation	V	m/s	6.1129	
Loss Coefficient at Bifurcation	fB		0.5	
Loss of Head at Bifurcation	hB	m	**0.958**	$fB*V^2/2g$

(6) Loss of Head at Outlet

$$h_o = f_o \cdot \frac{V_1^2}{2g}$$

Where, h_O : Loss of head at outlet (m)

f_B : Loss coefficient at outlet ($f_O \approx 1.0$)

V_1 : Flow velocity at upstream of outlet (m/s)

Table G1-7 Loss of Head at Outlet of Draft Tunnel

Items	Mark	Unit		Note
Cross Section Area at Draft Tunnel	A	m2	19.635	D=5.0m
Velocity at Draft Tunnel	V	m/s	3.565	Q/2/A
Loss Coefficient at Outlet	fo		1.000	
Loss of Head at Outlet	ho		**0.648**	$fo*V^{2/}2g$

1.2 Free Flow Section

(1) Outline of Free Flow Section

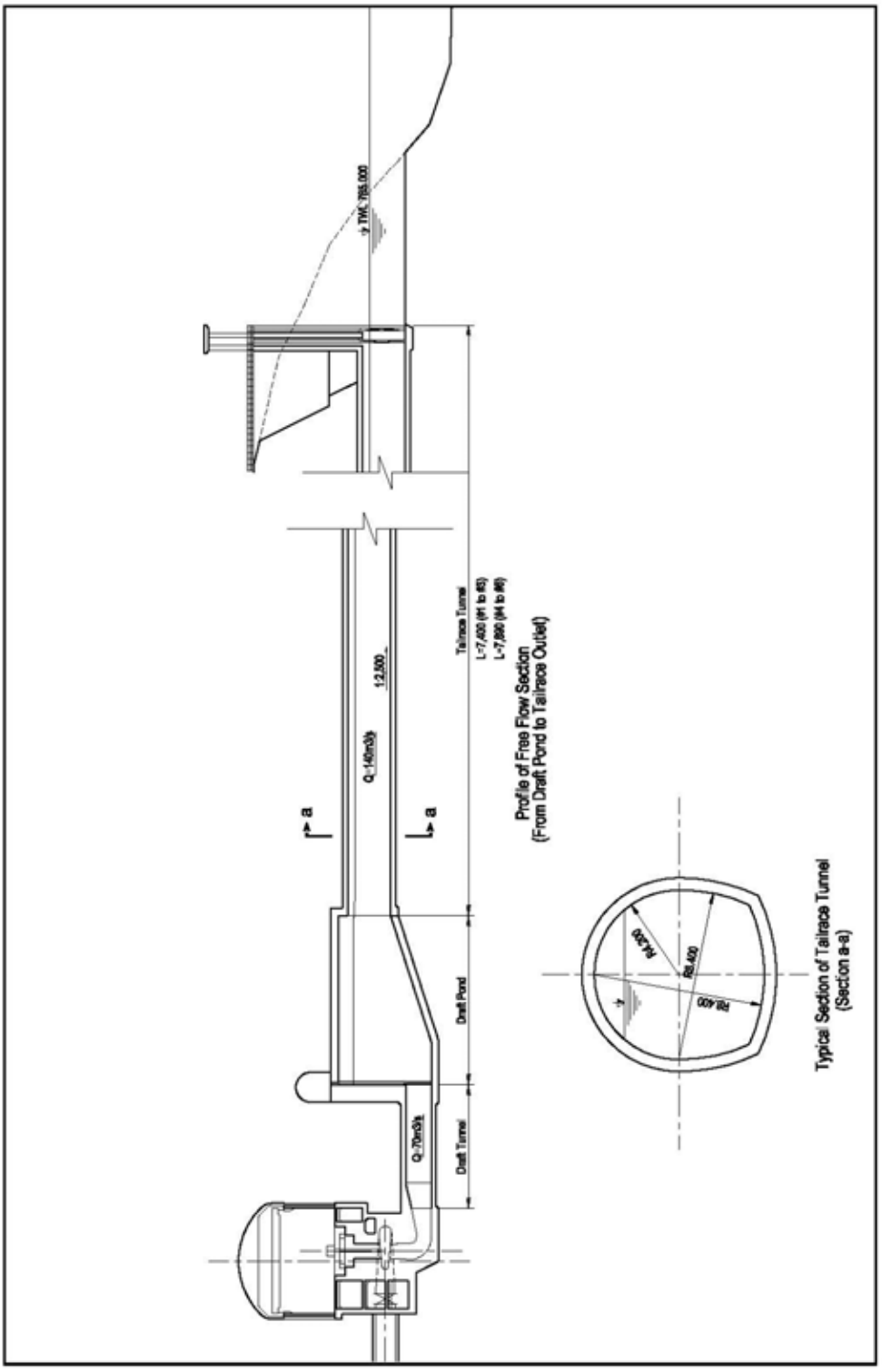


Figure G1-6 Profile and Cross Section of Free Flow Section (From Draft Pond to Tailrace Outlet)

(1) Water Level Drawdown at Entrance of Waterway

$$h_e = f_e \cdot \frac{V_2^2}{2g} + \frac{V_2^2}{2g} - \frac{V_1^2}{2g}$$

Where, h_e : Water level drawdown at entrance of waterway (m)

f_e : Loss coefficient at entrance (fe ≈ 0)

V_1 : Flow velocity at upstream of waterway entrance (m/s) (V_1 ≈ 0)

V_2 : Flow velocity at downstream of waterway entrance (m/s)

Table G1-8 Water Level Drawdown at Entrance of Tailrace Tunnel

Items	Mark	Unit	#1 to #3	#4 to #6	Note
Velocity at Tailrace Tunnel	V2	m/s	2.634	2.634	Refer to uniform calculation
Velocity at Draft Pond	V1	m/s	0.00	0.00	
Water Level Drawdown at Entrance of Waterway	he		0.354	0.354	$(V2^2-V1^2)/2g$

(2) Water Level Drawdown in Waterway

$$h_f = L \cdot S$$

Where, h_e : Water level drawdown in waterway (m)

L : Length of Waterway (m)

S : Slope of Waterway

Table G1-9 Water Level Drawdown in Tailrace Tunnel

Items	Mark	Unit	#1 to #3	#4 to #6	Note
Length of Tailrace Tunnel	Lt	m	7400	7890	
Slope of Tailrace Tunnel	S	%	0.0400%	0.0400%	1:2,500
Friction Loss at Tailrace Tunnel	hf		2.960	3.156	S*Lt

