to be 1450 mm.

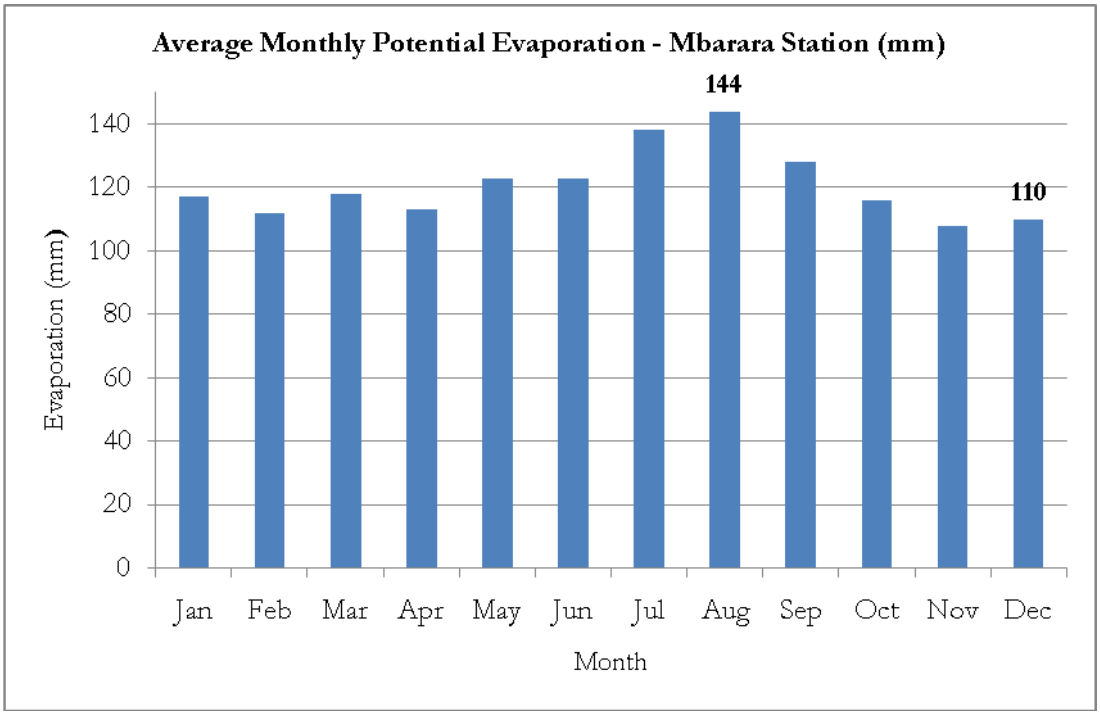

Figure 6-3: Seasonal Evaporation Pattern in Bigasha.

Temperature is said to have a direct effect on evaporation and it could be suggested as the reason why the evaporation is lowest in the coolest month of the year, December. However, this is not directly matched for the hottest month of the year, February, although the evaporation is noticeably high none-the-less (112 mm).

6.1.3 Hydrology and Drainage

A study of the existing water sources in regards to this assignment is crucial because these will affect the water flow into the proposed Bigasha dam or the dam's inflow will affect the water still available in these water sources after construction. During the rainy season, there is a high surface runoff that will feed into Bigasha dam and generally the ground water table will be high because of the rainfall. However during the dry season, the streams and springs will tend to dry up and go underground and it is possible that the ground water table will be low.

a) Characterization of the proposed dam site

The proposed Bigasha dam site lies at the border of Kashumba and Ngarama sub counties in Isingiro district at Coordinates Eastings 266102, Northings 9895171 (UTM Zone 36N). For the hydrology analysis of the dam site, the water sources in these two sub-counties are the ones that have been considered. It is assumed that any development on the dam site will directly affect the water sources in these two sub counties.

The water points within the area include Boreholes, Surface Water, Protected Springs, Rain Water Harvesting Tanks, Public Stand Posts, Valley tanks and Earth dams. The most common of these are the boreholes, public stand posts and rainwater tanks. Access to safe water in Ngarama and Kashumba is at 12% and 14% respectively (DWD-MWE, 2010).

b) Ground Water Sources

Ground Water sources at the Bigasha dam site include deep boreholes, protected springs and shallow wells. There is no ground water monitoring stations located within the catchment of the proposed Bigasha dam site. All the shallow wells, protected springs and boreholes in the area have specifically been put in place for water supply purposes. **Figure 6-4** shows the ground water sources in proximity to the dam site.

Data on the borehole yield and depth was not readily available. As a result, there is no data relating to the aquifer into which the boreholes were drilled. It is likely that there is interaction between groundwater and surface runoff especially during the dry season when the seasonal streams dry up or recede underground.

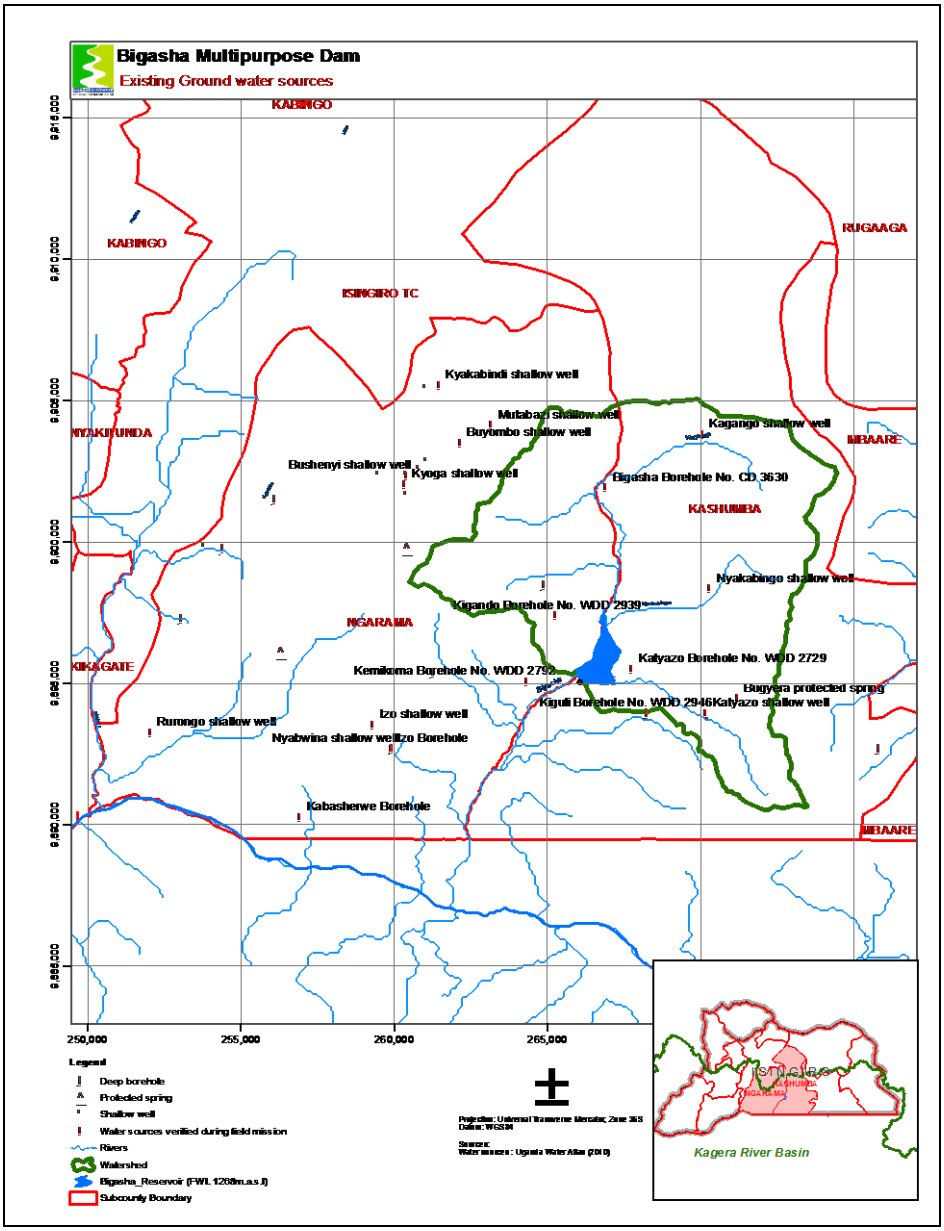

Figure 6-4: Existing Ground Water Sources

c) Surface Water Sources

Surface Water Sources include streams, wetlands, public stand posts, valley tanks and earth dams. The sub-counties have no wetlands. There are however, a number of streams and rivers, some of which are seasonal while others are perennial. Refer to **Figure 6-5**.

Some of the main rivers in Kashumba sub-County are Nyakabingo, Rushenyi, Kaganga and Bigasha while the main ones in Ngarama sub-county are Kikoma, Kyakabindi and Karuruma. It is claimed by the local people that Nyakabingo is a perennial river. The local people said Kaganga was perennial until the Kagango dam construction was completed because it pours all its water into the dam. Rushenyi is a seasonal stream that dries up in the dry season.

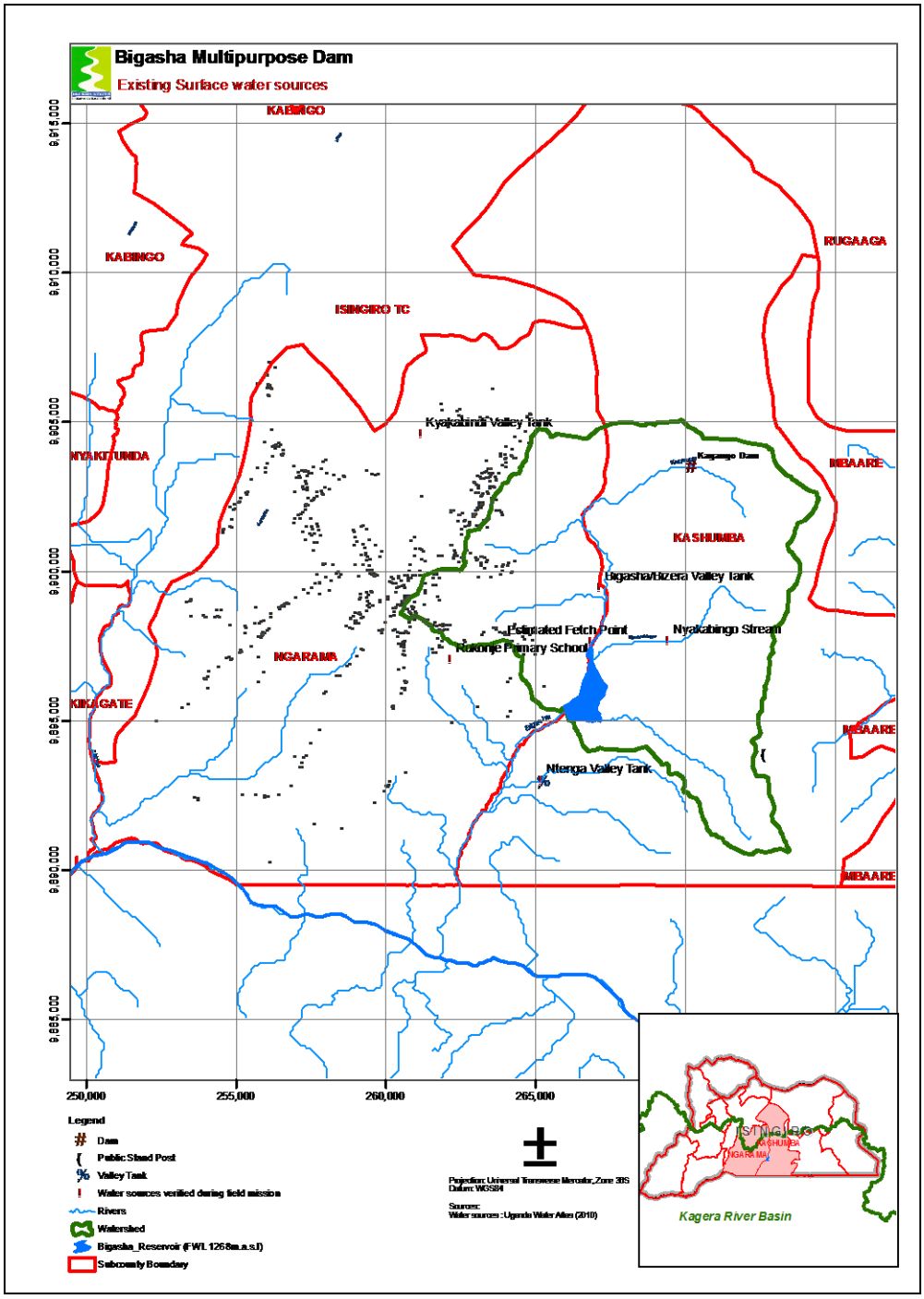

Figure 6-5: Existing Surface Water Sources

d) Principal Water Users

It is important to identify the principal water users upstream and downstream of the proposed dam site because once the facility is constructed and completed there will be impacts on the activities that these users are engaged in. **Figure 6-6** shows the principal water users.

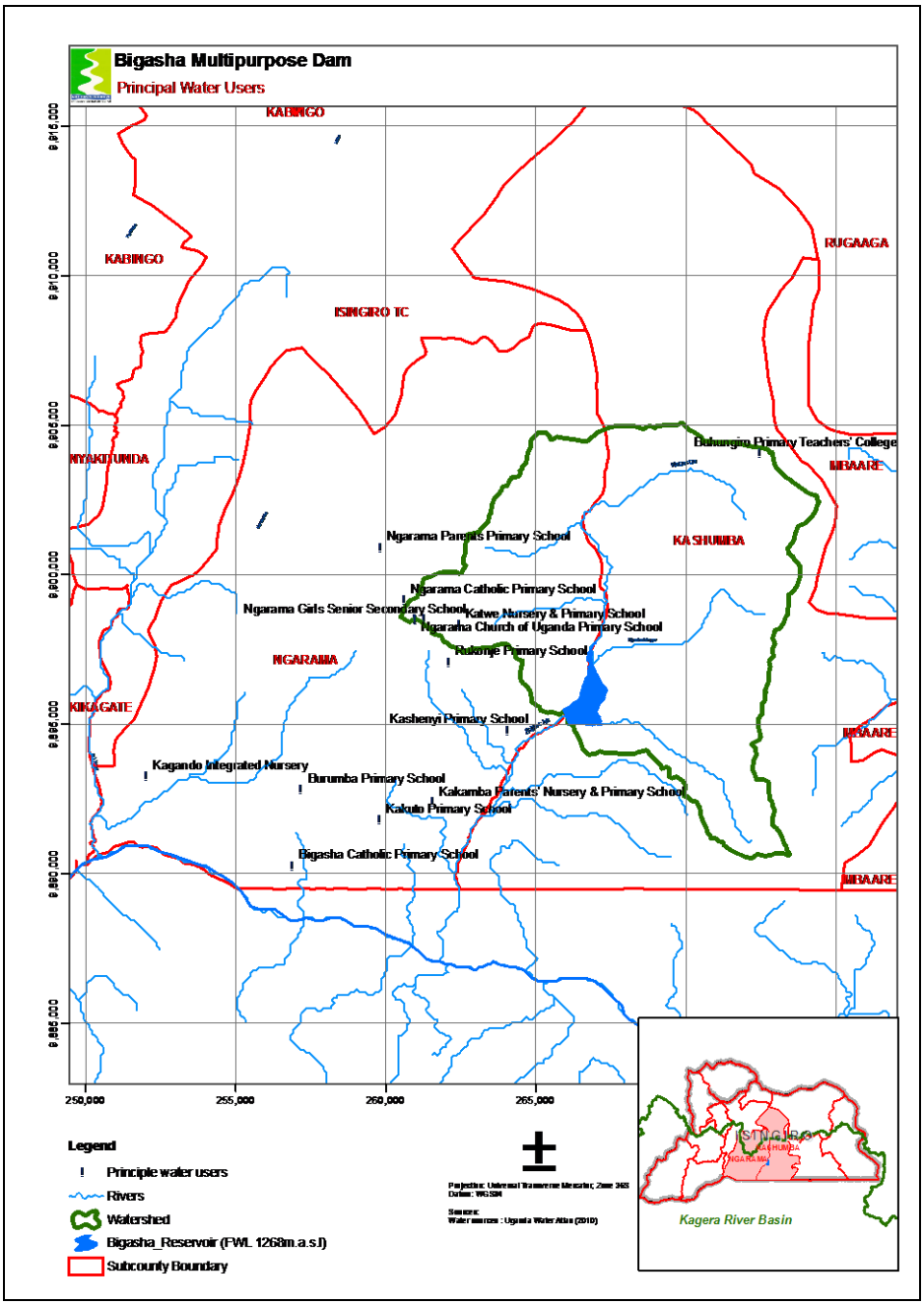

Figure 6-6: Principal Water Users in the Bigasha Dam Catchment

The Assistant Engineering Officer for Water for Isingiro district, Mr. Boaz Niwanya, advised that the biggest need for water currently is domestic use and livestock watering. As a result the only principal water users are homes and institutions/schools. There are no health centres, industries, factories, big farms, irrigation, aquaculture or even non-consumptive activities engaged in on a large scale, especially within Kashumba and Ngarama Sub counties. An estimate of the total water demand of the principal users can be made basing on the water demand per capita.

Water Demand Estimation

Table 6-1 shows the projected 2012 population for Ngarama and Kashumba sub counties. From the field visit, it was noted that the Bigasha catchment is very sparsely populated in regards to households.

Table 6-1: Sub County 2012 Projected Population

Sub-county	Males	Females	Total
Ngarama	20,700	21,400	42,100
Kashumba	18,100	18,500	36,600
Total	**38,800**	**39,900**	**78,700**

(Source: Uganda Bureau of Statistics, Sub National Projections Report, Western Region – 2008-2012)

The population was projected to 2037[2] for the two sub-counties as detailed in **Table 6-2**. For the water demand, the following assumptions made:

- An average day unit Water Demand of 50litres/person/day for low income consumers (DWD-MWE, 2000),
- Design life of the dam is 25 years[3] thus projecting water demand for 2037

Given in ***Table 6-2***; the water demand is estimated as:

= Population x Unit Water Demand/person/day

Table 6-2: Current (2012) and Projected (2037) Household Water Demand

Parameter/Year	2012	2037
Total Population (No.)	78,700	624,393
Total Water Demand (m^3/d)	3,935	31,220
Annual Total Water Demand (Mm^3)	**1.44**	**11.40**

Table 6-3 lists the schools in Bigasha catchment and student enrolment, which ranges 100 – 800 students per school. It also shows the water demand for 2012.

Table 6-3: Schools' Current Water Demand for 2012

Name of School/Institution	Total Enrolment (No.)[4]	Total Demand (l/d)	Water Demand (m^3)
Ngarama Secondary School	753	37,650	13,742

[2] Source: Tractebel Engineering S.A., 2012, Feasibility Study Report – Draft Report for Bigasha site in Uganda
[3] Source: Tractebel Engineering S.A., 2012, Feasibility Study Report – Draft Report for Bigasha site in Uganda
[4] *Source: Health Assistant, Ngarama Sub County, Isingiro District*

Name of School/Institution	Total Enrolment (No.)[4]	Total Demand (l/d)	Water Demand (m^3)
Ngarama Catholic Primary School	565	2,825	1,031
Ngarama C.O.U. Primary School	574	2,870	1,048
Ngarama Girls Secondary School	170	8,500	3,103
Katwe Children's Vocational Day & Boarding Primary School	550	27,500	10,038
Ngarama Parents' School	522	2,610	953
Kishojo Primary School	221	1,105	403
Kashenyi Primary School	189	945	345
Kagando Integrated Nursery	231	1,155	422
Kakamba Parents' Nursery & Primary School	127	635	232
Burumba Primary School	274	1,370	500
Bugwagye Nursery & Primary School	107	535	195
Rukonje Primary School	146	730	266
Kakuto Primary School	238	1,190	434
Bigasha Catholic Primary School	150	750	274
Buhungiro Primary Teachers' College	214	10700	3,906
Grand Total	**5,031**	**101,070**	**36,891**

For the institutions in Bigasha catchment as shown in *Table 6-3* above,

Total Annual (2012) Institutional water demand = *36,891m³*.

Assumptions in **Table 6-4** were used to calculate the demand per capita per day:

Table 6-4: Assumptions for Institutional Water Demand/Capita/Day

Day School: 5 l/p/day	5
Boarding School: 50 l/p/day	50

(Source: DWD Water Supply Manual 2000, Ministry of Water & Environment)

For the institutions in Bigasha catchment as shown in **Table 6-4, total current Institutional water demand = *101.07m³/d* ≈ 36,891m³/yr.**

The livestock population in the sub counties of Kashumba and Ngarama is shown in **table 6-5.** Assuming:

- 50% of the livestock came to water their animals from Bigasha dam, and

- 1 cattle = 0.7 Tropical Livestock Units[5] and 1 goat/sheep = 0.4 Tropical Livestock Units (DWD-MWE, 2000)
- A typical tropical livestock unit consumes 50litres/head/day (DWD-MWE, 2000)
-

Table 6-5: Livestock Population in Kashumba and Ngarama Sub counties

Sub-county	Total Number of Cattle	Total Number of Goats/Sheep	Total Water Demand (m^3/d)	Total Water Demand (m^3)
Kashumba	25,600	47,800	1,255	457,893
Ngarama	26,620	22,700	1,102	402,212
Total	52,220	70,500	**2,356**	**860,104**
		50% of Total	**1,178**	**430,052**

For livestock in the Bigasha dam catchment as calculated in in table 6-5 above:

Total current Livestock water demand = *1,178m³/d* ≈ 430,052 m³/y

The cumulative current water demand per day for the principal users in Kashumba and Ngarama sub-counties is estimated to be **5,214 m³/d**. **Table 6-6** gives a summary of the individual water demands for the Homesteads, Institutions and Livestock Watering.

Table 6-6: Total Current Water Demand in Kashumba and Ngarama sub-counties

Principal Water User	Current Water Demand (m^3/d)
Homesteads - Domestic	3,935.00
Institutions - Domestic	101.07
Livestock Watering	1,178.23
	5,214.30

Assuming a 5.35% GDP Real growth rate per year for the combined demand for domestic institutional and livestock water demand of 2012, the cumulative water demand for the principal water users is summarized as shown in *Table 6-7*:

Table 6-7: Cumulative Water Demand for Principal Users

	Water Demand (m^3)	
Principle Water User	**2012**	**2037**
Homesteads - domestic	1,436,275.00	11,395,180.28
Institutions - domestic	36,890.55	789,457.77
Livestock Watering	430,052.13	9,203,115.48
Grand Total	**1,903,217.68**	**21,387,753.53**

[5]1 TLU is equivalent to 1 Exotic Crossbreed Cattle, 0.7 Indigenous Cattle, 0.15 Goats or sheep or 0.4 Pigs and 0.01 Poultry

The team visited a few of the major water users upstream and downstream that happen to be schools and livestock watering points. As mentioned earlier, most of the homes practice rain water harvesting. There was some local brewing along Nyakabingo River upstream of the dam site. **Plate 6-1** *and* **Plate 6-2** below show some of the field findings.

Plate 6-1: Upstream Principal Water Users (Clockwise from Top Left: Rain Water Harvesting at Ngarama Catholic P/S, Local Brewing on Nyakabingo River, Bigasha/Bizera Valley Tank & Rushenyi Stream)

During consultations held at Inception stage, the communities prioritized the foreseen uses as:

- Water supply for domestic use and animals
- Fish farming
- Hydropower
- Irrigation

Asked on the foreseen uses if Bigasha dam is constructed, the local leadership reiterated that there is dire need to provide water for domestic use. Most institutions and homes have resorted to rain water harvesting. Provision of water will also encourage the locals to engage in livestock keeping and aquaculture on a large scale.

Plate 6-2: Downstream Principal Water Users (Clockwise: Domestic Water use & Livestock watering at Ntenga Valley tank, Kemikomo Deep Borehole & Kemikoma Valley Tank)

e) Hydrology

Bigasha is an un-gauged catchment with a seasonal Nyakabingo stream that feeds into the catchment. 5 rainfall gauge stations; namely Ndeija, Bugamba Forest, Gayaza Isingiro, Kikunda Rwoho, Rwoho Forest and 3 flow gauging stations; namely, Rwizi, Kikagati and Kibale were identified in neighbouring catchments. **Figure 6-7** following shows the location of these hydro-meteorological stations.

