NILE BASIN INITIATIVE

NILE EQUATORIAL LAKES SUBSIDIARY ACTION PROGRAM

KAGERA RIVER BASIN MANAGEMENT PROJECT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) AND DEVELOPING PRELIMINARY RESETTLEMENT POLICY FRAMEWORKS (RPFs) FOR FOUR (4) PROPOSED SMALL MULTIPURPOSE DAMS AT BIGASHA, BUYONGWE, KARAZI AND TABA-GAKOMEYE IN THE KAGERA RIVER BASIN

Burundi, Rwanda, Uganda and Tanzania

NBI/NELSAP/KAGERA/RFP02/2011

FINAL ENVIRONMENT AND SOCIAL IMPACT ASSESSMENT (ESIA)

KARAZI DAM SITE

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LIST OF ABBREVIATIONS

CBOs – Community Development Organisation
DWST - District Water Sanitation Team
EIA - Environmental Impact Assessment
ESIA – Environment and Social Impact Assessment
ESIS - Environment and Social Impact Statement
ESMP – Environment and Social Management Plan
FWL - Full Water Level
GHG - Green House Gases
HIV – Human Immunodeficiency Virus
KRBMP – Kagera River Basin Management Project
MWL – Maximum Water Level
NEMC – National Environment Management Council
NELSAP- Nile Equatorial Lakes Subsidiary Action Plan
NGOs - Non- Governmental Organisation
RAP - Resettlement Action Plan
RPF- Resettlement Policy Framework
STDs – Sexually Transmitted Diseases
TENESCO- Tanzania Electricity Supply Company
TOR - Terms of Reference
UNFCCC - United Nations Framework Convention on Climate Change

EXECUTIVE SUMMARY

1.0 Introduction

The Kagera River Basin Management Project (KRBMP) objective is to establish a sustainable framework for the joint management of the water resources of the Kagera River Basin and prepare for sustainable development investments, in order to improve the living conditions of the people and to protect the environment. KRBMP and the Tanzania Government selected Karazi dam site for the development of a multipurpose reservoir. The KRBMP identified Newplan Consulting Engineers and Planners to undertake an Independent Environmental and Social Impact Assessment (ESIA) of the Karazi dam site. The purpose of the ESIA study was to assess the technical, social, economic, financial and environmental viability of the multipurpose dam project; evaluate the environmental and social aspects of the multipurpose dam site and prepare a Preliminary Resettlement Policy Frameworks for the dam site. The study involved consultations and data gathering activities at regional, district and community levels. Newplan embarked on the study in earnest in January 2012. The first outcome of the study was the Inception Report which was submitted two months after the start of the study in March 2012. Application for registration of the project was submitted to NEMC. The second outcome of this study was the Interim Report which was also submitted 4 months after start of the study which was in June 2012. The Interim Report was submitted in three volumes namely, the Scoping Report which provided information on environmental and social impact scoping results with the relevant annexes. The Scoping Report further analyzed possible project alternatives and identified any other past, existing or planned projects in the area; the Baseline Report which provided key findings of the baseline environmental and social findings in the dam site. These included data on fauna and flora; fish and invertebrates; hydrology and water quality; community livelihoods; settlements and infrastructure; archaeology and culture; dam safety. The consultation and public participation process invoked was also described. The third volume was the Preliminary Resettlement Action Plan (RAP) for the Karazi dam site.

This now, is the third report (A3 Draft ESIA and RPF Report) which is submitted 8 months after start of the study in accordance with the Terms of Reference. This report provides identified potential positive and negative environmental and social impacts of the project on the social and biophysical environment prior to, during and after infrastructure construction including those of the different project alternatives. The report then proceeds to propose measures that will enhance positive impacts of the project and those that will mitigate, minimize, reduce or eliminate negative impacts of the project. It further provides Environmental Flows, Environmental and Social Management Plan (ESMP) and the Resettlement Policy Framework (RPF) for the Karazi dam with relevant annexes.

The project consists of the following component;

A dam of 9.5m with reservoir storage 9.2km2 which has surface area of about 2.36km2.
Irrigation command area is expected to cover about 523Ha with canals taking up about 6% - for right of way leaving 493Ha as actual area for irrigation. The area stretches for a distance of 18km between the dam and the downstream protection dyke.
A water supply system consists of a treatment plant, 3 main tanks and 14 storage tanks.
It is also proposed that during construction a camp site to accommodate some of the 100 expected workers will be established, burrow areas for material sources will be opened up and a

stone quarry will be established all of them close to the dam site.

2.0 Identified Impacts

Highlights of identified positive and negative impacts, their enhancement and their mitigation measures and institutions responsible for management and mitigation of these impacts are therefore provided below theme by theme.

2.1 Positive Impacts of the action on livelihoods and the socio-economy of the communities

a) Creation of employment opportunities and increase in income

Positive impacts will be associated with the Preparations/Planning and Construction Phase of the project. 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. Local people will be employed mainly as casual workers.

The local communities will further benefit through:

Increased spending of the workforce;
Sale of food stuffs, milk and other basic goods to the workers;
Creation of market for products;
Improvement of incomes and general welfare of the local communities and their families;
Revenue from rent paid by workers.
The magnitude of this impact is expected to be **low positive** as not everyone will benefit from this opportunity at the **Preparations/Planning** stage but its impact will rise at the **Construction** phase as more people will be employed. Further, as a result of opportunities generated by the project in aquaculture, fishing and tourism, there would be a **medium-positive** positive impact during operation.

b) 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. This can be enhanced through training programs for the unskilled and semi-skilled workers.

c) Gender balance

The project will improve women's livelihoods and welfare through direct and indirect employment opportunities. This will lead to greater socializing by women for example the formation of clubs which 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**.

Positive impacts associated with the Operation and Maintenance /Post Construction stage of the project include the following;

d) Improved water supply and sanitation facilities

The construction of the dam will improve the availability of safe water coverage in the area for both domestic and animal use and the communities will benefit in both the dry and wet seasons. Given the major water scarcity especially in the dry season and the fact that many people will benefit from water supply, the impact is expected to be **high positive**.

Enhancement measure will include the following:

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 roles.

e) Provision of employment

During the Operation and Maintenance phase, 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. Thus the impact is estimated to be **low positive**.

f) Tourism potential

The proposed development of Karazi dam will create a small lake which will attract wildlife and birds and other recreational activities including water sports, sport fishing and bird watching. This will be a big tourist attraction. Several recreational and sporting centres may be constructed near the reservoir thereby generating income. Tourism is expected to be long term. Tourism qualifies have a **medium positive** impact.

g) Generation of Hydropower

Although power generation as an option has been dropped by the Feasibility Consultant, hydropower generation would have been expected to benefit the local community for lighting, water supply, agro-based industries, milk processing. This impact will be long term, and thus qualifies as **medium positive** impact.

h) Improved farming through irrigation

The communities practicing farming will benefit from the proposed project as they will be able to practice modern farming through irrigation. Currently, crop farming is mainly rain fed and there are mainly two seasons for farming. The magnitude of this impact is expected to **be high positive.**

i) Accessibility to health services

The improved access roads will improve on accessibility to health services. The impact of accessibility to health services is expected to be medium positive.

j) Improved access roads

Infrastructure such as roads linking trading centers, education and health centers for example local markets and trading centre like Kayanga and Murushaka to other places will be improved. 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. This will bring about development in the two remote sub-wards. The impact is expected to be medium positive.

k) Post construction and operation phase

Positive impacts of the action on fauna will include the following:
The dam will induce more rain and better amenable micro-climate;

The dam will ensure sustainable water supply;
More rain and sustainable water supply will ensure better food security;
Water loving animals, birds, reptiles, and insects from far and wide will be attracted;
Better sustainable water supply will bring in more fish and more aquatic organisms.

i) Mammals

As indicated in the baseline report, none of the mammal species recorded is globally threatened or near-threatened. Thus, the proposed project will not have significant negative impacts on the conservation and survival of these species. The impact of the project on the ecology and conservation status of mammals will, therefore, be **low positive**.

ii) Birds

Fifty seven bird species of birds were recorded the Karazi daam site. These included one globally endangered species (Grey-crowned Crane) and 2 near-threatened (Grey Heron Ardea cinerea, and Woolly-necked Stork Ciconia episcopus), and 3 restricted range species in the East African region (Spot-flanked Barbet Tricholaema lachrymose, Bare-faced go-away-Bird Corythaixoides personata and Black-lored Babbler Turdoides sharpie). Because of their large global range, the impact of the project on the ecology and conservation status of the Grey Heron and the Woolly-necked Storks and other avifauna of Tanzania is expected to be negligible. The Grey Crowned Cranes require mixed wetland-grassland habitats where they nest within or on the edges of wetlands, while foraging in wetlands, nearby grasslands and croplands. 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**.

iii) Amphibians

A total of 12 species of frogs were recorded in the Karazi dam site area. Of the species recorded, none is globally threatened. The project will provide permanent water which will be a better ecosystem for the ecology and conservation of amphibians. The impact of the project activities on all the amphibians species will be **highly positive**.

iv Dragonflies and Butterflies

Nine species of Dragonflies were recorded in the project site as well as fourteen species of butterflies. None of the species of dragonflies and butterflies recorded is globally threatened or near-threatened. Dragonflies and Butterflies love aquatic habitats. Thus the impact of the project on the ecology and conservation of dragonflies and butterflies will be **highly positive**.

v) Fish and Invertebrates

Many fish species occur in the Kagera River Basin where species such as *Barbus acuticeps*, *Marcusenius victoriae* and *Synodontis ruanda* are endangered. With regard to the Invertebrates found in the dam site, none of the Invertebrates species seen are endangered or threatened.

The creation of a new reservoir in the Karazi 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. It would therefore be expected that when the Karazi dam is built, the dam will be 'invaded' by fish species locally found within the Kagera River basin through migration during flooding and through

purposeful physical translocation by people.

There is therefore potential for viable fish production in the Karazi dam when built Fisheries plays an important role in ensuring food security, economic development and poverty alleviation among the local community. 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. The proposed project will therefore have **high positive** impacts on fish and fisheries of the Karazi area.

l) Aquaculture and Fisheries

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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 Karazi 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. The creation of the Karazi reservoir will therefore, have very **high positive** impact on fish survival in the area. It will also have very high positive impact on fisheries, aquaculture as well as on food nutritional capacity of the local communities and offer opportunity for employment.

Strategies to enhance positive impacts on fauna, fish and fisheries

- *Institute a Water Use Committee to oversee fishing activities in the Karazi dam;*
- *Formulate and enforce regulations to control access to the dam and its resources;*
- *Educate the local community about the dam and its resources;*
- *Establish and train a cadre of extension staff to guide, monitor and regulate activity and use of dam water resources in general;*
- *Provide access feeder roads to landings on the dam;*
- *Provide clean fresh water for the communities;*
- *Provide market outlets for Karazi dam products;*
- *Provide good health and sanitation facilities for the communities living in the villages and landings along the dam shores.*
- *Formulate fishing regulations to control access to the lake and fishing ground;*
- *Control fishing gears and methods to avoid destructive methods;*

m) Protected Area (PA)

The nearest PAs to the project site are Biharamulo Game Reserve (13,000,000 ha) and Burigi Game Reserve (22,000,000 ha) that make up the Biharamulo-Burigi which are about 35km from the project area. The central part of the IBA lies between Bunkwe Bay on Lake Victoria in the east and Kagera swamps to the west. The Biharamulo-Burigi IBA is characterized by a series of north–south ridges, separated by drainage lines and rivers flowing north. The lion Panthera leo occurs while the African elephant Loxodonta africana were numerous as recently as 1975, but have suffered from poaching. The African elephant with a very big home range would reach the project area from Biharamulo-Burigi conservation area if there were wildlife corridors. There are settlements, cultivations and other forms of land use between Biharamulo-Burigi conservation

areas. It is unlikely that the elephants can move from Biharamulo-Burigi conservation area to the project area. It is therefore expected that project activities will not impact negatively on the ecology and conservation of the African elephant populations of Biharamulo-Burigi conservation area and the magnitude of impact on wildlife protected areas will be **low positive.**

n) Hydrological impacts

The construction of the proposed dams will result in changes in the flow regime downstream of the dams. The reservoirs will store excess water during the rainy season and spillage will occur when the reservoirs are full. Thereafter the reservoir will fill with water and the inflow flood hydrographs will be modified.(i.e. from inlet, storage and outlet over the spillway). The modification, which will take place, is that the peak of the inflow hydrograph will be reduced (peak attenuated) and the time base of the inflow hydrograph will be stretched such that there is time lag between the time of the peak of the outflow hydrograph and the time of the peak of the inflow hydrograph.

The amount of outflows from the dam storages will depend on both hydraulic conditions such as the height and width of the spillway and operational rules of the dam. Operational rules for the dams will take into account the various uses of water downstream of the dam. This includes water for domestic use, agricultural requirements including irrigation and water requirement for aquatic and environmental health. The most significant impacts for Karazi dam site are: presented below:

The seasonal nature of the stream at which the dam is to be constructed, firm yield of water flow into the reservoir cannot be guaranteed. In some of the years the water available may not be enough to fill in the reservoir. An **environmental flow of 0.135m^3/sec** has been estimated.

The characteristic of the catchment is that it is hilly. This characteristic makes the catchment susceptible to erosion which will cause siltation in the reservoir. It is also likely that the population of livestock in the area is going to increase and this will cause degradation in the catchment which will enhance erosion and thus causing siltation in the reservoir.

2.2 Negative Impacts of the action and their Mitigation

Negative impacts associated with the Preparations Phase/Planning phase of the project will include the following:

a) 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. 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. These can be mitigated through:

Dissemination of 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.

Carrying out continuous community consultations and sensitization throughout the project cycle so that all queries and fears are answered, reduced or eliminated from the public mind.

Negative impacts associated with the Construction Phase of the project will include the following:

b) Influx of people

There will be a temporary increase in population during the construction phase of the project as people look for work. 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 to market their products. The increase in population in the area will come with 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. However, population influx into the project area is temporary and the impact can be considered **medium negative**. This impact can be mitigated through the following:

The Developer in collaboration with the Contractor to prepare a workers recruitment plan;

Local people to be given priority in employment;

Local authorities shall to be strengthened to deal with the influx and the associated increase in crime, insecurity and cases of indiscipline;

Project to plan for an increase and improvement in infrastructure e.g. sanitary facilities, health facilities, and water facilities among others.

c) Unfulfilled community expectations

All people within the project area have high expectation to get jobs when the project is implemented but jobs are limited. Lack of employment is likely to lead to 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**. The following measures are suggested to mitigate these impacts.

Formulate clear, and well defined employment policy and transparent procedures to avoid conflicts and minimize expectations;

Develop a communication strategy between the project and the stakeholders for purposes of fostering continuous communication and feedback to all parties and minimizing expectations;

Prioritize recruitment of local people for less specialized activities.

d) 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. The impact is expected to be **medium negative** as it will be short term.

e) Increase in diseases

During construction, malaria, sexually transmitted diseases (STDs) and HIV/AIDS prevalence are likely to increase due to population influx. This impact is likely to be long term as HIV impacts may be noticed after several 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. This impact can be qualified as **medium negative** and can be mitigated through the following:

The project should put in place strategies to control malaria e.g. distributing mosquito nets and sensitizing communities through health centers and NGOs;

There should be a sensitization program targeting the workers and the communities regarding the spread of (STDs) and HIV/AIDS;

HIV/AIDs awareness campaigns in schools and communities should be undertaken periodically; and

Project workers should be provided with condoms.

f) Pressure on health infrastructure and services

This impact of the project on the health infrastructure and services is expected to be **medium negative** and can be mitigated through the following:

The project to provide support health services in Nyakakika ward, Chabuhora and Kayungu villages with laboratory equipment, medicines, extension of electricity, improvement of the buildings and others to contain the health challenges to 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.

g) Pressure on water and sanitation facilities

This impact is indirect, short term as it will cease after project construction and its extent is medium thus qualifying to be **medium negative**. It can be mitigated through:

Construction of water points at the workers' camp and construction site;.