1.3 Summary of Loss Head Calculation

Table G1-10 Summary of Loss Head Calculation

Items	Mark	Unit	No.1 to No.3 Waterway	No.4 to No.6 Waterway	Note
A. Head Loss at Intake, Headrace, Pressure Shaft, Penstock and Draft Tunnel					
A.1 Entrance Loss at Intake	he	m	0.010	0.010	
A.2 Screen Loss at Intake	hr	m	0.059	0.059	
A.3 Cross Section Reduction Loss					
a) At Intake	hgc1	m	0.004	0.004	
a) At Penstock	hgc2	m	0.057	0.057	
A.4 Friction Loss from Intake to Draft Tunnel	hf	m	1.086	1.086	
A.5 Bifurcation Loss at Penstock	h_B	m	0.958	0.958	
A.6 Outlet Loss at Draft Pond	ho	m	0.648	0.648	
A.7 Sub-total		m	2.822	2.822	
A.8 Allowance			0.078	0.078	
A.9 Total			2.900	2.900	A.7+A.8
B. Head Loss from Draft Pond to Tailrace Outlet					
B.1 Entrance Loss at Tailrace	het	m	0.354	0.354	
B.2 Friction Loss at Tailrace Tunnel	hft	m	2.960	3.156	
B.3 Sub-total			3.314	3.510	
B.4 Allowance			0.006	0.010	
B.5 Total			3.320	3.520	B.3+B.4
C. Ground Total of Head Loss	hloss	m	**6.220**	**6.420**	A.9 + B.5

2 Unifrom Flow Calculation

2.1 Manning's Uniform Formula

$$V = \frac{1}{n} \cdot R^{2/3} \cdot I^{1/2}, Q = A \cdot V$$

Where, V : Unifrom Flow Velocity (m/s)

n : Coefficient of Roughness

R : Hydraulic Mean Depth (m)

I : Gradient of River Channel / Waterway

A : Flow Cross Section Area (m2)

Q : Discharge (m3/s)

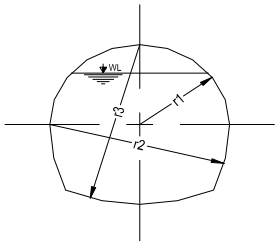
2.2 Calculation Results

(1) Tailrace Tunnel Case 1 ($Q=70m^3/s$)

******* Results of Uniform Analysis *******

[Title] **Ayago HEPP (Q=70m3/s)**
[Section Shape] Hose Shoe

r 1 : 3.250m
r 2 : 6.500m
r 3 : 6.500m



[Conditions]
Coefficient of Roughness: 0.014 Gradient: 1/2500.0

[Hydraulic Charactoristics at Maximum Discharge]

Water Depth (m)	Discharge (m^3/s)	Flow Velocity (m/s)	Flow Area (m^2)	Wetted Perimeter (m)	Hydraulic Mean Depth (m)	Froude Number	Coefficient of Roughness
6.094	74.997	2.194	34.176	17.951	1.904	0.284	0.014

[Hydraulic Charactoristics at Target Discharge]

Water Depth (m)	Discharge (m^3/s)	Flow Velocity (m/s)	Flow Area (m^2)	Wetted Perimeter (m)	Hydraulic Mean Depth (m)	Froude Number	Coefficient of Roughness
5.321	70.000	2.263	30.934	15.517	1.994	0.313	0.014

[Hydraulic Charactoristics in Each Water Depth]

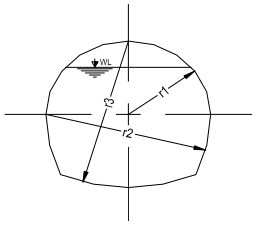
Water Depth (m)	Discharge (m^3/s)	Flow Velocity (m/s)	Flow Area (m^2)	Wetted Perimeter (m)	Hydraulic Mean Depth (m)	Froude Number	Coefficient of Roughness
0.0000	0.0000	—	—	—	—	—	—
0.2000	0.1588	0.3711	0.4280	3.2332	0.1324	0.2650	0.0140
0.4000	0.7063	0.5862	1.2049	4.5844	0.2628	0.2961	0.0140
0.6000	1.6954	0.7699	2.2020	5.5658	0.3956	0.3175	0.0140
0.8000	3.1540	0.9576	3.2935	6.0007	0.5489	0.3420	0.0140
1.0000	4.9136	1.1123	4.4175	6.4297	0.6870	0.3553	0.0140
1.2000	6.9318	1.2443	5.5710	6.8536	0.8129	0.3628	0.0140
1.4000	9.1775	1.3594	6.7511	7.2729	0.9283	0.3670	0.0140
1.6000	11.6256	1.4614	7.9550	7.6883	1.0347	0.3691	0.0140
1.8000	14.2550	1.5529	9.1799	8.1002	1.1333	0.3697	0.0140
2.0000	17.0467	1.6355	10.4231	8.5091	1.2249	0.3694	0.0140
2.2000	19.9831	1.7106	11.6820	8.9156	1.3103	0.3684	0.0140
2.4000	23.0479	1.7792	12.9539	9.3199	1.3899	0.3669	0.0140
2.6000	26.2251	1.8421	14.2365	9.7226	1.4643	0.3649	0.0140
2.8000	29.4994	1.8999	15.5271	10.1241	1.5337	0.3627	0.0140
3.0000	32.8556	1.9530	16.8232	10.5247	1.5984	0.3602	0.0140
3.2000	36.2787	2.0019	18.1224	10.9248	1.6588	0.3575	0.0140
3.4000	39.7530	2.0468	19.4220	11.3249	1.7150	0.3546	0.0140
3.6000	43.2557	2.0878	20.7180	11.7262	1.7668	0.3515	0.0140
3.8000	46.7593	2.1249	22.0052	12.1301	1.8141	0.3482	0.0140
4.0000	50.2349	2.1580	23.2788	12.5385	1.8566	0.3447	0.0140
4.2000	53.6515	2.1869	24.5333	12.9530	1.8940	0.3409	0.0140
4.4000	56.9762	2.2115	25.7633	13.3757	1.9261	0.3368	0.0140
4.6000	60.1735	2.2317	26.9631	13.8092	1.9525	0.3324	0.0140
4.8000	63.2048	2.2472	28.1262	14.2563	1.9729	0.3276	0.0140
5.0000	66.0272	2.2577	29.2459	14.7208	1.9867	0.3225	0.0140
5.2000	68.5924	2.2627	30.3144	15.2076	1.9934	0.3170	0.0140
5.4000	70.8437	2.2617	31.3227	15.7235	1.9921	0.3109	0.0140
5.6000	72.7120	2.2539	32.2602	16.2784	1.9818	0.3043	0.0140
5.8000	74.1065	2.2379	33.1137	16.8883	1.9607	0.2968	0.0140
6.0000	74.8951	2.2116	33.8652	17.5815	1.9262	0.2884	0.0140
6.2000	74.8437	2.1701	34.4881	18.4202	1.8723	0.2784	0.0140
6.4000	73.3101	2.0987	34.9319	19.6184	1.7806	0.2650	0.0140
6.5000	69.8959	1.9948	35.0389	21.2350	1.6501	—	0.0140