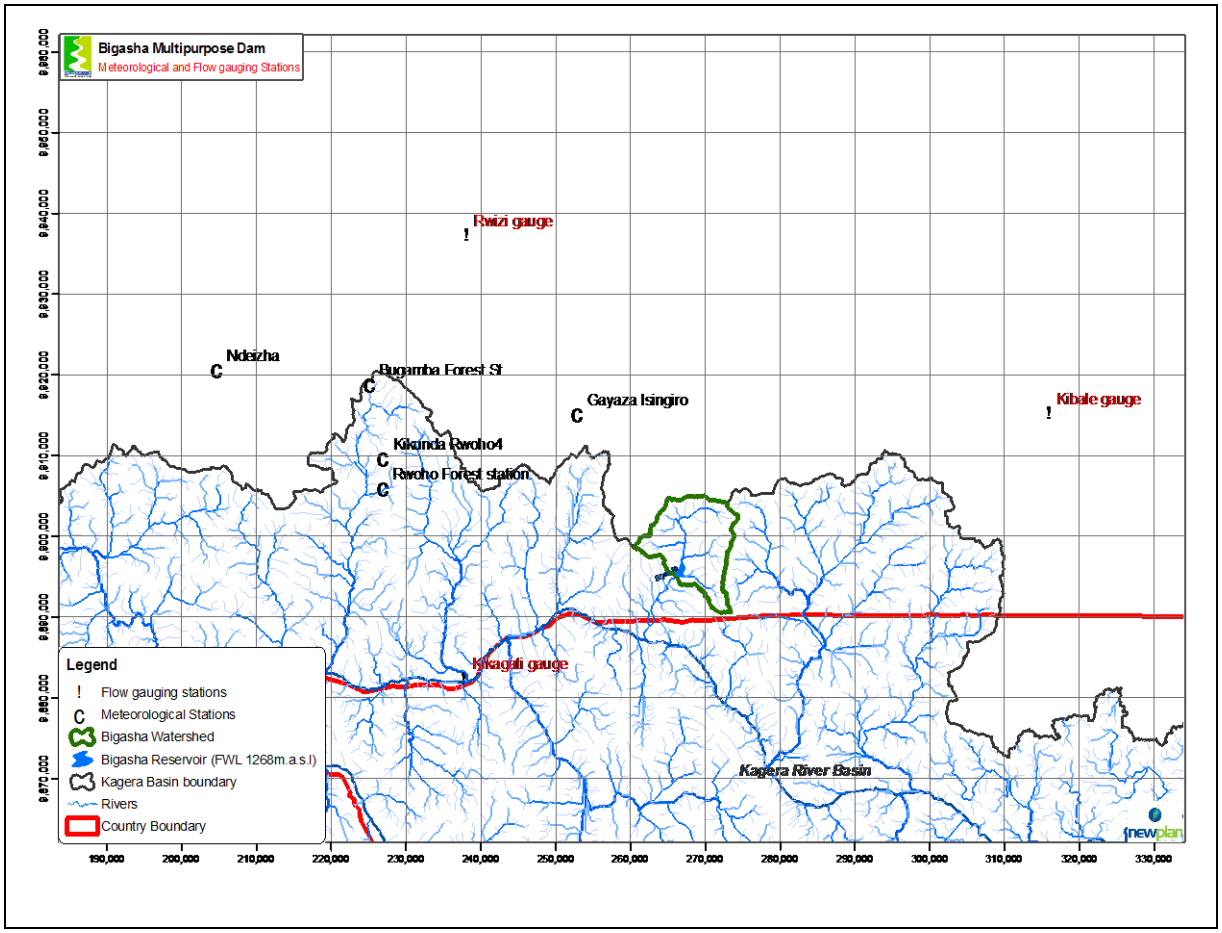

Figure 6-7: Location of Flow and Meteorological stations in proximity to Bigasha catchment

i) Water Yield Estimation

Estimation of water yield into Bigasha reservoir required compilation of Hydro-meteorological data from the neighbourhood since Bigasha catchment, as already mentioned, is not gauged. Stream flow data was collected from the nearby river gauging stations, namely, Rwizi, Kibale and Kikagati as shown in **Table 6-8**.

Table 6-8: Discharge Data from the Neighbourhood of Bigasha Catchment

Station Name	Years for Available Data	No. of Years of Available Data	Catchment (km^2)
Rwizi	1954 –2011	Approximately 57 years	2,091
Kibale	1968-1980; 1998-2005	Approximately 19 years	6,792
Kikagati	Jan-Jun 2010; August 2010 – April 2012	Approximately 3 years	41,619

(Source: DWD, Entebbe)

However, data for Rwizi was used since it is the longest and most continuous record. Additionally, Rwizi gauging station has a relatively smaller catchment area than Kibale and

Kikagati. Rwizi catchment yield may therefore be compared to that of the study area by use the catchment area ratio method.

Table 6-9 following shows the runoff estimation for the Bigasha catchment. The evaporation data has been adjusted by the correction factor of 0.7 which usually is meant to cater for the slow rate of evaporation from a natural water body.

For a long term situation, the rainfall-runoff relationship is given by the following expression:

$$Runoff(Yield) = Rainfall - Evaporation$$

Table 6-9: Yield Estimation

YIELD/RUNOFF ESTIMATION			
Month	**Rainfall (mm)**	**Evaporation (mm) Factored by (0.7)**	**Runoff (mm)**
January	48.3	81.9	0
February	59.6	78.4	0
March	99	82.6	16.4
April	127.1	79.1	48
May	86.1	86.1	0
June	16.6	86.1	0
July	14.9	96.6	0
August	35.5	100.8	0
September	80.6	89.6	0
October	102.6	81.2	21.4
November	119	75.6	43.4
December	82.6	77	5.6
Annual Runoff (Yield)			**134.8**

(Source: Department of Meteorology)

The annual yield from the Bigasha catchment under study is given using the following expression:

$$Annual\ Yield = Runoff * Catchment\ Area$$
$$Annual\ Yield = 0.1348 * 109.12 * 10^6 = 14.7 Mm^3$$

Figure 6-8 shows the flow duration curve for the proposed Bigasha dam derived from long term mean monthly flows of River Rwizi as earlier stated under the section on stream flow data. The not-so-steep curve indicates that River Bigasha has few floods with a large ground water contribution.

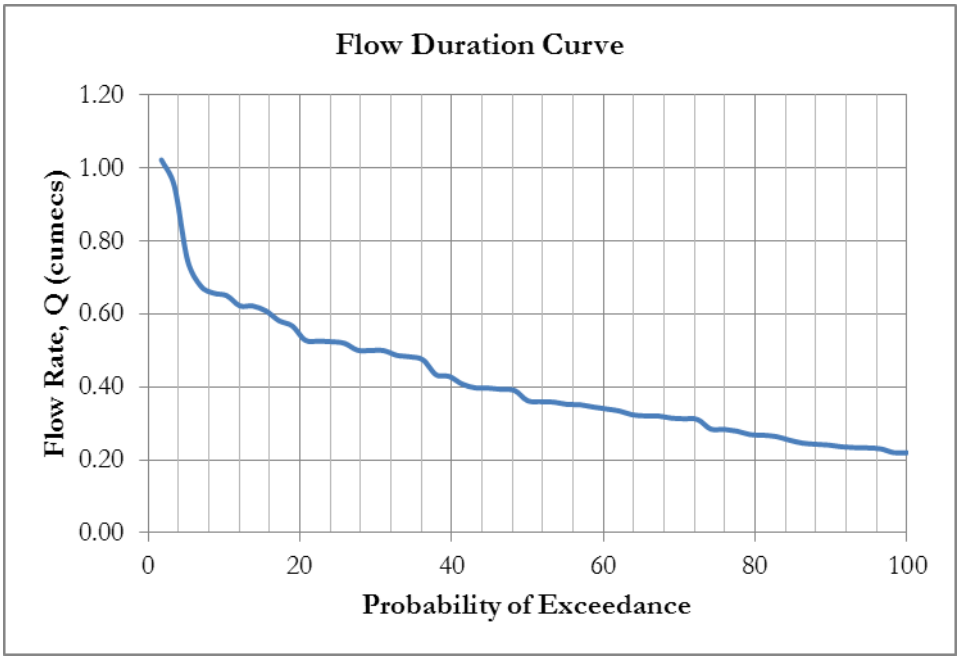

Figure 6-8: Flow Duration Curve for Bigasha Dam

(*Detailed hydrology report is attached in Appendix 4*).

ii) Design Flood

Design flood refers to the peak discharge or the flood hydrograph that is adopted for the design of water resources projects. The design flood is the maximum flood against which the project is protected. According to Singh (1992), three types of design are recognized:

(1) Probable Maximum Flood (PMF),
(2) Standard Project Flood (SPF), and
(3) Frequency Based Flood (FBF).

The concept of statistical flood frequency analysis can be used to estimate the flood. Chow (1988) presents the following equation for the estimation of the flood for a specified return period from sample data:

$$X_T = \bar{X} + K_T * S$$

Where by: X_T = Flood of return period T
K_T = Frequency factor for Return period T
S = Standard deviation for the sample data (Annual Maximum series)
T = Return Period

According to Chow (1988) and assuming the extreme value distribution, the frequency factor K_T for a specified return period T can be derived from the following equation:

$$K_T = -\frac{\sqrt{6}}{\pi}\left\{0.5772 + ln\left[ln\left(\frac{T}{T-1}\right)\right]\right\}$$

The annual maximum flood series for River Rwizi were used to estimate annual maximum flood series for the Bigasha catchment. This was achieved by transposing the Rwizi annual maximum flood series to Bigasha annual maximum series by use of the catchment area ratio method. Frequency analysis was then performed to obtain floods at return periods of: 5, 10, 25, 50 and 100 years. **Figure 6-9** presents the annual maximum discharges for River Rwizi and Bigasha catchment.

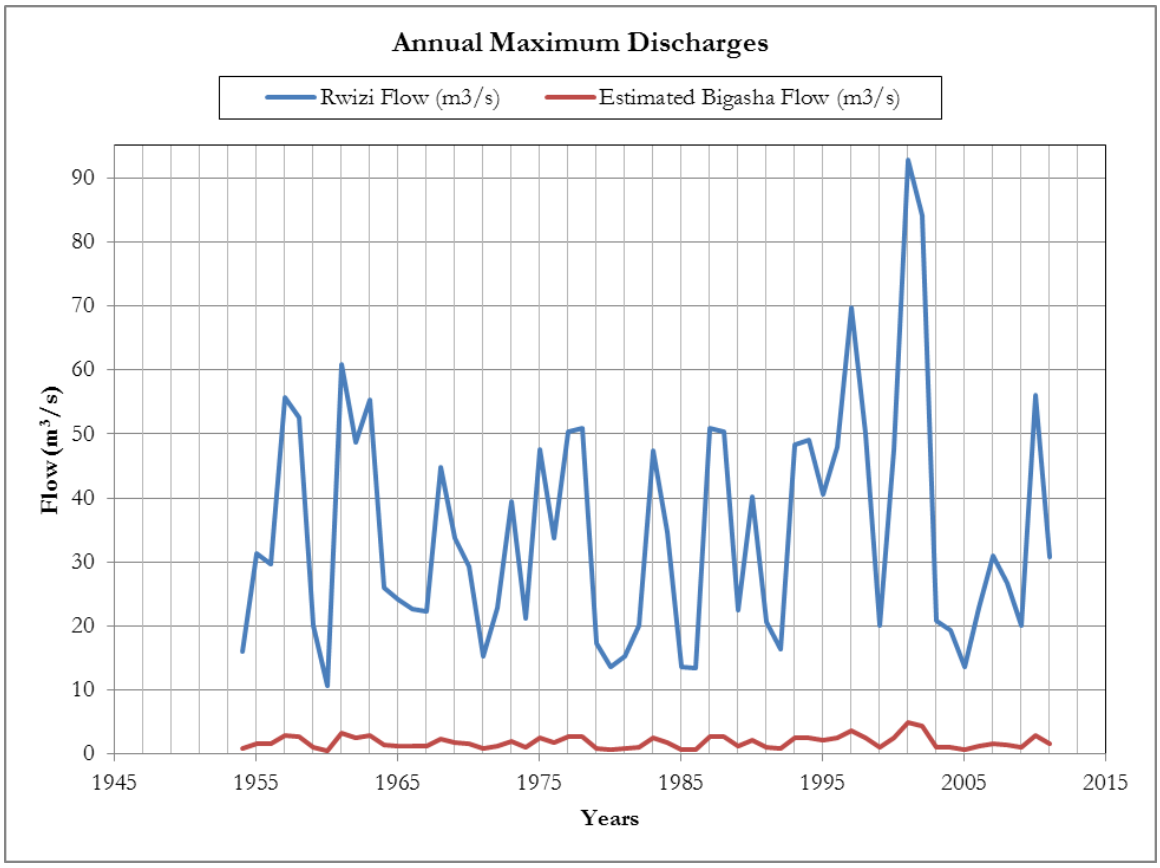

Figure 6-9: Time Series of annual maximum discharges for Rwizi and Bigasha

Using the frequency equation floods, return periods of 5, 10, 25, 50 and 100 years were estimated and presented for the Bigasha catchment as in *Table 6-10* below.

$$X_T = \bar{X} + K_T * S$$

$$K_T = -\frac{\sqrt{6}}{\pi}\left\{0.5772 + ln\left[ln\left(\frac{T}{T-1}\right)\right]\right\}$$

Table 6-10: Estimated Peak floods for Bigasha at the specified return periods

$T\,(Years)$	K_T	$\bar{X}\ (m^3/s)$	S	$X_T\ (m^3/s)$
5	0.719	1.847	0.960	2.538
10	1.304	1.847	0.960	3.100

25	2.044	1.847	0.960	3.809
50	2.592	1.847	0.960	4.336
100	3.136	1.847	0.960	4.859

iii) Environmental Flow

Since there were no flow records for Bigasha catchment, flows from River Rwizi were used to estimate flow series for Bigasha catchment. The catchment ratio method was used to transpose Rwizi flows to Bigasha catchment. *Figure 6-10* and *Figure 6-11* show flows for Rwizi and Bigasha catchments respectively. The average annual flow for the Bigasha catchment is **0.42m^3/s**.

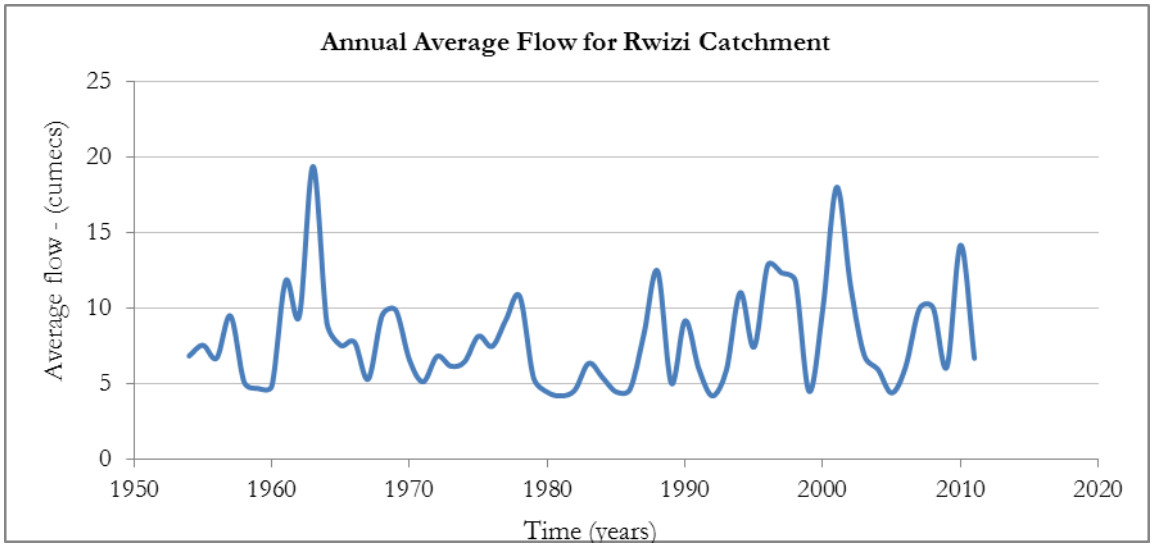

Figure 6-10: Annual Average Flow for Rwizi Catchment

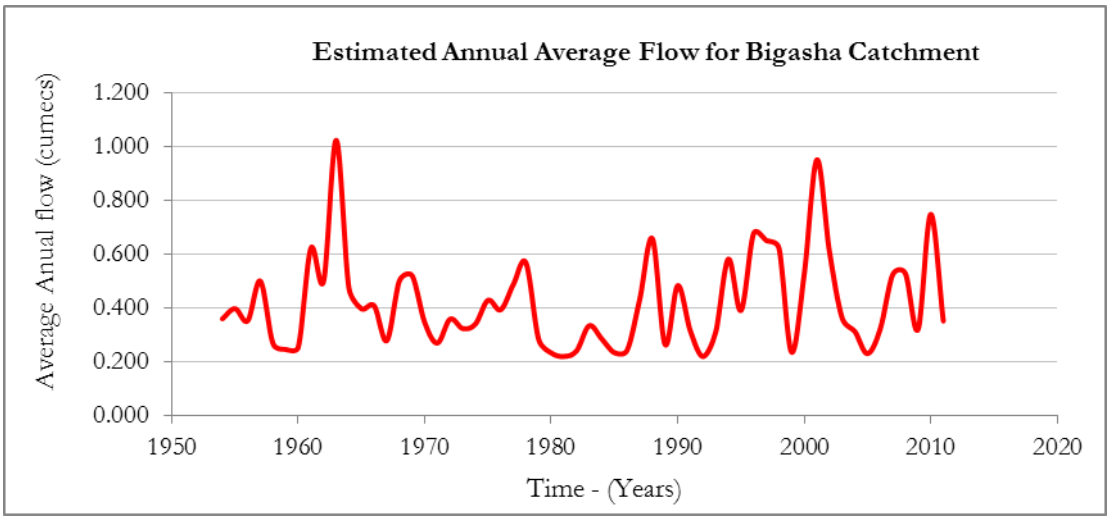

Figure 6-11: Estimated Annual Average Flow for Bigasha Catchment

There are various methodologies used to determine environmental flows and these are:

(1) Hydrology-based (Tennant (Montana) Method)
(2) Habitat simulation (In stream Flow Incremental Methodology)
(3) Holistic (Building Block Methodology).

The environment flows for Bigasha can be estimated by use of the Tennant Method. This method provides guidelines for flow management based on the percentage of average flow, daily and monthly stream flow records, that would maintain biological attributes of a river as optimum (>60%), outstanding (40%), excellent (30%), good (20%), fair, poor, minimum, or degrading (10%). *Figure 6-12* shows the estimated mean monthly flows for the Bigasha catchment. On the basis of the above 30% of the average flow is adopted for Bigasha catchment. Therefore an average of **0.13m^3/s** may be regarded as appropriate for environmental flows for Bigasha.

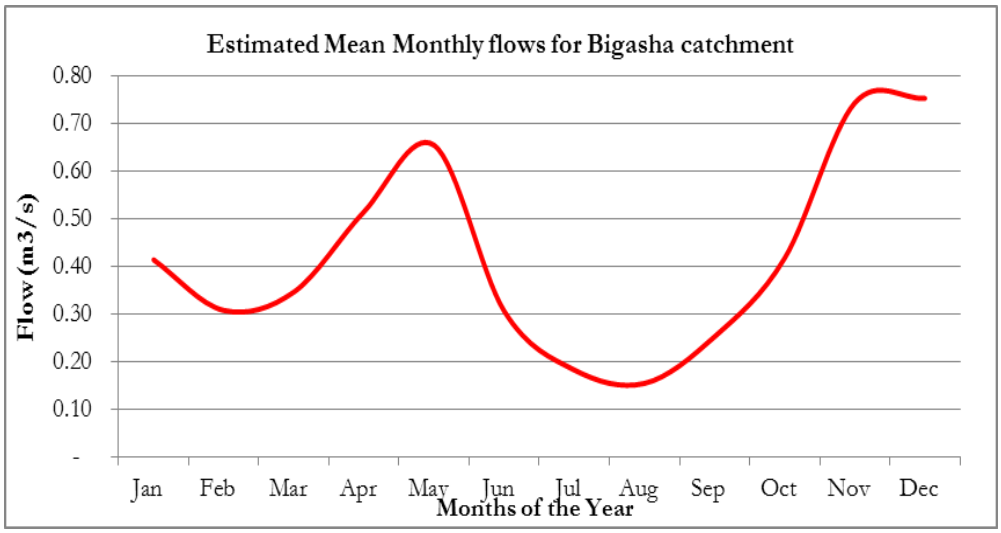

Figure 6-12: Estimated Mean Monthly Flows for Bigasha catchment

6.1.4 Water Quality

The water sample for Bigasha dam site was obtained from close to the origin of Nyakabingo stream just below the hills 1km upstream from the proposed dam axis. The GIS coordinates are: E 266657 N 9895990 (UTM Zone 36N).

Sampling was done in April on 5.4.2012 at 17.30 Hours. Column **(b)** in **Table 6-11** shows the results of a few water quality tests that were done on the spot using available probes from the Lake Victoria Environment Management Program-Bukoba Laboratory. Column **(a)** shows the results of water quality tests using samples collected from the same location but were later analysed by the National Water and Sewerage Corporation (NWSC) Laboratory at Bugolobi in Kampala. A copy of the Certificate of Analysis from the Laboratory showing the results is attached **in Appendix 4 (Hydrology report).**

Table 6-11: Results of water analysis for Nyakabingo stream in Bigasha (Samples picked in April 2012)

S/NO	PARAMETERS	(a)	(b)	WHO Guidelines
1	pH	7.25	6.85	6.50 – 8.50
2	Electrical Conductivity (µS/cm)	255	328	2000
3	Colour (mg PtCo/l)	22	----	15
4	Turbidity (FTU)	---	---	5
5	Total Dissolved Solids (mg/l)	163	328.1	1000
6	Total Hardness (mg/l as $CaCO_3$)	168	----	500
7	Total Alkalinity (mg/l as $CaCO_3$)	128	-----	Not Specified
8	Nitrate (mg/l)	-----	----	10
9	Nitrite (mg/l)	-----	----	10
10	Ortho-Phosphate (mg/l)	0.11	----	Not Specified
11	Total Phosphorus (mg/l)	0.26	----	Not Specified
12	Total Nitrogen (mg/l)	-----	----	Not Specified
13	Ammonia (mg/l)	0.08	----	Not Specified
14	Iron (mg/l)	----	----	0.3
15	DO mg/l	4.6	7.48	----
16	Temperature	-----	21.1	----

Water samples, (*K5838/12/C and K5839/12/C*) were again collected from the Nyakabingo stream in May 2012. The samples were taken to the National Water and Sewerage Corporation Central Laboratory in Bugolobi, Uganda for testing. The results are presented in **Table 6-12** below. An average of the results from the two sets of samples picked is also presented in **Table 6-12**.

Table 6-12: Water Quality Results (Samples picked in May 2012)

No	Parameters	Units	K5838/12/C	K5839/12/C	Average	National Standards for potable Water Quality
1	pH	-	7.25	7.24	7.25	6.50 – 8.50
2	Electrical Conductivity (EC)	µS/cm	255.00	276.00	265.50	2500
3	Colour	PtCo	22.00	22.00	22.00	15
4	Total Dissolved Solids (TDS)	mg/l	163.00	177.00	170.00	1200

No	Parameters	Units	K5838/12/C	K5839/12/C	Average	National Standards for potable Water Quality
5	Dissolved Oxygen (DO)	mg/l	4.60	4.90	4.75	Not Specified
6	Alkalinity: total as $CaCO_3$	mg/l	128.00	124.00	126.00	500
7	Hardness: total as $CaCO_3$	mg/l	168.00	184.00	176.00	500
8	Ammonia	mg/l	0.08	0.10	0.09	10
9	Ortho-Phosphate: Reactive	mg/l	0.11	0.09	0.10	5
10	Total Phosphorus (TP)	mg/l	0.26	0.24	0.25	Not Specified
11	BOD_5	mg/l	8.10	5.50	6.80	Not Specified
12	COD	mg/l	17.00	19.00	18.00	Not Specified

The two sets of results (April 2012 and May 2012) are comparable in range except that Temperature could not be tested by the NWSC and the spot reading is quite acceptable. Similarly, the DO could only be tested on the spot and the reading is normal. The NWSC reading is ignored as it was done many days after collection of water samples. The results of the water quality analysis were compared with the WHO guidelines for drinking water. In terms of chemical water quality characteristics, the Nyakabingo water is pristine and is within the WHO acceptable limits.

The pH value is well within the standard range, implying the water is not biased to acidity or alkalinity, thus neutral, acceptable for natural water. EC and TDS values are 265.5 μS/cm and 170 mg/l respectively, which are considered very low given the standard values. These two parameters give an indication of the impact of human activities on the water within the basin. Since the values are considered low, it is assumed that the human activity within proximity to the proposed dam site is low and subsequently the pollution of the water is still low.

It was noted however that the colour value was slightly higher at 22 PtCo compared to the standard of 15 PtCo. This might be attributed to the presence of certain minerals such as iron, manganese or other vegetation like algae or weeds. This can be further verified by the Consultant carrying out the Feasibility study.