The community should be provided with safe water points;

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.

h) Pressure on fuel wood

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***. It can be mitigated by Continuous sensitization of the communities about the dangers of deforestation and employment should be extended to the local people to reduce on the influx of people in the area.

i) Theft of project materials

Although this 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 to be **medium negative**. It is to mitigated by employing private security guards at the construction site; the developer and contractor to collaborate with the community and encourage community policing in order to identify the culprits and to ensure safety of project materials; and the contractor to put in place an internal control system to curb cases of theft of materials and to collaborate with the local security in the area.

j) Occupational Health and Safety

Occupational health and safety will be put at risk by employment of semi-skilled and unskilled workforce who will increase chances of occurrence of occupational accidents. This has far reaching consequences and qualifies to be categorized as **medium negative** and can be mitigated by the following:

- *Training of workers in safe operating procedures;*
- *Provision of appropriate Personal Protective Equipment;*
- *Labelling of danger zones and hazardous materials;*
- *Restrictions of access to potential danger zones;*
- *Control usage of hazardous chemicals;*
- *Instituting, enforcing and disseminating procedures to be followed when blasting.*

k) Increased traffic and its associated consequences

The magnitude of this impact is estimated to be **medium negative** as it will be short term mainly in the construction phase and its extent will be local. It can be mitigated through:

- *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 should be employed by the project in order to control traffic.*

l) Conflicts

With new people coming into the area, it is likely that there will be an increase in conflicts in the area. 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. It can be mitigated by:

- *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 cases of indiscipline and conflict.*

m) Loss of Land and change in land use

Implementation of the project will lead to loss of grazing land, loss of crops and loss of medicinal plants. The current land use will change permanently to become 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**. It can be mitigated by

- *Project Affected people should be fairly compensated;*
- *Provide alternative land for PAPs who have lost more than 20% of their land*
- *Livelihood restoration programs should be put in place to ensure that PAPs livelihoods are restored.*

n) Change in land tenure and ownership

The land where the project will be constructed belongs to individuals and after land acquisition it will belong to the Government. The magnitude of the impact is therefore **medium negative** as it is permanent but will affect a small section of the population in the project area.

o) Loss of residential and other structures/Resettlement

Construction of the reservoir will displace some 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**. It can be mitigated through the following measures:

A Compensation and Resettlement Action Plan 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.*

p) Increased risk of soil erosion

Due to the hilly and steep terrain construction activities may destabilize the soil cover triggering soil erosion. It can be concluded that this impact will be **medium negative** and can be mitigated through:

- *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 re-vegetation and tree planting to form part of the project;*
- *Loose soils should 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.*

q) Impact on Aesthetics

These is due to excavations and construction works, open burrow pits, soil spoil heaps at different locations and poor construction practices which all affect the beauty of the areas where such projects are located. This negative impact is expected to be significant but of **medium negative** magnitude. It can be mitigated through:

Restoration of excavated areas and other open areas and murram pits should be carried out as soon as construction is completed;

Restoration to include covering of pits, levelling, grassing of bare areas and planting of trees; and tree planting in the project area should be encouraged as part of catchment protection.

r) Operation and Maintenance /Post Construction stage

Negative impacts include impacts of population increase and impacts of HIV/AIDS and other STDs. These can be mitigated using methods already outlined above. Other risks and negative impacts include:

s) Flooding

This can be caused by poor project designs which may lead to dam breakage and therefore flooding leading to deaths and destruction of property. This impact is mitigable and the probability of its occurrence is minimal. Hence, the magnitude of this impact is **low negative** although its occurrence may have far reaching consequences. Mitigation measures will include:

- *Erection warning signs in case of the dam breaking;*
- *Any destroyed property as a result of dam breakage should be compensated;*
- *There should be coordination of the different institutions in case such an event occurs;*
- *Sensitization of the community of an emergency plan of action in case of a disaster should be done continuously.*

t) Risk of drowning

There is a risk of drowning by both children and adults in the reservoir. Furthermore, domestic animals may also drown in the reservoir while trying to drink from it. Although this risk leads to loss of lives it can be avoided and mitigated thus the magnitude of the impact is considered to be **medium negative** and can be mitigated by fencing off the dam area with live fence and sensitization of communities particularly children and livestock owners. Notices and signs can also be erected at strategic places like schools, health centers and markets. The community should also be sensitised on emergency plans of action in case of disasters.

u) Risk of water borne and insect-borne diseases

There will be a risk of increased water and insect-borne diseases as a result of the reservoir. The water in the reservoir will be stagnant or slow flowing and will act as a breeding ground for mosquitoes. This will increase the prevalence of malaria in the area. The water in the reservoir may also be contaminated by human activities in the vicinity of the dam, thereby leading to water borne diseases like cholera. This impact can be categorized as **medium negative**. It can be mitigated by:

- *Sensitization of communities about the need to boil water before drinking;*

- *Sensitizing communities to constantly sleep under treated mosquito nets;*
- *Distributing treated mosquito nets to communities surrounding the reservoir;*
- *Clearing bushes around the reservoir periodically.*

w) Negative impacts on vegetation

The construction of the Karazi dam will undermine the naturally occurring flooding regime that has been recurring over a very long time and this will affect the ecology of the area. The dam will reduce downstream flooding. This will cause the disappearance of the ecologically important wetland plants in the floodplain below. Further, the reservoir will destroy wooded grassland. The initial filling of the reservoir will flood the existing plant material, leading to the death and decomposition of the carbon-rich plants. The rotting organic matter will release large amounts of carbon into the atmosphere. The decaying plant matter itself will settle to the non-oxygenated bottom of the reservoir, and the un-aerated decomposition will produce methane gas which has negative impacts on the ozone layer. There were no plant species of conservation importance recorded as threatened or endangered in the study area. The plants killed through flooding of the reservoir are found also in other parts of the valley. Thus the impact of the project on the ecology and conservation of pant species in the Karazi dam area will be **low negative**.

Mitigation measures can include clearing all vegetation and woody biomass from the reservoir prior to filling it;

Instituting and enforcing good watershed management practices including aforestation, terracing, and good agricultural practices;

3.0 Waste Management

Wastes are predominantly generated during the construction and operation phases of this project through several ways for example, spillage of contaminants such as hydrocarbons, oils, concrete admixture, solvents and other chemicals, solid and domestic waste from the workers' camps. Waste of different types of about 100,000m^3 is expected to be generated at the campsite.

. Waste in its various forms has capacity to debilitate and derail the project by causing diseases, ill health and thereby raising morbidity and mortality amongst the work force. Hence, there is need to manage, minimize, treat and control waste at all stages of its generation .to avoid its negative impacts on Workers' health and safety is essential to the success of the project The following strategy is recommended to manage waste.

3.1 Management and mitigation strategies to minimize and control wastes

The sponsor of this project namely the Government and the District Local Government will make sure that the Contractor implements procedures and strategies for managing wastes in order to guarantee the safety of the environment and workers at all times. The Contractor will undertake to establish an emergency response plans, train employees on the risks and precautions, to provide employees with suitable protective equipment, to ensure recycling of wastes and waste water.

The Contractor and operators of the dam when built will be required to follow recommended guidelines for waste management. They will also be required to follow set emergency procedures for safeguarding against spills. A monitoring procedure is further recommended to guarantee proper and appropriate management of wastes during construction and operation of the dam project. Furthermore, implementation costs of the Waste Management program are recommended to be absorbed into the over all construction costs of the project.

4.0 Environment and Social Management Plan (ESMP)

The purpose of the Environmental and Social Management Plan (ESMP) is to mitigate and, wherever possible, prevent adverse environmental and social impacts of a project on the communities as well as on the environment. It is also aimed at helping to maximize positive impacts of the project. The ESMP further aims to ensure implementation of mitigation measures whilst identifying the necessary resources and budgets required for its implementation as well as identifying responsibility schedules of various stakeholders who will be involved in its implementation. The ESMP relies heavily on identified positive and negative environmental and social impacts for its proper formulation. The impacts of the project in the Karazi dam site area have been identified.

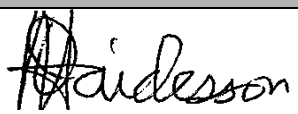
A mitigation plan has been proposed and costs for implementation of mitigation plan estimated. A monitoring plan has also been prepared and the cost estimated. These costs exclude Resettlement costs as they have been included in the Preliminary RAP report. Total cost for ESMP has been estimated at **USD 317,600 (**excluding RAP costs)

The implementation of the Karazi dam ESMP will require the full participation of key players from the Vice President's office-Department of Environment in close collaboration from the Ministry of Agriculture, Food security and Cooperatives; the Ministry of Livestock and Fisheries Development Department; Parastatals like Drilling and Dams Agency and Tanzania Electricity Supply Company.

Irrigation Committee and Water User Associations will be formed for sustainability of the management of the dam. Irrigation policy recognises formation of irrigation committee. Water Resources Act No. 11 of 2009 also recognizes the formation of Water User Associations. Otherwise, dam management for Karazi will mainly have the participation of the Client (Ministry of Water), Basin Water Office, Directorate of Water resources and National Environment Management Council (NEMC).

DECLARATION

The team of Experts who undertook this ESIA is as shown on the table below

SN	Name of Consultant	Position/Area of Expertise	Signature
1	Mr. Ojung Longdarei	Environmental Impact Assessment Expert	

ACKNOWLEDGEMENT

The consultant wishes to acknowledge the following for their invaluable contribution to the success of this ESIA study:

- The National Environmental Management Council for reviewing project brief and the scoping report. This has enabled the consultant to address all pertinent issues that would have been forgotten..
- All stakeholders as listed in Appendix 3 are also acknowledged for their invaluable comments, information and data

Lastly, special appreciation is due to the Nile Basin Initiative for entrusting us with the responsibility of undertaking the ESIA study.

1 INTRODUCTION TO THE STUDY

1.1 PROJECT BACKGROUND

The Nile Basin Initiative (NBI) is a collaborative effort of the Nile riparian countries which aims at developing the River Nile and its resources in an equitable and sustainable way for the benefit of the people of the Nile Basin. The NBI also aims at promoting regional peace and security. The Nile Basin Initiative has a Strategic Action Program which is composed of two complementary programs the first of which is the basin wide Shared Vision Program (SVP), whose mandate is to build confidence and capacity throughout the basin. The second program is the Subsidiary Action Program (SAP), whose objective is to initiate concrete investments in the Eastern Nile (ENSAP) and in the Nile Equatorial Lakes sub-basin (NELSAP). The Kagera Project is one of the three Trans-boundary integrated water resources management and development projects being implemented within the framework of the Nile Equatorial Lakes Subsidiary Action Program (NELSAP) of the Nile Basin Initiative (NBI). The others include the Sio-Malaba-Malakisi and the Mara River Integrated Water Resources Management and Development Projects.

The Kagera River Basin Management Project (KRBMP) objective is to establish a sustainable framework for the joint management of the water resources of the Kagera River Basin and prepare for sustainable development investments, in order to improve the living conditions of the people and to protect the environment. The Kagera River Basin Management Project (KRBMP) has undertaken various activities to improve the planning, management and utilization of the natural resources in the basin, including the completion of the development of the Kagera River Basin Monograph and the Integrated River Basin Management and Development Strategy. Ongoing activities being undertaken by the project and the NELSAP include Development of the Kagera Cooperative Framework Agreement, and Rusumo Hydropower and Multipurpose Project. In addition, the riparian countries have initiated activities related to water storage and these include the Nyabarongo dams in Rwanda; the Kikagati and Nsongezi dams in Uganda; the Kakono dam in Tanzania, and the Bugesera transboundary ecosystem management and development project which will focus among other things on the development of irrigation in the area.

The Kagera River Basin Management Project (KRBMP) has therefore completed a study for identification and rapid assessment of potential small dams for the multipurpose uses of agricultural development, hydropower generation, water supply, fisheries, and other ecosystem functions. The KRBMP study identified Twenty eight new dam sites were identified and assessed including three previously identified dams in Rwanda. From this list, eleven sites were selected based on criteria including those defined by World Bank OP4.37 such as:

i) Equity (targeting one site per country),
ii) Dam height (targeting small dams as),
iii) Reservoir storage capacity and reservoir yield,
iv) Site foundation conditions,
v) Material availability,
vi) Access to proposed sites,
vii) Potential water uses,

viii) Environmental and social considerations, and

ix) Priority of each participating governments.

From the above criteria, KRBMP and the riparian countries selected four dam sites for feasibility and these were Karazi in Tanzania, Bigasha in Uganda, Buyongwe in Burundi and Taba-Gakomeye in Rwanda.

The KRBMP identified Newplan Consulting Engineers and Planners to undertake an Independent Environmental and Social Impact Assessment (ESIA) for the four identified multipurpose dam sites in December 2011. The ESIA study w to assess the technical, social, economic, financial and environmental viability of the four identified multipurpose dam projects. The ESIA was to evaluate independently the environmental and social aspects of the four priority multipurpose dam sites ad prepare Resettlement Policy Frameworks for each dam site in accordance with the relevant World Bank guiding policies and procedures in full cognizance of national policies.

The ESIA study started in earnest in January 2012 after successful negotiations between the KRBMP Project Management Unit and Newplan Consulting Engineers and Planners in December 2011. The ESIA study was to run concurrently with the Feasibility study. Hence, Consultants from Newplan conducted a reconnaissance survey in January 2012 to identify key issues to be investigated further in a deeper study for the development of the multi purpose dams in the areas. The reconnaissance survey covered baseline studies on general environment assessment, hydrology, ecology, fisheries, archaeology, socio-economy, livestock and water demand. The survey results were used to prepare an Inception Report. The Inception Report was presented to key stakeholders in a regional workshop held in Bujumbura, Burundi on 7th February 2012.

Following the **registration of the project by NEMC** (**Appendix 1**) and Client's acceptance of the Inception Report, the Consultant proceeded to undertake baseline studies which started on 20 March 2012 ending on 7th April 2012. The study involved consultations and data gathering activities at regional and district level whilst at dam site level activities involved the following:

i) Carrying out stakeholder consultations through meetings with regional leaders, district leaders, community leaders and grass root village groups;

ii) Carrying out social surveys;

iii) Conducting training of enumerators and data recorders;

iv) Collecting baseline information and data on hydrology, fish, aquaculture, water quality characteristics, aquatic benthic invertebrates, settlements and infrastructure, archaeology and culture, livelihoods and socio-economy.

After the studies the consultant wrote the **Interim Report** which provided preliminary analysis of baseline environmental and social findings covering in particular, the following:

i) Baseline state of the environment;

ii) Identification and analysis of fauna and flora in the dam sites including fish and invertebrates;

iii) Information on the hydrology and water quality characteristics;

iv) Information on settlements and infrastructure;

v) Information on archaeology and culture; and

vi) Information on livelihoods and the socio-economy of the dam sites.

The Consultant also prepared separate reports for **Scoping** which provided information on environmental and social impact scoping results with the relevant annexes for each dam site. In particular, the following information was provided: existing policies, laws and institutions in the riparian countries, the East African Community and International Financial Institutions. The Scoping Report also provided information on Multilateral Environmental Agreements and gave a preliminary identification of impacts and possible mitigation measures. The Scoping Report further analysed possible project alternatives and identified any other past, existing or planned projects in the areas. Likewise, a separate report was prepared on **Preliminary Resettlement Action Plans (RAP)s.**

The TOR originally required the Consultant to prepare **Resettlement Policy Frameworks (RPFs)** for each of the dam sites. However, later, the Client suggested a change where the RPFs were dropped and the Consultant was asked to proceed to prepare **Preliminary Resettlement Action Plans (PRAPS)** for each dam site. These have been prepared.

1.1.1 Scope of the Study

The TOR originally required the Consultant to conduct an Environmental and Social Impact Assessment (ESIA) of the four dam sites one each for Burundi, Rwanda, Tanzania and Uganda and to prepare **Resettlement Policy Frameworks (RPFs)** for each of the dam sites. However, later, the Client suggested a change where the RPFs were dropped and the Consultant was asked to proceed to prepare **Preliminary Resettlement Action Plans (PRAPS)** for the four dam sites, including the Karazi site.

However due to the multipurpose nature of the dams, the dam at Karazi is expected to provide water for Irrigation, water supply, fisheries development. Therefore ESIA has taken into consideration the following;

- Dam and associated reservoir
- Irrigation Scheme
- Water Supply for livestock and domestic use
- Fisheries development

Hydropower development had also been proposed but the Draft Final Feasibility Report indicated that it was not feasible at Karazi dam site. Therefore it has not been included in the assessment.