(2) Tailrace Tunnel Case 2 (Q=140m^3/s)

******* Results of Uniform Analysis *******

[Title] **Ayago HEPP (Q=140m3/s)**
[Section Shape] Hose Shoe

r 1 : 4.200m
r 2 : 8.400m
r 3 : 8.400m



[Conditions]
Coefficient of Roughness: 0.014 Gradient: 1/2500.0

[Hydraulic Charactoristics at Maximum Discharge]

Water Depth (m)	Discharge (m^3/s)	Flow Velocity (m/s)	Flow Area (m^2)	Wetted Perimeter (m)	Hydraulic Mean Depth (m)	Froude Number	Coefficient of Roughness
7.875	148.601	2.604	57.075	23.197	2.460	0.296	0.014

[Hydraulic Charactoristics at Target Discharge]

Water Depth (m)	Discharge (m^3/s)	Flow Velocity (m/s)	Flow Area (m^2)	Wetted Perimeter (m)	Hydraulic Mean Depth (m)	Froude Number	Coefficient of Roughness
6.955	140.000	2.684	52.164	20.258	2.575	0.325	0.014

[Hydraulic Charactoristics in Each Water Depth]

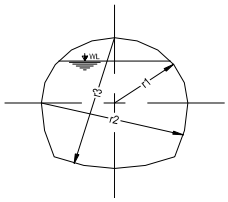
Water Depth (m)	Discharge (m^3/s)	Flow Velocity (m/s)	Flow Area (m^2)	Wetted Perimeter (m)	Hydraulic Mean Depth (m)	Froude Number	Coefficient of Roughness
0.000	0.000	—	—	—	—	—	—
0.200	0.181	0.371	0.487	3.673	0.133	0.265	0.014
0.400	0.806	0.587	1.373	5.205	0.264	0.297	0.014
0.600	1.927	0.767	2.513	6.388	0.393	0.316	0.014
0.800	3.606	0.937	3.849	7.247	0.531	0.335	0.014
1.000	5.835	1.110	5.258	7.682	0.685	0.354	0.014
1.200	8.428	1.258	6.701	8.112	0.826	0.367	0.014
1.400	11.344	1.388	8.174	8.538	0.957	0.375	0.014
1.600	14.549	1.504	9.676	8.961	1.080	0.380	0.014
1.800	18.018	1.608	11.204	9.380	1.194	0.383	0.014
2.000	21.728	1.703	12.755	9.796	1.302	0.385	0.014
2.200	25.660	1.791	14.328	10.209	1.404	0.386	0.014
2.400	29.794	1.871	15.921	10.619	1.499	0.386	0.014
2.600	34.115	1.946	17.532	11.028	1.590	0.386	0.014
2.800	38.607	2.015	19.158	11.434	1.675	0.385	0.014
3.000	43.253	2.080	20.797	11.839	1.757	0.384	0.014
3.200	48.041	2.140	22.448	12.243	1.834	0.382	0.014
3.400	52.955	2.197	24.109	12.645	1.907	0.381	0.014
3.600	57.981	2.249	25.777	13.046	1.976	0.379	0.014
3.800	63.106	2.299	27.451	13.447	2.041	0.377	0.014
4.000	68.316	2.345	29.129	13.847	2.104	0.375	0.014
4.200	73.596	2.389	30.808	14.247	2.162	0.372	0.014
4.400	78.932	2.430	32.488	14.648	2.218	0.370	0.014
4.600	84.301	2.468	34.163	15.049	2.270	0.368	0.014
4.800	89.678	2.503	35.831	15.452	2.319	0.365	0.014
5.000	95.037	2.535	37.487	15.857	2.364	0.362	0.014
5.200	100.350	2.565	39.128	16.267	2.405	0.359	0.014
5.400	105.588	2.591	40.749	16.681	2.443	0.356	0.014
5.600	110.722	2.615	42.347	17.102	2.476	0.353	0.014
5.800	115.720	2.635	43.916	17.530	2.505	0.350	0.014
6.000	120.546	2.652	45.452	17.968	2.530	0.346	0.014
6.200	125.166	2.666	46.950	18.417	2.549	0.342	0.014
6.400	129.538	2.676	48.404	18.879	2.564	0.338	0.014
6.600	133.620	2.683	49.810	19.357	2.573	0.334	0.014
6.800	137.363	2.685	51.159	19.855	2.577	0.329	0.014
7.000	140.711	2.683	52.446	20.377	2.574	0.324	0.014
7.200	143.597	2.676	53.661	20.931	2.564	0.319	0.014
7.400	145.940	2.663	54.794	21.524	2.546	0.313	0.014
7.600	147.632	2.644	55.832	22.172	2.518	0.306	0.014
7.800	148.521	2.617	56.760	22.897	2.479	0.299	0.014
8.000	148.351	2.578	57.554	23.746	2.424	0.291	0.014
8.200	146.562	2.519	58.174	24.839	2.342	0.281	0.014
8.400	138.493	2.367	58.517	27.442	2.132	—	0.014

(3) Tailrace Tunnel Case 3 (Q=210m^3/s)

******* Results of Uniform Analysis *******

[Title] **Ayago HEPP (Q=210m3/s)**
[Section Shape] Hose Shoe

r 1 : 4.900m
r 2 : 9.800m
r 3 : 9.800m



[Conditions]
Coefficient of Roughness: 0.014 Gradient: 1/2500.0

[Hydraulic Charactoristics at Maximum Discharge]

Water Depth (m)	Discharge (m^3/s)	Flow Velocity (m/s)	Flow Area (m^2)	Wetted Perimeter (m)	Hydraulic Mean Depth (m)	Froude Number	Coefficient of Roughness
9.188	224.154	2.885	77.688	27.065	2.870	0.304	0.014

[Hydraulic Charactoristics at Target Discharge]

Water Depth (m)	Discharge (m^3/s)	Flow Velocity (m/s)	Flow Area (m^2)	Wetted Perimeter (m)	Hydraulic Mean Depth (m)	Froude Number	Coefficient of Roughness
8.059	210.000	2.975	70.588	23.488	3.005	0.335	0.014

[Hydraulic Charactoristics in Each Water Depth]