Phosphorus is one of the factors that foster the survival of aquatic life. Total Phosphorus registered at 0.25 mg/l, a very low value. From the low value, it is concluded that the stream is not polluted e.g. with chemical fertilizers or otherwise.

BOD_5 and COD are indirect measures of the quantity of oxygen being used by the microorganisms and the organic compounds in water. Though not specified, the BOD_5 and

COD values were only at 6.8 mg/l and 18 mg/l respectively, which are low. High values would have indicated that there is a high level of microorganisms, a high content of organic material and hence organic pollution. These results are in line with other parameters discussed earlier that indicate little or no pollution from domestic or industrial wastes.

It can be concluded that the samples showed satisfactory physical-chemical characteristics of Nyakabingo stream. The water quality at the proposed dam site is commensurate with the National Standards for potable water quality.

6.1.5 Noise and Air quality

The Bigasha project site is located in Ngarama Sub/county, Bukanga County, Isingiro District in Uganda on the Bigasha River. There are hardly any human settlements in the proposed dam site and the few found are located on the slopes of the mountains a few kilometers away from the dam site. The total population for the two affected Sub counties of Ngarama and Kashumba is 78,700. Crop farming is very limited to a few banana plantations on the slopes of the mountains. The land at the proposed area for the dam is currently used mainly for cattle grazing and the area is water stressed. The key issue identified at the Bigasha dam site is that the dam is to be located on River Bigasha which is seasonal and completely dries up and cracks during the dry season. The proposed dam will be located in wooded grassland dominated by *Acacia, Euphorbia, Albizia, Combretum, Amaranthus* and *Dombeya* spp. There is ample grass cover and forestation in the catchment. The hillsides are moderately steep and are covered with grass and scattered indigenous trees. The Bigasha dam site area is therefore pristine, with LAdn ≤ 55 dB noise levels or less. However, current air quality in the Bigasha area is considered good as there are no industries, there is no significant agricultural activity and there has not been any recent reported volcanic activity. Even human settlements are non-existent. Furthermore, there are small access roads that are mostly covered with grass and some stones such that they do not cause dust to rise into the atmosphere, which would modify air quality in addition to vehicles producing carbon monoxide. The area is undisturbed by any human development and portrays a clean fresh environment in terms of air quality and no noise from human activity.

6.1.6 Quarry for sourcing stones and gravel

The Feasibility study identified an area of about 2 Km² and about on the main Ngarama road to the dam site. The area is not geo-referenced but it was calculated to be about one km from the prospective dam site. It stretches some 2 km long and on average about 1 km wide. Hence its area is about 2 km² and about 0.5 km from the main Ngarama road. The proposed quarry site is located in Ngarama Sub County, Kigando village and is located in an area covered by wooded grassland vegetation whose dominant tree species are *Acacia* sp, *Grewia* sp and *Euphorbia candelabrum* **(Plate 6-3).** The diversity of grasses and herbaceous plants is high. The grasses in the area are heavily grazed by cattle (Plate 6-4). No plant species of conservation importance were recorded.

Plate 6-3: Proposed area for the source of stones and aggregates

Plate 6-4: Cattle grazing near the quarry site

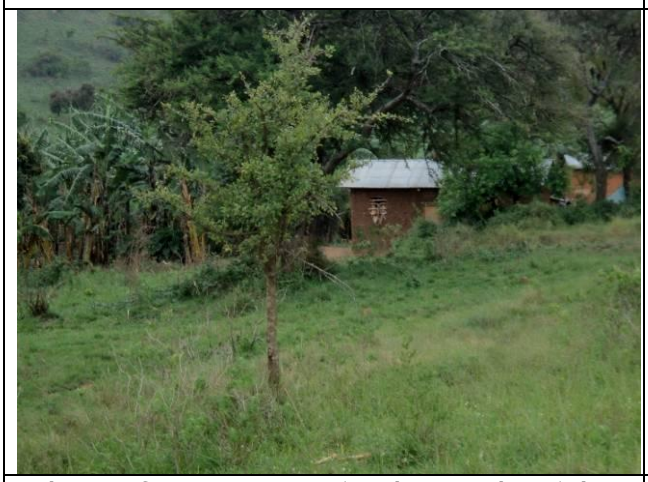

Plate 6-5: Semi-permanent residential structure located about 0.5km away from the source of stones and gravel.

Plate 6-6: Permanent residential structure located about 1km from proposed area for the site of stones and gravel

At the proposed area for sourcing stones and aggregates, the land is used for grazing cattle. There were no crops cultivated in the area. There were no settlements at the actual site. However, settlements were located 0.5–1 km away from the proposed site. These included temporary structures typically owned by laborers, semi-permanent structures and a permanent structure (plate 6-5) and (Plate 6-6) respectively). All these were used for residential purposes. There was no social infrastructure at the proposed site.

6.1.7 Sites for sourcing soils and clay materials

The Feasibility study identified an area to the north and south of the dam sites just below the hills as having suitable soils for the construction of the earth fill dam embankment. The site to the north is about 2 km from the dam axis and 0.5 km from the northern end of the dam itself. The southern arm of the source of soil is about 2 km from the dam axis and stretches about one km from the western tip of the end of the expected dam flood area. The area is not geo-referenced but its area could spread some 3 km² going round most of the expected reservoir. The area is located in an area covered by wooded grassland vegetation whose dominant tree species are *Acacia* sp, *Grewia* sp and *Euphorbia candelabrum* (plate 6-7) The diversity of grasses and herbaceous plants is high. The grasses in the area are heavily grazed by cattle. No plant species of conservation importance were recorded.

The proposed area for sourcing soil and clay is currently used for grazing animals. Sourcing of materials from this area will lead to loss of access for pastoralists to grazing land for their animals. There are no settlements in the area. There are some cattle watering points and crushes noted within this area (plate 6-8) and (Plate 6-9)*)*. There are some banana plantations on the periphery.

Plate 6-7 : Stretch of land for sourcing soil and clay material for construction of the dam

Plate 6-8: Cattle crush for spraying cattle in the site for sourcing soil and clay materials for the construction of the dam

Plate 6-9: Access road to the area for sourcing soils and clay materials

6.1.8 Irrigation command area

The Feasibility Consultant identified about 2,800 ha of land downstream as potential irrigation command area. The irrigation command area lies within both Ngarama and Kashumba sub-counties and several villages such as Kemikookoma, Kashenyi, Izo, Kabegaramire, Ntenga, Bigasha. This area spreads 7 km from the dam axis south to the Kagera River bordering Tanzania; at this border point, it roles again another 7 km east to west.

Ecological environment

The irrigation command area is located in an area covered by wooded grassland vegetation whose dominant tree species are *Acacia* sp, *Grewia* sp and *Euphorbia candelabrum* (Plate 6-10). The diversity of grasses and herbaceous plants is high. The grasses in the area are heavily grazed by cattle. There are many ant hills within the irrigation command area. No plant species of

conservation importance were recorded in the irrigation command area. There are expected to be many birds, reptiles, amphibian and perhaps some small mammals in the bush lands within the irrigation command area where they live, breed, feed and hide.

Human environment

Depending on the development alternative to be chosen, the irrigated area could be 800 ha (but for a start, 312 Ha will be considered) initially but this could be increased to 1300 ha. Immediately from the reservoir it was observed that the land was used for grazing. However, after about 1.5km the land use changes to cultivation. The crops grown include maize, beans, ground nuts, banana trees and fruit trees such as mangoes. The cultivated land spans a short distance and then land use changes back to grazing. There were few settlements observed in the irrigation command area. Trading centres in this area include Kashenyi and Kabegaramire. There is also a primary school known as Kashenyi Primary School in the command area (plate 6- 11) and (plate 6-12)

The valley is currently used for cattle grazing, watering cattle and some fish farming. Irrigated crops could be for fruits, mangoes, citrus, pineapple, fodder and forage (elephant grass, desmodium, and alfalfa), beans, sweet potatoes, Irish potatoes, vegetables and cereals. There is currently no experience in the area for rice growing but this can be introduced gradually. Hence, through irrigation, it is possible to grow two to three crops per year. It is planned to have two large lateral dykes running east and west of the river bed. These would be joined laterally by transverse canals which could be tapped by individual farmers for irrigation of their individual plots.

Plate 6-10: Cattle grazing in the command area for irrigation

Plate 6-11: Irrigation command area in Bigasha valley covered by wooded grassland vegetation with dominant Acacia tree spp

Plate 6-12: Household in the irrigation command area

Plate 6-13: Opened up area for cultivation in the proposed irrigation command area.

Plate 6-14: Kashenyi Primary School located in the irrigation command area.

Plate 6-15: Garden of maize crop in the irrigation command area

6.1.9 Water supply areas

It is proposed that water treatment facility will be located at the reservoir. The main tank will be located at the highest point on Ngarama hills (N9899000 E2605000 1705 m.a.s.l) at the Ngarama Trading centre some 7 km from the dam site. The main transmission line will therefore run from the reservoir to the main tank. It is proposed to have three gravity trunk mains to the West to Kikagati and Kibuyanda; to the East to Kashumba; and to the North to Isingiro, Nyakitunda and Kabingo. Booster tanks may be built along the way to supply as well as additional storage tanks for villages and urban centers. The main activity in water supply will include construction of the water treatment works, booster pumps and tanks as well as excavation works for water supply lines, transportation and movement of pipes and machinery.

Ecological environment

The water treatment facility will be constructed close to the reservoir. The main water supply

transmission line will run from the treatment plant uphill for about 7 km. The ecology of the area where the water treatment facility will be constructed as well as a distance of about 1.7 km uphill has similar characteristics with the reservoir site itself. This area is located in an area covered by wooded grassland vegetation whose dominant tree species are *Acacia* sp, *Grewia* sp and *Euphorbia candelabrum* Plate 6-16 The diversity of grasses and herbaceous plants is high. The grasses in the area are heavily grazed by cattle. There are many ant hills within this area. No plant species of conservation importance were recorded in this area. The wildlife in this area is similar that of the reservoir itself and will include many birds, reptiles, amphibian and perhaps some small mammals where they live, breed, feed and hide. None of these species were recorded as endangered or threatened.

Plate 6-16: Wooded grassland vegetation dominated by Acacia tree species at the bottom of the hill where the water transmission line will pass

Human environment

The land where the transmission line will passes is comprised of mainly grazing land at the bottom of the hill whereas on the upper part is farmland with individual houses at homesteads, settlements and trading centers. The main crops observed in this area were banana plantations (plate 6-17) trees, beans, cassava, a few coffee trees, Irish potatoes, some Gravellier and eucalyptus trees. There is an existing access road and the settlements are linear on both sides of this road. These houses are found close to the road at distances ranging from 10-30 meters from the road itself. The structures are mainly residential houses and the majority of them are of semi-permanent nature with a few permanent structures.

Before reaching Ngarama Trading Centre, the transmission line passes through 2 trading centres namely Kigando and Katwe trading centres. Like any other trading centre, structures in these trading centres are linear, concentrated and are mainly used as commercial buildings although some double for commercial and residential purposes. The structures are of both permanent and semi-permanent nature. In terms of social infrastructure and services, there are schools and health centers observed at the Ngarama Trading Centre namely, Ngarama Health Centre III, 2 private clinics, Ngarama Girls Secondary School, Ngarama Secondary School, Ngarama

Teachers' Education Centres, and a private primary school among others.

In regard to water supply, 2 artificial rock storage water sources were seen plate 6-18. In addition, a number of water harvesting tanks were observed on some of the houses and institutions in the area (plate 6-19).

Plate 6-17: Banana plantation along the main water transmission route from the dam site to Ngarama Trading Center

Plate 6-18: Rock water harvesting tank

Plate 6-19: Rain water harvesting

6.1.10 Camp site area

The Feasibility study identified an area of about 0.4 Km² on the main Ngarama road to the dam site. The area is not geo-referenced but it was calculated to be about one km from the dry Bigasha/Nyakabingo River bed and about 0.2 km from the main road. The proposed camp site

is located in Ngarama Sub County, Kigando village and is located in an area covered by wooded grassland vegetation whose dominant tree species are *Acacia* sp, *Grewia* sp and *Euphorbia candelabr*um (6-20). It is within the area already described in the baseline in Chapter 6.

Plate 6-20: Camp site on a clear flattened area of the upper hill overlooking the dam site

The land at the proposed area for the site is mainly used for cattle grazing. There were no crops grown and no settlements at the site. The nearest settlements are 2 households in a distance of about 400m (Plate 6-21)

Plate 6-21: Two households nearest to the proposed camp site seen on the far right corner of the picture

Plate 6-22: Banana plantations located about 400m from camp site

Plate 6-23: Goat rearing in the vicinity of the camp site

These were semi-permanent residential structures. Around these homes, banana plantations, coffee trees and beans were grown and goats were reared **(Plate 6-22-23)** There was no social infrastructure observed.The nearest trading centres from the camp site are Kigando and Kashenyi trading centres and the nearest health facilities are Ngarama and Kakamba Health Centres.

6.2 BIOLOGICAL ENVIRONMENT

6.2.1 Vegetation

a) Project site characteristics

The dam site is located (Coordinates: M E266017.80, N9895130.00 (UTM WGS 1984 Zone 36S) in Kashumba sub-county in Isingiro District in a valley with a seasonal stream or river Nyakabingo at about 1365m above sea level. The area is covered by wooded grassland vegetation whose dominant tree species are *Acacia* sp, *Grewia* sp and *Euphorbia candelabrum*. The diversity of grasses and herbaceous plants is quite high although no unique plants were site in the area. There is little agriculture within the seasonally flooded valley.

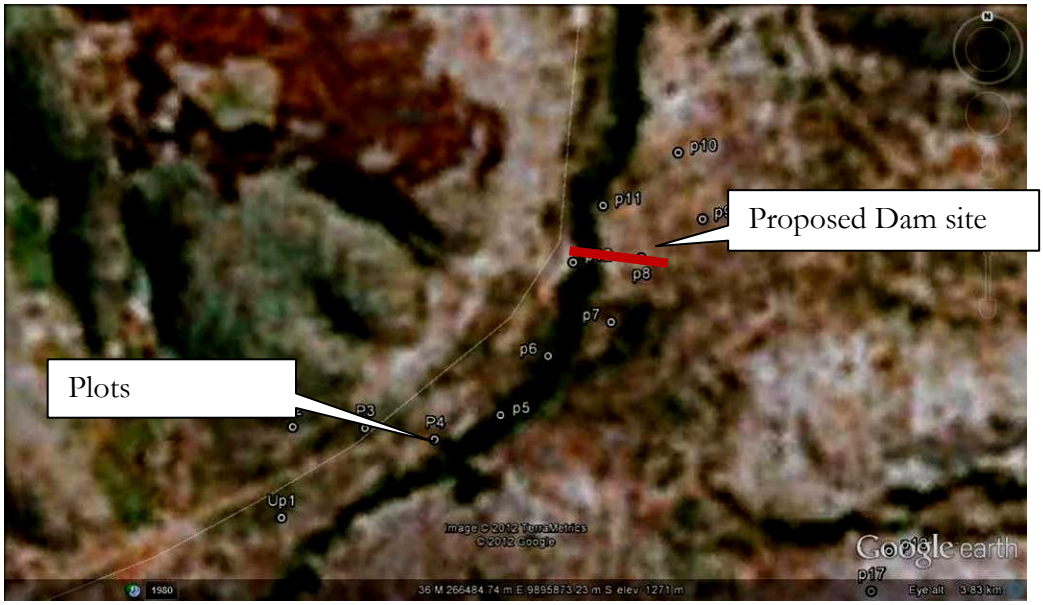

Figure 6-13: Study area and sampling sites in Bigasha dam site

Inventories of demarcated plots have been widely used in floristic sampling and ecological studies in the recent years (Poulsen 1997). However, the results of species richness depend on the size, shape and number of the plots being used, and the choice of the parameters depends on the scope of the study. Circular plots of 20 m radii were used in this survey. Plots were laid every 200 m within the grassed valley than is mainly used for grazing animals. Data of trees, climbers, and herbaceous plants were recorded. The GPS position and vegetation type of each plot was recorded and has been plotted on the Google map *(***Figure 6-13** and **Figure 6-14***)*. Trees and shrubs of less than 10 cm diameter at breast height (Dbh) were recorded from each plot nested in the bigger plot. These plots for the saplings were 10 m radius. Those trees that were greater than 10cm (dbh) were recorded in diameter classes of 10 cm –20 cm, 20cm-30cm, 30cm-40cm, 40cm-50cm and greater than 50cm in a radius of 20 m. Lianas were recorded by the presences absence mechanism in the same plot as the saplings of 10m radius. Herbs were also recorded by their presence in a nested plot of radius of 2 meters. The data have been used to show the relative distribution and diversity of the species within the sectors. Although the plots were able to give us fairly good data on distribution and abundance they were not able to exclusively give the total number of species in entire area. To achieve as complete a list as possible an opportunistic record was taken to account for species that were missed out in the plots within the reservoir area to obtain a better measure of species richness. Some of the species that could not be identified were photographed for further confirmation at Makerere University in Kampala, Uganda.

b) Key findings

A plant species lists (species richness) has been compiled from the plot data and additional opportunistic observations made.

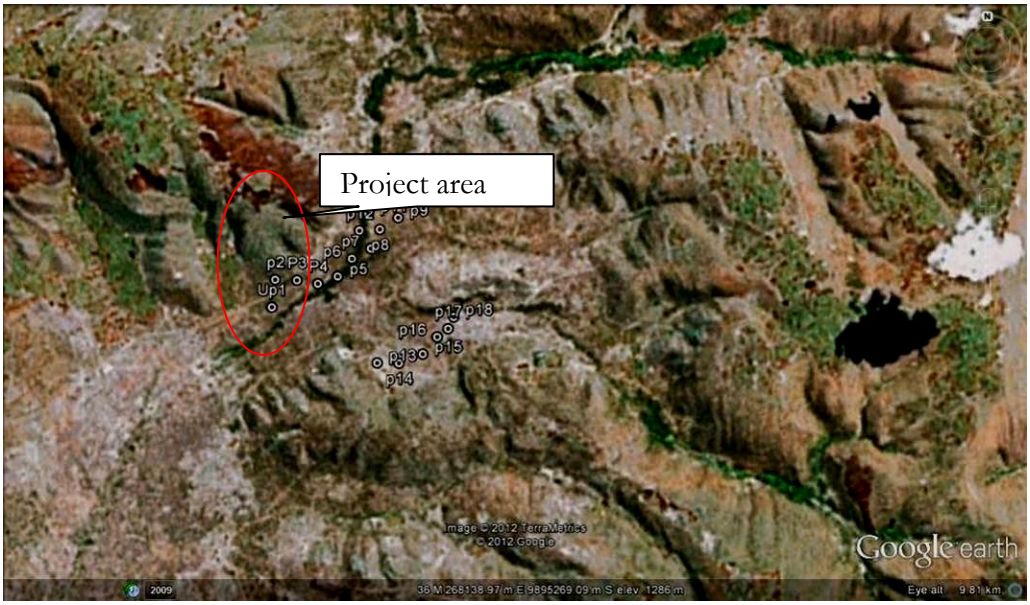

Figure 6-14: The proposed project area in Bigasha dam site

i) Project Area of Influence

The project area of influence for the Bigasha Dam includes areas affected by: (i) the primary project site, (ii) associated facilities; (iii) cumulative effects and (iv) unplanned but predictable developments.

The Dam Project Area of Influence will include:

- Land/water areas for dam, its facilities & reservoir
- Other linear infrastructure (roads and borrow pit) Unplanned but Predictable Developments.
- Project 'followers' offering various goods & services

ii) Landscape Units

Land use and vegetation cover have been strongly influenced by the climate, topography and population. The area has been greatly influenced through cultivation of bananas on the hill crests leaving the valleys for cattle grazing and annual crops cultivation. There are many small scattered natural vegetation ecosystems mainly in the valleys and along the small rivers and streams (Plate6-24 to 27) below). Acacia woodland/savannah predominantly covers the landscapes where cultivation has not taken place particularly the steep rocky slopes. It is evidently noticeable that vegetation associations have been disturbed by human activities and changes in hydrology (water regimes) leaving short and stout trees as well as thickets. The landscape along the proposed dam and reservoir can be considered as a seasonal wetland whose remnant vegetation is for cattle grazing with thickets that have remained after clearing for charcoal and pasturelands that have been left with few scattered trees, herbaceous plants and lianas.

Plate 6-24: The pasture lands in the valley

Plate 6-25: Some scattered trees within the valley

Plate 6-26: A small patch of cultivated land in the valley

Plate 6-27: The seasonal stream within the valley

iii) Plant assemblages

A total of 85 species were recorded from 33 families within the project area, stretching for about 2 km long and 700 m wide from the dam barrier point. The plants recorded are shown in **Appendix *5.*** Although species richness is low there were high numbers of shrubs and trees within the plots sampled. Of the tall plant species sighted, family poacea had 9 species, followed by Asteraceae (8), Fabaceae (6), Cyperaceae (5) and Rubiaceae (7) (plate 6- 28 to Plate 6-31. There were several families with one species. The most dominant life forms were shrubs (36%) followed by herbs (22%), trees (16%) and (10%) grasses of the total species recorded this however in term of abundance is dominated by grasses that cover 60% of the total sampled area. The most abundant trees were Acacias; which have been predominantly left among the other plant species as shade trees for the grazing animals. There are very few planted trees within the valley and on the ridge summits which have been cultivated with bananas.

Plate 6-28: Some herbaceous plants in the valley

Plate 6-29: Aloe volkensii found within the valley

Plate 6-30: The rolling landscapes showing the dominant vegetation type

Plate 6-31: The scattered trees left deliberately as shade for the grazing animals

There was no endemic or threatened plant species [according to the IUCN (2007) red list] recorded within the project area of importance to conservation.

6.2.2 Fauna

6.2.2.1 Mammals

Mammals recorded in the project area included: vervet monkey *(Chlorocebus pygerythrus),* Marsh Mangoose *Atilax paludinosus and* a fruit bat (*Epomophorus* sp). In addition, 9 species of rodents and 6 species of bats were recorded in the project area by Kingdon (1964a) and Kingdon (1964b) respectively although they were not sighted during the survey. Uganda has 330 mammal species 45 of which are of conservation significance (7 are endangered, 21 are vulnerable, and 17 are near-threatened) (IUCN 2008).None of the mammals is of conservation concern.

6.2.2.2 Birds

Uganda's avifauna is better known compared to other taxa. The county is endowed with over 1007 bird species, of which 10 are globally endangered, 13 globally Vulnerable and 27 Near-threatened (Caswell, *et al* 2005, Bennun *et al* 1996, Birdlife International 2012a. 70 species of birds were recorded mainly non-forest species, water bird specialists and water birds non specialists. Of the species recorded, **one is globally Endangered (Grey-crowned Crane,** (Plate 6-32) and **three are restricted range specie**s (Bare-faced Go-away-bird *Corythaixoides personata*, Golden-backed Weaver *Ploceus jacksoni* and Spot-flanked Barbet *Tricholaema lachrymose)* in the East African region.

Plate 6-32: Grey –crowned Cranes in the beans planted near Bigasha dam site

The Grey Crowned Crane has recently been uplisted from Vulnerable to Endangered because threats such as habitat loss and the illegal removal of birds and eggs from the wild have driven very rapid declines during the past three generations (45 years) (BirdLife International 2012b). The Grey Crowned Crane has a global population of 47,000-59,000 individuals in 10 African countries (Uganda has 3,000-20,000 individuals) and a very large breeding and home range of 630 ha and 2880 ha respectively (Meine and Archibald 1996; BirdLife International 2012b). Grey Crowned Cranes require mixed wetland-grassland habitats.

The recorded bird species with a restricted range in East African region are Bare-faced Go-away-bird *Corythaixoides personata*, Golden-backed Weaver *Ploceus jacksoni* and Spot-flanked Barbet *Tricholaema lachrymose.* Restricted-range species are present in only 7.3 million km^2 of remaining natural habitat (about 5% of the world's land area) (Stattersfield, et al 1998). Though with a restricted range in the East African region, the three birds species have a relatively large global range (720,000 km^2, 525,000 km^2 and 1,270,000 km^2 respectively). Their global populations are currently unknown but their population trends appear to be stable (BirdLife International 2012a). Because of the presence of globally endangered species (Grey Crowned Crane) and three species of restricted range in East Africa, the conservation value of the area in terms of bird

species is regarded as medium.

6.2.2.3 Amphibians

A total of 11 species of frogs were recorded the commonest being the Mascarene Grass Frog *Ptychadena mascareniensis (attached in appendix 6)* being the most common and two large species of toads, *Bufo* species (Plate 6-33). None of the species is globally threatened.