1.2 OBJECTIVES OF THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

1.2.1 Overall Objective

The Terms of Reference for this study indicated that the objective of the study was to undertake an environmental and social impact assessment of the proposed four multipurpose dams. It was to identify possible positive and negative impacts on the social and biophysical environment prior to, during and after infrastructure construction. The consultancy was also to prepare

Environmental and Social Management Plans (ESMPs) and Resettlement Policy Frameworks (RPFs) for each dam site. The consultancy was to coordinate closely with the Feasibility Study Consultancy of the same project which will run concurrently with the ESIA study.

1.2.2 Specific Objectives

The specific objectives of the study were:

i) To identify, analyze and evaluate the type and extent of likely positive and negative environmental and social impacts with emphasis on significant benefits and negative effects of the project on the existing biophysical and socio-economic environment and to assess the capacity of the institutions responsible for management and mitigation of these impacts;

ii) To develop Environmental and Social Management Plans (ESMPs). The ESMPs will identify mitigation measures that will address the concerns associated with the proposed projects and provide details needed to implement the plan. The ESMPs will include the costs of the mitigation measures and monitoring requirements; a capacity building plan of the defined key stakeholders in the ESMP and the RPF will be also included.

iii) To elaborate and customize to the project the Resettlement Policy Frameworks (RPFs) basing on existing templates for Burundi, Rwanda, Tanzania and Uganda.

1.3 ENVIRONMENTAL ASSESSMENT METHODOLOGIES

1.3.1 Scoping

According to Section 13 (1-2) of the EIA and Audit Regulations 2005, it is a requirement in Tanzania to carry-out a scoping exercise and prepare Terms of Reference (TORs) for the project to be submitted to the Council for approval.

Operational Policies (OP 4.01) Environment Management emphasizes public disclosure. Section 14 & 15 of these procedures require public scoping, consultation and disclosure for category 'A and B' projects. At Karazi project site, there are no settlements or structures within the affected area; however there's a small access road that will be affected by the project and a substantial amount of land with some banana plantations. The project at Karazi has therefore been categorized as "B" project because it has less adverse impacts on the community and the general environment than would be for a category "A" project.

Borrowers are required to first consult the affected public immediately after screening and before 'Terms of Reference' for the environmental assessment are finalized. A summary of the proposed project's objectives, functions and potential impacts are expected to be provided at this stage. Therefore a scoping report has been carried out for this site. The **Terms of Reference were also developed, submitted to NEMC and are attached in Appendix 2.**

This involved identification of potentially significant environmental impacts and/ or eliminating

of insignificant impacts. It is applied to all activities that require full Environmental Impact Study. Scoping methodology is outlined below;

Scoping methodology is outlined below;

i. A review of the proposed project and available documents in the region that are related to this project
ii. Consultations with stakeholders at National level, NELSAP –TAC Members, NELSAP Staff, Local authorities, technical teams in Karagwe District and other stakeholders like the community members to identify potential impacts
iii. A biophysical assessment of the project area by technical specialists to further identify the impacts.
iv. A Draft Scoping Report was produced and presented to stakeholders in a Workshop.

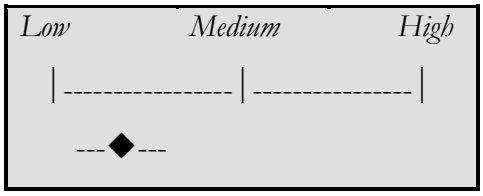
1.3.2 Impact Assessment Methodology

The method for assessment of impacts was adapted from the methods recommended by Hydro-Québec (1990), the World Bank (1991) and by the Canadian Environmental Assessment Agency (2000). These methods assess the Intensity, Extent, and Duration of the anticipated positive or negative impacts of the project and determine the environmental and social value of the components. The three components are then grouped together under one indicator, the Significance of the impact. This indicator provides an overall assessment of the anticipated impacts on a given environmental or social component. The assessment of impacts was on the basis of a three step procedure which makes impact assessment conclusive and its recommendations objective and easier to conceptualize, follow and trace back if desired. The core of the procedure was to combine the 'value' (step 1) of the affected environment and the 'magnitude of impacts' (step 2) to obtain the 'overall impact assessment' (step 3).

Step 1: Base line data was collected using different methodologies as follows:

i. Review of existing information;
ii. Onsite assessments –this involved site visits to` observe what exists in the area covering physical, biological and social –cultural issues;
iii. Focus group discussions;
iv. Public /stakeholder consultations – process is highlighted in this report;
v. Social surveys by use of questionnaires.

Baseline environmental and social conditions was described in detail and valued on a continuous scale from 'low value' to 'high value', which was assigned to the impact zones and the characteristics thereof. This value is related to international, national or local guidelines, standards and evaluations. Values were assigned to elements of the biological environment such as flora and vegetation, aquatic ecosystem etc. The human environment aspects will be taken to have "high value" due to their intrinsic value in addition to others. These are presented below diagrammatically.



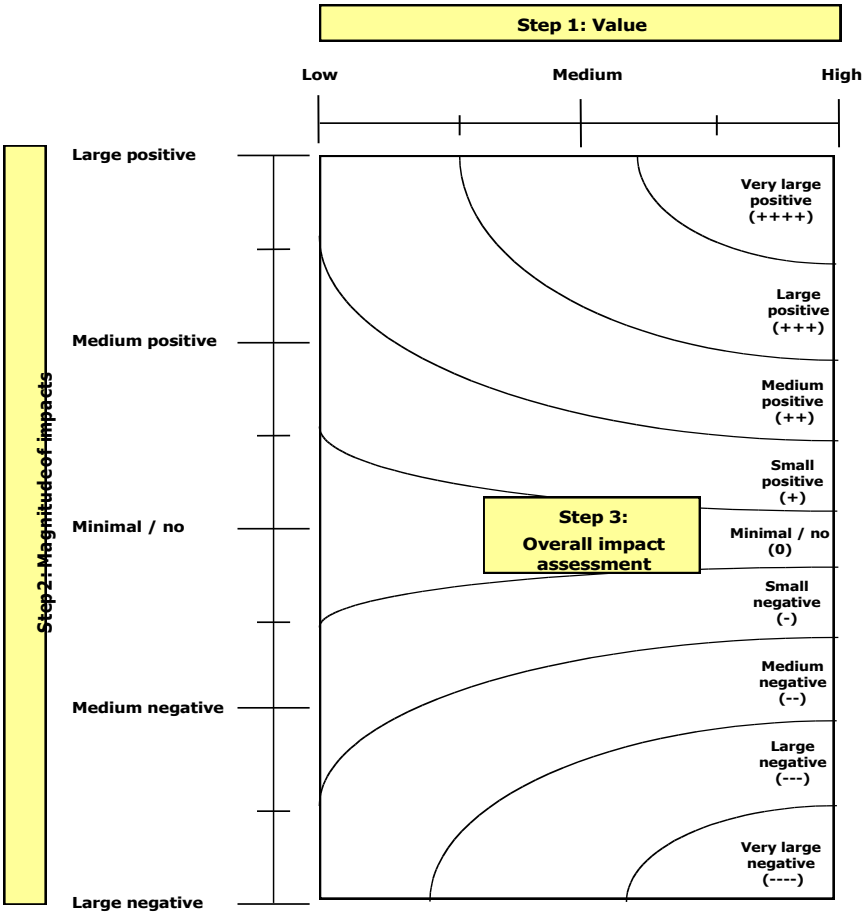
Step 2:

The second step was to describe **and evaluate the magnitude of potential project impacts,** measured in terms of their **extent in time (long term/short-term), and space (local, national, regional etc), the vulnerability of the environments affected, the reversibility (permanent or temporary) of the impacts and the probability that the impacts will occur.** The magnitude of impacts was evaluated on a scale from 'high negative' to 'high positive' as shown below.

Phase	**Magnitude of Impacts**
	High neg. Medium neg. Low/ Low pos. Medium pos. High pos.
Planning	------▲------
Construction	------▲------
Operation	

Step 3:

The third and final step was combining 'value' (Step 1) and 'magnitude of impacts' (Step 2) to obtain the 'overall impact assessment' (Step 3). This assessment evaluated the importance of an impact on a scale ranging from 'very large negative'; 'medium negative'; 'low negative' to 'very large positive'; 'medium positive' or 'low positive'.



1.4 PUBLIC DISCLOSURE

Environment management Act 2004 for Tanzania require public involvement to be an ongoing process throughout the study. It is required before the study, during the study and after the study. Regulation 17 (1) requires that the developer seeks views of any person that will be or is likely to be affected by the project in consultation with the Council. After approval of the project brief, the developer has to publicise the project, its effects and benefits (Reg. 17 par 2). The Council may also issue a notice to members of the public to participate in all steps of conducting EIA (Par.3 of Reg. 17). After closing public hearing the council has to ensure that both oral and written comments, minutes of the meeting are attached as an annex to the Environmental Impact Statement. Regulation 23 (1) also requires that the council submits a copy of the EIS to the relevant ministries institutions and notify and invite the public for comments within 14 days of receipt of the EIS. The Council may conduct public hearing once oral and written comments are received (Reg. 27). Outcome of this process guides decision of the Council. EIS shall be a public document and may be inspected at any reasonable time by any person.

Furthermore, according to World Bank Environmental Assessment (OP/BP 4.01) January 1999, revised in 2011, Karazi dam project has been categorised as B project (see Chapter 3, Requirements of International Financial Institutions). The disclosure requirements are that EA

reports will have to be accessible to local affected groups (in the local language) in their country

1.5 STRUCTURE OF THE REPORT

This report is organized in twelve chapters. Chapter one is the introduction while chapter two entails the project background and its description. Chapter three is on the policy, administrative and legal framework within which the project will operate. Chapter four presents the baseline or existing conditions of the project site and area of influence. Chapter five entails Stakeholders' consultation and public participation while chapter six deals with assessment of impacts and identification of alternatives. Chapter seven deals with impacts and mitigation measures. Chapter eight presents the environmental and social management plan. Environmental and social monitoring plan is presented in Chapter nine. Chapter ten is on resource evaluation or cost benefit analysis while chapter eleven is on decommissioning. The last chapter is number twelve which gives the summary and conclusions of the report.

2 PROJECT DESCRIPTION

2.1 GENERAL DESCRIPTION:

The project consists of a multipurpose dam with its associated reservoir, irrigation system and water supply. **Figure 2-1** shows the project layout out excluding Water supply.
Detailed description of **the dam and reservoir are discussed in section 2.3** below.

Irrigation command area is expected to cover about 523Ha but designed perimeter is 570Ha. 6% of the irrigation area will be occupied by canals and drains leaving 493Ha as actual area for irrigation. Irrigation area is divided in two sections; one of 248Ha supplied directly from the dam and 245Ha which will need construction of diversion weir. The main canal has a length of 7.12km. The irrigation area stretches for a distance of 18km between the dam and the downstream protection dyke.
According to the feasibility report, the irrigation area will be mainly used for growing of rice, maize and vegetables on rotational basis.

Water supply
At Karazi, a water supply system will consists of a treatment plant near the intake, 3 main tanks located at Kakiika, Kyanyamisa and Nyakahanga. It will also have 14 storage tanks for supplying 14. The treatment system will be at the intake. The water will be pumped to the 3 main tanks and will flow by gravity to the storage tanks. **Figure 2-2** shows the water supply system. The feasibility Consultant recommends further study on water supply due to the terrain.

Production of **hydropower o**n Karazi dam was not found feasible by the Feasibility Consultant; therefore it has not been discussed in detail in this ESIA report.