Water Depth (m)	Discharge (m^3/s)	Flow Velocity (m/s)	Flow Area (m^2)	Wetted Perimeter (m)	Hydraulic Mean Depth (m)	Froude Number	Coefficient of Roughness
0.000	0.000	—	—	—	—	—	—
0.200	0.196	0.372	0.526	3.967	0.133	0.265	0.014
0.400	0.873	0.588	1.484	5.619	0.264	0.297	0.014
0.600	2.088	0.768	2.718	6.894	0.394	0.317	0.014
0.800	3.869	0.927	4.172	7.974	0.523	0.331	0.014
1.000	6.339	1.096	5.782	8.600	0.672	0.350	0.014
1.200	9.328	1.255	7.435	9.034	0.823	0.366	0.014
1.400	12.713	1.394	9.121	9.464	0.964	0.376	0.014
1.600	16.455	1.518	10.837	9.890	1.096	0.383	0.014
1.800	20.523	1.631	12.582	10.314	1.220	0.388	0.014
2.000	24.890	1.734	14.354	10.734	1.337	0.392	0.014
2.200	29.535	1.829	16.151	11.151	1.448	0.394	0.014
2.400	34.437	1.916	17.970	11.566	1.554	0.395	0.014
2.600	39.579	1.998	19.811	11.979	1.654	0.396	0.014
2.800	44.943	2.074	21.671	12.389	1.749	0.396	0.014
3.000	50.513	2.145	23.548	12.798	1.840	0.396	0.014
3.200	56.275	2.212	25.441	13.205	1.927	0.395	0.014
3.400	62.213	2.275	27.349	13.610	2.009	0.394	0.014
3.600	68.315	2.334	29.268	14.014	2.088	0.393	0.014
3.800	74.566	2.390	31.199	14.417	2.164	0.392	0.014
4.000	80.952	2.443	33.138	14.819	2.236	0.390	0.014
4.200	87.461	2.493	35.085	15.221	2.305	0.389	0.014
4.400	94.079	2.540	37.038	15.622	2.371	0.387	0.014
4.600	100.792	2.585	38.994	16.022	2.434	0.385	0.014
4.800	107.589	2.627	40.953	16.422	2.494	0.383	0.014
5.000	114.455	2.667	42.913	16.822	2.551	0.381	0.014
5.200	121.374	2.705	44.872	17.222	2.605	0.379	0.014
5.400	128.321	2.740	46.825	17.624	2.657	0.377	0.014
5.600	135.273	2.774	48.770	18.027	2.705	0.374	0.014
5.800	142.204	2.805	50.704	18.432	2.751	0.372	0.014
6.000	149.090	2.833	52.622	18.841	2.793	0.369	0.014
6.200	155.902	2.859	54.522	19.254	2.832	0.367	0.014
6.400	162.613	2.883	56.400	19.671	2.867	0.364	0.014
6.600	169.193	2.904	58.253	20.094	2.899	0.361	0.014
6.800	175.612	2.923	60.076	20.524	2.927	0.358	0.014
7.000	181.835	2.939	61.865	20.963	2.951	0.355	0.014
7.200	187.829	2.953	63.616	21.410	2.971	0.351	0.014
7.400	193.557	2.963	65.325	21.869	2.987	0.348	0.014
7.600	198.976	2.970	66.986	22.341	2.998	0.344	0.014
7.800	204.044	2.975	68.594	22.829	3.005	0.340	0.014
8.000	208.710	2.975	70.143	23.335	3.006	0.336	0.014
8.200	212.919	2.973	71.627	23.863	3.002	0.332	0.014
8.400	216.605	2.966	73.038	24.419	2.991	0.327	0.014
8.600	219.690	2.954	74.368	25.009	2.974	0.322	0.014
8.800	222.075	2.937	75.604	25.643	2.948	0.316	0.014
9.000	223.627	2.914	76.736	26.337	2.914	0.310	0.014
9.200	224.152	2.883	77.744	27.115	2.867	0.304	0.014
9.400	223.317	2.841	78.605	28.029	2.804	0.296	0.014
9.600	220.377	2.780	79.277	29.206	2.714	0.287	0.014
9.800	208.907	2.623	79.648	32.016	2.488	—	0.014

3 Break Down of BOQ and Construction Cost for Civil and Hydromechanical Works

3.1 Installed Capacity Alternatives

(1) Civil Works

Item	Unit	Unit cost (US$)	100MW		200MW		300MW		400MW		500MW		600MW		800MW		Remark
			Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	
1. Weir				***28,613***		***28,613***		***28,613***		***28,613***		***28,613***		***28,613***		***28,613***	
1.1. Care of river	LS		1	5,723	1	5,723	1	5,723	1	5,723	1	5,723	1	5,723	1	5,723	(1.2)×25%
1.2. Weir				22,891		22,891		22,891		22,891		22,891		22,891		22,891	
Excavation (rock)	m^3	14	10,500	147	10,500	147	10,500	147	10,500	147	10,500	147	10,500	147	10,500	147	
Concrete	m^3	213	83,400	17,764	83,400	17,764	83,400	17,764	83,400	17,764	83,400	17,764	83,400	17,764	83,400	17,764	
Reinforcement bar	ton	1,115	360	401	360	401	360	401	360	401	360	401	360	401	360	401	
Others	LS		1	4,578	1	4,578	1	4,578	1	4,578	1	4,578	1	4,578	1	4,578	25%
2. Intake				***3,272***		***6,526***		***9,781***		***13,051***		***16,276***		***19,531***		***26,056***	
Excavation (common)	m^3	5	12,500	63	24,900	125	37,300	187	49,800	249	62,200	311	74,600	373	99,500	498	
Excavation (rock)	m^3	16	59,900	958	119,700	1,915	179,500	2,872	239,300	3,829	299,100	4,786	358,900	5,742	478,500	7,656	
Concrete	m^3	234	4,300	1,006	8,600	2,012	12,900	3,019	17,200	4,025	21,400	5,008	25,700	6,014	34,300	8,026	
Reinforcement bar	ton	1,135	520	590	1,030	1,169	1,540	1,748	2,060	2,338	2,570	2,917	3,080	3,496	4,110	4,665	
Others	LS		1	654	1	1,305	1	1,956	1	2,610	1	3,255	1	3,906	1	5,211	25%
3. Headrace / Pressure Shaft				***3,609***		***7,053***		***10,600***		***14,048***		***17,641***		***21,053***		***28,072***	
Tunnel Excavation	m^3	69	6,200	428	12,400	856	18,600	1,283	24,800	1,711	31,000	2,139	37,100	2,560	49,500	3,416	
Shaft Excavation		73	7,300	533	14,600	1,066	21,900	1,599	29,100	2,124	36,400	2,657	43,700	3,190	58,200	4,249	
Shotcrete 20cm	m^2	116	1,900	220	3,700	429	5,500	638	7,400	858	9,200	1,067	11,000	1,276	14,700	1,705	
Shotcrete 10cm	m^2	58	2,800	162	5,600	325	8,400	487	11,200	650	14,000	812	16,800	974	22,400	1,299	
Rock Bolt	m	32	5,600	179	11,200	358	16,700	534	22,300	714	27,800	890	33,400	1,069	44,500	1,424	
Steel Support	ton	2,014	100	201	190	383	280	564	370	745	470	947	560	1,128	740	1,490	
Concrete, lining	m^3	214	4,300	920	8,600	1,840	12,800	2,739	17,100	3,659	21,400	4,580	25,600	5,478	34,200	7,319	
Re-bar	ton	1,184	400	474	700	829	1,100	1,302	1,400	1,658	1,800	2,131	2,100	2,486	2,800	3,315	
Consolidation Grout	m^2	46	3,542	163	7,084	326	10,626	489	14,168	652	17,709	815	21,251	978	28,335	1,303	
Others	LS		1	328	1	641	1	964	1	1,277	1	1,604	1	1,914	1	2,552	10%
4. Penstock				***854***		***1,694***		***2,536***		***3,377***		***4,213***		***5,060***		***6,737***	
Tunnel Excavation	m^3	69	4,400	304	8,700	600	13,000	897	17,400	1,201	21,700	1,497	26,000	1,794	34,700	2,394	
Shotcrete 10cm	m^2	58	2,200	128	4,300	249	6,500	377	8,700	505	10,800	626	13,000	754	17,300	1,003	
Rock Bolt	m	32	2,600	83	5,200	166	7,700	246	10,300	330	12,800	410	15,400	493	20,500	656	
Concrete, filling	m^3	119	2,200	262	4,400	524	6,600	785	8,700	1,035	10,900	1,297	13,100	1,559	17,400	2,071	
Others	LS		1	78	1	154	1	231	1	307	1	383	1	460	1	612	10%