About 98 species of amphibians occur in Uganda (Ravenswood Media Newsletter 2008) and 7 of these are globally threatened. However of the species recorded, none is globally threatened (Dr Mathias Behangana personal communication) thus of **low conservatio**n value. The project area is drained by two seasonal streams (Kagango and the Nyakabingo streams) which feed into the Bigasha River below but in the dry season, there is no water and the amphibians probably aestivate.

Bufo sp.1

Bufo sp. 2

Plate 6-33: Species of Toads recorded in the project area

Dragonflies and Butterflies

Six species of Dragonflies were recorded in the project site (in appendix 6). This is just 2.5 % of the 231 dragonfly species recorded in Uganda (Tushabe *et al.* 2006). Uganda is known to harbour 13 species that are globally threatened or near-threatened (Clausnitzer*, et al* 2011). None of those recorded in Bigasha was globally threatened or near-threatened. 14 species of butterflies were recorded in Bigasha site. Uganda has 1,249 butterfly species recorded (Davenport 1996, Tushabe *et al.* 2006). None of the species of dragonflies and butterflies recorded is globally threatened or near-threatened (Perpetua Akite personal communication) and thus of low conservation value.

Fish and aquatic invertebrates

No fish was caught in the pools located within the proposed Bigasha dam site or in the Nyakabingo stream. However small boys who fish in the pools stated that they sometimes catch

catfish (*Clarias* sp) locally known as Nsozi and also lungfish (*Protopterus* sp). The Bigasha stream dries up during the dry seasons and the river bed becomes completely desiccated. The pools within the dam site lie exposed direct to sunlight and were used for cattle drinking. This leads to temperatures rising too high in the pools. Further, cattle trample over the water in the pools making the water murky, full of silt and detritus thus eliminating oxygen in the water. Hence, absence of cichlids and *Barbus* species from the Bigasha pools may be due to the severe desiccation of the dam site in the drought leaving pools where temperatures are too high and oxygen levels fall too low for fish to survive. Indeed if the cat fish and mud fish are found in the pools, it is understandable as these species breathe air and can avoid asphyxiation.

Invertebrates
Invertebrates found in the Nyakabingo spring during sampling included *Glossiphonia complanata, Notonectida buenoa(* **Hemiptera),** *Biomphalaria pfeifferi* **(Gastropoda),** *Belostoma bakeri (* **Heteroptera),** *Chaenius sp* **(Coleoptera)** and *Aquarius remigis (***Hemiptera).**

6.2.2.4 Protected Areas

Uganda has an extensive system of Protected Areas (PA) with the following categories: 10 National Parks, 11 Wildlife Reserves, 12 Controlled Hunting Areas, 710 Forest Reserves and 30 Important Bird Areas (10 of which are National Parks, 3 are Wildlife reserves, 7 are Forest Reserves and 10 have no legal protection) (Caswell et al 2005).

The nearest PA to the project area is Sango Bay Forest Reserve/Important Bird Area (UG013) (Central coordinates 31° 35.00' East 0° 55.00' South), a distance of about 100 km apart. Sango Bay is important for the conservation of the papyrus endemic globally near-threatened Papyrus Gonolek *Laniarius mufumbiri*, globally Vulnerable Blue Swallow *Hirundo atrocaerulea* (intra-African migratory species) and the globally vulnerable African Elephant *Loxodonta africana*.

6.3 SOCIO-ECONOMIC ENVIRONMENT

6.3.1 Administrative Structure

Uganda's administrative structure is divided into two; the Central Government and the Local Government. Initially, the Central Government centralized all the power until 1993 when parliament enacted the Local Governments statute and functions, powers and services were gradually transferred from the Central Government to the Local Governments. In regard to local government, Isingiro like any other district in Uganda is subdivided into Counties and Municipalities or Towns depending on their size and criteria set by the Ministry of Local Government (MoLG). Every County is further subdivided into Sub-counties while Municipalities are subdivided into Divisions. The Sub-counties, Divisions and Towns are further subdivided into Parishes and Wards respectively. The Parishes and Wards are further subdivided into Villages, which are the lowest administrative units. On the technical side, the District is led

by a Chief Administrative Officer (CAO) while the head of the district political team is the Chairperson Local Council V (LC V). Isingiro District is divided into 2 Counties, 14 Sub-counties, 90 Parishes and 797 villages.

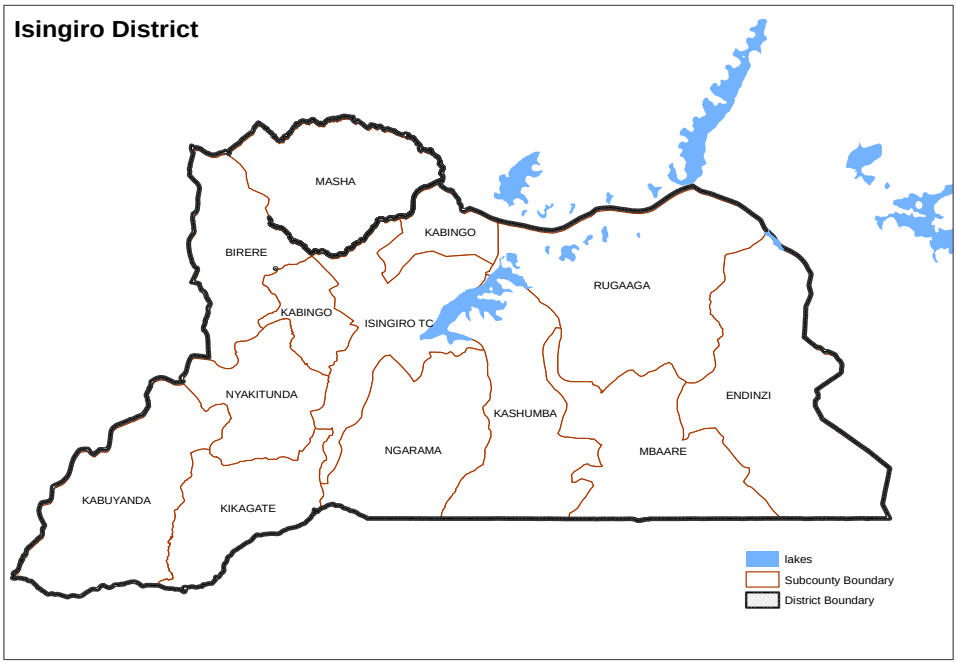

Figure 6-15: Map of Isingiro District

The proposed Bigasha multipurpose dam lies within Isingiro District in Kashumba and Ngarama Sub-Counties. The reservoir, one of the major components of the dam lies within 3 villages that is Kigando (Ngarama Sub-County) and Katyazo and Nyakabingo (Kashumba Sub-County). See **Figure 6-15** showing administrative boundaries. The biggest part of the reservoir is in Kashumba Sub-County. Immediate villages downstream of the reservoir are Kemikokooma and Ntenga. See **Figure 6-16** for the layout of these villages. A good understanding of the administrative structure is paramount during project implementation, right from consultation to operational phase. This is because it maps out the levels of authority and the inter linkages and jurisdictions at different levels in Society.

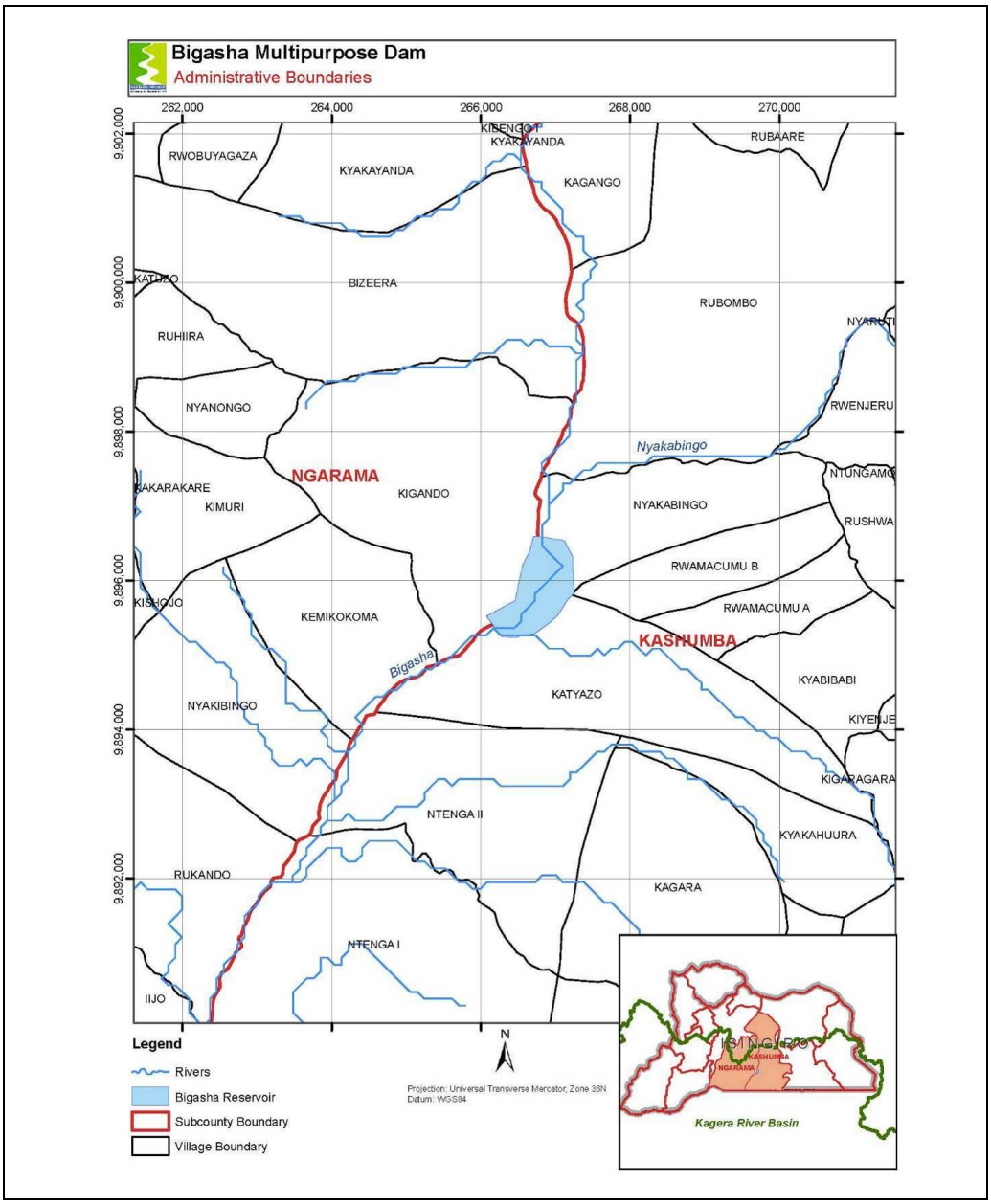

Figure 6-16: Administrative boundaries of Kashumba and Ngarama sub-counties

6.3.2 Demographic characteristics

a) Population

According to the 2002 Population and Housing Census, the total population of the country was 24.4 million people and that of Isingiro district stood at 316,025 persons. The population of the district was projected to be 420,200 persons by 2012 of which 204,800 would be males and 215,400 would be females (Uganda Bureau of Statistics, Sub National Projections Report, Western Region – 2008-2012). The total population for the 2 affected Sub counties of Ngarama and Kashumba projected by 2012 is shown in the **Table 6-13**.

Table 6-13: Total Population of Ngarama and Kashumba Sub-counties

Sub-county	Males	Females	Total
Ngarama	20,700	21,400	42,100
Kashumba	18,100	18,500	36,600
Total	**38,800**	**39,900**	**78,700**

(Source: Uganda Bureau of Statistics, Sub National Projections Report, Western Region – 2008-2012)

From the interviews it was established that 86.7 % of the households in the project area were headed by males while 13.3% of the households were female headed. Female headed households are usually considered as being vulnerable implying that within the project area there are vulnerable persons. The female headed households who are still energetic and productive should be given a chance to compete for jobs in the project so as to uplift the wellbeing of their families

In terms of age, the interviews showed that the average age of the household head was 43 years with majority of them (46.%) being in the age group of 18-39 years, followed by those in the age group of 40-64, while 12.4% of the household heads were in the elderly category (65+ years). Among the sampled households there were no child headed households. The results further imply that the population in the project area is highly commendable for employment as the majority is still in the productive stage.

The average household size in the project area is 5 persons which is almost the same as the national average of 4.7 persons.

b) Ethnic composition

The majority of the people in the project area are Banyankole. The Bahima (cattle keepers) constitute of 20%, the Bairu (cultivators) constitute of 69% and the Bakiga constitute of 11% of the total population. Other ethnic groups include Banyarwanda. The cultural setup of these ethnic groups is patrilineal with men dominating the decision making process including the right of inheritance. The most common language spoken in the project area is Runyankore.

c) Religious affiliations

Results from the household interviews revealed that in the project area, the majority of the people are Christians (92.9%) with the Protestants/Anglicans constituting 50.4% of the households and Catholics 41.6% and Seventh Day Adventists 0.9% (**Figure 6-17**). The Muslims constitute 1.8% of the households while other religions (traditional beliefs, atheists) constitute 5.3% of the households.

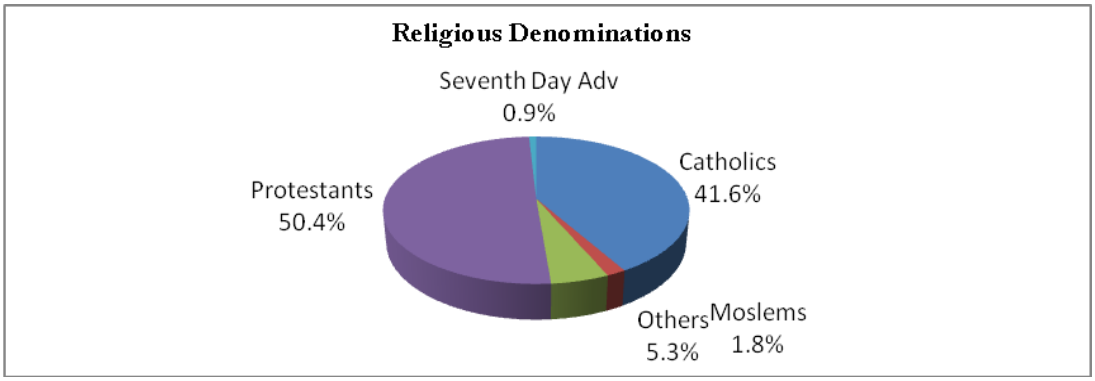

Figure 6-17: Religious groups in the project area

The project developer and implementers should put into consideration the different beliefs and religions in the area. The minority religious groups should be considered and respected while make decisions regarding the people.

d) Marital status

In reference to household survey results, 89.5% of the households were married, 9.7% were widowed, 0.9% were divorced and 0.9% were single. Out of the married respondents, 82.3% had only one wife while 6.2% had more than one wife. The institution of marriage is still respected in the area. The project employees should ensure that they also respect this institution by avoiding sexual affairs with married women and men. **Figure 6-18** shows the marital status of household heads in the project area.

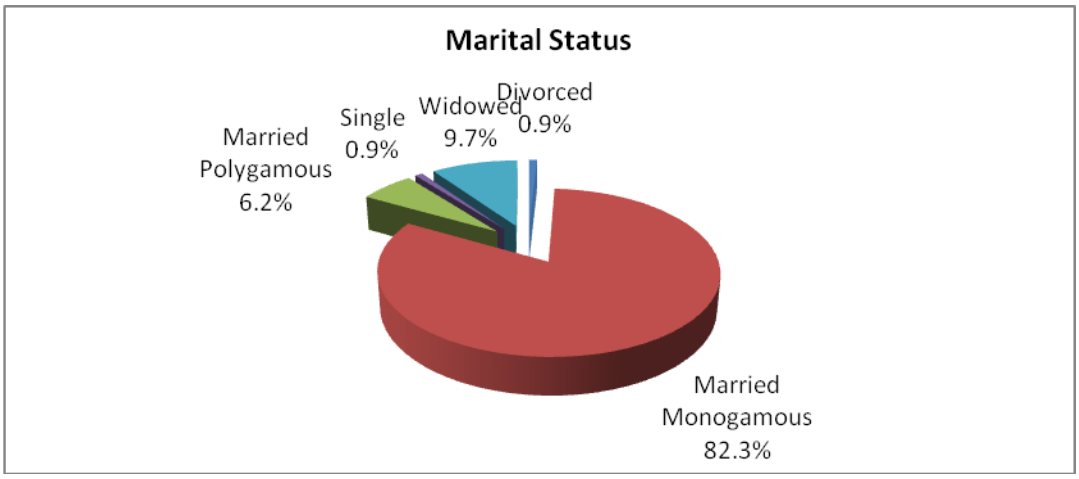

Figure 6-18: Marital Status of Household Heads

A closer look at the results indicates that majority 67% of the female heads of the households were unmarried. These are either widowed or divorced/separated. The results imply that there are vulnerable groups in the project area who should be given special consideration by the project developers.

e) Level of education

The literacy rate for Isingiro district is 67% of the population aged 10 and above. This means

33% of the population aged 10 and above is illiterate. The majority of the illiterate fall in the age group of 18-44 years. (Higher Local Government Statistical Report, Isingiro District – 2009)According to Ngarama and Kashumba Sub County Development Plans, literacy rates in the two Sub Counties stand at 50% and 73.6% respectively. In terms of formal education, 8.5% of the population aged 6 and above attained Primary 7, 0.3% secondary level, 1% completed Certificate/Diploma and 0.07 were Degree holders. *Source:* (Uganda Population and Housing Census, 2002). Results from the household interview indicated that 29.2% of the respondents did not attend school, 50.4%attended primary school, 11.5% attended secondary school, 8% attended tertiary institutions and 0.9% attended university. In terms of gender, 80% of the female respondents did not go to school as opposed to 21.4% of male respondents. This concurs with the findings of the 2006 Uganda Demographic and Health Survey (UDHS) which reported that there is a large gender gap in education where 39% of Ugandan women age 15-49 cannot read at all, compared to 16% of men. **Figure 6-19** shows the educational levels by gender in the project area.

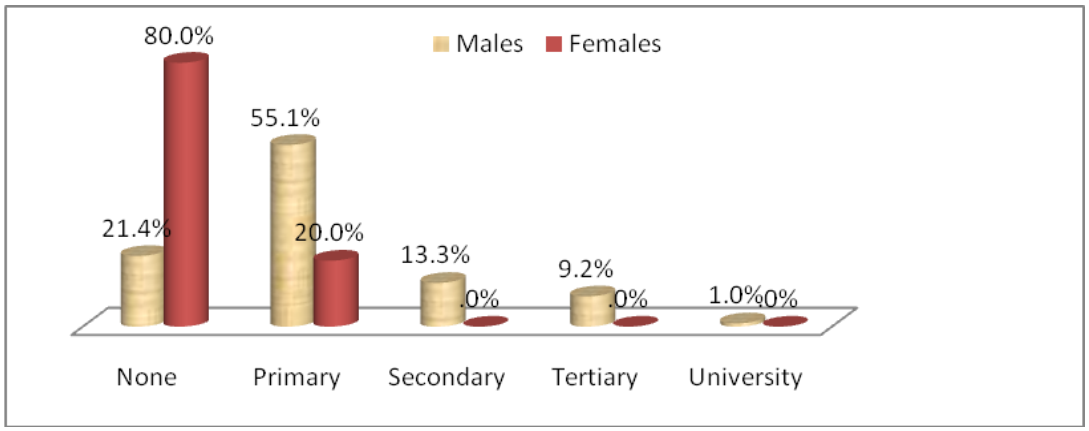

Figure 6-19: Education Levels by Gender

The above statistics indicate generally low literacy levels in the project area. Out of the households interviewed 14.6% admitted that they had household members who were of school going age but did not go to school. The low literacy rate is attributed to early marriages among the females, poverty, cultural factors, and long distances to schools/institutions. The results therefore imply that if the communities in the project are to be considered for jobs, they will mainly be employed as unskilled labourers. However, households whose members attained tertiary/vocational education and attained some skills should be given the opportunity to compete for semi-skilled and skilled jobs.

f) Employment opportunities

From the results of the interview, it was revealed that 0.9% of the population is engaged in some sort of paid labour as civil servants and 79.6% of the population is engaged farming and 1.8% is involved in trading.

In terms of availability of labour, the results indicate that there is abundant labour in the project

area since there are a significant number of youths within the productive age. The assessment of the quality of labour available that 23.1% of the population within the productive age had not attended school at all, meaning that they can only be available as casual labourers, 55.8% of the same age group had only attained primary school education with no additional training, which means that they can only provide casual labour, 15.4% of the same age group had attained secondary education though still without additional training; meaning that they also have no skill but can probably be trained and therefore develop capacity for semi-skilled jobs, while 5.8% of the productive age group had attained further education and could therefore be used for skilled labour.

6.3.3 Economic activities

a) Agriculture

The 2002 Population and Housing Census categorized agricultural activities as; crop, livestock, poultry and fish farming. The statistics revealed that 89.2% of the population aged 10 years and above are engaged in agriculture in the district. The results from the socio-economic interviews revealed that 80% of the households in the project area are engaged in agriculture. The major crops grown include; bananas **(Plate 6-34)** cassava, sweet potatoes, maize, millet, beans, groundnuts, and coffee. It should be noted the banana crop is the most common among the households while coffee is grown by a few households. In the proposed area for the reservoir, banana plantations were cited. As is the case in most rural areas, the women in the project area are more involved in the digging and the tilling of the land yet they have little or no influence in decision making as regards the land. In terms of crop production, **Table 6-14** summarizes the average annual crop production for the different crops as reported by the district documents.

Table 6-14: Average Annual Crop production

Sub County	Products	Unit of Measure	Est. Annual Quantities
Ngarama	Bananas	Tons	21,300
	Beans	Tons	600,000
	Maize	Tons	515,000
Kashumba	Bananas	Tons	12,000
	Beans	Tons	1,500
	Maize	Tons	1,000

(Source: Isingiro 5 Year District Development Plan 2011-2016)

As regards marketing of the crops, results from the household survey indicated that 84.8% of the households engaged in crop farming sold some of their crops. Majority of them sold the crops at their farm gates, while others brought them to trading centres to be picked by trucks involved in buying of crops. The major challenges faced when marketing the crops included fluctuating prices and bad roads.

Plate 6-34: Bananas ready to be sold

b) Livestock rearing

According to the 2002 Population and Housing Census, Isingiro district is one of the major producers of indigenous cattle and goats. In terms of animals reared, statistics revealed that 52% of the population in the district is engaged in goat rearing while 2% rear exotic/cross breed cattle, 32% is engaged in rearing indigenous cattle, **(Plate 6-35),** 8% rear sheep and 5% rear pigs. The sub-counties of Kikagati and Ngarama have the highest number of households engaged in major livestock keeping at 15%, and 12% respectively 89% of the population rears local chickens. The major types of poultry kept include; exotic chicken, local chicken, ducks, turkeys, guinea fowls and geese. **Table 6-15** shows numbers of the major livestock in Isingiro District in 2008.

Table 6-15: Major Livestock

Major livestock	Number (2008)
Cattle	180,345
Goats	221,491
Sheep	30,298
Pigs	7,552

(Source: National Livestock Census 2008)

In the project area, 53.7% of the households own cattle, 62.1% own goats, 25.3% own sheep, 7.4% own pigs, 63.2% are engaged in poultry farming and 14.7% owned other types of animals.

Plate 6-35: Cattle rearing in the Project area

The average numbers of animals owned by households in the project area are indicated in **Table 6-16**.

Table 6-16: Average number of animals owned by households in the project area

Animals owned	N	Minimum	Maximum	Mean
Sheep	24	1	25	6.6
Goats	56	1	65	11.4
Cattle	48	1	300	31.6
Pigs	12	1	20	3.5
Poultry	58	1	30	6.4
Other Animals	14	1	10	2.4

In terms of production, **Table 6-17** below summarizes the animal production for the different animals for Kashumba and Ngarama Sub-Counties between July 2010 and June 2011 as reported by the Isingiro District Production Department.