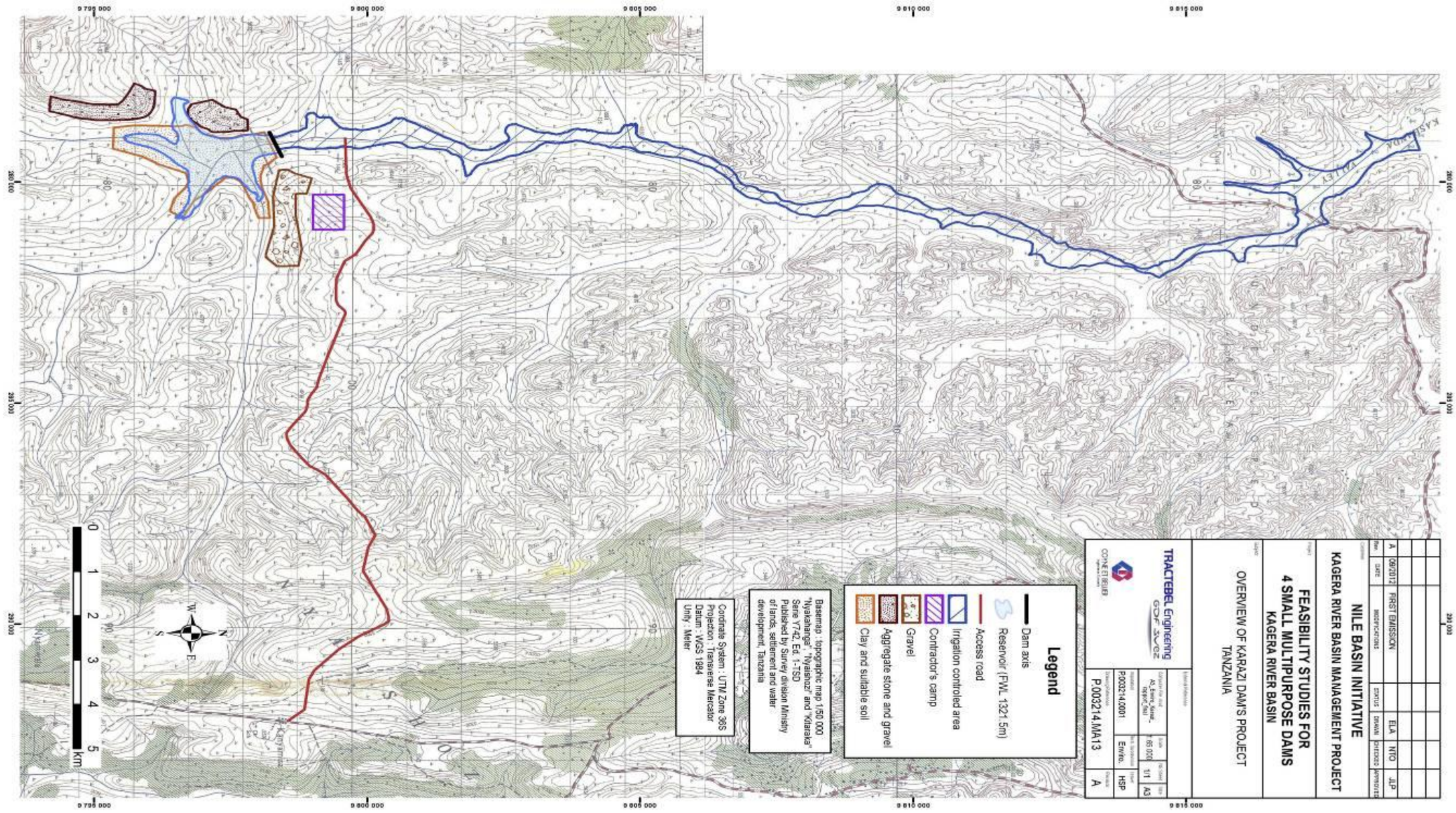


Figure 2-1: Karazi Project Layout excluding water supply

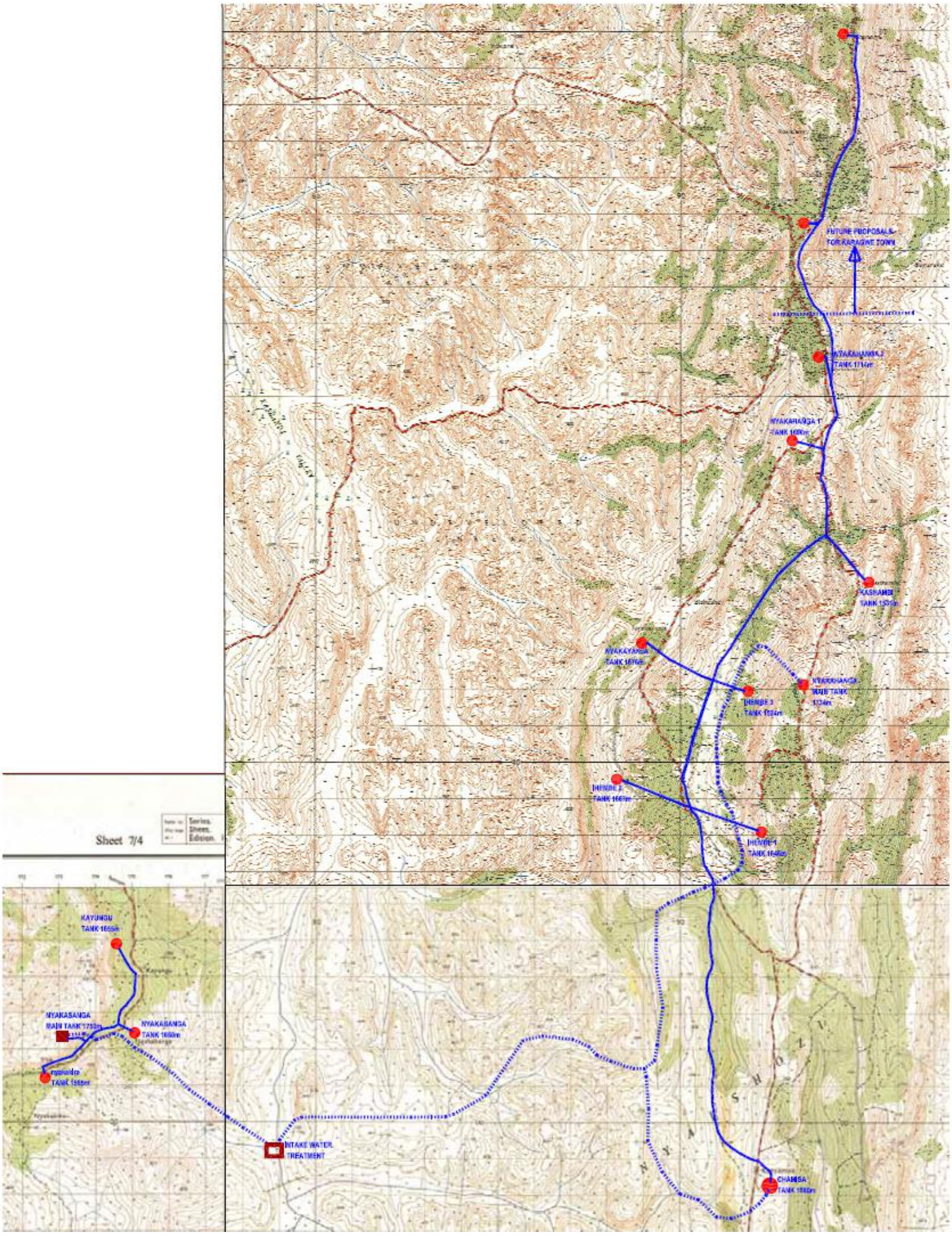


Figure 2-2: Karazi Water Supply.

2.1.1 Project Location and dam site

The project area is located at 010 49.693"; E 0310 01.013" and lies between Chabuhora and Kayungu Villages, in Nyakakika Ward, Nyabiyonza Division, Karagwe District in Tanzania. The site is on a seasonal river with *Hyparrhenia* wooded grassland. The catchment slopes are steep with undulating hills which were well vegetated.

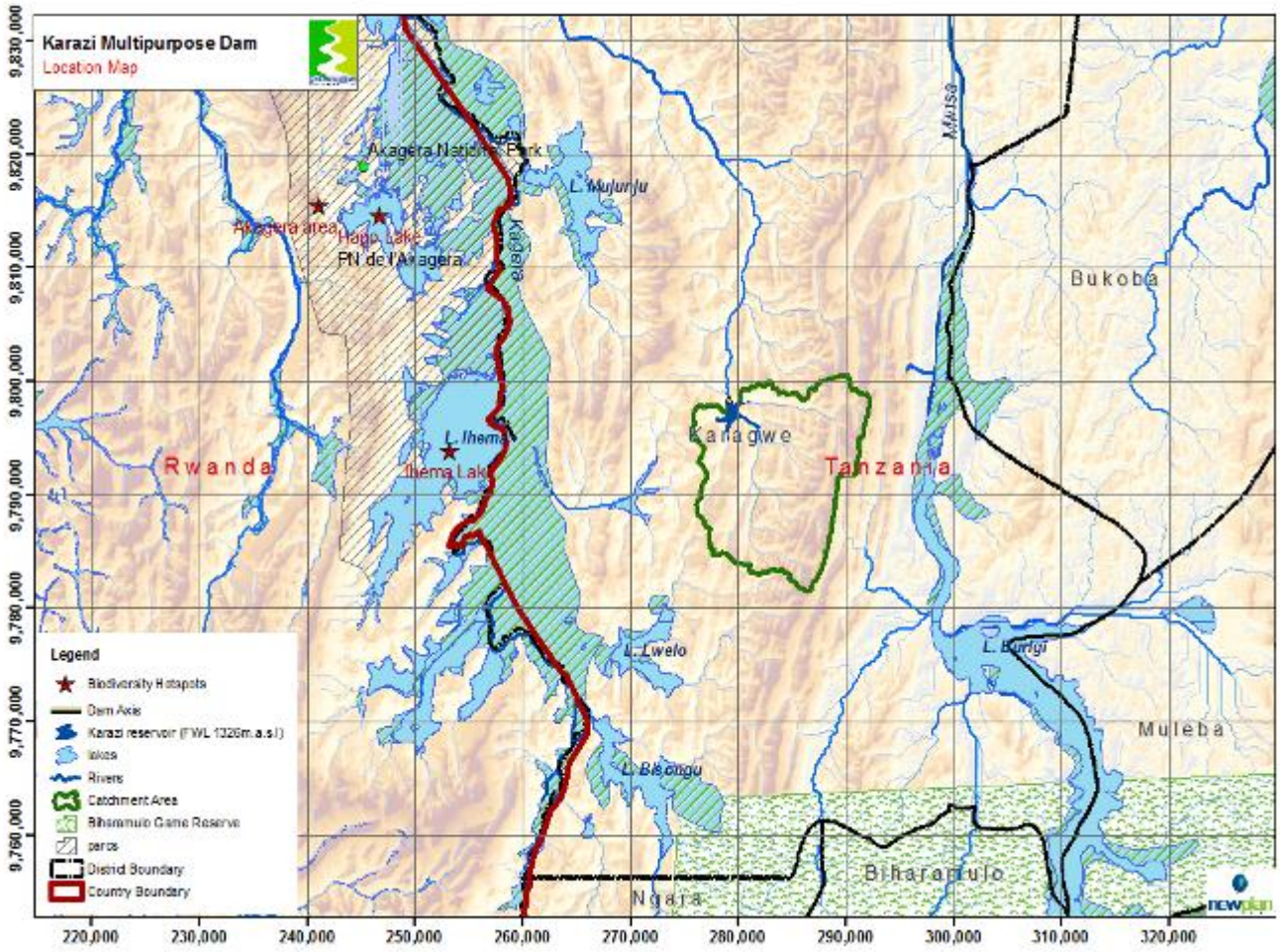


Figure 2-3: Map of the Kagera River Basin showing Karazi catchment and Dam site location in Tanzania

Figure 2-4: Map of Kagera Basin showin Karazi Catchment and the Surrounding Areas

Note: The Protected Areas

2.2 AREA OF INFLUENCE

The dam site area is dry with limited agriculture. There was widespread subsistence rain fed agriculture on the slopes but tree cover on the slopes was sparse. Livestock grazing is the main pre-occupation of the dam site including cattle, goats and sheep (Picture 2-4). Since there is no crop farming, there is limited cutting of the natural vegetation. The proposed project will provide water for domestic use, hydropower, irrigation, and livestock, fisheries, aquaculture and flood control. Currently there is no irrigation practiced in the catchment. The bottom valley is mainly used for livestock. The people in the area are using shallow wells for their water supply. The local community indicated that their priorities for using the dam were irrigation, fishing and hydropower. In the proposed area of the project, there are hardly any settlements However, settlements were observed on the slopes of the mountains a few kilometers away from the dam site.

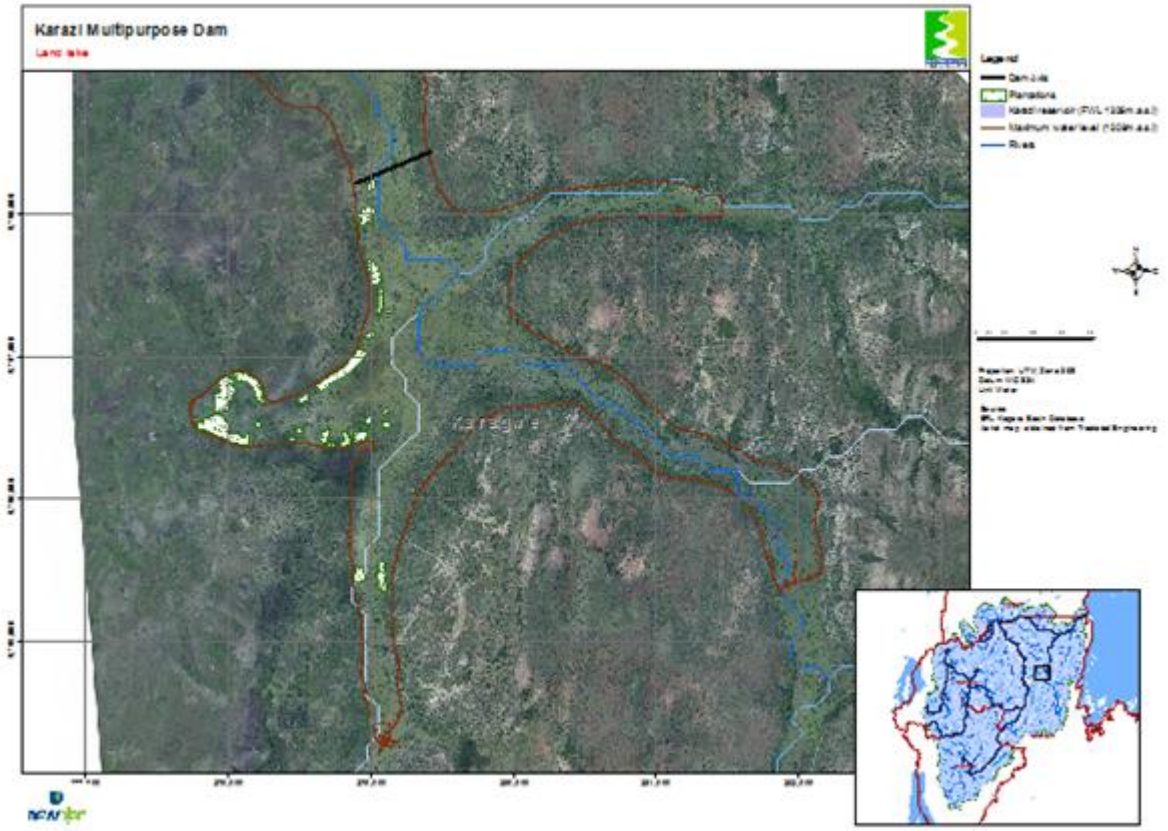


Figure 2-5: Karazi Reservoir Area

(Source: 1st Interim Report, Feasibility)

Picture 2-1: Karazi dam site covered with grass and acacia shrubs

Picture 2-2: Cattle grazing in the Karazi dam site

Picture 2-3: Banana plantation on a hill side in the Karazi dam site area

Picture 2-4: Artificially dug watering hole for cattle in the Karazi dam site

2.3 TECHNICAL DESIGN/DAM FEATURES

The proposed dam will be an earthen embankment dam of 9.50 m high with a storage capacity of 9.2 million m³ and reservoir surface area at FWL 2.36 km² .(Table 2-1).

Table 2-1: Dam site features for the Karazi Dam site, Tanzania

Coordinates of dam (Longitude, Latitude)	E 279238, N9799341 31.0126°E , 1.8219 °S
Dam height (m)	9.50
Storage capacity (Mm3)	9.2
Dam length (m)	518.74
Dam crest width (m)	6
Reservoir surface area at MWL (km2)	2.71
Reservoir surface area at FWL (km2)	2.36
Contributing catchment area (km2)	213
Catchment sediment yield (Tons/km2/yr)	576

2.3.1 Civil works

Foundation

The dam footprint will be stripped of grass, trees, excessively plastic soil and any deleterious material. Then a cut-off wall will be excavated to a maximum depth of 3m or to groutable rock

foundation and the trench will be covered with 500mm thick sand. Shortcrete, dental concrete and slush grout will be applied where necessary.

Outlet works

This will consist of;

Intake trash screen, upstream pressure conduit, Agate shaft of 3m by 2m with 600mm thick reinforced concrete walls. Gate house will be 5m in diameter and 2.5m high with a 200 mm thick reinforced concrete roof, downstream pressure conduit and stilling basin.

Spill Way

Approach channel, Spill Way Ogee of 15.0m long, Spill Chute, Stilling Basin will have a concrete slab of 20m long and Return channel with lateral walls of 2.0-2.5m high

2.4 PLANNED ACTIVITIES

Having a multipurpose dam in place may involve a number of activities. However, main activities planned for the proposed Karazi multipurpose dam include site clearance, construction of embankments, inundation and commissioning of the dam. It is envisaged that the proposed dam will be vital in supporting a variety of other projects such as irrigation schemes, water supply project etc as already described in the earlier sections.

According to the Draft Final feasibility report for Karazi, the activities and equipment are similar to those of Bigasha Dam in Uganda.

2.4.1 Pre - Construction Stage

Setting out (Demarcation of project area) and Site clearing (including dam axis and access roads)

i) Surveying: The proposed project area (dam site and reservoir) have been surveyed using aerial survey and detail surveys to mark off the project area on ground shall also be carried out.
ii) Clearing: the removal of all vegetation from dam axis
iii) Access road construction: this will involve the construction of the various roads required to access the area, construction camps, material sources etc.

Transport of Material to Site and sources

Road transport: materials sourced outside of the project area will be transported to the construction site by road. The existing Karagwe –Chyanyamisa to Omukariro roads and other access roads will be utilised as a means of delivering these materials to site, with potential impacts on the transport infrastructure and road users in the area. Clay will be sourced from just around the reservoir and also aggregates will be from with the project area as indicated in project layout.

Establishment of Construction Camps

Construction of temporary camp: this will be established by the contractor, and involve clearing of the vegetation, fencing of the camps and the construction of houses, workshops, store-rooms and vehicle parking areas. There will be need for storage of fuel as there are no fuel stations in the neighborhood.

The camp will be electrified and ablution and potable water provided. According to the project layout (figure 2-1) the campsite will be established within the project area. The camp will be 700m2 but other details of the camp are not yet determined. An Environmental Management Plan (EMP) has been compiled as part of the EIA, which will describe parameters to be considered and the management of the camp. About 100 workers are expected to participate in construction. It is also estimated that 100,000m3 of waste will be generated.

2.4.2 Construction Phase

Construction equipment

A number of equipment will be required during this phase; they include 2 Bulldozes, 2 cement trucks, 2 Compactors, 1 Grader, 2 Hydraulic shovel, 5 Trucks and 2 Wheel loaders.

2.5 MATERIALS AND THEIR SOURCES

During construction, the project will require various standard construction materials including: compaction/fill materials, aggregates, sand, and water. The amount of construction materials needed is indicated in the bills of quantities for dam construction. About 30 tons of cement will be purchased from Bukoba town. At the quarry site and burrow pits located in Chabuhora village, stones and murram will be excavated by excavator and wheel loader machine and loaded into trucks.

Table 2-2: Materials requirement for construction works

Type of materials	Potential Source
Gravel	Chabuhora village
Aggregates	Chabuhora village
Sand	Bukoba
Water	Within the site
Fill material	Excavated earth (Backfill)
Soils for compaction	Burrow pits at Chabuhoravillage
Cement	From Bukoba

3 REVIEW OF RELEVANT EXISTING LAWS AND POLICIES

3.1 POLICY FRAME WORK

Environment and Social Impact Assessment is considered to be one of the planning tools which is used to facilitate and promote sustainable development by integrating environmental conservation and management in the decision making process. It ensures that the integrity of the environment does not suffer as a result of development projects. Due to the importance of ESIA, most sectorial policies and legislations in Tanzania have incorporated the requirement of undertaking ESIA in the designing and implementing development activities.