Item	Unit	Unit cost (US$)	100MW		200MW		300MW		400MW		500MW		600MW		800MW		Remark
			Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	
5. Access Tunnel				***6,965***		***8,437***		***8,437***		***11,725***		***13,238***		***13,018***		***17,616***	
Tunnel Excavation	m^3	64	50,100	3,206	62,500	4,000	62,500	4,000	87,300	5,587	99,100	6,342	99,100	6,342	135,700	8,685	
Shotcrete 20cm	m^2	100	1,200	120	1,200	120	1,200	120	1,200	120	1,200	120	1,200	120	1,200	120	
Shotcrete 10cm	m^2	50	17,300	865	20,000	1,000	20,000	1,000	31,100	1,555	35,500	1,775	31,500	1,575	43,100	2,155	
Rock Bolt	m	30	26,300	789	32,500	975	32,500	975	44,800	1,344	50,700	1,521	50,700	1,521	68,900	2,067	
Concrete, lining	m^3	212	4,000	848	4,700	996	4,700	996	6,300	1,336	7,000	1,484	7,000	1,484	9,300	1,972	
Re-bar	ton	1,068	360	384	430	459	430	459	560	598	630	673	630	673	840	897	
Steel Support	ton	1,983	60	119	60	119	60	119	60	119	60	119	60	119	60	119	
Others	LS			633		767		767		1,066		1,203		1,183		1,601	10%
6. Powerhouse				***24,820***		***33,059***		***40,695***		***58,800***		***66,290***		***78,520***		***112,278***	
6.1 Powerhouse and Transformer Cavern				22,586		30,826		38,461		54,015		61,506		73,735		104,442	
Excavation (rock)	m^3	75	46,200	3,465	89,600	6,720	127,900	9,593	153,900	11,543	192,100	14,408	257,700	19,328	385,500	28,913	
Sf Shotcrete, 8cm x 3-layers	m^2	160	5,200	832	9,300	1,488	12,700	2,032	14,500	2,320	17,400	2,784	25,400	4,064	34,700	5,552	
Sf Shotcrete, 8cm x 2-layers	m^2	80	72,400	5,792	73,700	5,896	75,000	6,000	147,400	11,792	148,700	11,896	150,000	12,000	223,700	17,896	
Shotcrete 10cm	m^2	52	0	0	0	0	0	0	1,600	83	1,600	83	1,600	83	3,100	161	
Rock Bolt,	m	28	37,300	1,044	39,900	1,117	42,100	1,179	80,300	2,248	82,300	2,304	86,800	2,430	126,600	3,545	
Concrete, Structure	m^3	232	13,500	3,132	22,100	5,127	30,800	7,146	42,000	9,744	50,600	11,739	62,100	14,407	84,100	19,511	
Re-bar	ton	1,182	680	804	1,110	1,312	1,540	1,820	2,100	2,482	2,530	2,990	3,110	3,676	4,210	4,976	
Building and utility works	LS	3,000,000	1	3,000	1	3,000	1	3,000	1	3,000	1	3,000	1	3,000	1	3,000	
Others	LS			4,517		6,165		7,692		10,803		12,301		14,747		20,888	25%
6.2 Cable Tunnel/ Shaft				2,233		2,233		2,233		4,784		4,784		4,784		7,836	
Tunnel Excavation	m^3	69	7,543	520	7,543	520	7,543	520	15,086	1,041	15,086	1,041	15,086	1,041	22,629	1,561	
Shaft Excavation	m^3	73	5,933	433	5,933	433	5,933	433	5,933	433	5,933	433	5,933	433	11,866	866	
Shotcrete, 10cm	m^2	58	3,016	175	3,016	175	3,016	175	7,689	446	7,689	446	7,689	446	12,363	717	
Rock Bolt	m	32	5,400	173	5,400	173	5,400	173	13,740	440	13,740	440	13,740	440	22,080	707	
Concrete	m^3	214	2,300	492	2,300	492	2,300	492	6,200	1,327	6,200	1,327	6,200	1,327	10,200	2,183	
Reinforcement bar	ton	1,184	200	237	200	237	200	237	560	663	560	663	560	663	920	1,089	
Others	LS			203		203		203		435		435		435		712	10%
7. Draft Tunnel / Pond				***4,340***		***7,912***		***11,869***		***16,379***		***20,451***		***23,712***		***31,839***	
Excavation	m^3	75	22,600	1,695	40,800	3,060	61,200	4,590	81,600	6,120	102,000	7,650	122,400	9,180	164,800	12,360	
Shotcrete, 10cm	m^2	52	8,100	421	9,800	510	14,600	759	28,600	1,487	35,800	1,862	29,200	1,518	40,500	2,106	
Rock Bolt	m	28	2,400	67	4,800	134	7,200	202	10,900	305	12,600	353	14,400	403	19,100	535	
Concrete	m^3	232	5,200	1,206	10,300	2,390	15,500	3,596	20,600	4,779	25,800	5,986	30,900	7,169	41,200	9,558	