Table 6-17: Production levels per sub-county, July 2010- June 2011

Sub-county	Total number of Cattle	Total number of Goats/ Sheep	Milk Production per Litre	Annual Cattle Sales	Annual Goats/Sheep Sales
Kashumba	25,600	47,800		1488	660
Ngarama	26,620	22,700	252,000	1056	540

As regards marketing of livestock, 68.7% of the respondents said that they sold some of their livestock. Households which owned cattle not only sold some of their cattle but also milk and other products like eggs. The main marketing point for the livestock and its products is the farm gate. The main problems faced while marketing these products include lack of enough market, low prices and a poor road network.

c) Fish farming

Fishing farming in the district is popular, though most of the fish ponds are unstocked. According to the Higher Local Government Statistical Abstract, Isingiro District–2009, the District had 1,521 ponds with Kikagati Sub-County having the highest number. Ngarama and Kashumba Sub-counties had 124 and 107 fish ponds respectively. Of these 21% and 21.5% for Ngarama and Kashumba were unstocked respectively. In the project area, none of the households reported to be engaged in fish farming.

d) Other economic activities

Households in the project are involved in other economic activities which include casual labour as reported by 11.5% of the respondents, trading (1.8%), service provision e.g. cycle riders (*bodabodas*), restaurants, and salons), brick making and carpentry. **Table 6-18** summarizes the

economic activities engaged in by households in the project area. In terms of gender, the results of the interview indicated that only 60% of the farmers were females, 33.3% of the females are involved in casual labour and no females are involved in civil service, commercial farming, trade and others provisions as illustrated in the table below. The reasons for lack of competitiveness among women in many are a result of low levels of education, denial of women to own property like land and traditions and cultural beliefs.

Table 6-18: Economic Activities by Gender

Economic Activities	Gender				Total	Total %
	Male	*%*	*Female*	*%*		
Peasant farmer	81	82.7	9	60	90	79.6
Commercial farmer	4	4.1	0	0	4	3.5
Salaried worker	1	1	0	0	1	0.9
Trader	2	2	0	0	2	1.8
Service provision	0	0	1	6.7	1	0.9
Casual labourer	8	8	5	33.3	13	11.5
Other	2	2	0	0	2	1.8
Total	98	100	15	100	113	100.0

e) Income and expenditure

The results of the interview indicate that the average monthly income for the households within the project area is UGX 251,650/= while the average annual income is UGX 2,910,000/=. However, for female headed households the average monthly income is UGX 85,500/= and the annual income is UGX 1,050,000/= It was reported that farmers who own cattle attach great value to them and only sell them once in a while to cater for a unique need. Generally, population in the project area can be regarded as poor and from the average income it can be deduced that the poverty levels are high.

f) Assets owned

Some of the indicators of poverty are usually the nature of assets owned by households; the results of the interview indicate that the most common assets owned by households include, houses, radios, land, livestock, cell phones, bicycles, motorcycles, televisions and cars. Less than 3.6% of the total households own televisions and cars.

6.3.4 Land tenure, ownership and use

a) Land tenure

Land tenure means the system by which land is owned, occupied, used and disposed of. This as well constitutes rules, regulations and procedures that govern the rights, duties and liabilities of the people in their use and control of land as a resource. Presently, the management and control of land in the country is regulated by the Land Act, 1998. The Act recognizes four tenure systems namely: Customary, Mailo, Freehold, and Leasehold. According to the District Census

Analytical report 2002, land ownership in the Isingiro district is predominantly customary. **Table 6-19** shows the land tenure system distribution among the land owners in the district.

Table 6-19: Land Tenure systems in Isingiro District

Land Tenure system	Male Head	Female Head	Frequency	%age
Customary	40,828	10,566	51,394	76.23
Free hold	3,253	781	4,034	5.98
Mailo land	788	219	1,007	1.49
Leasehold	2,607	533	3,140	4.66
Other	6,129	1,718	7,847	11.64
Total	**53,605**	**13,817**	**67,422**	**100**

(Source: District Census Analytical Report – 2002)

Similarly, in the project area, results from the household interviews indicated that majority (88.2%) of the respondents own land customarily, 3.6% of the respondents own land communally, 3.6% of the respondents have freehold titles, 1.8% of the respondents have leasehold titles and 2.7% of the respondents own the land under other arrangements.

b) Land ownership

Majority of the households in the project area (87.6%) own land while 12.4% do not own land. In terms of land ownership by gender, the results of the interview indicate that 66.7% of the female headed households own land while 33.3% do not own land whereas 90.8% of the male respondents own land while 9.2% do not own land. In regard to the size of land owned, the interviews indicated that the average land holding per household is 10.3 acres, while for female headed households the average size of land owned is 2.2 acres.

c) Land use

Land in the project is comprised of grazing land, farming land settlements, swamps and settlements. The area where the proposed project will is mainly used as grazing land for the households with animals (cattle, sheep and goats). A small section of it is used for banana cultivation. The project is therefore likely to affect a big piece of grazing land.

d) Housing and settlements

Settlements in the project area are scattered. However, in the trading centres they are concentrated and are near the road. In regard to the nature of structures, majority (86.3%) of the dwelling units in the district were of temporary nature 8.7% were semi-permanent and only 4.9% were permanent (Isingiro District Development Plan 2006/2007).

In the project area, from the interviews it was established that semi-permanent structures (**Plate 6-36***)* and *(***Plate 6-37***)* were the most dominant type of structures in the project area as reported by 54% of the respondents followed by temporary structures reported by 28.3% of the respondents and 17.7% of the respondents owned permanent structures. In terms of ownership of the dwelling units in the project area, 98.2% of the respondents owned the structures they

were occupying, while 0.9% were renting, 0.9% had other forms of arrangements including stewardship. In terms of ownership by gender, the results of the interview indicate that 86.7% of the female households own their residential premises, 6.7% rent their residential premises while 1% are using residential premises under special conditions like stewardship, or staying with relatives. **Plate 6-36** and **Plate 6-37** show some of the structures found in the project area.

Plate 6-36: Temporary structures in the project area

Plate 6-37: Semi permanent structure in the project area

6.3.5 Infrastructure

a) Health

Health Infrastructure

The district is made up of three health sub-districts namely Bukanga, Isingiro North and Isingiro South. The Distribution of Health Units per Sub-county is shown in Table 6-21Table 6-20. The district has several government-owned health centers. Besides, government-owned health centers; there are a number of drug shops and private clinics operating in district. The district government-owned health centers have a total of 282 beds, 103 beds in maternity wards, 42 beds in the general ward, 29 beds in the male ward, 35 beds in the female ward, 4 beds in medical and 69 beds in the paediatric wards.

Table 6-20: Distribution of Health Units per Sub-county

Sub-county	Health Center II	Health Center III	Health Center IV
Endinzi	2	1	0
Kashumba	2	2	0
Ngarama	2	1	1
Rugaaga	3	1	0
Mbaare	1	1	0
Birere	4	1	1
Kabingo	3	0	0
Masha	1	1	0
Isingiro T/C	2	3	0

Sub-county	Health Center II	Health Center III	Health Center IV
Kabuyanda	7	1	1
Kikagati	4	2	0
Nyakitunda	4	1	0

According to the Higher Local Government Statistical Abstract of Isingiro District -2009, the distribution of the health centres in the district fair as apart from Kabingo sub-county, each sub-county has a Health Centre III and each Sub District has a Health Centre IV.

Health care delivery

The ratio of health centers to the population in the district is alarming. On average, a single health center serves 7,236 people, Isingiro T/C having the lowest ratio of 4,547 people. According, the 2002 Population and Housing Census, only 6% of the households resided in a radius of half a kilometer and 35% lived more than 5kms from a health unit. Results from the household interview, indicated that majority (48.5%) of the households in the project area travel a distance of more than 6km to reach a nearest health centre which is not within the recommended distance by the Ministry of Health 31.8% travelled 1-3kms, 15.5% travelled 3-5 km and only 4.5% travelled a distance of 500-1km to the nearest health centre. The distance to the nearest referral health unit for the majority of the respondents (96.2%) was more than 6km. In terms of services provided, different levels of health units offer different services. For example, Health centers IIs only have outpatients departments hence they cannot handle acute cases. Health centers IIIs, operate both outpatient and inpatient departments. However, their services are limited to diagnostic and maternity for normal deliveries only. Health Centre IVs offer both Outpatient and Inpatient services including surgical theatre in case patients require surgery. All health centers IVs have a permanent doctor on a full time basis, while HC IIIs are run by Medical Assistants and HC IIs are run by Clinical Officers. The Medical units provide services, which include in and outpatient services, deliveries, family planning and antenatal, immunization, health education and HIV counselling and testing especially at health centers IIIs and IVs. In regard to adequacy of services provided 9.1% of the respondents reported that the services were very good, 50% of the respondents reported that the services offered were average and 24.5% of the respondents reported that services provided were poor due to inadequacy of drugs, incompetent personnel and poor customer care. In regard to staffing most health centers still had gaps and in regard to drug supply as most of them reported a delay in drug delivery. According to Isingiro District Health Department, the health centres face a number of problems such as lack of proper means of transport to the next referral unit, lack of ICT, understaffing and insufficient drugs. The implication of this to the project is that existing health centers are distant from the project area and they should therefore not be relied on for adequate services as they already have their own limitations and are overwhelmed by the numbers of patients.

Diseases

Isingiro Local Government Statistical Abstract, June 2009, reported that the most common diseases in outpatients wards include; malaria, ARI Not- Pneumonia, intestinal worms,

pneumonia, sexually transmitted infections (STI), skin diseases, urinary tract infections, acute diarrhoea, eye conditions, injuries and trauma and ear nose and throat infections. From the interviews conducted within the project area, malaria was reported as the most common disease. Other diseases included water related diseases like typhoid. Sexually Transmitted diseases (STDs), back pain, brucella, chest pain, cold and flu, stomach pain and accidents.

HIV/AIDS

Like the rest of Uganda, Isingiro District has also been affected by HIV/AIDS. According to Isingiro District Development Plan (2011-2016), the HIV/AIDS prevalence rate in the district is at 3% which is lower than the national average of 6.4%. Isingiro district has 18 health centers providing HIV/AIDS services and care. These health centers provide general HIV/AIDS care, Prevention of Mother to Child Transmission (PMTCT) and Voluntary Counselling and Testing (VCT).

In terms of support and service providers involved in HIV/AIDS, Isingiro has 9 NGOs involved in HIV/AIDS activities which include; Family Planning Association of Uganda, Mayanja Memorial Hospital, the Millennium Village Project, Mbarara University of Science and Technology, The Aids Information Center, Sister and Brothers of Joseph and Mary, The Aids Support Organization and Foundation for AIDS Orphaned Children. In the project area, HIV/AIDS prevalence awareness is very high. Results from the household interviews indicated that 92.8% of the population is aware of HIV/AIDS while 7.2% of the population is not aware of the existence of the HIV/AIDS prevalence. Some of the causes of HIV/AIDS **(Figure 6-20)** as reported by the respondents included, having unprotected sex with an infected person, sharing sharp objects with infected people, increasing prostitution Isingiro district being at the border with the Republic of Tanzania and through blood transfusion.

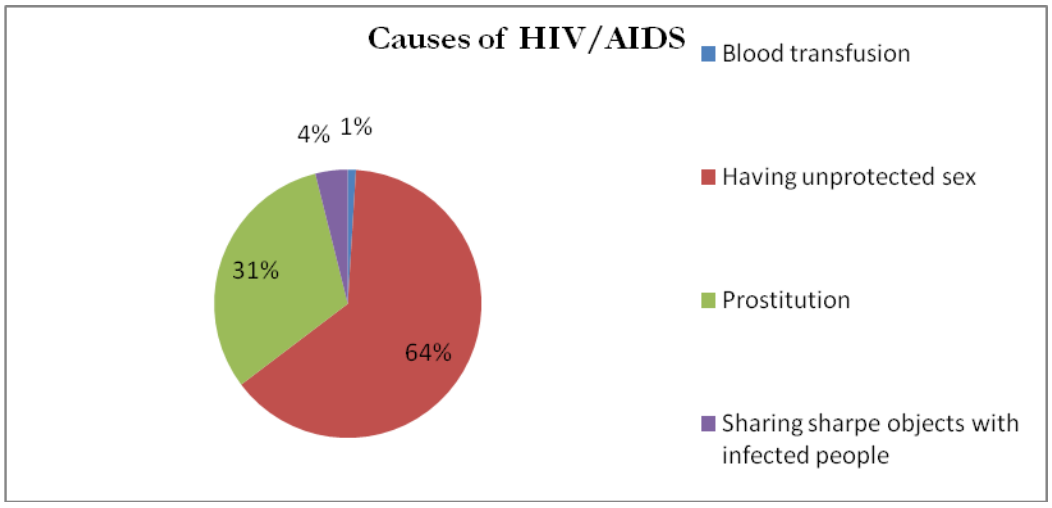

Figure 6-20: Causes of HIV /AIDS

It is most likely that during the construction phase, HIV/AIDS will be on the increase due to the expected influx of people in the area. The project should therefore plan for HIV/AIDS

awareness and prevention programs.

6.3.6 Education

a) Education Infrastructure

Isingiro District has 189 government and 132 private primary schools, 14 government and 132 private secondary schools. In addition to this, 9 more schools were set up with the help of a grant. Kashumba and Ngarama Sub Counties have 9 and 16 primary schools respectively **(Plate 6-38).** There are 296 permanent classrooms and 21 permanent teachers' houses for primary school, while for secondary schools there are 82 permanent classrooms and 14 permanent teachers' houses.

Plate 6-38: Kashenyi Primary School

b) Education Service Infrastructure

In terms of distance, 38.5% and 89.2 % of the respondents from the household survey reported that their children trek above 3kms to reach the nearest primary and secondary school. **Figure 6-21** below shows the distances travelled by the households to reach the nearest primary and secondary schools.

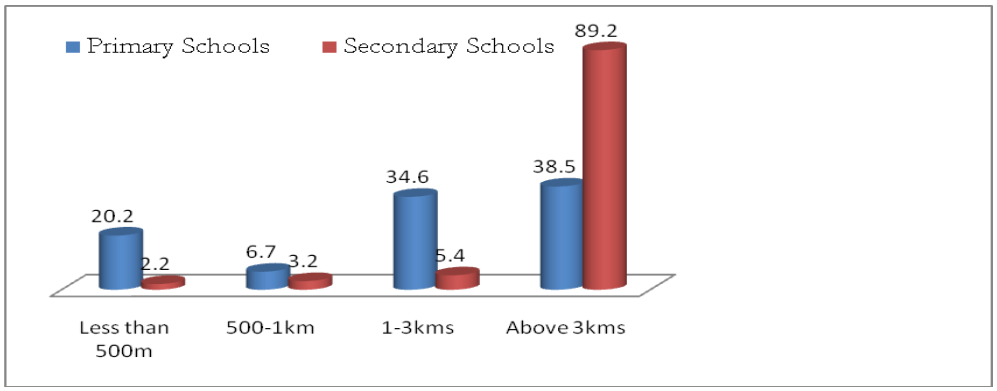

Figure 6-21: Distances Travelled to the nearest Primary and Secondary School

As regards student/teacher ratio, the District Development Plan of 2009-2013 showed that in 2008 the student: teacher ratio was 1:49 for primary schools and 1:30 for secondary schools. In regard to teacher houses the report indicated that there was 1 house for 70 teachers in primary while in secondary there was 1 house for 11 teachers. The statistics indicate there is lack of facilities for these schools and therefore some teachers travel long distances to go and teach thus affecting the service delivery.

6.3.7 Water supply

Generally, safe water coverage in Isingiro District is at 35% which is much lower than the national average of 64% while in Kashumba and Ngarama Sub-counties it stands at 27.7% and 47.8% respectively. The major water sources in the district include; Gravity Flow Scheme (GFS), springs, boreholes, shallow wells and valley dams **(Table 6-21)**. Source (Isingiro District Development Plan 2009/10/11/12).

Table 6-21: Water distribution points per sub-county

Sub county	Types of Water Sources						Safe water coverage %
	GFS tap	Spring	Boreholes	Shallow Wells	Valley Dams/Tanks	Household water tanks	
Endinzi	0	0	6	12	3	112	33.49
Isingiro T/C	23	0	41	18	0	6	28.68
Kashumba	8	0	15	5	3	80	27.73
Mbaare	0	0	15	1	8	11	20.53
Ngarama	16	5	32	30	4	114	47.86
Rugaaga	8	1	14	13	1	66	13.15
Birere	37	21	33	8	1	30	32.81
Kabingo	16	4	15	15	1	32	45.54
Kabuyanda	120	33	30	8	0	20	55.86
Kikagate	8	3	19	10	2	132	17.92
Masha	4	0	15	2	5	82	23.33
Nyakitunda	6	23	1	20	0	102	15.14

Result from the household interviews, indicated that the major sources of water in the project area include; public boreholes evidenced by 55.4% of the respondents, rain water harvesting with 43.5% *(***Plate 6-39** and **Plate 6-40***)* and 1.1% for protected springs/wells. In the proposed area for the reservoir several water ponds and an earth dam were observed and these might be submerged by the reservoir.

Plate 6-39: Water tank at Kashumba sub-county

Plate 6-40: Water tapped from a rock

In the project area, 50.5% of the people walk for less than 50m to fetch water. This is because 43.5% of the people harvest rain water while 49.5% of the respondents walk for between 500m-3kms to access water. Consultations with the cattle keepers in the area revealed that in the dry season, the cattle keepers move very long distances in search of water for their animals. The problem of scarcity of water especially for animals in the dry season still remains a challenge as shown in **Table 6-22**.

Table 6-22: Distance covered in search of water

Distance	Frequency	%age
Less than 50m	53	50.5
500-1km	15	14.3
1km-3kms	34	32.4
Above 3kms	3	2.9
Total	105	100

In terms of water quality, the perception was assessed from four dimensions i.e. taste, color, smell and hardness. Majority of the respondents said that the water which they use from the different sources was average in terms of taste, color, smell and hardness. The project should ensure that water quality tests are carried out periodically throughout construction phase so as to mitigate such impact. In terms of reliability it was established from the interviews that 59.5% of the water sources within the project is reliable throughout the year while 39.6% are unreliable characterized by insufficient supply during the dry season and dirty water during the rainy season 0.9% are others. From observation and discussion with some of the members of the community, some people fetch water from the ponds especially during the dry season while families with water tanks use water sparingly. The terrain has hindered water coverage in the district, making it expensive to construct a water source like boreholes. As a result a number of household tanks have been constructed in the district through cost sharing between the government and the

communities. Being relatively cheaper, they remain the majority water points in the district.

6.3.8 Sanitation

Isingiro district has gazetted 2 centers for solid waste collection. The Town council authorities are working with the communities encouraging them not to litter their wastes and in return a tractor routinely moves around the town collecting the waste. The town council also procured one waste disposal point where the waste is collected and disposed. The district also having the largest number of livestock has no abattoir. In reference to the household interview, approximately 94.1% of the respondents have latrines as opposed to 5.9% who did not have latrines. In addition, the most common type of latrine used is the pit latrine **(Plate 6-41)** used by 95.7% of the respondents, 1.1% used shallow pits and 3.3% used other types like open holes.

Plate 6-41: Typical latrine in the project area

In order not to contaminate water in the proposed dam, there is need for having proper latrines and the local authorities should aim at having 100% latrine coverage in the area.

6.3.9 Transport and Communication

a) Transport

Isingiro District is connected to Mbarara-Kikagati Road at the border between Uganda and Tanzania. The road continues into Tanzania as a highway. The Mbarara-Kikagati road starts from Mbarara then passes through Gayaza, Isingiro, Kibwera and ends in Kikagati. The road is approximately 62 kilometers (39 miles). The road is made of unsealed gravel and has been earmarked for tarmacking (bitumen). Isingiro district has a total of approximately 474.5 km of feeder roads and 1421 km of community roads. The district is in charge of maintaining the condition of feeder roads while the Sub-county maintains the community roads. The roads leading to the project area are made of unsealed gravel (**Plate 6-42** and **Plate 6-43);** hence making access to the project site difficult especially during the rainy season due to their muddy and slippery surface. Traffic on this road is low, dominated by lorries ferrying bananas and salon cars and motorcycles (*bodabodas*) transporting people to their various destinations.

Plate 6-42: A section of the road to the project area

Plate 6-43: Traffic along the road in the project area

b) Communication

Isingiro District is connected to different telecommunication networks such as MTN Uganda, Airtel Uganda, and Warid Telecom (**Plate 6-44)**. This has made communication cheaper, easier and faster in the area. However, in the project area, there is evidence of poor network across all networks due to interference from Vodacom Telkom from Tanzania especially at peak hours; this can be noted in the phone when interference happens.

Plate 6-44: Telephone Mast

6.3.10 Vulnerable Groups

Vulnerable people are those persons who bear a substantive risk of suffering physical, social, psychological /mental and emotional harm in comparison with other persons in the similar environment. Examples of such people include Persons with Disabilities, children, women, the elderly, and refugees from Congo and Rwanda living in refugee settlements. Like any other person, these groups of people need equal opportunities such as better education, employment, justice and the right to own property. According to the 2002 Population and Housing Census, 4% of the population in Isingiro District comprises of the elderly (60+ years), 2.3% comprised

of People with Disabilities (PWDs), 7.2% comprised of orphans and the youth comprised of 41% of the population. Similarly, these vulnerable groups also exist in the project area. Household interviews showed that 12.4% of the household heads were in the elderly category (65+ years), 13.3% of the households were headed by women who were majorly widows, 12.4% did not own land, 23.3% had orphans in their households and 12.7% of the respondents had disabled people in the homes. The causes of the orphans and widows include HIV/AIDS, malaria, other diseases and accidents among others. The major type of disability was the physical lameness reported by 69% ***(*Figure 6-22**) of the respondents. Other types were blindness (16%) and mental illness (15%).

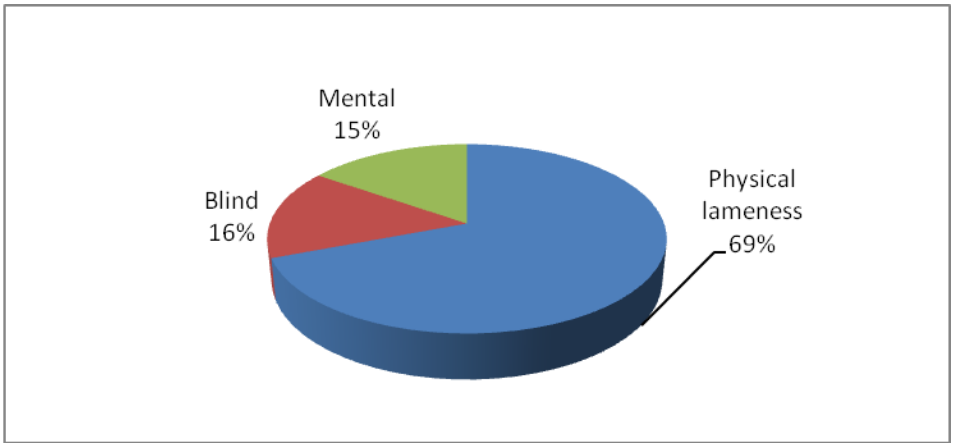

Figure 6-22: Types of Disabilities

The vulnerable groups face a number of problems which include heavy workload on women, low participation in decision making, lack of ownership of resources, early marriages for girls, defilement and rape, abuse and neglect of orphans, discrimination against and marginalization of people with disabilities, low incomes and thus high levels of poverty, high levels of illiteracy, lack of support and domestic violence. Special consideration should be given to the vulnerable groups in case they are affected by the project. The project should ensure that their already vulnerable situation is not made worse by the project.