The following are relevant sectorial and cross-sectorial policies applicable in the Tanzanian legal and regulatory framework which stipulate the need for ESIA and provide directives on how projects should be implemented especially if they impact on natural resources and sensitive ecosystems. The project proponent will consult these policies in the course of designing and implementing the proposed project activities.

3.1.1 The National Environmental Policy (URT, 1997)

Chapter 4 of the National Environmental Policy (NEP) elaborates clearly the importance of ESIA. Paragraph 64 states that:

> *"It is in the context of an EIA regime that policy guidance on choices to maximise long-term benefits of development and environmental objectives can be revealed and decided upon".*

On public consultation the policy in paragraph 66 states that:

> *"One of the cornerstones of the EIA process will be the institution of public consultations and public hearing in the EIA procedures".*

While by undertaking EIA, the project proponent has observed one of the requirements of the policy, it is also important that this policy is adhered to throughout the project life cycle.

3.1.2 Land Policy (URT, 1996)

The National Land Policy advocates the protection of land resources from degradation for sustainable development. The policy addresses several environmental issues. Of relevance to this project is the protection of rivers basin which is the source of livelihood for communities located downstream. The policy further requires that water abstraction permit be sought from relevant authorities prior to actual taping of water from the river for any use.

3.1.3 Forest Policy (URT, 1998)

The National Forest Policy statement number 23 states that:

> *"Environmental Impact Assessment will be required for the investment which use or may cause potential damage to the forest environment".*

Although there is no conserved forest in the project area but Burigi game reserve is adjacent to the proposed Karazi dam site hence the developer will ensure that the game reserve is not impacted by any of its development projects.

3.1.4 The National Water Policy (URT, 2002)

The National water policy recognises the following:

i. There is a growing scarcity, misuse and wastage of water resources in many places of Tanzania, which may become a serious threat to sustainable availability of the resource.

ii. Existence of uncontrolled abstraction of water resources from different water basins.

iii. Existence of ecological minimum flow levels of surface water flow to sustain ecosystem's flora and fauna.

iv. The state of the quality of water resources is not comprehensively known and no regular monitoring is done due to inadequacy of resources and institutional capacity.

v. Water resources are one of the major agents for socio-economic activities. There are various socio-economic water use activities that compete for limited resources particularly during droughts and times of scarcity. Criteria for prioritisation of water use at different times of year to address the growing competition for water are lacking, resulting into conflicts among users. The policy, however, states that priority in this circumstances shall be, supply of domestic water and water needed to maintain ecosystem functioning.

vi. There is inadequate linkage between water and land development which result in pressures on water resources. With the ongoing liberalisation there is need to have co-ordination mechanism to facilitate smooth linkage. Water Rights shall not be tied to any land, and they shall not be transferable with land transfer.

Given the fact that the proponent intends to develop a multipurpose dam it is envisaged that all of the above provisions of the water policy shall be observed

3.1.5 National Agriculture and Livestock Policy (1997)

The Policy states that

> *"It is crucial for the long-term future of the country that Tanzanian's natural resources (soils, water, forests, wildlife) be managed so that agricultural production is sustainable and negative externalities are kept to a minimum".*

With this understanding, the project proponent has a responsibility of working with local communities (Village governments) to conserve these natural resources that are found within the earmarked area for project development.

3.2 LEGAL FRAME WORK

This section addresses the legal and regulatory conditions which are relevant to the proposed project. This ESIA has been conducted in general compliance with the following legislations.

3.2.1 The Village Land Act No. 5 of 1999

The village Land Act No. 5 of 1999 was enacted specifically to cater for the management of and administration of land in villages, the role of local government in land administration, land allocation and occupation. The Act empowers the village council to manage all village lands in

accordance with the principles of a trustee with the villagers being the beneficiaries.

Section 3 (f) of the Act stipulates that one has to take into account that Land has value and that value is taken into consideration any transaction affecting that interest. This means if one acquired land he/she will have to compensate owners for bare land in addition to un-exhausted improvements.

Section 3 (g) of the Act, requires "to pay full, fair and prompt compensation to any person whose right of occupancy or recognized long standing occupation or customary use of land is revoked or otherwise interfered with to their detriment by the state under this act or is acquired under the Land Acquisition Act." Registered Professional or Specialist will determine the amount of compensation payable on the market value of land or property and the concept of opportunity cost shall be based on:

Also the Act contains provisions of critical environmental importance. One of important fundamental principles of the Land Act 1999 is

> "*to ensure that land is used productively and that any such use complies with the principles of sustainable development*".

The project is being developed with the intention of contributing to National sustainable development thus contributing to poverty alleviation. There will be measures in place to avoid excessive use of water especially during dry seasons. These measures if implemented will ensure that the project activities do not adversely affect the environment.

3.2.2 The Water Resource Management Act, 2009 (Act No. 11/2009)

The Water Resource Management Act 2009 is a new principal legislation dealing with the protection of water resources and control of water extraction for different uses. According to section 39 (1) of this act, owner or occupier of land on which any activity or process is or was performed or undertaken, or any other situation exists which causes has caused or is likely to cause pollution of a water source, shall take all reasonable measures to prevent any such pollution from occurring, continuing or recurring. It is stated under section 39 (2) that a Basin Water Board may direct any person who fails to take the measures required under subsection (1) to;-

a) commence taking measures before a given date;

b) diligently continue with those measures; and

c) complete the measures before a given date.

Section 40 (1) states that where a person fail to comply or comply adequately with a directive given under Section 39 (2), the Basin Water Board may take measures as it considers necessary to remedy the situation. Section 40 (2) provide more that the responsible person, any other person involved in the incident or any person with knowledge of the incident must, as soon as is practicable after obtaining knowledge of the incident, report the incident to the Basin Water Board or any public officer and the responsible person shall:-

a) take all reasonable measures to contain and minimise the effects of the incident;

b) undertake clean-up procedures; and

c) take such measures as the Basin Water Board may verbally or in writing direct, and any verbal directions shall be confirmed in writing within fourteen days to have effect under this subsection.

Part X section 86-95 of this act stipulates that the Client or proponent will apply and secure the

dam construction permit and environmental permit from Director of Water resources before and during construction. The proponent will also be required to apply to Basin Water Office for a **Water User Permit** before use of the water.

The proponent shall strive to comply with the provisions of the Water Resource Management Act of 2009.

3.2.3 The National Environment Management Act (2004)

The Environmental Management Act of 2004 seeks to provide for legal and institutional framework for sustainable management of the environment in the implementation of the National Environmental Policy.

Section 7 (2) provides

"This Act provides a legal framework necessary for coordinating harmonious and conflicting activities with a view to integrating such activities into an overall sustainable environmental management system by providing key technical support to sector Ministries"

And true to the above quoted provision this is a cross-sectoral piece of legislation and supersedes all other written laws relating to environmental management and specifically section 232 stipulates:

"Where the provision of this Act is in conflict or is otherwise inconsistent with a provision of any other written law relating to environmental management the provision of this Act shall prevail to the extent of such inconsistency"

In other words all matters pertaining to environment management may be governed by sectorial legislation however the same shall not be in conflict with Environment Management Act of 2004 (EMA CAP 191).

EMA introduces a concept of right of Tanzanians to clean, safe and healthy environment and right of Tanzanians to access to various segment of environment for recreational, educational, health, spiritual, cultural and economic purposes (Article 4 (1) and (2)).

Section 81discusses the obligation to undertake environmental impact assessment. It states that, "(1)Any person, being a proponent or a developer of a project or undertaking of a type specified in the Third Schedule to this Act, to which environmental impact assessment is required to be made by the law governing such project or undertaking or in the absence of such law, by the regulations by the Minister, shall undertake or cause to be undertaken, at his own cost, an environmental impact assessment study.

(2) An Environmental Impact Assessment study shall be carried prior to the commencement or financing of a project or undertaking.

(3) A permit or licence for the carrying out of any project or undertaking in accordance with any written law shall not entitle the proponent or developer to undertake or to cause to be undertaken a project or activity without an environmental impact assessment certificate issued under this Act.

(4) Any person who contravenes subsection (3), commits an offence."

3.2.4 Land Use Planning Act, No. 6 of 2007

The National Land Use and Planning Commission (NLUPC) was established under this Act as the principal advisory organ of the Government on all matters related to land use. Among other things, the Act recommends measures to ensure that Government policies, including those for development and conservation of land are in harmony. It also takes adequate account of their

effects on land use and seeks the advancement of scientific knowledge of changes in land use. It encourages development of technology to prevent, or minimize adverse effects that endanger man's health and his/her welfare. It also specifies standards, norms and criteria for beneficial uses and maintenance of the quality of land.

In accordance with the functions mentioned in the Act, the Commission may indirectly help to prevent or minimize environmental and socio-economic impacts through advising on proper location of economic activities. The proposed project is planned in accordance with the requirement of the Act and future developments shall also adhere to it.

3.2.5 Local Government (District Authorities) Act Cap 287 of 1982

This act provides for a detailed responsibility for the District Councils on administration of day-to-day activities within its area of jurisdiction. Since the project area is within the jurisdiction of the Karagwe District Council, the provisions under this act have to be followed or adhered and therefore the project proponent shall liaise with the district council in implementing the proposed project

3.2.6 Forest Act, 2002

The Forest Act classifies forests in Tanzania under four main types: national forest reserves, local authority forest reserves, village forests and private forests. .The Act encourages and facilitates the active participation of the citizen in the sustainable planning, management, use and conservation of forest resources. The Act also establishes that any development in a forest reserve, private forest or sensitive forest is subject to the carrying out of an EIA.

Although the project being assessed is not in either of the above categories of forests, the project proponent has to comply to this legislation in collaboration with other stakeholders in conserving the nearby forests which are actually in the catchment area of the dam.

3.3 REQUIREMENTS OF INTERNATIONAL FINANCIAL INSTITUTIONS

International financial institutions require that for any project to qualify for their funding, environmental integrity must be ensured. Given the fact that the proposed project is funded by the World Bank, EIA will be carried out to comply with its guidelines as highlighted below.

World Bank Safeguard Policies review

The 'Environmental and Social Safeguard Policies' of the World Bank consist of Operational Policies (OP), Operational Directives (OD) and Bank Procedures (BP). Some of these policies likely to be triggered by the proposed dam construction at Karazi are highlighted below.

- *Safety of Dams (OP 4.37)*

Section 1 of these procedures clearly indicates that the responsibility of ensuring that appropriate measures are taken and sufficient resources provided for the safety of the dam lies with the owner irrespective of its funding sources or construction status.

Section 2 to 6 of OP 4.37 concerns the "New Dams". When the project includes the construction of a new dam for example a water storage dam for multipurpose project, it requires that the dam be designed and its construction supervised by experienced and competent professionals. It also requires that the lender makes sure that the borrower adopts and implements certain dam safety measures for the design, bid tendering, construction, operation,

and maintenance of the dam and associated works (section 2). Section 3 distinguishes between small and large dams. Section 3a stipulates that small dams are normally less that 15meters in height. Section 3b indicates that large dams are 15 meters or more in height. However if they present special design complexities--for example, an unusually large flood-handling requirement, location in a zone of high seismicity, foundations that are complex and difficult to prepare, or retention of toxic materials then if such dams are between 10-15meters in height are treated as large dams. However according to the feasibility studies, this is not a complex dam.

Karazi dam is a proposed new dam of 14 m high with storage capacity of about 22,75Mm^3. Therefore from OP 4.37 section 3 (a) this is a small dam as its height is less than 15m. According to section 4 of these procedures for small dams generic dam safety measures designed by qualified engineers are usually adequate.

- *Environmental Assessment (OP/BP 4.01) January 1999, revised in 2011*

Section 7 requires that a range of EA instruments be used depending on the project. Section 8 categories the project according to type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts. This policy emphasizes consultation and public disclosure. Section 14 requires that developer of category A and B projects consults the project-affected groups and local non-governmental organizations (NGOs) about the project. The policy also requires that relevant material be provided in a timely manner prior to consultation and in a form and language that is understandable by groups being consulted (section 15). Before the project can be upraised by the Bank, an EA report for such project (category A and B) has to be disclosed to the affected persons and the public. Furthermore, the developer is required to report on compliance monitoring of the EMP.

A proposed project is classified as Category A if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works. A proposed project is classified as Category B if its potential adverse environmental impacts on human populations or environmentally important areas--including wetlands, forests, grasslands, and other natural habitats are less adverse than those of Category A projects.

Karazi dam project is likely to cause very significant loss of grazing and some of agricultural land the reservoir is likely to inundate about 1780 acres of land. Furthermore, it is a large dam as classified by International Communication on Large Dams. Therefore this project can be categorized as a Category A project.

- *Cultural Property (OP/BP 4.11) Physical Cultural resources*

These procedures assist in preserving physical cultural resources (PCR) and held in avoiding the destruction or damage. PCR includes resources of archaeological, paleontological, historical religious (including graveyards and burial sites), or other cultural significance.

These procedures will be triggered for this development as exemplified by some artifacts identified during the reconnaissance visit and some discussions held with some local people of the area.

- *Involuntary Resettlement (OP/BP 4.12)*

This Involuntary resettlement may cause severe long-term hardship, impoverishment, and environmental damage unless appropriate measures are carefully planned and carried out. Therefore the Bank has the following objectives on involuntary resettlement; to avoid

involuntary resettlement and where this is not feasible, resettlement activities should be conceived and executed as sustainable development programs through meaningful consultation, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits. Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

From preliminary assessments, no resettlement is envisaged as no settlements will be affected by the project. However, households will be affected by the inundation through loss of agricultural land which is another form of displacement.

- *Natural Habitats (OP/BP 4.04)*

The policy promotes environmentally sustainable development by supporting the protection, conservation, maintenance, and rehabilitation of natural habitats and their functions. The policy limits the circumstances under which projects can damage natural habitats. Specifically it prohibits projects which would lead to significant loss or degradation of any Critical Natural Habitats, while in Non-Critical Natural Habitats, feasible alternatives can achieve the projects potential overall net benefits.

Most of the area which will be affected by the project is covered by natural habitats as described in the project description section. Thus this policy will be triggered.

- *World Bank guidelines on vulnerable people*

The World Bank resources and toolkits for vulnerable people are relevant to this project. They describe the vulnerable as those who are most likely to fall through the cracks of regular programs and need to be protected from negative outcomes and/or allowed participation. Vulnerable people need to be given special attention to remove the barriers that stand in the way of equal participation in projects, or through special project components and targeting strategies tailored to their needs.

A number of children and women were noted around the area some of whom were grazing. It is therefore likely that there will be groups of vulnerable people which will trigger this safeguard during implementation of this project.

- *Public Disclosure*

The policy requires that;

- Category A project EA reports be disclosed at the World Bank Infoshop (English) and should be accessible to local affected groups (local language) in their country.
- Category B project reports be accessible to local affected groups (local language) in their country
- Category FI should have their Framework disclosed at the World Bank Infoshop and appropriate in-country Web site (e.g. Ministry of Water, Environment, Land Management and Urban Affairs) Individual subproject disclosure requirements defined in Framework (OP 4.01, Environment Assessment January 1999, revised in 2011).

Being a category A, Environmental Assessment reports will have to be disclosed as indicated above for the category A projects.

3.4 INTERNATIONAL AGREEMENTS

3.4.1 International Convention on Biological Diversity

Tanzania signed the Convention on Biological Diversity (CBD) in June 1992 and has prepared a Country Study on Biodiversity, which describes the state of biodiversity in Tanzania, forces affecting it and proposes measures to ensure conservation and use of these resources in judicious ways. The report stresses the need to ensure proper biodiversity conservation measures are taken before any development is undertaken.

3.4.2 Africa Convention on the Conservation and Natural Resource

This Convention intends to promote conservation efforts by requiring contracting States to adopt the measures necessary to ensure conservation, utilization and development of soil, water, flora and fauna resources in accordance with scientific principles and with due regard to the best interests of the people. The proponent will support the national commitment by promoting conservation efforts in all phases of the project.

3.4.3 Convention for the Protection of the Ozone Layer and its Montreal Protocol;

This is a protocol to the Vienna Convention for the Protection of the Ozone Layer) (a protocol to the Vienna Convention for the Protection of the Ozone Layer) is an international treaty designed to protect the ozone layer by phasing out the production of a number of substances believed to be responsible for ozone depletion. The treaty was opened for signature in January 1987 and was last revised in 1999 at Beijing. This was ratified by Tanzania in 1993 and all the amendments have also been ratified. . The Ozone depleting substances are Chlorofluorocarbons (CFCs) and Hydrochlorofluorocarbons (HCFCs). The ozone shield is important because it protects plant and animal life on land from the sun's ultraviolet rays, which can cause skin cancer, cataracts, and damage to the immune system. Thinning of the ozone layer also may alter the DNA of plants and animals.