Item	Unit	Unit cost (US$)	100MW		200MW		300MW		400MW		500MW		600MW		800MW		Remark
			Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	
Reinforcement bar	ton	1,182	470	556	930	1,099	1,390	1,643	1,860	2,199	2,320	2,742	2,780	3,286	3,710	4,385	
Others	LS		1	395	1	719	1	1,079	1	1,489	1	1,859	1	2,156	1	2,894	10%
8. Tailrace Tunnel				***103,649***		***199,406***		***295,024***		***397,860***		***499,921***		***601,861***		***816,496***	
8.1Work adit				7,848		7,848		7,848		8,636		8,636		8,636		11,161	
Open Excavation, common	m^3	5	23,360	117	23,360	117	23,360	117	23,360	117	23,360	117	23,360	117	23,360	117	
Tunnel Excavation	m^3	64	65,400	4,186	65,400	4,186	65,400	4,186	73,300	4,691	73,300	4,691	73,300	4,691	98,700	6,317	
Shotcrete 20cm	m^2	100	1,200	120	1,200	120	1,200	120	1,200	120	1,200	120	1,200	120	1,200	120	
Shotcrete 10cm	m^2	50	21,700	1,085	21,700	1,085	21,700	1,085	24,400	1,220	24,400	1,220	24,400	1,220	33,000	1,650	
Rock Bolt	m	30	21,200	636	21,200	636	21,200	636	23,700	711	23,700	711	23,700	711	31,700	951	
Steel Support	ton	1,983	500	992	500	992	500	992	500	992	500	992	500	992	500	992	
Others	LS		1	713	1	713	1	713	1	785	1	785	1	785	1	1,015	10%
8.2Tailrace Tunnel				95,800		191,558		287,175		389,224		491,285		593,225		805,336	
Tunnel Excavation	m^3	69	561,700	38,757	1,123,400	77,515	1,685,100	116,272	2,283,900	157,589	2,882,800	198,913	3,481,700	240,237	4,726,500	326,129	
Shotcrete 10cm	m^2	58	163,700	9,495	327,300	18,983	490,900	28,472	665,300	38,587	839,800	48,708	1,014,200	58,824	1,376,800	79,854	
Shotcrete 15cm	m^2	87	5,500	479	11,000	957	16,400	1,427	22,300	1,940	28,100	2,445	33,900	2,949	46,000	4,002	
Shotcrete 20cm	m^2	116	2,658	308	5,316	617	7,974	925	10,808	1,254	13,642	1,582	16,476	1,911	22,366	2,594	
Rock Bolt	m	32	157,700	5,046	315,400	10,093	473,100	15,139	641,300	20,522	809,400	25,901	977,600	31,283	1,327,100	42,467	
Steel Support	ton	1,184	400	474	800	947	1,100	1,302	1,500	1,776	1,900	2,250	2,200	2,605	3,000	3,552	
Concrete, lining	m^3	214	111,300	23,818	222,500	47,615	333,700	71,412	452,200	96,771	570,800	122,151	689,400	147,532	935,900	200,283	
Re-bar	ton	1,184	7,360	8,714	14,710	17,417	22,060	26,119	29,900	35,402	37,730	44,672	45,570	53,955	61,860	73,242	
Others	LS			8,709		17,414		26,107		35,384		44,662		53,930		73,212	10%
9. Outlet				***848***		***1,694***		***2,526***		***3,503***		***4,481***		***5,444***		***7,400***	
Excavation (common)	m^3	5	3,500	18	6,900	35	10,400	52	15,300	77	20,300	102	25,200	126	35,200	176	
Excavation (rock)	m^3	16	13,800	221	27,500	440	41,200	659	61,000	976	80,800	1,293	100,600	1,610	140,200	2,243	
Concrete	m^3	234	1,300	304	2,600	608	3,900	913	5,200	1,217	6,500	1,521	7,800	1,825	10,400	2,434	
Reinforcement bar	ton	1,135	120	136	240	272	350	397	470	533	590	670	700	795	940	1,067	
Others	15%			170		339		505		701		896		1,089		1,480	25%
10. Miscellaneous	L.S.			***17,697***		***29,439***		***41,008***		***54,736***		***67,113***		***79,681***		***107,511***	Σ((1)-(9))×10%
Sub Total				**194,667**		**323,833**		**451,089**		**602,092**		**738,238**		**876,494**		**1,182,618**	

(2) Hydro-Mechanical Works

Item	Unit	Unit cost (US$)	100MW		200MW		300MW		400MW		500MW		600MW		800MW	
			Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)
1. Intake Dam				2,495		2,495		2,495		2,495		2,495		2,495		2,495
Sand Flush Gate and Stoplog	ton	9,900	252	2,495	252	2,495	252	2,495	252	2,495	252	2,495	252	2,495	252	2,495
2. Intake				3,750		5,840		7,057		10,807		12,854		14,114		19,081
Main and Sub-gate	ton	8,300	400	3,320	600	4,980	700	5,810	1,100	9,130	1,300	10,790	1,400	11,620	1,900	15,770
Screen	ton	4,300	100	430	200	860	290	1,247	390	1,677	480	2,064	580	2,494	770	3,311
3. Penstock (steel pipe)	ton	4,700	230	1,081	450	2,115	670	3,149	890	4,183	1,110	5,217	1,330	6,251	1,770	8,319
4. Tailrace gate and Stoplog	ton	8,300	80	664	120	996	160	1,328	230	1,909	270	2,241	310	2,573	420	3,486
5. Draft Gate	ton	8,300	140	1,162	280	2,324	420	3,486	560	4,648	700	5,810	840	6,972	1,120	9,296
6. Others	L.S.		20%	1,830	20%	2,754	20%	3,503	20%	4,808	20%	5,723	20%	6,481	20%	8,535
Subtotal				10,982		16,524		21,018		28,850		34,340		38,886		51,212