6.3.11 Tourism

Uganda "the Pearl of Africa" is one of the most beautiful countries in Africa, with fantastic natural scenery. Half of the World's remaining mountain gorilla population is in Uganda. The western part of Uganda has a great potential for tourism and the natural attractions are among the best in the region. In Isingiro district, the long horned cattle play an important role in attracting tourists. The other tourist attractions include; Lake Nakivale (**Plate 6-45*)*** and Lake Mburo. The other lakes are Oruchinga and Misyera which borders Ngarama, Kashumba, Isingiro T/C, and Rugaaga sub-counties. The district is also blessed with two permanent rivers and these are River Kagera and River Rwizi

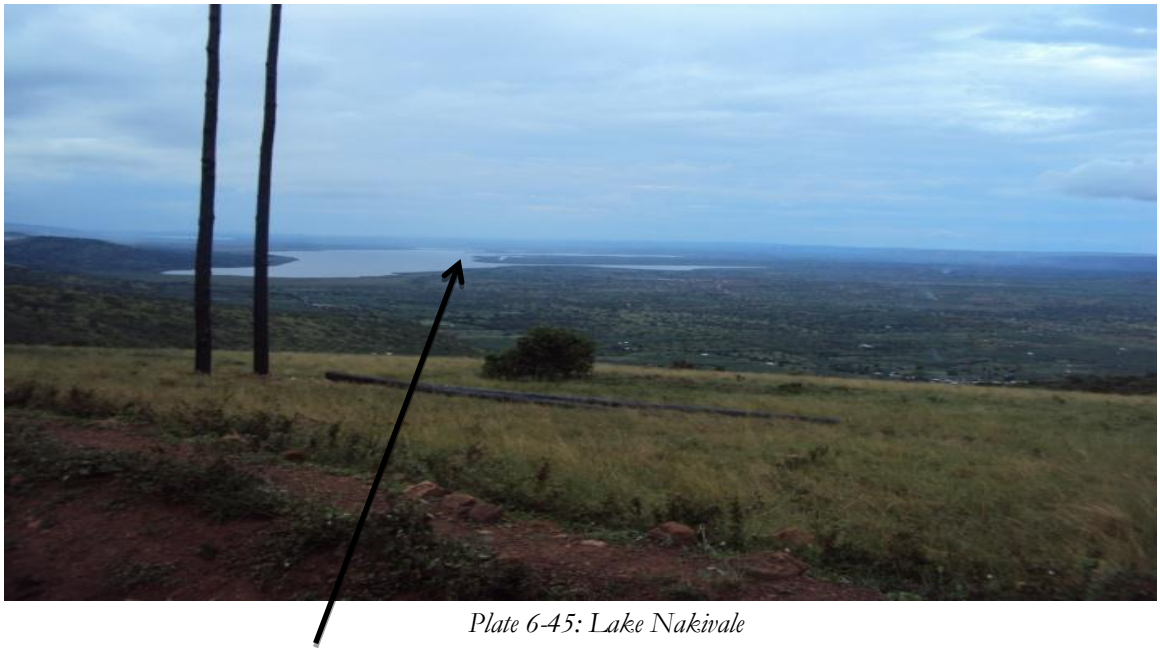

Plate 6-45: Lake Nakivale

6.3.12 Security

Uganda is one of the most peaceful and secure place to live and do business unlike in the 1980s and early 1990s when the country was under the civil war. The country adopted Multi-Party system of governance where every after a period of 5 years presidential and parliamentary elections are held. Also elections of lower local leaders follow suit. Through this kind of system of governance, women, Persons with Disabilities and youth have been elected to bridge the gap of gender imbalance. Due to the prevalence of security in the country, this has contributed to the infrastructural development, boosted tourism and attracted investors. However, there are crimes and conflicts reported in the district in general and the project area in particular and these include domestic violence cases, family conflicts, land conflicts, rape and defilement, theft and murder. These were highlighted during community consultations. The major causes of crime and conflicts in the area include drunkenness, poverty, trespass, drug abuse, closing off access roads/paths and distribution of land among the family members. Resolution of conflicts is by family members, church leaders, local council committee members, police and the Courts as the last resort.

6.3.13 Gender Considerations

a) Ownership and access to resources

The Isingiro Five Year District Development Plan, reported that there are inequalities among the women, youth, orphans, elderly, Person with Disabilities, refugees and the urban poor. Among the factors that have brought about inequalities include but are not limited to; low levels of education, cultural factors, unequal opportunities of education and unequal distribution of social services.

From the focus group discussions with the women in the project area, it was revealed that women do not own property including land and cannot participate in key decision making. Given the patrilineal cultural set up of the ethnic groups in the area, decision making including the right of inheritance is dominated by men. Consultations further revealed that among the Bahima, women can participate in decision making, but among their counterparts the Abairu (agriculturalists), decisions are made by men only. The women have a right use the land and to sell crops like beans, maize which are low income fetching items whereas the men have the right to sell high income earning assets like cattle and bananas. This has greatly contributed to the high inequalities in incomes between the men and the women. In regard to access to credit, due to lack of collateral the women have difficulties in accessing credit from financial institutions. In addition, there are no financial institutions operating in the area as most of them operate in town. In regard to access to social services, consultations with the women showed that the women travel long distances to get maternity services. There were no traditional birth attendants in the area to help the women in case of a maternity emergency. This sometimes leads to death of the women and/or the babies during birth.

b) Gainful employment

The 2002 Uganda Population and Population and Housing Census Analytical Report revealed that nationally, the majority (66%) of the working women aged 14-64 years were unpaid family workers and only 10% of the working women were paid employees. In the project area, none of the female headed were gainfully employed. Their main source of income is peasant farming.

c) Division of labour

As regards division of labour or gender roles, the women do farming activities and most of the domestic chores like cooking, looking after the children, fetching water, washing clothes and collecting firewood. On the other hand men are involved in farming, grazing and other activities which generate income like trading. It was noted that women are more involved in agriculture than men yet men tend to benefit more than women. Project planners and implementers should provide the women with equal job opportunities as this will enable them to generate income hence empowering them economically.

6.3.14 Donor/Government Development Programs in the Area

There are quite a number of civil society organisations in Isingiro District of which 9 are NGOs while others are Community Based Organisations. These organisations mainly target children, orphans, HIV/AIDS victims, women, widows, traders and farmers. With particular reference to the Kashumba and Ngarama Sub Counties, **Table 6-23** shows some of the NGOs/CBOs operating in the area.

Table 6-23: NGOs /CBOs Operating in the Project Area

Name of NGO/CBO	Activities	Target group	Area of operation
Integrated Development Alliance for Health (IDEAH)	Sensitizing the youth against HIV/AIDS Distribution of condoms	Out of school youths aged 10-35 years	All the five parishes in Ngarama Sub County
Ngarama FAL Instructors Association	Provide scholastic materials to orphans Sensitise communities about HIV/AIDS Provide adult education.	Orphans, elderly, widows, adult learners	All the five parishes in Ngarama Sub County
Africare / UWESO	Caring for orphans and children from disadvantaged and vulnerable children	Orphans, disadvantaged and vulnerable children	All the five parishes in Ngarama Sub County
UNHCR	Provision of education services to the vulnerable children	Refugees children	Nakivale,Kankingi Parish,
TASO	Support people with HIV/AIDS by supplying of food, medicine, counselling services and pays school fees for orphans whose parents died of HIV/AIDS	People with HIV/AIDS Orphans of those who died of HIV/AIDS	All parishes in both sub-counties
GLIA	Supporting People living with HIV/AIDS	People living with HIV/AIDS	All parishes in Kashumba Sub County
CARITAS	Supporting sustainable agriculture.	Farmers	Kashumba Parish

Source: Kashumba and Ngarama Sub-County Five Year Development Plans (2011-2016)

6.3.15 Energy Sources

The main source of energy for cooking in the project area is firewood while the major source of energy for lighting is paraffin. A few households use solar for lighting and few use charcoal for cooking. There was no household interviewed that reported to use electricity for its energy needs.

6.4 ARCHAEOLOGICAL AND CULTURAL RESOURCE

6.4.1 Cultural Landscapes

The dam is on the upper reaches of a small lowland tributary of the Kagera River **(Figure 6-23)** just downstream of the point at which the Uganda/Tanzania border leaves the river to run along the latitudinal parallel. This area is known to have high Stone Age potential due to important sites in a very similar tributary just to the west and along the Kagera River valley. The most famous site at Nsongezi located just downstream of the Kitagati-Nsongezi gorge was discovered

in 1930 by Wayland and excavated by O'Brien in the 1930s, Wayland and Posnansky in the 1950s and Cole in the 1960s (Bishop & Clark 1967). This site has produced very large numbers of both Early Stone Age (ESA) lithics (Acheulian) and Middle-Late Stone Age lithics (MSA-LSA, Sangoan and Lupemban). ("Lithics" are stone tools). Most, have come from the M-N gravel (or rubbley) horizon of sediments underlying the '100 ft.' Kafunzo flat. The site also represents the Nsongezi Series which are sandy fluvio-lacustrine thought to be a remnant deposit of a former Lake Victoria. It is believed that the sediments grade easterly to still-water facies (fully lacustrine towards Sango Bay) but are up warped up to 400 ft. above Lake Victoria to the west. The Nsongezi series is expected to crop out in the Bigasha area and therefore needs to be surveyed prior to flooding of the dam. Recent archaeological survey and excavations by Basell (2012) has located interstratified ESA/MSA lithics at an unusually high concentration in sandy terraces of the Orichinga River which drains into the Kagera at Nzongezi. This tributary is only 13 kilometers west of Bigasha and very similar in geology and topography. It is highly likely that similar archaeologically rich deposits lie within the Bigasha catchment and within the area to be dammed downstream.

6.4.2 Archaeological features

These were identified as follows as shown in **Figure 6-23**.

i) Pottery site was located at GPS 36m 0265653, 9895275, elevation; 1260m which was characterized by 2 plain pottery shards exposed by soil erosion on the village road;

ii) At location; 36m 0265757, 9895023, we recorded what seem to be recent or ethno-archaeological material in form of grinding stone and a few late Iron Age pottery scatters;

iii) Iron slag material was recorded at GPS location 36m 0265975, 9895125, elevation; 1282m. the site was characterized by one single tiny block of iron slag eroding from the road;

iv) One single pottery shard was recorded at GPS 36m0267154, 9895090, elevation; 1283m, which was also exposed as a result of soil erosion on a small village path crossing the dam valley at the upstream side;

v) One important archaeological recovery came from GPS location; 36m 0267328, 9895299, elevation; 1264m, characterized by stone tool in form of a spear head (Plate 6-46) which was recovered upstream of the proposed dam. The single piece was excavated during the construction of the local dams for watering the animals by the local people.

Plate 6-46: A stone tool in form of a spear recovered from upstream of the dam

From **Figure 6-23**, it is concluded that there were no surface archaeological finds seen in the current stretch of the proposed dam. Most of the recoveries came from the surrounding areas but within the project area. The most significant recovery was in form of a stone spearhead tool shown above.

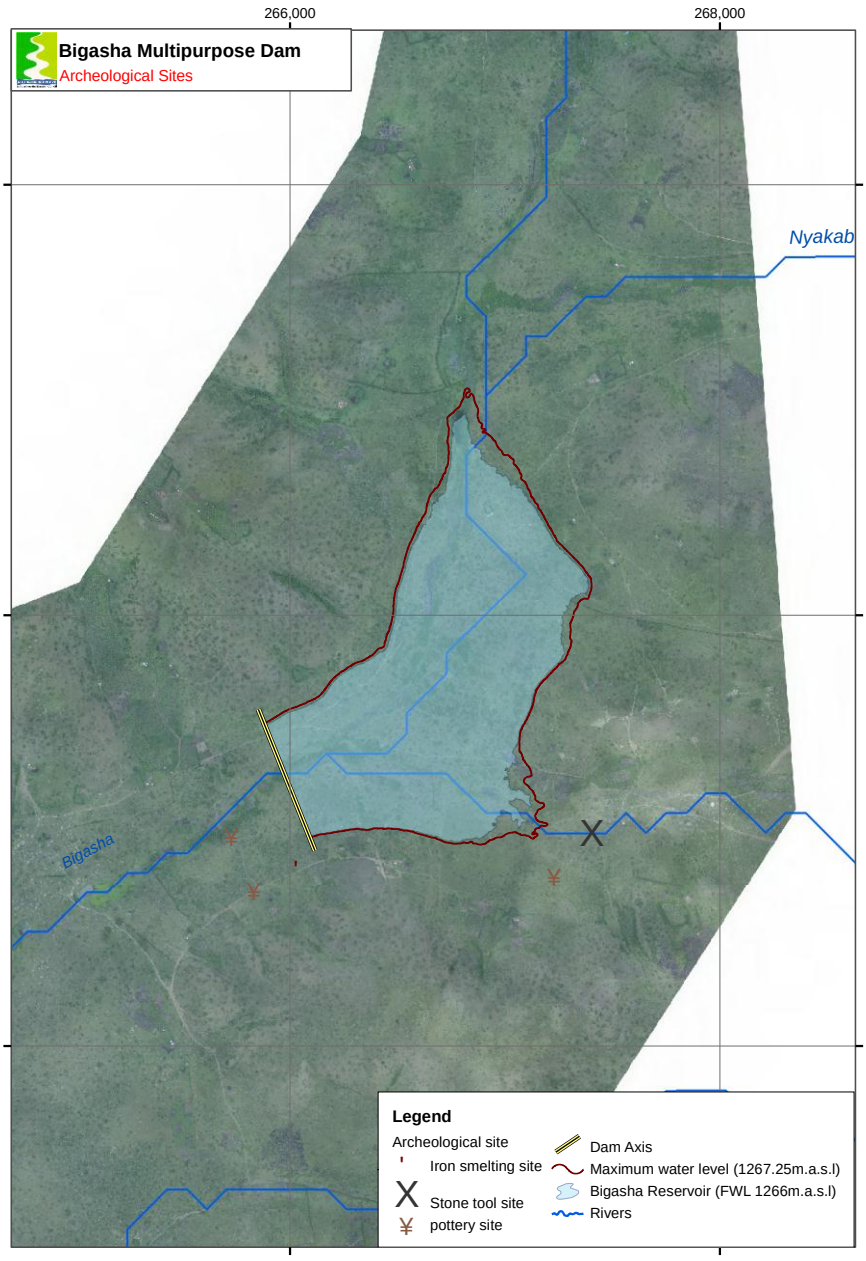

Figure 6-23: Bigasha dam site showing Archaeological sites

7 EVALUATION OF POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS

7.1 POSITIVE IMPACTS OF THE ACTION

7.1.1 Preparations Phase/Planning

7.1.1.1 Socio-economic and Physco-cultural Environment

- **Job opportunities**

The positive impacts associated with this phase include job opportunities for a few community members. From consultations with the sub-county authorities of Ngarama and Kashumba it was revealed that there are a number of youth who are redundant even in the neighbouring sub-counties. Some of these are likely to get some jobs. However, the jobs are in form of casual labourers and data enumerators being hired during the study phase of the project. The magnitude of the impact of job opportunities is however **low positive** due to the small number of people employed as compared to the many who would need the opportunity.

In addition, during this phase, different stakeholders contribute to the project through their views, opinions and suggestions. The views, participation and contribution of the different stakeholders during this phase greatly contribute to finding measures of minimizing negative impacts of the project and could also inform the design of the project.

7.1.2 Construction Phase

7.1.2.1 Socio-economic and Physco-cultural Environment

- **Creation of employment opportunities and increase in income**

During the construction phase, workers including both skilled and unskilled are expected to be employed directly by the project which will in turn contribute to an increase in their income. As already indicated, there are many people in the area especially the youth who are available for employment. However, the baseline findings indicated that although the literacy rate of the district is at 67%, only 8.5%, 0.3%, 1% and 0.07% completed primary, secondary, certificate/diploma and degree programs respectively. The local people will thus be employed mainly as casual workers. The number of workers expected during construction of the dam is about 100 which is small as compared to the job seekers and the opportunity will only last for the construction phase. There are other project components like irrigation scheme, water supply which will also provide some work during their construction**.** In addition, basing on the nature of activities required for the construction, most of the workers that will be taken on will be men as compared to the women.

The local communities will also benefit indirectly from the increased spending of the workforce.

Local people will gain through sale of items like food stuffs, milk and other basic goods to the workers. The increase in demand of products will lead to increased supply and creating market for products thereby improving the incomes and general welfare of the local communities and their families. In addition, the community members with rent houses especially near Kashumba and Ngarama sub-counties for accommodation to the project workers. The overall magnitude of impact is expected to be **medium positive** as it will be short term and benefiting mainly people around the project area.

Enhancement of positive impacts

- Sensitization of communities and information dissemination on the existing job opportunities in the project.
- Priority should be given to sourcing local labour from the project area.

- **Skills development**

Those who will have the opportunity to work with the project during the construction phase, particularly the unskilled and semi-skilled, will get an opportunity for skill development. The unskilled are likely to be upgraded to semi-skilled while the semi-skilled will be exposed to better techniques and work methodologies. Improved skills are always beneficial as they result into more income opportunities for the holder.

Enhancement of positive impacts

- Training programs for the unskilled and semi-skilled workers.

- **Improvement of Road network and access to social services**

The proposed development of Bigasha multipurpose dam will bring about economic development in the two remote sub-counties which are characterized by poor infrastructure such as inaccessible roads. Infrastructure such as roads linking the two sub-counties of Ngarama and Kashumba to other places will be improved. The existing two accesses are narrow and one through the hills is so rough; these will need to be widened to handle the construction traffic. The improved roads will bring about a boost in trade and will create market opportunities for the agricultural products like bananas, animals and milk as more traders will be able to access the area.

The baseline findings showed that majority of the farmers sold their products at the farm gates. With new markets, there will be an increase in production of agricultural products and thus increase in incomes of the local people. Furthermore, due to the improved access roads, more trading centers may emerge in the area thereby leading to further development of the area.

Access to other services like health centres and schools will also improve. Despite the fact that each sub-county in the project area has a health centre as per the Government of Uganda Health policy, accessibility to these facilities still remains a challenge to the communities in the project

area. The improved access roads will improve on accessibility to health services.

Although the impact will be long term and will benefit a number of people the sections of the roads to be improved may not be very long thus the impact is expected to be **medium positive**.

Enhancement of road improvement

Local government and the community should continue to carry out maintenance of these roads even after construction.

- **Gender balance**

The project will improve in particular women's livelihoods and welfare. This will be through both direct and indirect employment opportunities. In addition, the World Bank guidelines emphasize that special attention be given to vulnerable people of which women are a part. More so, as part of the livelihood restoration program for PAPs, clubs/groups will be formed to benefit all categories of people such as women. These women's clubs will serve as physical spaces where women can network, learn, support each other, and undertake both group and individual income earning activities. The magnitude of this impact is expected to be **medium positive;** this is because a small number of women may benefit from the project.

Enhancement of positive impacts

- Women should be considered for the available job opportunities.
- Women and youth should be supported to participate in income generating activities

- **Development of archeo-tourism through Cultural heritage**

The Bigasha finds were located on the periphery of the proposed dam site and further downstream. These are closely related with those of the renowned Nsongezi series. They have a high concentration of cultural artifacts of unique nature such as spearhead stone tools, slag, pottery and metal pieces. Therefore there will be need to preserve the sites for income generation through cultural heritage and archeo-tourism. Part of the proceeds from tourists can be used to redevelop the site. Professional archaeologists need to be on the look to salvage the site and do any rescue excavations when need arise because archaeological assets includes even those that are not yet discovered. A few jobs can therefore be anticipated and could be a long term employment opportunities if valuable sites are identified and protected. The creation of a dam will be an added advantage for attraction of tourists and professional archaeologists to the area. The expected positive impact on the gender is the employment of both male and female to the site as conservators, custodians and interpreters. However the impact is expected to be **low – medium positive** as this impact may develop slowly although long term.

Enhancement of Archeo-tourism impacts

- Sensitization of communities on the importance of the sites;

- Training local residents on site protection strategies and handling of valuable artifacts;
- Construction of transport and communication networks to the site in order to attract tourists
- Contractors should work hand in hand in hand with professional archaeologists in the preparatory, construction and post construction stages for effective handling of the site and since the site and its components are non-reversible and priceless when destroyed, first hand approach and care must be taken in protecting and preserving

7.1.3 Operation and Maintenance /Post Construction stage

7.1.3.1 Socio-economic and Physco-cultural Environment

- **Improved water supply and sanitation in the Bigasha dam site area**

The communities will fully benefit after the dam is constructed both in dry and wet seasons in terms of water supply for both domestic use and other productive uses like watering of animals. Currently, safe water coverage in the district stands at 35% and at 27.7% and 47.8% in Kashumba and Ngarama Sub Counties respectively. The construction of the dam will improve the availability of safe water coverage in the area.

Consultations with the cattle keepers in the area revealed that in the dry season, water scarcity was a major challenge as they moved very long distances in search of water for their animals. With the dam in place, this problem will be solved. Given the major water scarcity especially in the dry season and the fact that many people even those outside the project area will benefit from water supply that is wider coverage and is a long term benefit, the impact is expected to be **high positive.**

Furthermore, in order not to contaminate the water in the reservoir, 100% latrine coverage and proper garbage disposal mechanisms should be a requirement. This will result in improved sanitation in the area. In addition, the communities will benefit from the additional water and sanitation facilities constructed by the project thereby reducing the existing problem of lack of such facilities.

Enhancement measures

- Continuous sensitization of the communities in regard to use and maintenance of the facilities will be required at all levels.
- Regular maintenance programs should be put in place.
- Measures should be put in place to ensure that the technical personnel are well facilitated to properly carry out their roles.
- Water user and maintenance committees should be put in place and should be well facilitated to carry out their role.

- **Improvement in water supply in the Bigasha dam catchment**

Isingiro District as well as the sub counties of Ngarama and Kashumba and the villages of Kemikookoma, Kashenyi, Izo, Kabegaramire, Ntenga and Bigasha suffer from regular annual water scarcity which is severe during droughts. The trading centers and villages are currently supplied by mainly bore holes. These tend to dry during the dry seasons. It is proposed that water treatment facility will be located at the reservoir. The main tank will be located at the highest point on Ngarama hills (N9899000 E2605000 1705 m.a.s.l) at the Ngarama Trading centre some 7 km from the dam site. The main transmission line will therefore run from the reservoir to the main tank. It is proposed to have three gravity trunk mains to the West to Kikagati and Kabuyanda; to the East to Kashumba; and to the North to Isingiro, Nyakitunda and Kabingo. Booster tanks will be built along the way to supply villages and urban centers. Trading centres in this area include Kashenyi and Kabegaramire. Before reaching Ngarama Trading Centre, the transmission line passes through 2 trading centres namely Kigando and Katwe trading centres. In terms of social infrastructure and services, there are schools and health centers observed at the Ngarama Trading Centre namely, Ngarama Health Centre III, two private clinics, Ngarama Girls Secondary School, Ngarama Secondary School, Ngarama Teachers' Education Centres, and a private primary school among others. All these centres will be supplied with clean portable water from the Bigasha dam when constructed. This supply is expected to be fully operational and sustainable going through even the dry season. The magnitude of water supply is therefore expected to be **high positive** as it will supply clean water to many homes and settlements on a long term basis.

Positive impacts of water supply

- Availability of clean water for domestic use;
- Availability of water for livestock;
- Potential for better food supply;
- Guaranty in food security;
- Reduction in poverty levels;
- Possibility of better health service delivery systems;
- Reduction in intestinal worms;
- Reduction in diarrhoeal diseases;
- Better education facilities.

Enhancement of Positive impacts

- Proper planning, construction and maintenance of water supply system;
- Adequate funding of maintenance of water supply system;
- Establishment of practical management structure to oversee the maintenance of the water supply system;
- Formulation of bye-laws and regulations for the management of the water supply system;
- Good enforcement mechanisms for management of the water supply system;
- Establishment of good bye-laws and security strategies for the management of the water

supply system;
- Provision of adequate points for accessing domestic water supply from the main transmission lines.

- **Provision of employment**

During Operation and Maintenance phase, a few employment opportunities will be available such as clearing of bushes around the dam site, maintenance of the fence and provision of security for the dam among others. Although the people that will benefit from this impact will be directly employed over a long period of time, only a small number will be employed compared to the many job seekers in the area**.**

However, the reservoir will have a multiplier effect where by people will also be employed indirectly in the activities that may result from the reservoir like fish farming, improved livestock keeping and crop farming that will be boosted by irrigation etc. Although siltation will not be a major problem to Bigasha dam, there will be some de-silting activities periodically which will be a source of employment for some people. All these activities will engage a number of people however there will still be many more job seekers thus the impact on employment is expected to be **medium positive.**

- **Tourism potential**

The proposed development of Bigasha dam will act as a tourist attraction. Several recreational and sporting centres may be constructed near the reservoir thereby generating income for both the local people and the Government. This impact will go beyond the project area and will be long-term. Although tourism is expected to be long term, the fact that there are already tourist attractions in the area such as Lake Nakivale, River Kagera, Nsongezi Rock Shelter, Mburo National Park and Lake Mburo among others, there will be competition for tourists thus the magnitude of this impact is expected to be **Low to medium positive.**

- **Generation of Hydropower**

One of the potentials of the proposed Bigasha multipurpose dam project is to generate hydropower which is expected to benefit the local community. Presently, there is no power at Ngarama sub-county. Generation of power at Bigasha site will provide an opportunity for these areas to get power. Power will be used mainly for lighting, water supply to the communities through pumping, as well as medium scale industries like grinding mills, welding etc. Agro-based industries, milk processing plants and diary storage facilities could be established. As a result, these will create employment to the local people and will improve on the storage of milk which is a major product of the cattle keepers. Although this impact will be long term, not everybody will be able to afford it thus qualifying the impact to be **low to medium positive.**

Enhancement measure
- Government should put in place the infrastructure to generate electricity

- The price of electricity should be subsidized to enable many people to access it.