They also act as greenhouse gases, with several thousand times the per-molecule greenhouse potential of carbon dioxide.

The signatory are required to;

- Recognize that worldwide emissions of certain substances can significantly deplete and otherwise modify the ozone layer in a manner that is likely to result in adverse effects on human health and the environment.
- Determine to protect the ozone layer by taking precautionary measures to control equitably total global emissions of substances that deplete it, with the ultimate objective of their elimination on the basis of developments in scientific knowledge.
- Acknowledge that special provision is required to meet the needs of developing countries.
- Accept a series of stepped limits on CFC use and production, including:

Construction of Karazi dam will require a number of construction machinery and other equipment that may be used at the camp sites including refrigerators and air conditioners especially the used ones and these use CFCs and HCFCs thus triggering the Protocol.

3.4.4 United Nations Framework Convention on Climate Change (UNFCCC)

The Convention on Climate Change sets an overall framework for intergovernmental efforts to

tackle the challenge posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. The convention encouraged industrialized countries to stabilize greenhouse gases while the Kyoto protocol commits them to do so.

Tanzania ratified this protocol in August 2002 and entry into force was 2005. As already discussed under Convention for the protection of Ozone layer and its Montreal Protocol), greenhouse gases are gases in an atmosphere that absorb and emit radiation within the thermal infrared range and greatly affect the temperature of the Earth.

Several policies and measures to assist in the implementation of GHG mitigation options as well as the adaptation of response measures to the climate change impacts are in place in Tanzania. These are included in the macro-economic policy and sectoral policies as well as the long term Tanzania Development Vision to the year 2025.

The National Environmental Policy of 1997 in Tanzania serves as the framework for implementing both the adaptation responses and mitigation measures.

Carbon dioxide one of the major greenhouse gases is expected to be released from different sources in the project like construction vehicles and equipment during construction of Karazi dam. Thus UNFCCC will be relevant to this project.

4 BASELINE ENVIRONMENTAL AND SOCIAL FINDINGS

4.1 PHYSICO-CHEMICAL ENVIRONMENT

4.1.1 Geology and Soils

Information regarding the topography and landforms was determined from the "Landforms Map" by Nile Basin Initiative – Kagera River Basin as well as site inspection observations. Karazi in Tanzania is located in a hilly, mountainous area. The catchment upstream of the dam site is characterized as hilly and covered by vegetation and shrubs.

Detailed geological maps are not available for this area. However, useful information was obtained from The Nile Basin Initiative – Kagera River Basin "Soils map" and "Lithology map".

Karazi in Tanzania is a quartzite area with ferrasols soils. Ferrasols possesses good agronomic qualities. The clay fraction consists mainly of Laoline minerals, free iron oxides, amorphous gels and sometimes small amounts of clay. These soils are known as Mulinda series, also developed on non-volcanic rock mass and their pediments. The dominant soil type is brown, gritty clay loams and sandy loams. Productivity is low to medium.

Geophysical investigations performed at the site in the feasibility study indicate that the top layer down to a depth of ca. 8 to 12 meters consist of black, grayish stiff clay with a high plasticity over bedrock. The bedrock is most likely of weathered shale and phyllites. The soils on the banks of the river have a top layer down to a depth of 5 meters consisting of reddish brown dense sandy gravels, lateritic soils. The sandy gravels are over a weathered rock over bedrock. Feasibility report also indicate "the overlaying material is suitable for dam core as it is practically impervious (< 10-8 m/s) after compaction while still plastic".

4.1.2 Climate

The climate of Karazi catchment is characterized by the topography and latitudinal position of the catchment. The precipitation of the catchment is associated with the equatorial trough of low pressure. The airflow into the Kagera River Basin from the northern and southern hemisphere high-pressure belts occurs as north-east and south-east winds. The surface winds are predominantly south-easterly from January to March and north-easterly from September to November producing, respectively, the south-easterly monsoon season (locally called the long rains) and the north-easterly monsoon season (or short rains). The later season gives less depth of rainfall over a shorter period.

The climate of Karazi catchment was characterized by analyzing climatic data obtained from Kayanga climate station. This station is located in the neighbourhood of Karazi catchment. Within the year variation of rainfall amounts for Karazi indicates the dominance of the transition rainfall regime with a well-defined peak during the long rains and a weak peak during the short rains (Figure 4-1-1). The seasonal variation indicate the relatively dry period between June and August with monthly rainfall amounts predominantly below 50 mm. July is the driest month in the catchment while the wettest month is April whereby the average rainfall amounts recorded are as high as 180 mm per month (Figure 4-1-1). The total amount of annual rainfall recorded for Karazi catchment is about 1000 mm.

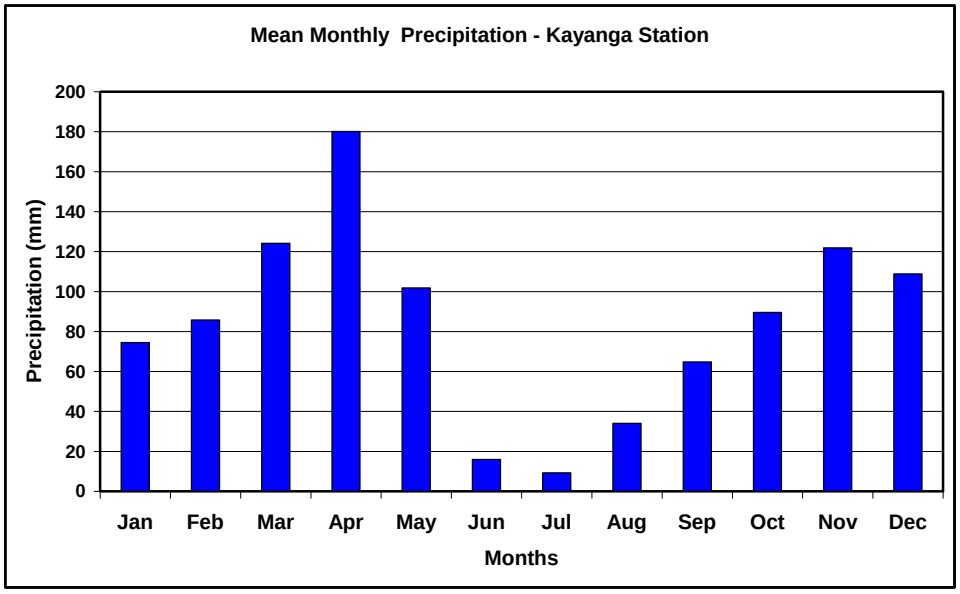


Figure 4-1-1: Seasonal rainfall pattern in Karazi catchment

The variation in mean monthly temperature is quite small ranging from 19° C – 20.5° C (Figure 4-2). The temperature of Karazi can be characterized to be cool and it is closely influenced by altitude, whereby temperature is known to reduce with elevation. The apparent movement of the sun also has effect on the seasonal variation of temperature. Slight increase in temperature are realized when the sun crosses the equator. The lowest temperature in Karazi is recorded in November (19° C) while the highest temperature is recorded during the month of August (20.5° C).

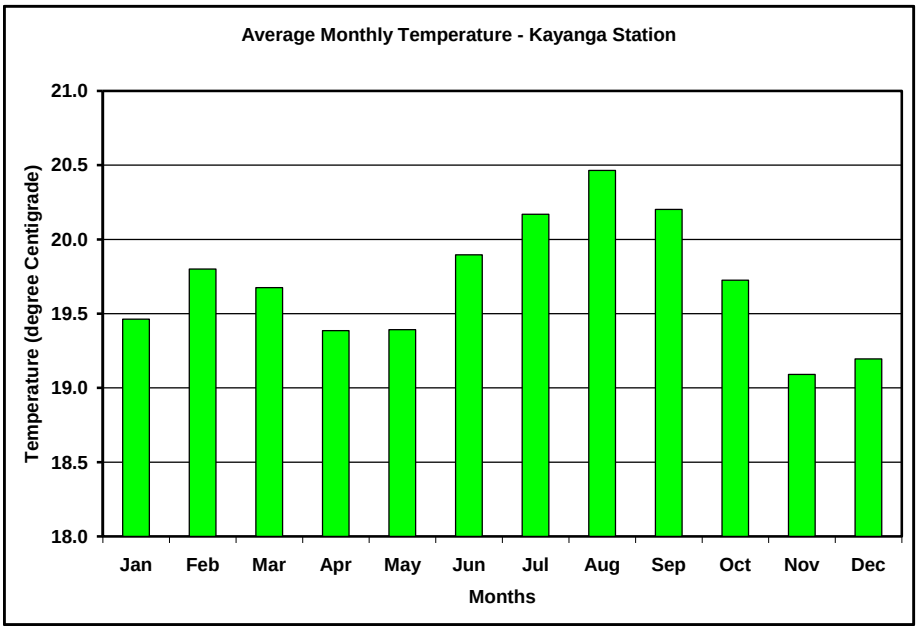


Figure 4-2: Seasonal variation of temperature in Karazi

The seasonal variation of Potential Evaporation in Karazi catchment is ranging from 69 – 80 mm per month (Figure 4-3). Temperature is the key factor that has direct effect on evaporation. In view of this fact, the pattern of evaporation variation at Karazi resembles the pattern of temperature variation. The highest rate of potential evaporation in Karazi is recorded during the month of August, corresponding to the highest temperature during the month of August. The annual total potential evaporation is estimated to be 890 mm.

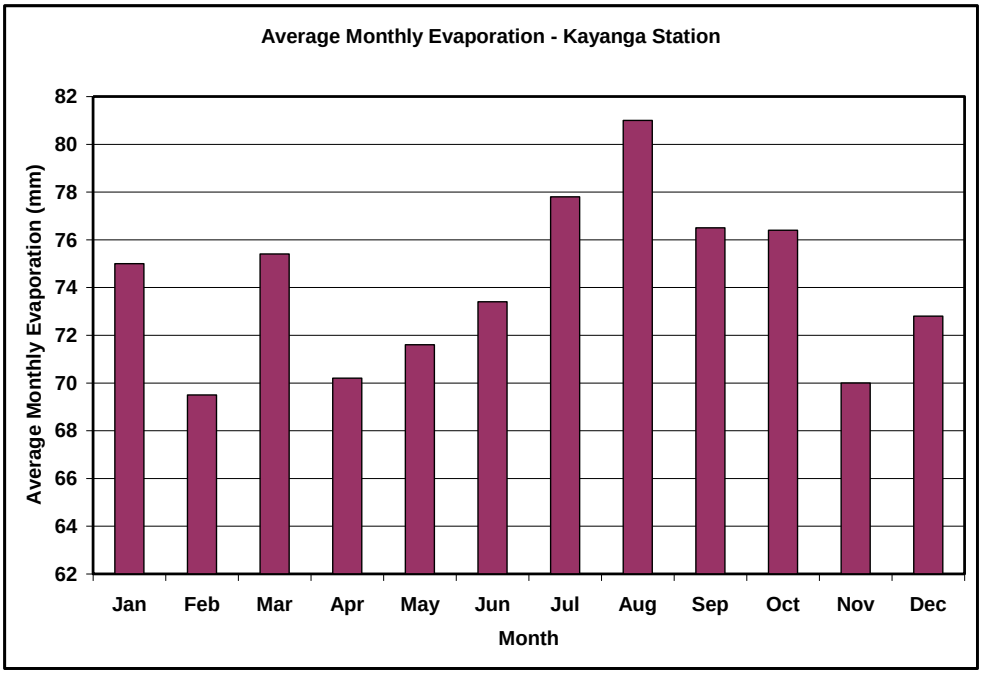


Figure 4-3: Evaporation pattern in Karazi

4.1.3 Hydrological characterization of Karazi dam site

a) Characteristics of the Karazi dam catchment

The Karazi catchment is a seasonal stream and it is ungauged and thus there are no historical flow records to estimate runoff from the catchment. The catchment upstream of the dam site can be characterized as hilly and covered by scattered trees and shrubs. The valley bottom is covered by grass (Plate 1). In view of the current status of land cover in the catchment erosion is expected to be low and therefore there is no threat of sedimentation into the reservoir once the dam is constructed.

Picture 4-1: Karazi catchment characterized by hilly areas covered by scattered shrubs and bottom valleys covered by grass

The bottom valley is reported to be flooded during the rainy season to a depth of 1.5-2.0 meters. The flooding does not affect human settlements as they are build on high ground. Few banana plantations planted close the bottom valley will be affected by floods. Currently there is no irrigation practiced in the catchment. The bottom valley is mainly used for livestock grazing.

Karazi stream carries water for short durations (several days) following the occurrence of a rainfall event. In view of the flat nature of the bottom valley, the valley is filled with water to a depth of up to one meter during intense rainfall. This situation provides excellent conditions for the growth of vegetation. The flow of water in Karazi is mainly surface water generated from rainfall. There is no groundwater contribution as conditions observed in the field do not show any interaction between groundwater and surface water. No springs were observed in Karazi catchment.

The runoff from Karazi catchment was estimated from monthly rainfall data obtained from the nearby climate station of Kayanga. Total catchment runoff yield is the function of catchment area, runoff coefficient and rainfall distribution. Taking into consideration the fact that average annual precipitation at Kayanga is 1010 mm, total annual evaporation is 890 mm, the soil type is clay pans/inelastic clays and adoption of a runoff coefficient of 0.20 for Karazi catchment, the annual runoff yield for Karazi is estimated to be 40 Mm3. The estimates of catchment runoff yields on monthly basis are presented in Table 4-1. The estimates were made based on observed past rainfall records. However, future estimates will be affected by climate change. Downward change in rainfall amounts will cause reduction in runoff o be generated from rainfall and vice versa.

Table 4-1: Estimates of runoff yields for Karazi catchment

Month	Catchment yield (Mm^3)	Cum. Inflow (Mm^3)
Oct	3.773	3.773
Nov	5.133	8.828
Dec	4.582	13.273
Jan	3.137	16.222
Feb	3.613	19.615
Mar	5.226	24.613
Apr	7.584	31.923
May	4.287	35.926
Jun	0.670	36.296
Jul	0.392	36.379
Aug	1.432	37.484
Sep	2.725	39.865

On the basis of the hydrological investigations carried out at the field, key environmental and social impact issues that are likely to emerge as the result of the construction of the dams were identified. Also, information was collected on the ground to characterize the catchments of the proposed dam sites.

The Karazi dam is located on a suitable site in the sense that it can provide considerable storage estimated to be 30 Mm^3. The stream where the dam is located is seasonal and it is ungauged and thus there are no historical flow records. The catchment upstream of the dam site can be characterized as hilly and covered by scattered trees and shrubs (**Picture 6- 2**). The valley bottom is covered by grass. On the lower parts of the catchment nearby the dam site there are banana plantations.

In view of the current status of land cover in the catchment erosion is expected to be low and therefore there is no threat of sedimentation into the reservoir once the dam is constructed.

Picture 4-2: Karazi catchment characterized by hilly areas covered by scattered shrubs and bottom valleys covered by grass

The bottom valley is reported to be flooded during the rainy season to a depth of 1.5-2.0 meters. The flooding does not affect human settlements as they are build on high ground. Few banana plantations planted close the bottom valley will be affected by floods. Currently there is no irrigation practiced in the catchment. The bottom valley is mainly used for livestock grazing.

The people in the area are using shallow wells for their water supply. No springs were reported in the area. The local community has indicated that their priorities for using the dam are irrigation, fishing and hydropower.

The Karazi catchment was delineated using Space-borne Thermal Emission and Reflection Radiometer (ASTER) Global Digital Elevation Model (GDEM). The ASTER DEM is available at 30 m resolution. Delineated catchment is shown in Figure 4-4.

The ***key issues*** of concern from the hydrological point of view were that the dam site is located along a river which is seasonal and un-gauged and therefore water yield to the reservoir may be expected to be limited and lack of data will make the estimation of water yield to have an element of uncertainty. Furthermore, banana plantations located close the bottom valley will be subject to inundation following the dam construction.