3.2 Cost Breakdown for Stepwise Development

(1) Civil Works

Item	Unit	Unit cost (US$)	1st Stage (100MW)		2nd Stage (200MW)		3rd Stage (300MW)		4th Stage (400MW)		5thStage (500MW)		Final Stage (600MW)		Remark
			Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	
1. Weir				***28,613***		***28,613***		***28,613***		***28,613***		***28,613***		***28,613***	
1.1. Care of river	LS		1	5,723	1	5,723	1	5,723	1	5,723	1	5,723	1	5,723	(1.2)×25%
1.2. Weir				22,891		22,891		22,891		22,891		22,891		22,891	
Excavation (rock)	m^3	14	10,500	147	10,500	147	10,500	147	10,500	147	10,500	147	10,500	147	
Concrete	m^3	213	83,400	17,764	83,400	17,764	83,400	17,764	83,400	17,764	83,400	17,764	83,400	17,764	
Reinforcement bar	ton	1,115	360	401	360	401	360	401	360	401	360	401	360	401	
Others	LS		1	4,578	1	4,578	1	4,578	1	4,578	1	4,578	1	4,578	25%
2. Intake				***19,531***		***19,531***		***19,531***		***19,531***		***19,531***		***19,531***	
Excavation (common)	m^3	5	74,600	373	74,600	373	74,600	373	74,600	373	74,600	373	74,600	373	
Excavation (rock)	m^3	16	358,900	5,742	358,900	5,742	358,900	5,742	358,900	5,742	358,900	5,742	358,900	5,742	
Concrete	m^3	234	25,700	6,014	25,700	6,014	25,700	6,014	25,700	6,014	25,700	6,014	25,700	6,014	
Reinforcement bar	ton	1,135	3,080	3,496	3,080	3,496	3,080	3,496	3,080	3,496	3,080	3,496	3,080	3,496	
Others	LS		1	3,906	1	3,906	1	3,906	1	3,906	1	3,906	1	3,906	25%
3. Headrace / Pressure Shaft				***3,609***		***7,053***		***10,600***		***14,048***		***17,641***		***21,053***	
Tunnel Excavation	m^3	69	6,200	428	12,400	856	18,600	1,283	24,800	1,711	31,000	2,139	37,100	2,560	
Shaft Excavation		73	7,300	533	14,600	1,066	21,900	1,599	29,100	2,124	36,400	2,657	43,700	3,190	
Shotcrete 20cm	m^2	116	1,900	220	3,700	429	5,500	638	7,400	858	9,200	1,067	11,000	1,276	
Shotcrete 10cm	m^2	58	2,800	162	5,600	325	8,400	487	11,200	650	14,000	812	16,800	974	
Rock Bolt	m	32	5,600	179	11,200	358	16,700	534	22,300	714	27,800	890	33,400	1,069	
Steel Support	ton	2,014	100	201	190	383	280	564	370	745	470	947	560	1,128	
Concrete, lining	m^3	214	4,300	920	8,600	1,840	12,800	2,739	17,100	3,659	21,400	4,580	25,600	5,478	
Re-bar	ton	1,184	400	474	700	829	1,100	1,302	1,400	1,658	1,800	2,131	2,100	2,486	
Consolidation Grout	m^2	46	3,542	163	7,084	326	10,626	489	14,168	652	17,709	815	21,251	978	
Others	LS		1	328	1	641	1	964	1	1,277	1	1,604	1	1,914	10%
4. Penstock				***854***		***1,694***		***2,536***		***3,377***		***4,213***		***5,060***	
Tunnel Excavation	m^3	69	4,400	304	8,700	600	13,000	897	17,400	1,201	21,700	1,497	26,000	1,794	
Shotcrete 10cm	m^2	58	2,200	128	4,300	249	6,500	377	8,700	505	10,800	626	13,000	754	
Rock Bolt	m	32	2,600	83	5,200	166	7,700	246	10,300	330	12,800	410	15,400	493	
Concrete, filling	m^3	119	2,200	262	4,400	524	6,600	785	8,700	1,035	10,900	1,297	13,100	1,559	
Others	LS		1	78	1	154	1	231	1	307	1	383	1	460	10%

Item	Unit	Unit cost (US$)	1st Stage (100MW)		2nd Stage (200MW)		3rd Stage (300MW)		4th Stage (400MW)		5thStage (500MW)		Final Stage (600MW)		Remark
			Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	
5. Access Tunnel				***8,437***		***8,437***		***8,437***		***13,018***		***13,018***		***13,018***	
Tunnel Excavation	m^3	64	62,500	4,000	62,500	4,000	62,500	4,000	99,100	6,342	99,100	6,342	99,100	6,342	
Shotcrete 20cm	m^2	100	1,200	120	1,200	120	1,200	120	1,200	120	1,200	120	1,200	120	
Shotcrete 10cm	m^2	50	20,000	1,000	20,000	1,000	20,000	1,000	31,500	1,575	31,500	1,575	31,500	1,575	
Rock Bolt	m	30	32,500	975	32,500	975	32,500	975	50,700	1,521	50,700	1,521	50,700	1,521	
Concrete, lining	m^3	212	4,700	996	4,700	996	4,700	996	7,000	1,484	7,000	1,484	7,000	1,484	
Re-bar	ton	1,068	430	459	430	459	430	459	630	673	630	673	630	673	
Steel Support	ton	1,983	60	119	60	119	60	119	60	119	60	119	60	119	
Others	LS			767		767		767		1,183		1,183		1,183	10%
6. Powerhouse				***34,989***		***37,828***		***40,695***		***72,800***		***75,638***		***78,520***	
6.1 Powerhouse and Transformer Cavern				32,756		35,594		38,461		68,015		70,853		73,735	
Excavation (rock)	m^3	75	127,900	9,593	127,900	9,593	127,900	9,593	257,700	19,328	257,700	19,328	257,700	19,328	
Sf Shotcrete, 8cm x 3-layers	m^2	160	12,700	2,032	12,700	2,032	12,700	2,032	25,400	4,064	25,400	4,064	25,400	4,064	
Sf Shotcrete, 8cm x 2-layers	m^2	80	75,000	6,000	75,000	6,000	75,000	6,000	150,000	12,000	150,000	12,000	150,000	12,000	
Shotcrete 10cm	m^2	52	0	0	0	0	0	0	1,600	83	1,600	83	1,600	83	
Rock Bolt,	m	28	42,100	1,179	42,100	1,179	42,100	1,179	86,800	2,430	86,800	2,430	86,800	2,430	
Concrete, Structure	m^3	232	15,100	3,503	22,900	5,313	30,800	7,146	46,400	10,765	54,200	12,574	62,100	14,407	
Re-bar	ton	1,182	760	898	1,150	1,359	1,540	1,820	2,320	2,742	2,710	3,203	3,110	3,676	
Building and utility works	LS	3,000,000	1	3,000	1	3,000	1	3,000	1	3,000	1	3,000	1	3,000	
Others	LS			6,551		7,119		7,692		13,603		14,171		14,747	25%
6.2 Cable Tunnel/ Shaft				2,233		2,233		2,233		4,784		4,784		4,784	
Tunnel Excavation	m^3	69	7,543	520	7,543	520	7,543	520	15,086	1,041	15,086	1,041	15,086	1,041	
Shaft Excavation	m^3	73	5,933	433	5,933	433	5,933	433	5,933	433	5,933	433	5,933	433	
Shotcrete, 10cm	m^2	58	3,016	175	3,016	175	3,016	175	7,689	446	7,689	446	7,689	446	
Rock Bolt	m	32	5,400	173	5,400	173	5,400	173	13,740	440	13,740	440	13,740	440	
Concrete	m^3	214	2,300	492	2,300	492	2,300	492	6,200	1,327	6,200	1,327	6,200	1,327	
Reinforcement bar	ton	1,184	200	237	200	237	200	237	560	663	560	663	560	663	
Others	LS			203		203		203		435		435		435	10%
7. Draft Tunnel / Pond				***4,434***		***8,139***		***11,869***		***19,008***		***21,374***		***23,712***	
Excavation	m^3	75	23,700	1,778	42,400	3,180	61,200	4,590	118,000	8,850	120,200	9,015	122,400	9,180	
Shotcrete, 10cm	m^2	52	8,100	421	11,400	593	14,600	759	22,700	1,180	26,000	1,352	29,200	1,518	