- **Improvement in food security and crop farming**

Isingiro District as well as the sub counties of Ngarama and Kashumba and the villages of Kemikookoma, Kashenyi, Izo, Kabegaramire, Ntenga and Bigasha suffer from regular annual water scarcity which is severe during droughts. The proposed irrigation command area lies within both Ngarama and Kashumba Sub Counties and several villages. This area spreads 7 km from the dam axis south to the Kagera River bordering Tanzania. There are some settlements observed in the irrigation command area. Trading centres in this area include Kashenyi and Kabegaramire. The valley is currently used for cattle grazing, watering cattle. Current crop farming involves the growing of crops like beans, sweet potatoes, Irish potatoes, vegetables and cereals. There are also some fruit trees such as mangoes and citrus. However from community consultations, if was found out that farmers face the problem of drought and most times they lose their crops There is potential to grow pineapple, fodder and forage crops such as elephant grass, desmodium, and alfalfa plus all the currently grown food crops. There is currently no experience in the area for rice growing but this can be introduced gradually. Irrigation in this area will therefore have huge potential positive impacts in the area. There is a potential of growing about 2800 ha of land downstream whereas the immediate potential is the irrigation of 800 ha initially but this could be increased to 1300 ha. Hence, it is possible to grow two to three crops per year in the irrigation command area. Potential positive impacts and strategies to enhance these impacts are detailed in the box below. The magnitude of this impact is expected to be **high positive** because it will be long term and it will be benefit many people.

Positive impacts of irrigation in the Bigasha area

- Availability of water during both rainy season and the dry season;
- Availability of clean water for domestic water supply;
- Availability of water for cattle drinking;
- Availability of water for irrigation;
- Availability of water for growing two-three crops annually;
- Potential for better food supply;
- Guaranty in food security;
- Reduction in poverty levels;
- Increased income for the communities;
- Improved drainage in the irrigation command area;
- Improved access roads;
- Possibility of better health service delivery systems;
- Better education facilities;
- Availability of agrochemicals and other pesticides;
- Improved public health services for livestock

Enhancement of Positive impacts

- Proper planning, construction and maintenance of irrigation dykes and canals;
- Adequate funding of maintenance of irrigation dykes and canals;
- Establishment of practical management structure to oversee the maintenance of the irrigation dykes and canals;
- Formulation of bye-laws and regulations for the management of the irrigation dykes and canals;
- Good enforcement mechanisms for the management of the irrigation dykes and canals;
- Establishment of good law and order, security and public health strategies in the irrigation command area;
- Separation of cattle watering areas;
- Provision of safe points for accessing domestic water supply;

- **Creation of suitable habitats for Fish and Invertebrates and improvement in open water fisheries**

There were no fish seen in the Bigasha dam site area during the survey. However, issues of conservation status of the fish in the Kagera River Basin could be considered as a whole given that species such as *Barbus acuticeps* and *Marcusenius victoriae* are endangered in other Kagera River streams and rivers where *Synodontis ruanda* is a species at risk. With regard to the Invertebrates found in the dam site, none of the species seen are in the IUCN Red list of endangered or threatened species.

The creation of a new reservoir in the Bigasha area will favour all water loving organisms and biota including fish, invertebrates and aquatic plants. The wetlands surrounding the new dam will also be ideal habitats for littoral biota including fish, invertebrates and plankton. However, although no fish were caught in the Bigasha stream and in the pools, this does not mean that there are no fish in the Bigasha catchment. The Bigasha stream is part of the Kagera River catchment. It would be usual for fish species in the Kagera River catchment to be found in all the rivers and streams of the catchment through migration during floods. Fish species that occur in the Akanyaru and Nyabarongo Rivers (which form part of the Kagera River Basin) is a good representation of the fish species that occur normally within this catchment as a whole. These species have capacity to invade the entire basin during heavy rains and flooding periods. These species can be represented by those that occur in the Akanyaru and Nyabarongo Rivers as shown in **Table 7-1**.

Table 7-1: Fish species that occur in the Akanyaru and Nyabarongo Rivers (take to base line)

Family	Species
Mormyridae	*Pollimyrus nigricans*
Cyprinidae	*Barbus(Labeobarbus) acuticeps* (e), *Barbus (Labeobarbus) altianalis*
	Barbus apleurogramma
	Barbus neumayeri, Barbus ruasae, Cyprinus carpio & Labeo victorianus
Mochokidae	*Synodontis ruandae*
Clariidae	*Clarias gariepinus & Clarias liocephalus*
Schilbeidae	*Schilbe intermedius*
Poeciliidae	*Lacustricola pumilus*
Mastacembelidae	*Mastacembelus frenatus*
	Astatoreochromis alluaudi, Haplochromis burtoni, Haplochromis sp
	Oreochromis leucosticus, Oreochromis macrochir, Oreochromis niloticus
	Tilapia rendalli
Protopteridae	*Protopterus aethiopicus*

It would therefore be expected that when the Bigasha dam is built, the dam will be 'invaded' by fish species locally found within the Kagera River basin including species such as those found in the Akanyaru and Nyabarongo Rivers through migration during flooding and through purposeful physical translocation by people.

Table 7-2: Capture fish production in the Kagera River Basin lakes in 1992

	Surface area	Fish production t/year	No. People employed
1. Akagera Lakes	148.2	231.8	90
2. Nasho Lakes	44.9	152.0	192
3. Gisaka Lakes	58.7	282.0	560
4. Bugesera Lakes	58.4	388.9	438
5. Lake Muhazi	34.1	75.0	646
6. Lake Burera	54.0	27.0	94
7. Lake Ruhondo	26.1	47.0	150

Source:
1) Kagera River Basin Monograph (Basin Development Report); NBI 15 July 2008
2) Plan Directeur Pêches et Aquaculture, 1993 ; Rapport annuel 2006 et Rapport mois d'Août 2007, PAIGELAC-MINAGRI.

However, in 2006, fish production from these lakes shot up 10-2,000 metric tonnes per year. Further, introduction of fish species with commercial prospects such as the ubiquitous Cichlidae, Cyprinidae and Clariidae ha a real potential in the new Bigasha 'lake'. There are examples of other small lakes within the Kagera River catchment where effective commercial fishing using introduced fish species has been very successful as shown in Lake Rweru and Cyohoha where (Mughanda, 1989) shows the fish production potential, especially for *Cichlids* (3 species of *Tilapia*) introduced in 1950 have the average production potential of about 1,500 and 900 metric tons per annum in, respectively. **Table 7-2** shows the capture statistics from the River Kagera Basin lakes in 1992.

There is therefore no reason not to believe that similar fish production levels can be achieved in the Bigasha dam as well as in the other small multi-purpose dams in the Kagera River Basin. Certainly, the potential is there to produce fish. Fisheries can play an important role in ensuring food security, economic development and poverty alleviation among the local community around Bigasha dam site area. This will add value to the current status of capture fisheries in the Kagera River Basin where fish stocks in the majority of these lakes have been over fished. It is therefore concluded that the creation of the Bigasha reservoir will have **high positive impact** because it will be long term effect and it will be benefit many people.

Positive impacts of the project on fish and fisheries in the Bigasha dam

- It will ensure permanent availability of good water supply for fish;
- It will ensure constant availability of aquatic organisms which form the food of fish including algae which good oxygenation of the dam water for survival of fish ;
- There will be suitable substrate and habitat for fish to breed through flooding of wetlands and littoral vegetation;
- Fish fry will have adequate food supply in form of phytoplankton, zooplankton, aquatic invertebrates and detritus;
- Water temperatures in the dam will be buffered and regulated through constant water flow through the dam thereby ensuring optimum water temperatures for fish survival;
- Flooded littoral vegetation will ensure protection of fish from predators as this will provide suitable hiding and feeding habitat for fish; and
- Overall impact of the project on fisheries will be increase in fish stocks, increase in fish catches, increase in community incomes and improvement of the nutritional status of the Bigasha communities and even those far from the dam.

- **Improvement in Aquaculture Fisheries**

Capture fisheries in general is facing increasing risks including overexploitation of natural fish stocks, use of irrational fishing gears, pollution of the basin waters from industrial effluents, domestic sewage and agrochemicals. Introduction of aquaculture in the Bigasha dam can therefore ensure sustainable fish production. Further, aquaculture can provide an alternative to capture fisheries in the existing lakes and rivers, hence preserving their biodiversity. It can also

help the local people engage into other productive activities. Fish species with potential for aquaculture include the tilapias, *Oreochromis* spp., *Haplochromis* spp., *Bagrus* sp., *Clarias* spp., *Protopterus* sp. and the foreign carp species. The magnitude of this impact is expected to be **high positive** because it will be long term and it will benefit many people. It will also improve the food nutritional capacity of the local communities and offer opportunity for employment.

Enhancement of positive impacts

- Government should endeavour to put in place infrastructure to facilitate irrigation and fish farming
- Capacity building of the local people in proper irrigation methods.
- Continuous sensitization about fish farming.
- Potential fish farmers should be provided with fish stocks.
- Training and capacity building in fish farming methodologies.

7.1.3.2 Positive Impacts on the Biophysical Environment

The creation of a reservoir will change habitats significantly and ensure sustainable water supply. This may attract water loving animals, birds, reptiles, and insects from far and near as well as bringing in more fish, and other aquatic organisms.

- **Potential for creation of Wetlands**

A small strip of wetlands is likely to be created around the reservoir as a result of permanent water body which encourages growth of aquatic plants. This may start small but will increase with time. These will provide breeding places for fauna like fish etc. and provide other wetland services. The impact is expected to be localized but long term, thus will be **medium positive**.

- **Climate Change Mitigation**

Construction of the reservoir can help mitigate climate change impacts like flood control etc. During the wet season, the downstream communities get affected by floods which sometimes dam crops and other properties in the valley. This issue was raised during consultations at Ngarama and communities. With a dam in place, these floods will be controlled. The reservoir will also improve in recharge of ground water. This will therefore be a positive impact on climate change. This impact is long-term, and it covers all the downstream area up to River Kagera thus the extent of impact is wide thus it will be **medium positive.**

- **Creation of habitats for Birds**

From the baseline it was found that of the species recorded, one is globally endangered namely, the Grey-crowned Crane. The Grey Crowned Crane has recently been uplifted from Vulnerable to Endangered. The Grey Crowned Cranes require mixed wetland-grassland habitats. Because the project will provide more aquatic environment, the impact of the project activities on water

fowl and the Grey-crowned Cranes will be **high positive**. This is because the species typically nest within or on the edges of wetlands, while foraging in wetlands, nearby grasslands and croplands. Nesting usually occurs in wetlands where the vegetation is significantly high to conceal the cranes and their nests.

- **Creation of suitable habitats for Amphibians**

The project will provide permanent water which will be a better ecosystem for the ecology and conservation of amphibians. The project will provide more aquatic environment, however all the 11 species of frogs recorded none is; globally threatened, near threatened or vulnerable. Thus the impact of the project activities on all the amphibians species will be **medium positive**.

- **Creation of suitable habitats for Dragonflies and Butterflies**

Dragonflies and Butterflies love aquatic habitats where there is plenty of aquatic vegetation. Creation of the reservoir will provide such environments. However none of the species of dragonflies and butterflies recorded is globally threatened or near-threatened (Perpetua Akite personal communication).Thus the impact of the project on the ecology and conservation of dragonflies and butterflies will be **medium positive**.

7.2 NEGATIVE IMPACTS OF THE ACTION AND THEIR MITIGATION

7.2.1 Preparations Phase/Planning

7.2.1.1 Socio-economic and Physico cultural Environment

- **Social expectations generated by disclosure of information to the Community**

This stage gives higher social expectations in anticipation for jobs from the project considering the high rate of unemployment in the project area. Another potential impact at this stage is the fear generated in the mind of the public with regard to land acquisition and loss of crops through the activities as expressed during consultation meetings. This is a **high negative** impact as it affects all the people in the community and it will continue until the project has been implemented.

Mitigation Measures

- To avoid negative social expectations, all information regarding the project and its relationship with the local community, including aspects of hiring labour and compensation should be disseminated to the community.
- There should be continuous community consultations and sensitization throughout the project cycle so that all queries and fears are answered, reduced or eliminated from the public mind.

7.2.2 Construction Phase

7.2.2.1 Socio-economic and Physico-cultural negative Impacts

- **Influx of people**

There will be a temporary increase in population during the construction phase of the project. The influx of people looking for work is a common phenomenon with all development projects, especially in communities with limited possibilities for paid labour. An increase in population will result from project workers who will settle in the area until project completion and job seekers who will want to work for the project. The project will require a workforce of skilled and non-skilled personnel. In addition, businessmen may want to settle in the area and utilize the opportunity of available market for their products.

The increase in population in the area will come with its associated negative consequences like increased conflicts, struggle for the limited resources, and increase in diseases like HIV/AIDS, insecurity, and increase in the price of commodities.
Though influx of people in the project area is temporary, considerable pressure will be felt in some sectors in particular the health sector thus the impact will be considered **medium negative**.

Mitigation measures

- The Developer in collaboration with the Contractor shall prepare a workers recruitment plan that prioritizes local people and local staff employment percentage shall be determined. This will help in reducing the influx of people in the area and avoid marginalization of local communities in securing employment opportunities.
- Local authorities shall need to be strengthened to deal with the increased cases of indiscipline.
- Project should plan for an increase in infrastructure e.g. sanitary facilities, health facilities, and water facilities among others.

- **Unfulfilled community expectations**

During the consultations, the issue of employment opportunities was raised in almost all the meetings. Naturally, all people within the working age group have the desire for gainful employment. It is always everyone's wish to have an opportunity to offer services on the project: however, the number of job seekers may be higher than the number of available vacancies and this is likely to result into dissatisfaction and frustration among the unlucky ones. This may affect the relations between the community and the project and may affect the successful completion of the project. The impact is thus qualified as **high negative**.

Mitigation measures

- Clear, precise and well defined employment policy and transparent procedures will be required to explain the situation, avoid conflicts and minimize expectations.

- Develop a communication strategy between the project and the rest of the stakeholders for purposes of fostering continuous communication and feedback to all parties and minimizing expectations.
- Recruitment of local people for the less specialized activities, wherever possible.
- Encourage sub-contractors and suppliers to priorities employment of locals wherever possible.
- Since employment opportunities will be limited, other measures like enhancement of community infrastructure should be considered.

- **Increase in price of commodities**

There will be an increase in the prices of basic goods like soap, sugar, salt, and paraffin among others due to their increased demand. From socio-economic survey, the average income of the households in Bigasha project was found to be about UGX 250,000 per month for male headed households while for female headed house hold it is about UGX 80,000. Workers on the project may earn much more thus having more buying power. Therefore the local people may not afford to purchase some of the things that they presently can afford. In addition, business speculators might hike the prices with a perception that workers are wealthier and have more money to spend than the local people. The impact is expected to be **medium negative** as it will be short term.

- **Increase in disease incidences**

From the interviews conducted within the project area, malaria was reported as the most common disease. Other diseases included water related diseases like typhoid and Sexually Transmitted diseases (STDs) like HIV/AIDS. According to Isingiro District Development Plan (2011-2016), the HIV/AIDS prevalence rate in the district is at 3% which is lower than the national average of 6.4%.

During construction, malaria and HIV/AIDS prevalence as well as other sexually transmitted infections are likely to increase as already indicated under population influx. This impact is likely to be long term as HIV impacts may be noticed after some years and will continue even during the construction phase. In addition, during construction, pools of stagnant water in the excavated area are expected especially during the rainy season and may act as breeding places for mosquitoes. The fact that the impact of increased HIV/AIDS and other diseases like malaria can lead to death and the effects are long term as they continue even in the operation phase qualifies the magnitude to be **high negative.**

Mitigation measures

- The project should put in place strategies to control malaria such as distributing mosquito nets and sensitization of communities especially the affected villages of Kagando, Nyakabingo and Katyazo. This should be done through health centers and NGOs operating in the area.
- There should be a sensitization program targeting the workers and the communities regarding the spread of Sexually Transmitted Diseases (STDs) including HIV/AIDS spearheaded by NGOs specialized in such work like The AIDS Support Organization.
- Ngarama HC IV and Kashumba HC III should be strengthened by the project to carry out HIV/AIDS voluntary testing and counselling.
- HIV/AIDs awareness campaigns in schools and communities should be undertaken periodically.
- Project workers should be provided with condoms.

- **Pressure on health infrastructure and services**

The influx of people in the project area during the construction phase will stress the already inadequate health infrastructure and services in the area. The baseline findings showed that the health infrastructure and service delivery in the project area were in poor condition and inadequate. In addition, Ngarama and Kashumba health centre III are characterized by inadequate drugs and inadequate personnel, lack of electricity among others. With an increase in population in the area, the health facilities will be overwhelmed and may not be able to offer adequate services to this population. However the population will reduce after construction. Therefore, the impact of the project on the health infrastructure and services is expected to be **medium negative.**

Mitigation measures

- Where possible the project should support Ngarama Health IV and Kashumba Health III which are nearer to the project with the identified challenges like laboratory equipment and medicine, extension of electricity, improvement of the buildings and others to contain the health challenges for both the community and the workforce.
- The project should plan for additional health infrastructure for its workforce to cater for the increased population.
- Employment opportunities should be extended to the local people to reduce on the influx of people in the area.

- **Pressure on water and sanitation facilities**

The baseline findings indicated that the project area is generally water stressed with insufficient water throughout the year. Findings indicated that safe water coverage stands at 35% at the district level as compared to the national average of 64%.The baseline findings further indicated that the majority of the households had latrines. However, an increase in the population will put pressure on both water and sanitation facilities in the area and may lead to an outbreak of

hygiene related diseases like diarrhoea, cholera among others. The impact is indirect, short term as it will cease after project construction and its extent is medium thus qualifying to be **medium negative.**

Mitigation measures

- Adequate water facilities should be constructed e.g. at the workers' camp and construction site. The community should also be provided with safe water.
- The project should provide additional sanitation facilities to its workers.
- Bins for solid waste and garbage collection should be placed at the workers' camp to ensure that any wastes generated at the site are properly disposed of.
- The local people should be priority for job opportunities.

- **Pressure on fuel wood**

Like many rural societies in the country, wood fuel is the major source of energy for the households in the project area. An increase in population will mean increased demand for wood which will in turn lead to deforestation and its consequences. This impact is long term and will not only affect the local area but the entire region. Although there will be a decrease in population after construction, the effects on the general environment of the area will be high thus the magnitude will be **medium negative.**

Mitigation measures

- Continuous sensitization of the communities about the dangers of deforestation should be carried out.
- Employment opportunities should be extended to the local people to reduce on the influx of people in the area.
- Provision of a centralised canteen to the workers at the workers' camp.

- **Insecurity**

Usually, the influx of new people in a project area comes with all sorts of vices including stealing project materials and equipment. Materials prone to theft include cement, fuel and equipment. Theft of materials will lead to an increase in the project cost and project delays. Although the impact is reversible and short term as it is likely to occur in the construction phase only, it will have a great impact on project costs and project schedule thus qualifying it to be **medium negative**.

Mitigation measures

- Employ private security guards at each construction site.
- The developer and Contractor should collaborate with the community and encourage community policing in order to identify the culprits and to ensure safety of project

materials.

- The Contractor should put in place an internal control system to curb cases of theft of materials.
- Collaborate with the local security in the area.

- **Occupational Health and Safety**

The project will require skilled, semi-skilled and unskilled workforce. However, given the nature of the project, the workforce is likely to be made up of more semi-skilled and unskilled labourers compared to the skilled workers. Usually, the unskilled and semi-skilled workers are recruited locally and may never have been exposed to projects of such nature, and therefore may not be aware of the safe operating procedures while undertaking their assignments. It is likely that the limited exposure might increase the likelihood of occurrence of occupational accidents. Likely occupational hazards include; exposure to physical hazards from use of heavy equipment , trip and fall hazards, exposure to dust and noise, exposure to falling objects, exposure to electrical hazards from the use of tools and machinery and increased risk of accidents as a result of blasting among others. Although, it has far reaching consequences if not properly handled, it can be mitigated and will be short term mainly during construction thus it is regarded as **medium negative.**

Mitigation measures

- Training of workers in safe operating procedures.
- Provision of appropriate Personal Protective Equipment (e.g. helmets, overalls, nose masks, ear muffs, etc.).
- Labelling of danger zones and hazardous materials.
- Restrictions/control of access to potential danger zones or usage of hazardous chemicals.
- Instituting, enforcing and disseminating procedures to be followed when blasting.

- **Community Health and Safety**

During construction of the dam, it is likely that onlookers will be attracted to the construction sites curious to see the different activities going on. Furthermore transportation of materials may result into accidents especially in this area where vehicles have been rare. The local people may be affected in the process. There is high probability that this can happen although it is short term and mitigable. Therefore the impact is expected to be **medium negative.**

Mitigation measures

- Together with local authorities, enforce restrictions on unnecessary entry into the project site or even the protected zone.
- Instituting speed limits on project vehicles,
- Putting warning signs, etc.
- Sensitization of the communities

- **Increased traffic and its associated consequences**

During the construction phase, there will be an increase in the traffic in terms of humans and vehicles as a result of movement of materials and manpower. If the traffic is not handled properly, it could lead to accidents, destruction of property and noise and air pollution among others. The magnitude of the impact is estimated to be **medium negative** as it will be short term and mitigable mainly in the construction phase and its extent will be local.

Mitigation measures

- Existing access roads should be widened and used wherever possible for transportation of both personnel and materials.
- Skilled and properly trained drivers should be employed.
- Safe speed limits should be instituted and enforced.
- Warning signs in busy places like trading centres should be installed.
- Flag men where necessary should be employed by the project in order to control traffic.

- **Conflicts**

With new people coming into the area, it is likely that there will be an increase in conflicts in the area. This could be as a result of people of different backgrounds settling in the area. Learning and complying with the values and norms of the area might take some time and the process might come along with clashes and conflicts between the local people and the new comers. The magnitude of the impact is expected to be **medium negative** due to the fact that it will be short term in nature since most people will go back to where they came from after construction works are complete.

Mitigation

- Local labour should be given priority for employment as this will solve many of the problems associated with influx of people.
- There should be sensitization of the workers in cultural values and norms of the area.
- Local authorities shall need to be strengthened in order to deal with any cases of indiscipline and conflict brought about by the increased population influx, and any disputes that are likely to ensue;

- **Loss of Land, change of tenure and land use**

The project and its associated sub projects will require a total of 405 acres (164 Ha) of land and about 40 households will directly be affected. This land will need to be permanently acquired from individuals and some more land will be used temporarily like for campsite and other temporal uses. This will lead to change in tenure and ownership. Loss of land will lead to loss of grazing land, loss of crops like bananas and loss of medicinal plants. The current land use will change permanently to a reservoir area. The impact of loss of land will be permanent,

irreversible, and direct and will affect people's livelihoods. The impact of the magnitude is thus **high negative.**

Mitigation measures

- Project Affected people should be fairly compensated.
- Provide alternative land for PAPs.
- Livelihood restoration programs should be put in place to ensure that PAPs livelihoods are restored.

- **Loss of residential and other structures/Resettlement**

Construction of the reservoir will displace about 2 households. Resettlement is expected to generate mainly three types of social impacts such as, psychological stress, loss of social networks and loss of livelihoods or business opportunities. Other project components may also displace a number of people with agricultural land residence, business and other structures. Although the impact of resettlement is long term and irreversible, it will not affect many people as the land mainly comprises of grazing and cultivation land thus the impact is qualified as **medium negative.**

Mitigation measures

- A Preliminary RAP is being prepared alongside this ESIA report but a comprehensive Compensation and Resettlement Action Plan will be required and should be prepared in accordance with the national laws and the World Bank guidelines
- All households losing any structures should be compensated fairly and adequately.
- In-kind compensation for the households should be considered as option by the implementing agency.
- Livelihood restoration programs should be put in place to ensure that PAPs' livelihoods are restored.

- **Impact on vulnerable groups**

In the project area, there are several categories of vulnerable people including orphans, female headed households (Hh), widows, the elderly, and People with Disabilities. From socio-economic surveys, 12.4% of the household heads were 65+years while 9.7% were widowed. 12.4% of interviewed household did not own land, 23.3% Hhs had an orphan in their home while 12.7% Hhs had a person with disability in their home. These groups are very vulnerable. Construction of the dam will lead to a reduction in farm land and loss of livelihoods for these households thereby making their already vulnerable situation worse. Although the impact is expected to be long term and irreversible, the fact that strategies can be put in place to make the lives of vulnerable groups better as compared to the pre-project status qualifies the impact to be **medium negative**.

Mitigation measures

- The affected households should be compensated fairly and adequately.
- Livelihood restoration strategies should be extended to the vulnerable groups and their income levels monitored closely during the implementation process.
- Vulnerable households should be considered for employment opportunities.

- **Impact on gender**

- Women are likely to be least favoured in the job provision. This is because of the nature of jobs available during construction are perceived to be done by mainly men.
- There is likely to be developments of relationships between workers and the women of the area that are either engaged or already married, this can result into marriage break ups.
- Immorality could also result especially with the young girls of the area in efforts to gain favour for employment opportunities, this can result into spread of sexually transmitted diseases such as HIV/AIDS. Impact on HIV will be long-term as its spread and associated impacts will continue even after construction.

In general therefore, the impact on gender is expected to high negative as it is long-term and spreads beyond project area.