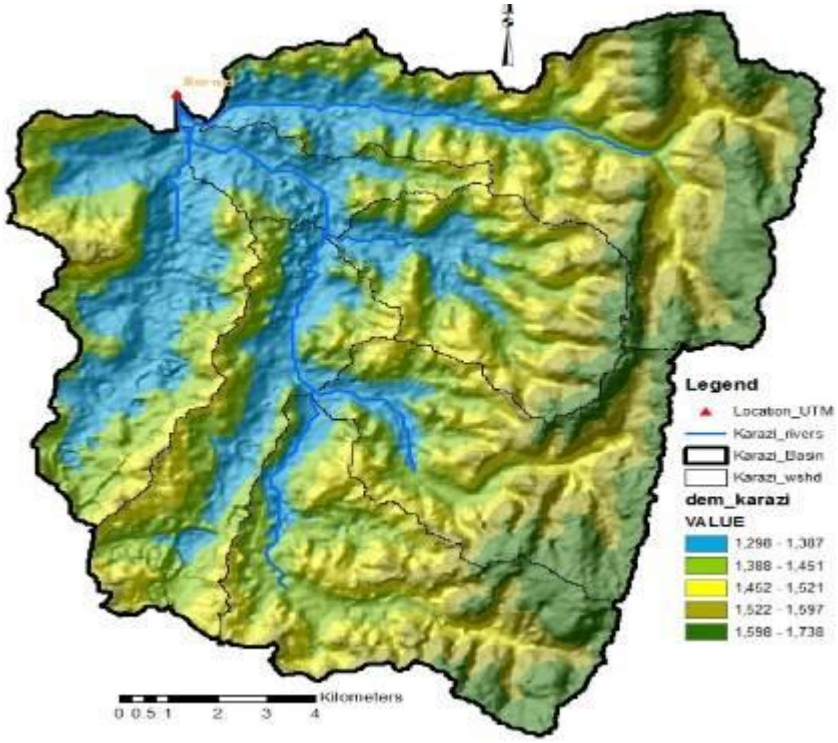


Figure 4-4: Catchment of Karazi dam site

b) Data compilation

Considerable efforts were made to collect hydrological data required for carrying out the hydrological assessment at the proposed dam site. The data was obtained on request from the institutions responsible for operating hydrological, climatic and groundwater monitoring networks in Tanzania. The data collected for the study is summarised below:

Records from Kayanga Climate Station

- Monthly rainfall data: 1969 - 2011
- Maximum Annual daily rainfall data: 1969 – 2010
- Monthly Mean Temperature data: 1978 – 1996

c) Environmental Flows Assessment

The construction of the dam embankment across the stream valley will practically block the flow of water downstream. This move will impact on the livelihood of the ecosystem on the area downstream of side of the dam embankment. As such, some water of specified quantity must be

allowed to continue to flow on a continuous basis for purposes of maintaining the health of the ecosystem downstream of the dams.

For purposes of establishing the level of water to be released to flow downstream of the dams to maintain the environment a simple methodology referred to as 'Montana Method' proposed by Tennant (1976), where by an environmental flow regimes are prescribed on the basis of the average daily discharge or the mean annual flow (MAF). In general cases, 10% of the MAF is recommended as a minimum instantaneous flow to enable most aquatic life to survive, 30% MAF is recommended to sustain good habitat. In UK for example, the minimum compensation flow from reservoirs is $Q_{95,}$ i.e., flow that is exceeded 9% of the time.

In the case of Karazi, a value of 10% of MAF was used to estimate the value for environmental flow required to be released downstream of the dam embankment. The Q_{95} flow value for Karazi could not be determined because there are no historical flow records for Karazi catchment.
The value of 10% of the Mean Annual Flow (MAF) for Karazi site was determined from estimates of runoff for Karazi. The estimates were made based on rainfall records that were obtained from the station located in the neighbourhood of Karazi catchment. From Table 4-4, the MAF was determined to be 1.35 m^3/sec. The 10% value of MAF value was thus determined to be **0.135 m^3/sec**. This value is the one recommended to be adopted as an environmental flow value for Karazi dam.

d) Elevation-Area-Storage characteristics

Area/elevation and storage/elevation curves for the dam catchment (Figure 4-5) were derived from calibrated Space-borne Thermal Emission and Reflection Radiometer (ASTER) Global Digital Elevation Model (GDEM). The ASTER DEM is available at 30 m resolution. The DEM was projected to Cartesian UTM coordinate system before being used to map the ground surface at the study area. The topographic sheets (16/3 and 27/1) at 1:50,000 scale, sourced from Surveys and Mapping Division of the Ministry of Land were used to calibrate and validate the DEM. The data was processed using Geographical Information System (GIS) software with tools for filling pits, stream flow generation and delineation of water sheds.

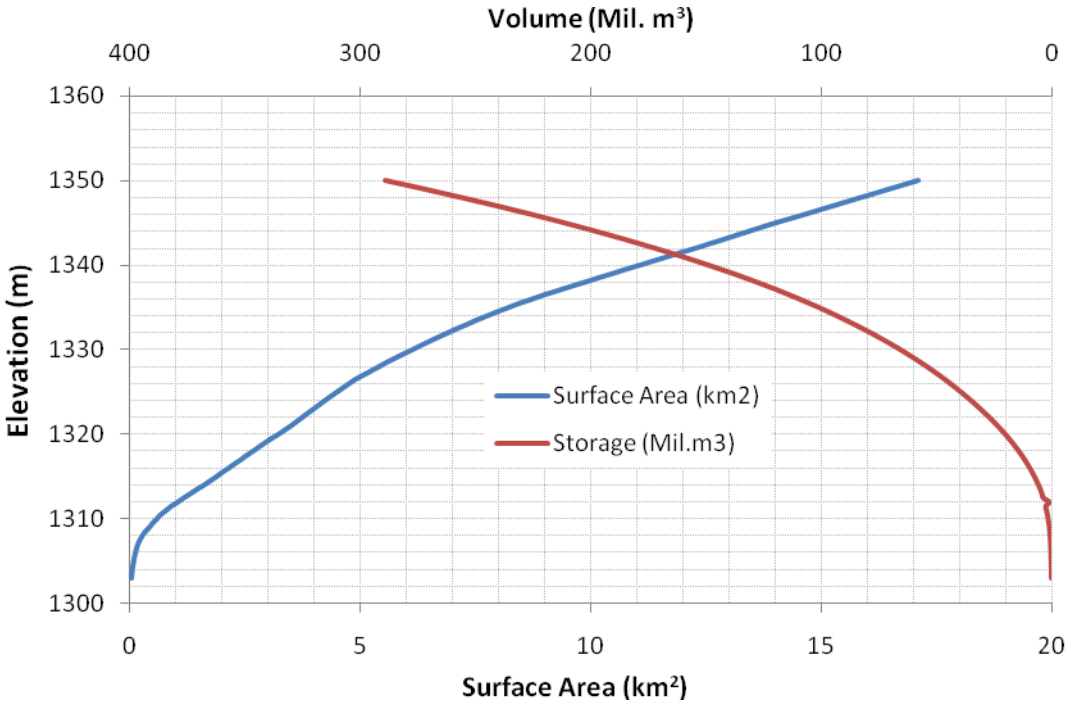


Figure 4-5: Area – Elevation and Volume (capacity)-elevation curves for Karazi site

e) Rainfall and evaporation variations in Karazi

A climate station located at Kayanga was selected as a representative station for Karazi catchment (Figure 4-6). This station is located nearest to Karazi and for that matter was used to estimate rainfall and evaporation at Karazi. The within the year variation of rainfall amounts for Karazi indicates the dominance of the transition rainfall regime with a well-defined peak during the long rains and a weak peak during the short rains (Figure 4-7). The peak during the short rains is usually absent in relatively dry years and becomes well-defined in exceptionally wet years. The seasonal variations indicate the relatively dry period between June and August with monthly rainfall amounts predominantly below 50 mm. July is the driest month in the sub-basin area while the highest rainfall amounts are mainly experienced March/April (Table 4-2and Figure 4-7). The Potential evaporation pattern derived for Kayanga is shown in Figure 4-8. The highest evaporation rate is observed during the month of August.

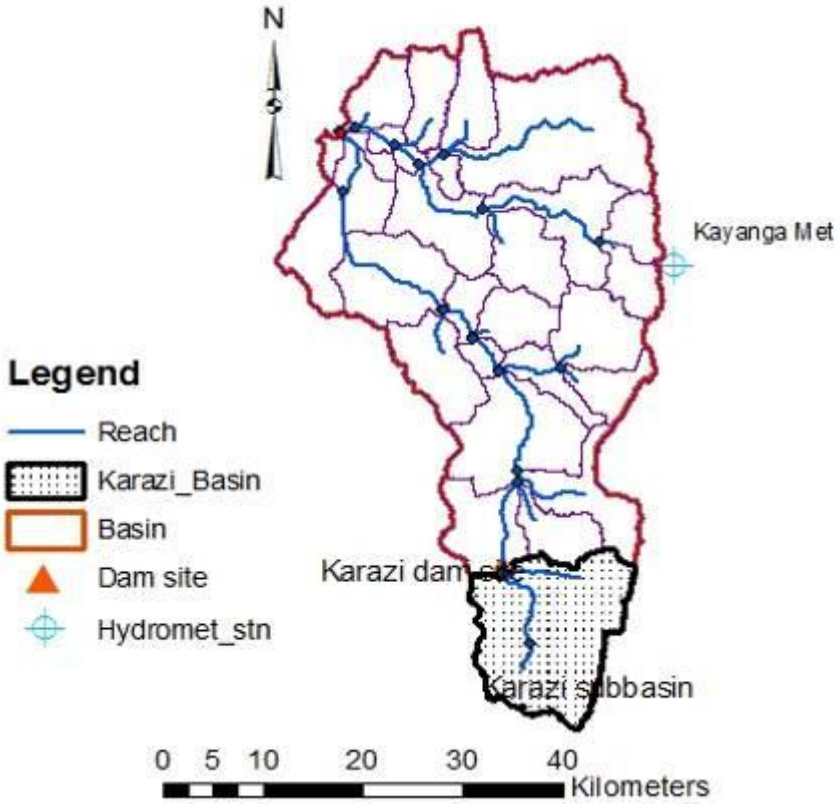


Figure 4-6: Karazi catchment showing gauging station

Table 4-2: Seasonal rainfall variation at Kayanga

Month	Mean Rainfall (mm)
Jan	74
Feb	86
Mar	124
Apr	180
May	102
Jun	16
Jul	9
Aug	34
Sep	65
Oct	90
Nov	122
Dec	109
Annual Average	**1010**

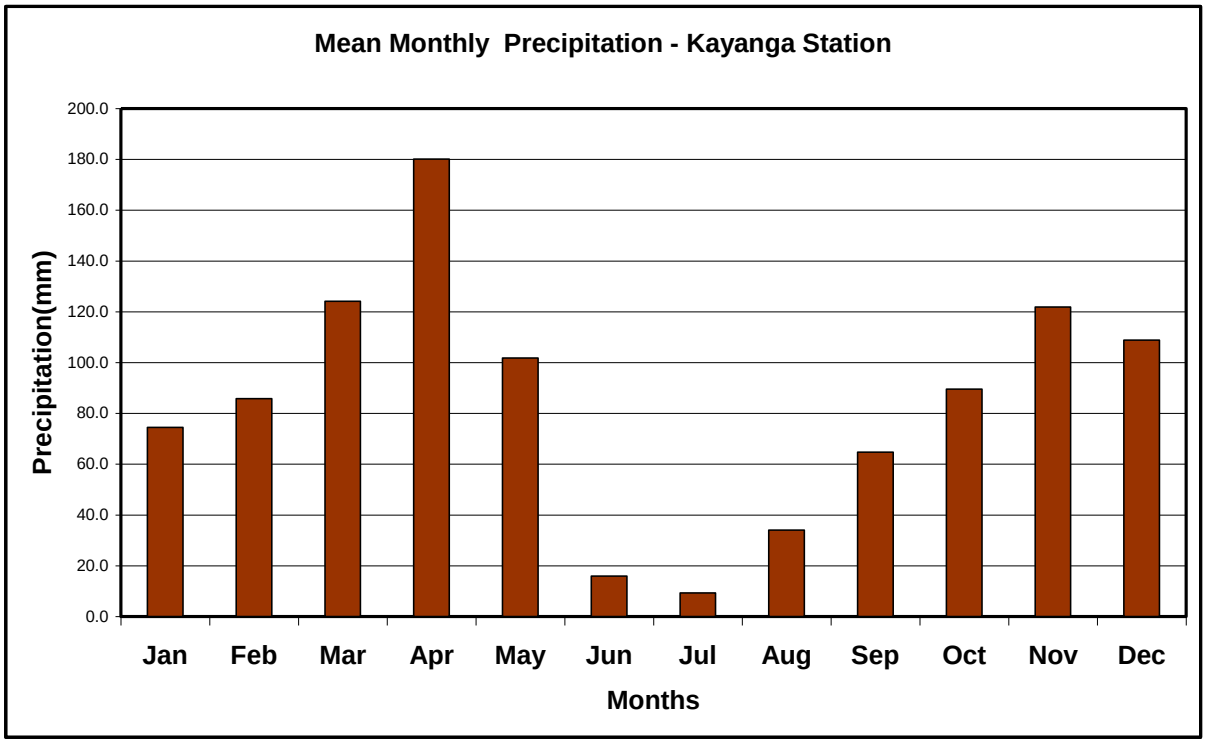


Figure 4-7: Typical seasonal rainfall patterns in Karazi Project Area

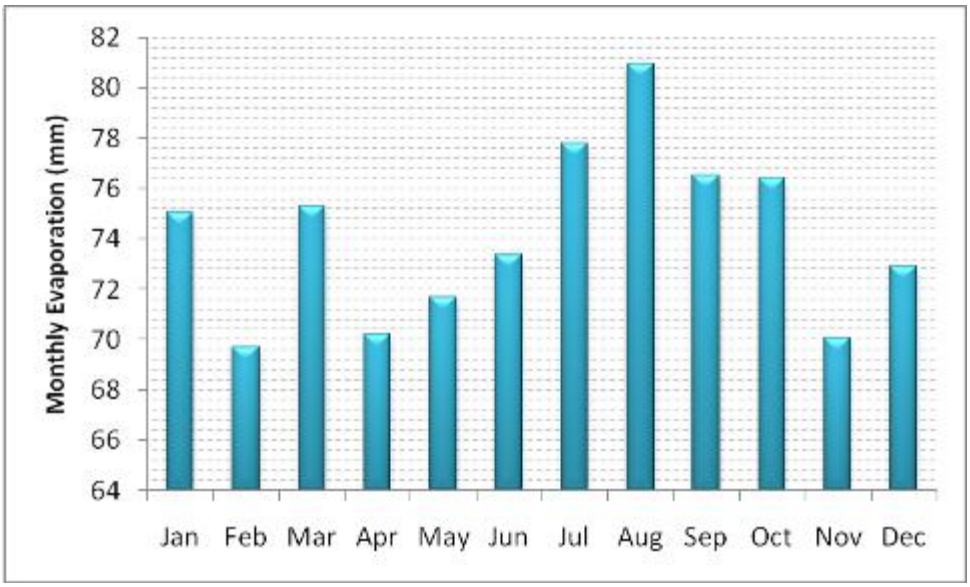


Figure 4-8: Evaporation pattern at Kayanga station

f) Catchment yield estimation

The Karazi catchment is completely ungauged. Under such a situation, the water yield to Karazi reservoir was estimated from monthly rainfall data obtained from the nearby climate station of Kayanga. Total catchment yield is the function of catchment area, runoff coefficient and rainfall distribution. The runoff coefficients for different types of soils and for different ranges of

rainfall and evaporation are presented in Table 4-3.

The total catchment runoff is estimated as: $Q = A \times R \times Rcoeff$.

where Q is the total runoff volume (m^3), R is the rainfall depth (m) and Rcoeff, is the runoff coefficient.

Taking into consideration the facts that average annual precipitation at Kayanga is 1010 mm, total annual evaporation is 890 mm and the soil type is clay pans/inelastic clays a runoff coefficient of 0.20 was adopted for Karazi catchment. The results of estimates of catchment yields on monthly basis are presented in Table 4-4.