Item	Unit	Unit cost (US$)	1st Stage (100MW)		2nd Stage (200MW)		3rd Stage (300MW)		4th Stage (400MW)		5thStage (500MW)		Final Stage (600MW)		Remark
			Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	
Rock Bolt	m	28	2,500	70	4,900	137	7,200	202	9,700	272	12,000	336	14,400	403	
Concrete	m^3	232	5,200	1,206	10,300	2,390	15,500	3,596	20,600	4,779	25,800	5,986	30,900	7,169	
Reinforcement bar	ton	1,182	470	556	930	1,099	1,390	1,643	1,860	2,199	2,320	2,742	2,780	3,286	
Others	LS		1	403	1	740	1	1,079	1	1,728	1	1,943	1	2,156	10%
8. Tailrace Tunnel				***103,649***		***199,406***		***295,024***		***397,860***		***499,920***		***601,861***	
8.1Work adit				7,848		7,848		7,848		8,636		8,636		8,636	
Open Excavation, common	m^3	5	23,360	117	23,360	117	23,360	117	23,360	117	23,360	117	23,360	117	
Tunnel Excavation	m^3	64	65,400	4,186	65,400	4,186	65,400	4,186	73,300	4,691	73,300	4,691	73,300	4,691	
Shotcrete 20cm	m^2	100	1,200	120	1,200	120	1,200	120	1,200	120	1,200	120	1,200	120	
Shotcrete 10cm	m^2	50	21,700	1,085	21,700	1,085	21,700	1,085	24,400	1,220	24,400	1,220	24,400	1,220	
Rock Bolt	m	30	21,200	636	21,200	636	21,200	636	23,700	711	23,700	711	23,700	711	
Steel Support	ton	1,983	500	992	500	992	500	992	500	992	500	992	500	992	
Others	LS		1	713	1	713	1	713	1	785	1	785	1	785	10%
8.2Tailrace Tunnel				95,800		191,558		287,175		389,224		491,285		593,225	
Tunnel Excavation	m^3	69	561,700	38,757	1,123,400	77,515	1,685,100	116,272	2,283,900	157,589	2,882,800	198,913	3,481,700	240,237	
Shotcrete 10cm	m^2	58	163,700	9,495	327,300	18,983	490,900	28,472	665,300	38,587	839,800	48,708	1,014,200	58,824	
Shotcrete 15cm	m^2	87	5,500	479	11,000	957	16,400	1,427	22,300	1,940	28,100	2,445	33,900	2,949	
Shotcrete 20cm	m^2	116	2,658	308	5,316	617	7,974	925	10,808	1,254	13,642	1,582	16,476	1,911	
Rock Bolt	m	32	157,700	5,046	315,400	10,093	473,100	15,139	641,300	20,522	809,400	25,901	977,600	31,283	
Steel Support	ton	1,184	400	474	800	947	1,100	1,302	1,500	1,776	1,900	2,250	2,200	2,605	
Concrete, lining	m^3	214	111,300	23,818	222,500	47,615	333,700	71,412	452,200	96,771	570,800	122,151	689,400	147,532	
Re-bar	ton	1,184	7,360	8,714	14,710	17,417	22,060	26,119	29,900	35,402	37,730	44,672	45,570	53,955	
Others	LS			8,709		17,414		26,107		35,384		44,662		53,930	10%
9. Outlet				***2,526***		***2,526***		***2,526***		***5,444***		***5,444***		***5,444***	
Excavation (common)	m^3	5	10,400	52	10,400	52	10,400	52	25,200	126	25,200	126	25,200	126	
Excavation (rock)	m^3	16	41,200	659	41,200	659	41,200	659	100,600	1,610	100,600	1,610	100,600	1,610	
Concrete	m^3	234	3,900	913	3,900	913	3,900	913	7,800	1,825	7,800	1,825	7,800	1,825	
Reinforcement bar	ton	1,135	350	397	350	397	350	397	700	795	700	795	700	795	
Others	15%			505		505		505		1,089		1,089		1,089	25%
10. Miscellaneous	L.S.			***20,664***		***31,323***		***41,983***		***57,370***		***68,539***		***79,681***	$\Sigma((1)-(9)) \times 10\%$
Sub Total				**227,306**		**344,549**		**461,814**		**631,069**		**753,932**		**876,494**	

(2) Hydro-mechanical Works

Item	Unit	Unit cost (US$)	1st Stage (100MW)		2nd Stage (200MW)		3rd Stage (300MW)		4th Stage (400MW)		5th Stage (500MW)		Final Stage (600MW)	
			Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)	Quantity	Cost (10^3US$)
1. Intake Dam				2,495		2,495		2,495		2,495		2,495		2,495
Sand Flush Gate and Stoplog	ton	9,900	252	2,495	252	2,495	252	2,495	252	2,495	252	2,495	252	2,495
2. Intake				7,057		7,057		7,057		14,114		14,114		14,114
Main and Sub-gate	ton	8,300	700	5,810	700	5,810	700	5,810	1,400	11,620	1,400	11,620	1,400	11,620
Screen	ton	4,300	290	1,247	290	1,247	290	1,247	580	2,494	580	2,494	580	2,494
3. Penstock (steel pipe)	ton	4,700	230	1,081	450	2,115	670	3,149	890	4,183	1,110	5,217	1,330	6,251
4. Tailrace gate and Stoplog	ton	8,300	160	1,328	160	1,328	160	1,328	310	2,573	310	2,573	310	2,573
5. Draft Gate	ton	8,300	140	1,162	280	2,324	420	3,486	560	4,648	700	5,810	840	6,972
6. Others	L.S.		20%	2,625	20%	3,064	20%	3,503	20%	5,603	20%	6,042	20%	6,481
Subtotal				15,747		18,383		21,018		33,615		36,251		38,886