Mitigation

- Jobs should be equitably distributed to both women and men as long as one has the qualification rather than basing on gender to allocate jobs.
- Information dissemination about dangers of HIV/AIDS to the community should be done all throughout the period of the project. The messages should be passed on using the locally understood language for better understanding.
- The parents should advice their girls against indulging in any kind of relationships with the workers.

7.2.2.2 Biophysical environment

- **Increased Risk to Soil Erosion**

Generally the project site including some of the hill slopes is well vegetated and soil erosion is not a problem at the moment. However during construction, there is a possibility that soil erosion may occur. Due to the hilly and steep terrain construction activities may destabilize the soil cover triggering soil erosion. Activities will include excavations, murram mining, access roads construction, construction of campsite etc. There is a probability that there will be soil erosion as some areas will become bare during this period, but the impact is short time since it is expected only during construction and it will only affect those areas where construction and associated activities will take place (localized impact). The impact is expected be **low to medium negative.**

Mitigation

- Plan excavation and grading activities to be conducted during the dry season where possible
- After construction, vegetation should be planted in areas where vegetation was removed including area where soil spoil was previously dumped.
- General catchment protection through vegetation and tree planting form part of the project
- Loose soils should always be removed from worksite.
- Proper drainage should be put in place along access roads, murram pits and all other cut areas to avoid water seepage into the ground making slopes vulnerable to landslides.

- **Impact on Aesthetics**

There are some negative impact of the scenic nature of the surrounding landscape, mainly due to excavations and construction works. Vegetation will be cleared along the project areas and the constructions will introduce a visual obstruction to the surrounding areas. Burrow pits are most times left open, soil spoil heaped at different locations and other poor construction practices; they all affect the beauty of the areas where such projects are located. However this will also be short term but there is high probability that will happen although it will affect a few areas (localized impact) where such activities will take place. Therefore the negative impact is expected to be significant but of **medium magnitude**.

Mitigation

- Restoration of excavated areas and other open areas like those at murram pits should be carried out as soon as construction is completed. This should include covering of pits, levelling, grassing of bare areas and planting of trees.
- Tree planting in the project area should be encouraged as part of catchment protection. This also brings out the natural beauty of the surroundings.
- The visual impact on the landscape can also be improved by keeping a neat and tidy construction phase

- **Solid Waste Generation (including spoil material and Stripped Vegetation)**

During levelling and construction of the road, camp sites and stores, vegetation will be stripped and the overburden will create need for disposal. Presently the two access roads to the dam site at Bigasha are poor and narrow. These will need to be expanded which will generate waste a lot of waste. Excavations on at the dam site to give way for construction of the foundation will also generate waste. More soil spoil will be generated at murram burrow areas.

Generation of spoil material will stop after construction. It is expected therefore that the impact will be short term and mitigable thus magnitude of impact is expected to be **medium negative.**

Camp sites and worksites are also major sources of waste. They include metal scrap/ bars, waste oil, tyres, plastics, food waste, empty cement bags, human waste, paper and others. These are usually a source of soil pollution, a health risk and others. Further waste will be generated at the camp site from sanitation areas. This will include; waste water and night soil. Waste from this source is not expected to be so much as few workers are expected.

However, this impact is short to medium term and can be mitigated. Thus the impact is expected to be **medium negative**. Campsite locations are yet to be identified.

Mitigation measures

- Top soil should be kept and used in gardens, other overburden or spoil material should be used to fill depressions that are not in wetlands. Any abandoned borrow areas can also be filled if identified.
- Pit latrine shall be constructed at the camp site if camp site is located at an area with low water table while a mobile toilet could be used at the quarry and murram burrow area. Any other top soil remaining should be stored and used in landscaping for grassing and tree planting.
- Owners of areas identified and borrow pits for filling will need to be consulted so as to have a mutual consent before any dumping and the type and/or nature of spoils can start.
- Generally issues related to waste disposal will have to be implemented following the regulations stipulated in the National Environment (Waste Management) Regulations 1999.
- Waste will have to be sorted into degradable and non-degradable metals etc.
- Dust bins shall be placed at different locations especially in the camp sites and properly labelled. The degradable shall be composted and given to farmers as manure. Metal cuttings and cans shall be sold off to the metal vendors in Isingiro town who will take them to Mbarara for subsequent transmission to steel mills in the country. The non-degradable especially plastic shall be stored and taken for recycling in Mbarara town.
- **Waste Management hierarchy** (3 or 4Rs – reduce, reuse, recycle (and recover) which is an acceptable guide for prioritizing waste management practices shall be considered (**Figure 7-1**).
- A sub-contractor responsible for waste should be procured but given guidelines for managing the waste.

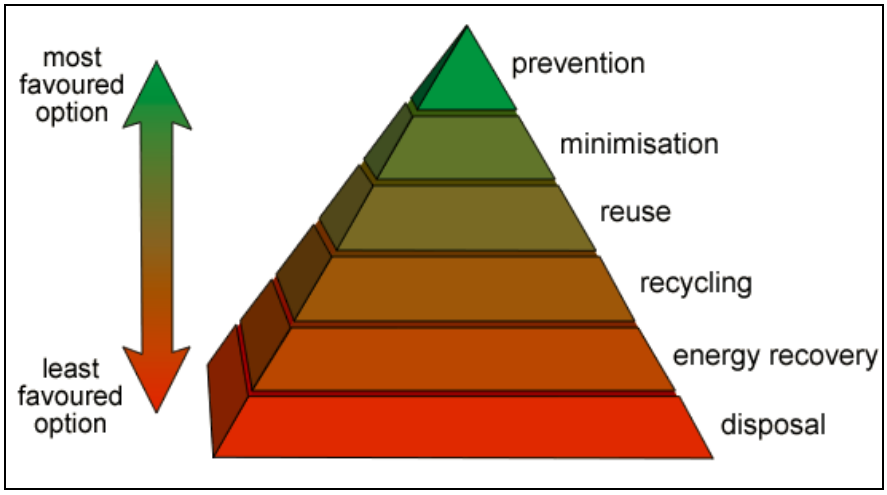

Figure 7-1: Waste Management hierarchy
(Source: http/encrypted.google.com)

- **Oil spill and subsequent contamination of soil**

It is expected that during oil storage accidental spillages are likely to occur especially during loading and off-loading at the storage sites and/or campsites. This is more so during vehicle maintenance and repair at the park yards where these vehicles will be parked.
The fuel related wastes are also envisaged to become a menace both at the camp sites and at the construction sites and/or park yards. This results from poor disposal techniques and occasionally burning causing contamination of the adjacent environment.

Mitigation

- In cases of spillage drums should be placed in areas that can be easily cleaned and disposed to designated places.
- An oil interceptor should be put in place at the work shop area so as to contain any oil spills.
- Drums used for oil storage should be placed on top of wooden structures during loading and offloading and these can be kept well for further use to minimize the extent of spilling oil in several locations.
- All records of major spillages should be well kept to enable proper monitoring.

- **Negative Impacts of noise and vibrations**

Noise pollution in the Bigasha dam site area will occur mainly during Construction Phase although there will be some noise during the preparatory phase. The construction phase will involve excavations, blasting, and clearance of vegetation within the reservoir burrowing, quarrying and large scale transportation of materials. This phase will have very significant negative impacts. It will cause physical removal and disturbance of plants and animals; it will destroy habitats, burrows and nests as well as feeding and breeding grounds. Hence many animals will have to flee to safer grounds. These are considered transitory impacts but could have medium term impacts.

Noise during project activity in the Bigasha dam site area will be generated from the following sources:

i) Transport vehicles
ii) Vibrations from blasting and excavations
iii) Noise from camps

Noise impact evaluation can be estimated using two parameters as follows:
a) The extent of the noise impact expressed as extent of noise effect in space which refers to the distance or an area over which the noise effect is felt. Three levels of extent are recognized:

- Regional extent when an impact affects a large geographic area reaching a significant distance from the project site, or when it is experienced by the entire population or by a significant portion of the population in the study area;
- Local extent when the impact affects a relatively restricted area located within, near, or at a limited distance from the project site; or when it is experienced by a limited portion of the population in the study area; and
- Site-Specific extent when the impact affects only a very restricted area in the proximity of the project site; or is experienced by only a small number of individuals in the study area.

b) The Duration of the impact as the period of time the impacts last during project implementation and after.

Duration can therefore be:

- Long term if the effects are experienced continuously for the life of the activity or after if the impact is irreversible;
- Medium term if the impact occurs over a period of time, but less than the duration of the life of the activity;
- Short term if impact is short for example occurring during construction, start-up or over a single season.

In terms of noise intensity from these sources, noise will be maximum or highest during dam site clearing and construction. But this noise will be transitory, in other words, it will be temporary in that after construction phase noise intensity from transport vehicles, blasting, excavations and camps will disappear or be minimal at worst. The operation of the dam is not expected to be a significant source of noise. The variables of impact extent, duration and impact intensity, determine the significance of an impact on a given environmental component. Essentially, in the Bigasha dam site, the intensity of the magnitude of impact of noise on the percentage of the population seriously affected by the noise made by the project will have limited site-specific spatial extent given that human population in the project area is near non-existent. Further, this impact will be highly limited duration period since the sources of noises themselves are transitory

in nature. This would render noise pollution to be evaluated as **low negative** in qualitative and quantitative terms and can therefore be considered as negligible and it could be excluded from further analysis. However some mitigation has been proposed.

Construction of a dam can use heavy machines which may cause noise and vibration and crack nearby houses. Fortunately, the dam site is far from community structures so the impact is very minimal or negligible. Vibrations can be mitigated through informing nearby homesteads in advance. The following mitigation measures are suggested to mitigate noise pollution:

Mitigation Measures for Noise Pollution

- Formulation of a Grievance Management Plan within the Environmental and Social Management Plan to handle complaints on noise;
- Limiting construction vehicles to travel during certain hours of the day;
- Limiting the speed of construction and operational vehicles;
- Limiting blasting to acceptable times during the day;
- Limiting social activities of camps like discos to certain acceptable times e.g. up to midnight.

- **Negative Impacts of Air pollution**

Air quality in the Bigasha project area can be evaluated in terms of aerial dust particulate matter and toxic gases like carbon monoxide, carbon dioxide and other acidic gases. Air pollution in the Bigasha dam site will occur mainly during the construction phase of the project and it will originate from the following sources:

- Transport vehicles and machinery used for construction and transport of workers emitting toxic gases such as CO_2, CO, NOx, SO_2 and fine particulate matter;
- Excavation works during the construction;
- Excavations at quarries and borrow pits;
- Fumes and odours from operation of the plant and machinery;
- Green House Gas emissions (Carbon dioxide and methane) released by decay of inundated biomass at the bottom of the reservoir.

There will be maximum or highest potential for air pollution during dam site clearing and construction. But this will be transitory, in other words, it will be temporary in that after construction phase intensity of air pollution from transport vehicles, blasting, excavations and quarries will disappear or be minimal at worst. The operation of the dam is not expected to be a significant source of air pollution. Both during the preparatory phase and during construction and operation of the dam, air pollution can be minimized through mitigation measures as described below. This renders air pollution to be evaluated as **medium negative** in qualitative terms and can therefore be considered as negligible and it could be excluded from further analysis.

Mitigation measures

The major effect on air quality during construction will be increase in dust during transportation of materials and disposal by vehicles. Murram extraction and stone quarrying will also produce a lot of dust because of the earth movements and blasting. The following mitigation measures are suggested to control air pollution during the construction and operational phases of the project:

Mitigation Measures for Air Pollution

- Dust control management plan in order to prevent dust emissions from movement and circulation of construction machinery and vehicles on unpaved roads;
- Formulation of transportation and traffic management plan to prevent risk of accident related to increased traffic due to the implementation of the project;
- Ensuring project vehicles are in top conditions and that they are properly and regularly maintained and serviced;
- Watering unpaved roads and trails during vehicle movements;
- Watering of roads that go through trading and rural growth centers in the countryside;
- All trucks carrying the granular material should be covered;
- Vegetation around the proposed campsite should be conserved;
- Providing dust respirators with filters to employees exposed to dust; and
- Instituting and enforcing speed controls through speed limits and humps on roads and trails used by project vehicles.
- Provision of dust respirators with filters to employees exposed to dust

- **Loss of vegetation**

This impact will result from vegetation clearing to give way for construction of the dam, campsite, and access roads and trampling by the heavy machines as they try to manoeuvre in different areas. This will cause disturbance of habitats and may affect species richness and the persistence is transitory. This may lead to loss of wooded grass land and fauna micro habitats. As already discussed under baseline, Bigasha dam area is heavily vegetated with grass, shrubs and scattered short trees especially acacia all of which are of no conservation value. However removal of vegetation will increase degradation and the risk of soil erosion which at present is not a problem around the area. There is a high probability that this impact will happen but it is localised, mitigable and is short term as some of these areas will recover after construction. Therefore it is expected that this impact will be **medium negative**.

Mitigation

- Constructor should make sure that vegetation clearing should be limited to those areas that are required; re-vegetation should be carried out as soon as activities in that area are completed. It should not wait when construction is complete and the works should be

undertaken under the guidance of the Contractor's Environmental Specialists.

- The adjacent communities be encouraged to plant trees on some pieces of their land; and
- As a contribution towards addressing global warming, the project could set aside some funds for tree planting through community based organisations.
- In the approach Road Sections, clearly mark out the areas to be cleared of vegetation before clearing commences; according to the standard procedures and specifications and best practices regarding such civil works

- **Increased need for forest resources**

A number of people are expected to be attracted to this area in search of opportunities. Some of these people are likely to stay in the area and acquire land even after construction. These may later attract their friends and relatives to come. This will increase a need for forest resources like charcoal and firewood. Although the project area is not yet faced with deforestation and lack of firewood the project is likely to trigger this. This impact is likely to affect the wooded plants like acacia in the surrounding areas. Although this impact will start small it will increase with time and may go beyond the project area. This impact is also long term and thus the magnitude of impact is regarded as **medium negative.**

Mitigation

- The project can provide tree seedlings to the communities during planning period so that by the time of construction, the trees are almost mature and can be used to reduce on the likely pressure to the conservation areas.
- Local people within the affected community should be given priority especially for casual labour to reduce on influx of people to the project area thus reducing on the pressure to forest resources.

- **Impacts on Mammals**

As indicated in the baseline, mammal species recorded in the project area were Mammals recorded included: vervet monkey *(Chlorocebus pygerythrus),* Marsh Mangoose *Atilax paludinosus and* a fruit bat (*Epomophorus* sp), some rodents and bats. Uganda has 330 mammal species 45 of which are of conservation significance (7 are endangered, 21 are vulnerable, and 17 are near-threatened) (IUCN 2008. None of the mammal species recorded in the area is threatened or near-threatened.

During construction, these mammals that have inhabited the woodlands of Bigasha valley will be affected by vegetation clearing and disturbance from the workers. Therefore some animals will migrate to other areas while others may be killed in the process. The impact on mammals will be long-term as the mammals will not come back to the area. However the impact of the project on the ecology and conservation of mammals will be **medium negative** because none of the

mammals recorded were of major conservation importance.

- **Impacts on Birds**

The recorded bird species with a restricted range in East African region are Bare-faced Go-away-bird *Corythaixoides personata*, Golden-backed Weaver *Ploceus jacksoni* and Spot-flanked Barbet *Tricholaema lachrymose.* During construction the birds will be disturbed through vegetation clearing, and construction workers moving around in the bushes. Disturbance will mainly be at the dam site which is a small area and will be short term. Though with a restricted range in the East African region, the three bird species have a relatively large global range (720,000 km^2, 525,000 km^2 and 1,270,000 km^2 respectively). Their global populations are currently unknown but their population trends appear to be stable (BirdLife International 2012a). Although short term and affecting a small area, the impact of the project on the ecology and conservation of these species during this phase will be **medium negative** as it will affect globally threatened Crested Crane.

- **Impact on Protected Area (PA)**

Already indicated, the nearest PA to the project area is Sango Bay Forest Reserve/Important Bird Area (UG013) and is important for the conservation of the papyrus endemic globally near-threatened Papyrus Gonolek *Laniarius mufumbiri*, globally Vulnerable Blue Swallow *Hirundo atrocaerulea* (intra-African migratory species) and the globally Vulnerable African Elephant *Loxodonta africana* .

The Papyrus Gonolek being a papyrus endemic, it cannot leave the papyrus swamps of the Sango bay area, thus it will not be impacted at all by the project activities. The migratory Blue Swallow is in Uganda between April to August and migrates to southern Africa to breed between September to March. There are chances that the Blue Swallows can transit through the project area but the impact of the project on the species is **minimal.** The African elephant with a very big home range 14-3,120 km^2 would reach the project area from Sango Bay if there were wildlife corridors or if Bigasha and Sango Bay were continuous as protected areas. Since there are settlements, cultivations and other forms of land use between Sango Bay and Bigasha, the project activities will **not impact on the ecology and conservation** of the African elephant populations of Sango Bay area.

- **Potential negative impacts of the camp site**

Most of impacts of campsites related to influx of people, diseases and HIV and waste generation have already been discussed in the earlier sections on impacts. Only brief discussion especially related to the location will be handled in this section.

Approximately 0.4 Km^2 of land will be required for the camp site and this will lead to loss of grazing land. A lot of goats and cattle graze in the area. Putting a camp in this area where vehicles are rare will bring in heavy traffic leading to accidents involving people and animals. The

banana plantation in the neighbourhood may be affected by workers. Noise is expected to be generated by the different activities at the camp site including the movement of machinery. Noise will mainly affect only a few households (2) in the vicinity of the camp site.

There may also be visual impacts resulting from landscape degradation as well damage to cultural heritage sites uncovered by accident. Liquid wastes and solid wastes will be generated at the camp site, some plants animals will be destroyed as well as nesting grounds for birds. A few camp followers expected Overall impact resulting from camp site establishment are regarded as **medium negative** as they only last up to end of construction (short term), will affect a small area and few people (localised) and are mitigable.

Mitigation measures

- The owner who loses land will be adequately compensated;
- Noise can be mitigated by control measures and using national standards like restricting night activities e.g. discos, bars, speed of vehicles;
- Restoration of the land to its former state through grassing and planting trees; It is also recommended that the site be selected in consultation with the local leaders and the communities so that after consultation, the structures are used by the community as school or other structure for social gatherings. This reduces cost on land acquisition and rehabilitation
- Proper drainage at the camp site to avoid liquids finding its way to the nearest homesteads and their gardens;
- Consultation with the local population must be conducted to make sure that there is no sacred site;
- Proper control and management of used oils and greases;
- Proper disposal of solid wastes through dump pits;
- Removal of all garbage, derelict materials and broken down machinery and metals;
- Contractor to put in place better health services, better water supply, tight control and security mechanisms;
- Demobilize work camp, equipment and staff, taking care to prevent adverse impact on the environment.

- **Potential negative impacts of the quarrying activity**

Approximately 2 km² of land will be required for the quarry site and this will lead to loss of grazing for the owner. Semi-permanent structure and other temporary structures found between about 0.5km-1km away from the quarry will be affected. It is expected that there will be stone blasting at this source during the construction phase of the project. This may bring about psychological torture to the people as they may have never experienced this kind of noise of before. Accidents may arise as a result of the flying stones that may cause damage to the neighbouring structures, banana plantations or to any passer-by. A lot dust from crushing plant is also expected. This impact is expected to be **medium negative** as most homesteads are not

very close and probability of happening is medium and also impacts will cease after construction. Given the location of the source of the stones and aggregates, only a few households will be affected and the impact is mitigable;

There will be stockpiles of rock and earth materials, ponding and accumulation of still water, Visual impacts through excavations and a few animals may be killed through road accidents and some plants affected especially through vehicle manoeuvres as they load stones. This impact is also expected to be short term, localised and mitigable.

Mitigation Measures

- Separate Environmental Assessments (EA) for the proposed quarry and other alternatives should be carried out as required (by Environment Act Cap 153) before quarrying activities start to ensure that community concerns are identified and properly addressed
- All requirements for the approval of earthworks and drilling have been met;
- Areas that will be identified for quarrying must be clearly identified with tape and survey markers and fenced off;
- The owner who loses land will be adequately compensated;
- Accidents: The contractor should carry out a structural baseline survey for all structures in the vicinity of the blasting area so as to monitor and measure the magnitude of damages in case of any accidents;
- Institute speed limit for vehicles ferrying aggregates
- Consultation with the local population must be conducted to make sure that there is no sacred site;
- The contractor should implement a clear time table for blasting and this should be distributed to the local people in addition to continuous sensitization;
- Restoration of the land to its former state through back filling, grassing and planting trees;
- Demobilize work equipment and staff, taking care to prevent adverse impact on the environment.

- **Potential negative impacts of material (soils and clay) mining and transportation**

Approximately 3-4 km² of land will be required for sourcing soils and clay and this will lead to loss of grazing for the owner.

There are some cattle watering points and crushes for spraying cattle within the proposed area which will be destroyed by material mining activities. There are also some banana plantations in the neighbourhood of this area which may also be affected. Stockpiles of rock and earth materials will be a source of pollution. Digging and excavation will upset the drainage pattern in the area leading ponding and accumulation of water. Excavation will also have visual impacts resulting from landscape degradation and may expose some cultural artefacts as well as

increasing soil erosion. The existing access may also need improvement as traffic will increase. It is also envisaged that transportation of materials will result into accidents on people and cattle as well as causing air pollution through release of dust. Impact on flora and fauna for the project area has already been discussed in the earlier sections

The overall impact resulting from material mining and transportation is likely to be of **medium magnitude** because most impacts will be short term, localised in one area and mitigable. Even the land will be for temporary use and will revert to the owners after construction and rehabilitation.

- **Mitigation**
- All requirements for the approval of earthworks should be met;
- Proper drainage to be done all round the pits and burrows to avoid soil erosion;
- Removal of all garbage, derelict materials and broken down machinery and materials;
- Restoration of the land to its former state through backfilling, grassing and planting trees
- Owners of the property like temporary land to be used for access, crushes, crops, etc. should be properly valued and compensated by the contractor.
- Non-active areas of the borrow pits should be landscaped and re-vegetated as soon as possible to avoid erosion and stagnant water
- The mining of materials should be planned so that overburden and top soil is used in re-development
- District Environmental Officers should be involved in sensitizing borrow pit owners about their obligations in implementing sound environmental management measures.
- Agreements between the contractor and borrow pit owners should clearly indicate the contractors obligations of sound environment management
- Access roads to the borrow areas should be maintained and dust minimized by regular watering of the road in dry seasons

- **Potential negative impacts of Irrigation activities**

- Houses within the irrigation area will not be affected; they will remain except if a canal passes through it which is not likely. About 10% of the land to be irrigated (31.2Ha) will be used for wayleave for canals. Change in land use from grazing to crop farming and possibly aquaculture. This will be **low negative** as more land will be irrigated and grown with fodder and forage crops for cattle. A
- Reduction of agricultural land through digging of canals. However, more land will be opened up through irrigation;
- Destruction of crops. This is **low negative** as it will be limited and could be done when crops have been harvested;
- Possibility of increase in water borne diseases and malaria;
- Some plants will be destroyed but this is **low negative** as the area is small;
- Some animals including Small Mammals, Reptiles and Amphibia will be killed and some will

be forced out of the area but this is **low negative** as the area is small and many animals can migrate and escape;

- There will be loss of nesting, foraging and feeding grounds for birds but this is **low negative** as the birds can migrate;
- Destruction of cattle watering points and crushes for spraying cattle; This **low negative** as these structures can be compensated and re-located;
- Destruction of banana plantations and other crops. This is **low negative** as the activity is of a short duration and the crops can be compensated;
- There will be stockpiles of earth materials from canals and ponding due to accumulation of still water.
- Digging and excavation will upset the drainage pattern in the area.
- The access roads and bridges will be destroyed. This is **low negatives** as better bridges and feeder roads will be built.
- Damage to cultural heritage sites uncovered by accident- This is **low negative** as any artefacts will be properly taken care of if found.

Mitigation measures

- All requirements for the approval of earthworks and excavations will have to be met;
- The owners of the land and crops will be adequately compensated;
- Trees will be felled selectively;
- Wildlife including birds can migrate to neighbouring areas;
- Restoration of the land to its former state through back filling, grassing and planting trees;
- Proper drainage to be done to avoid soil erosion;
- Provision of mosquito nets,
- Provision of clean portable water for domestic use;
- Removal of all garbage, derelict materials and broken down machinery and materials;
- Demobilize work camps, equipment and staff, taking care to prevent adverse impact on the environment.

- **Impacts related to Water supply infrastructure**

- Change in land use though digging and excavation. This will be **low negative** as it will be short lived and cover small areas;
- Reduction of agricultural land through digging of canals. This is **low negative** as it will be short lived and cover small areas;
- Destruction of crops. This is **low negative** as it will be very limited;
- Some animals including Small Mammals, Reptiles and Amphibia will be killed and some will be forced out of the area but this is **low negative** as the area is small and many animals can migrate and escape;