Table 4-3: Runoff as a percentage of annual rainfall

Average annual rainfall (R) mm	**Total annual evaporation (mm)**	**Runoff as % of average annual rainfall ($R_{coeff.}$)**			
		Shallow sand or loam soils	**Sandy clays**	**Elastic clays (%)**	**Clay pans, Inelastic clays or shales (%)**
>1100	< 1300	10 - 15	10 - 15	15 – 20	15 – 25
		6.5 - 10	6.5 - 10	10 – 13	10 – 16.5
901 - 1100		10 – 12.5	10 - 15	12.5 – 20	15 – 20
		6.5 - 8	6.5 - 10	8 – 13	10 – 13
501 - 900		7.5 - 10	7.5 - 15	7.5 – 15	10 -15
	1300 - 1800	5 – 6.5	5 - 10	5 -10	10 -15
250 - 400	< 1800	5 – 7.5	5 – 12.5	5 – 10	10-15
		3 - 5	3 - 8	3 – 6.5	6.5 -10
	>1800	2.5 - 5	5 -10	2.5 – 5	7.5 – 12.5

Source: Wischmeier et al (1978)

Table 4-4: Catchment yields for Karazi dam site

Month	**Rainfall**	**Evaporation**		**Catchment yield**	**Cum. Inflow**	**Surface Area**	**Net Storage (Cum. Inflow Minus Evaporation)**
	(mm)	**(mm)**	**(Mm^3)**	**(Mm^3)**	**(Mm^3)**	**(m^2)**	**(Mm^3)**
Oct	89.6	76.44	0.079	3.773	3.773	1.034	3.694
Nov	121.9	70.05	0.137	5.133	8.828	1.949	8.691
Dec	108.8	72.92	0.189	4.582	13.273	2.586	13.084
Jan	74.5	75.05	0.220	3.137	16.222	2.933	16.002
Feb	85.8	69.71	0.228	3.613	19.615	3.267	19.387
Mar	124.1	75.31	0.275	5.226	24.613	3.651	24.338
Apr	180.1	70.21	0.283	7.584	31.923	4.036	31.639
May	101.8	71.67	0.300	4.287	35.926	4.189	35.626
Jun	15.9	73.38	0.308	0.670	36.296	4.201	35.987
Jul	9.3	77.78	0.327	0.392	36.379	4.204	36.052

Aug	34	80.95	0.343	1.432	37.484	4.241	37.140
Sep	64.7	76.51	0.330	2.725	39.865	4.317	39.535

g) Groundwater Resources

Availability of information on groundwater resources at the sites proposed for dam construction is quite limited. There is no groundwater monitoring stations located within the catchments of the dam sites. In Karazi, information is available for two drilled boreholes on the upstream part of the dam site. The information on yield and depth and operational status of the boreholes is presented in Table 4-5. The formations through which the drilling was made indicate that types of aquifers found in the area are confined aquifers found below clay or reddish laterites.

Table 4-5: Drilled boreholes in Karazi Catchment

	Borehole	**Location**		**Yield**	**Depth (m)**	**Remark**
		Easting	**Northing**			
1	Kanoge A (JTK 85)	E277695	N9796243	1440 l/hr	58.6	Not Function
2	Kanoge B (JTK 86)	E278516	N9796222	9000 l/hr	25.6	Function

Interactions between groundwater and surface water runoff were investigated by the consultant at this dam site. The investigation emphasized on observing presence of springs discharging flow to the streams. In Karazi catchment, no springs were observed indicating that there is no obvious interaction between groundwater and surface runoff.

h) Water Quality Assessment

During the field visit to the dam site, the consultant collected water samples at the dam site for water quality analysis. The Water Laboratory at the department of Water Resources Engineering of the University of Dar es Salaam, Tanzania carried out the laboratory analysis of the water samples. The sampling was aimed to give a quick assessment of the present status of the water quality at the dam sites.

The water samples taken to the laboratory were analyzed for the following parameters: pH, Electrical Conductivity (EC), Colour, Turbidity, Total Dissolved Solids (TDS), Total Hardness (TH), Total Alkalinity (TA), Nitrate (NO2), Nitrite (NO), Ortho-Phosphorus, Total Phosphorus (TP), Total Nitrogen (TN), Ammonia (NH4) and Iron. The results of the analysis are presented in Table 4-6.

Table 4-6: Results for Water Quality Analysis

S/No	**PARAMETERS**	**Karazi**	**WHO Guidelines**
1	pH	6.58	6.50 – 8.50
2	Electrical Conductivity (uS/cm)	305	2000
3	Colour (mg PtCo/l)	215	15
4	Turbidity (FTU)	75	5

S/No	PARAMETERS	Karazi	WHO Guidelines
5	Total Dissolved Solids (mg/l)	165	1000
6	Total Hardness (mg/l as $CaCO_3$)	82.50	500
7	Total Alkalinity (mg/l as $CaCO_3$)	65	Not Specified
8	Nitrate (mg/l)	4.62	10
9	Nitrite (mg/l)	0.12	10
10	Ortho-Phosphate (mg/l)	0.55	Not Specified
11	Total Phosphorus (mg/l)	0.20	Not Specified
12	Total Nitrogen (mg/l)	5.58	Not Specified
13	Ammonia (mg/l)	0.54	Not Specified
14	Iron (mg/l)	0.05	0.3

The results of the water quality analysis were compared with the WMO guidelines for drinking water. The results of water quality analysis are discussed below:

The values for pH Karazi are close to 6.5 indicating that the water is slightly acidic but it is within the expected value for natural waters. The parameter EC indicates the extent of dissolved solids in the water and hence the intensity of non-point sources of pollution. The observed values of EC were about 300 μS/cm. This value is relatively on the lower side indicating that the impact of human activities on water quality within the basin is still low. The results for EC can be related to the determined values of Total Dissolved Solids (TDS).

Phosphorus as well as Nitrogen are considered to be the nutrients in water bodies and responsible for aquatic plant growth. These nutrients normally originate from non-point source of pollution. The values for TP is about 0.2 indicating it is on a lower side. The value for Total Nitrogen was determined to be around 6 mg/l for Karazi. The relatively higher value of Total Nitrogen is most likely attributed to livestock rearing in the basin.

The turbidity of water sample is a measure of the ability of suspended and colloidal materials to diminish the penetration of light through the sample. The values of turbidity are expected to vary with season. Turbidity values are expected to be at a higher level during the start of the rainy season when surface runoffs carry considerable amounts of suspended sediment. The high turbidity values observed at the sampling point was determined to be 75 FTU. The relatively high value of turbidity determined at the sampled point was likely attributed to sediments resulting from erosion taking place in the upper reaches of the dam catchment.

The findings presented in the above section suggest that the water quality at the proposed dam site is good. From the ecological point of view, these results indicate that the stream where the dam is proposed to be constructed is healthy.

i) Reservoir Sedimentation

The Revised Universal Soil Loss Equation (RUSLE) discussed below one of the commonly used empirical methods was used to estimate the sediment yield from the dam

catchments. This information is provided to highlight the potential for reservoir sedimentation in the future. Actual estimates for sedimentation are not provided because of complete lack of sediment transport data. The **Revised Universal Soil Loss Equation was d**eveloped by United States Department of Agriculture (Renard, et al., 1997). According to RUSLE, the annual soil loss is expressed as:

$$A = R \cdot K \cdot L \cdot S \cdot C \cdot P \quad (\text{tons/km}^2\text{/year}) \tag{4}$$

Where A = computed spatial soil loss per unit area

R = rainfall-runoff erosivity factor

K = soil erodibility factor

L = slope length factor

S = slope steepness factor

C = cover-management factor

P = Supporting practices factor

The factors R, K, L, S, C and P are estimated on an empirical basis. The estimation of such parameters was performed, on a cell-by-cell basis, using GIS techniques.

The sedimentation rate is highly dependent on the storage capacity of the reservoir. With a storage capacity of about 9, 24 Mm3 for 9,5m high dam, using empirical formula the ratio of storage capacity to mean annual inflows is high (31%) (Draft Final Feasibility report Karazi Dam, 2012). The report also indicated that the Annual sedimentation rate is 1.1%. This indicates that the sedimentation rate is not significant therefore the site is not likely to be exposed to siltation.

j) Rainfall-Runoff Erosivity Factor (R)

The energy in particular storm depends upon the intensities at which the rain occurs and the amount of precipitation that is associated with each intensity value. Within the RUSLE rainfall erosivity is estimated using EI_{30}, which is the product of total rainfall energy (E) and the maximum rainfall intensity (I_{30}) (Renard *et al.*, 1997). The rainfall-runoff factor is the average annual total of all the computed EI30 values of the storms for a one year period. The storm energy indicates the volume of rainfall and runoff, but a long, slow long rain may have the same E value as a shorter rain at much higher intensity. Raindrop erosion increases with intensity. The I30 component accounts for the prolonged peak rates of detachment and runoff. The product term EI is a statistical integration term that reflects how total energy and peak intensity are combined in a given storm. Technically, the term indicates how particle detachment is combined with transport capacity (Renard *et al.*, 1997). In the calculation, only storms with the amount of rainfall more than 12.5 mm are considered, and a storm period with total rainfall less than 1.25 mm is used to divide a longer storm period into two storms (Renard et al., 1997). The rainfall energy of a given storm is calculated as

$$E = 0.29\left[1 - 0.72\exp\left(-0.05 i_m\right)\right]$$

(5)

Where E is rainfall energy [MJ ha^{-1}mm^{-1}] and i_m is rainfall intensity [mmhr^{-1}].

The rainfall-runoff factor is then calculated by using the formula

$$R = \frac{\sum_{i=1}^{j} (EI_{30})_i}{N} \quad (6)$$

Where $(EI_{30})_i = EI_{30}$ for storm i, and j = number of storms in an N year period.

Because detailed rainfall data was not available, the method proposed by Arnoldus (1980) is employed. In this method, the value of R factor is estimated with only monthly and yearly rainfall data by the following equation

$$R = (4.17 \times MFI) - 152 \quad (7)$$

Where MFI stands for Modified Fourier Index and is calculated by

$$MFI = \sum_{i=1}^{12} \frac{p_i^{\,2}}{P} \quad (8)$$

p_i = Monthly rainfall [mm] and P = yearly rainfall [mm]

R = Rainfall erosivity factor [MJ*mm/ha/yr/h].

k) Soil Erodibility (K)

Soil erodibility is a lumped parameter that represents an integrated average annual value of the total soil and soil profile reaction to a large number of erosion and hydrologic processes (Renard et al., 1997). Like the rainfall erosivity factor, the soil erodibility factor is determined from long-term measurements at standard soil plots. From these plots, scientists have derived relationships between the K factor and soil properties.

RUSLE model utilizes the technique proposed by Wischmeir et al., (1971) to calculate the K factor value of a soil. Calculation of a K value is based on five parameters, routinely characterized through standard soil profile description. These parameters are percent of silt, percent of sand, organic matter content, structure and permeability. Based on the above parameters the soil erodibility factors are derived for common soil textures as presented in Table 4-7.

Table 4-7: Soil Erodibility values (K) for common surface textures

Textural Class	**Organic Content**		
	< 2%	>2%	Average
Clay	0.032	0.028	0.029
Clay Loam	0.044	0.037	0.040

Coarse Sandy Loam	-	0.009	0.009
Fine Sand	0.012	0.008	0.011
Fine Sandy Loam	0.029	0.022	0.024
Heavy Clay	0.025	0.020	0.022
Loam	0.045	0.038	0.040
Loamy Sand	0.007	0.005	0.005
Sand	0.001	0.003	0.001
Silty Clay Loam	0.046	0.040	0.042

Source: Wall, G.J, et.al. 2002

l) Land Cover Factor (C) and Support Practice Factor (P)

For representing the effect of land use and erosion conservation practice, RUSLE uses the C factor to express the effect of cropping and management and the P factor for support practices (Renard *et.al.*, 1997). Table 4-8 shows the values of C and P for different land covers.

Table 4-8: C and P factor for different land covers

Land cover	C factor	P factor
Drainage/Water	1.00	1.0
Buildup area	1.00	1.0
Barren area	0.28	1.0
Mixed forest and cropland	0.10	1.0
Dense Forest	0.001	1.0
Agricultural area (crop field)	0.65	0.5
Paddy field	0.10	0.5
Grassland	0.15	0.5
Wetland	0.56	1.0
Mixture	0.40	0.5

m) Slope length (L) and slope steepness (S) factors

The effect of topography on erosion in RUSLE is accounted for by the LS factors. Erosion increase as slope length increases, and is considered by the slope length factor (L). Slope length is defined as the horizontal distance from the origin of overland flow to the point where either the slope gradient decreases enough that deposition begins, or runoff becomes concentrated in a defined channel (Wischmeier and Smith, 1978; Renard et al., 1997). The slope steepness factor S reflects the influence of slope gradient on erosion. Slope is often estimated in the field by use of an inclinometer or other devices, or can be estimated from elevation map. Both slope length and steepness substantially affect sheet and rill erosion estimated by RUSLE. The effects of these two factors have been evaluated separately in research using uniform-gradient plots. However, in

erosion prediction, the factors L and S are usually evaluated together by following formula

$$LS = \left(\frac{\lambda}{22.13}\right)^{m}\left(65.41\sin^{2}\theta + 4.56\sin\theta + 0.065\right)$$

(9)

Where λ is slope length (m) and θ is the slope angle.

The result of estimated sediment yield from the Karazi dam catchment is displayed in Figure 4-9. The values estimated for erosion rate are presented in Table 4-9. According to Wall, et.al. (2002), the values determined for erosion rate for the proposed dam site is low for Karazi (Table 4-10). The result obtain reflect the observations that were made in the field.

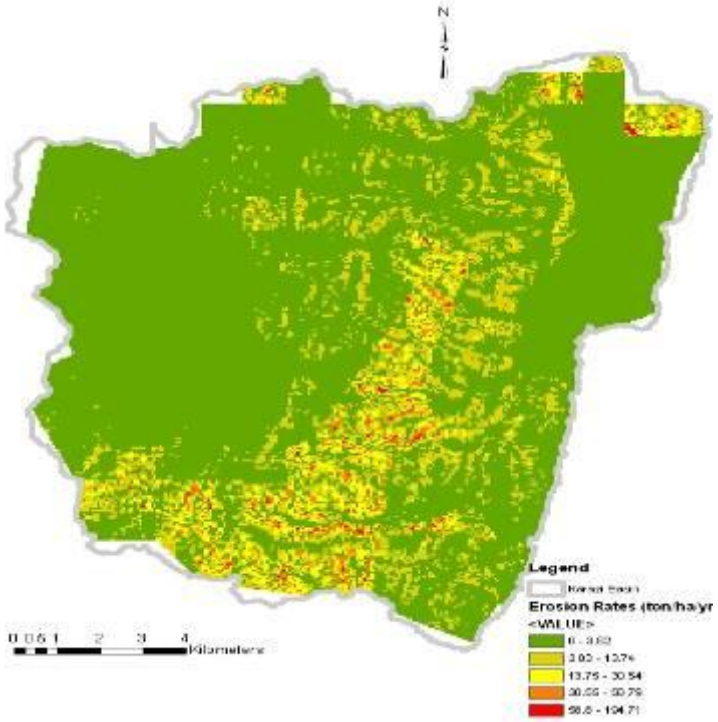


Figure 4-9: Erosion Rate from Karazi Catchment

Table 4-9: Estimated Soil Erosion Rates for the Proposed dam sites

Dam Site	**Mean Soil Erosion Rate**	
	Tons/ha/yr	**Tons/km^2/yr**
Karazi	3.4	340

Table 4-10: Guidelines for Assessing Potential Soil Erosion Classes

Soil Erosion Class	Potential Soil Loss	
	ton/ha/yr	ton/acre/yr
1. Very low (i.e tolerable)	< 6	<3
2. Low	6-11	3-5
3. Moderate	11-22	5-10
4. High	22-33	10-15
5. Severe	> 33	>15

Source: Wall, G.J, et.al. 2002

n) Flood Estimation

Peak flow estimates for Karazi dam site were made using the TRRL method. The peak flows for this site were estimated based on rainfall records obtained from the nearby climate station of Kayanga. The 24-hr Annual Maximum (AM) rainfall obtained from Kayanga climate station were used to derive a frequency curve for the 24-hr Annual Maximum rainfall records using the Extreme Value type I (EV1) distribution (Figure 4-10). From the frequency curve, rainfall magnitudes of return periods, T= 20, 50, and 100 years were determined. These values were used as input to the TRRL model to generate the peak flows of the same frequencies.

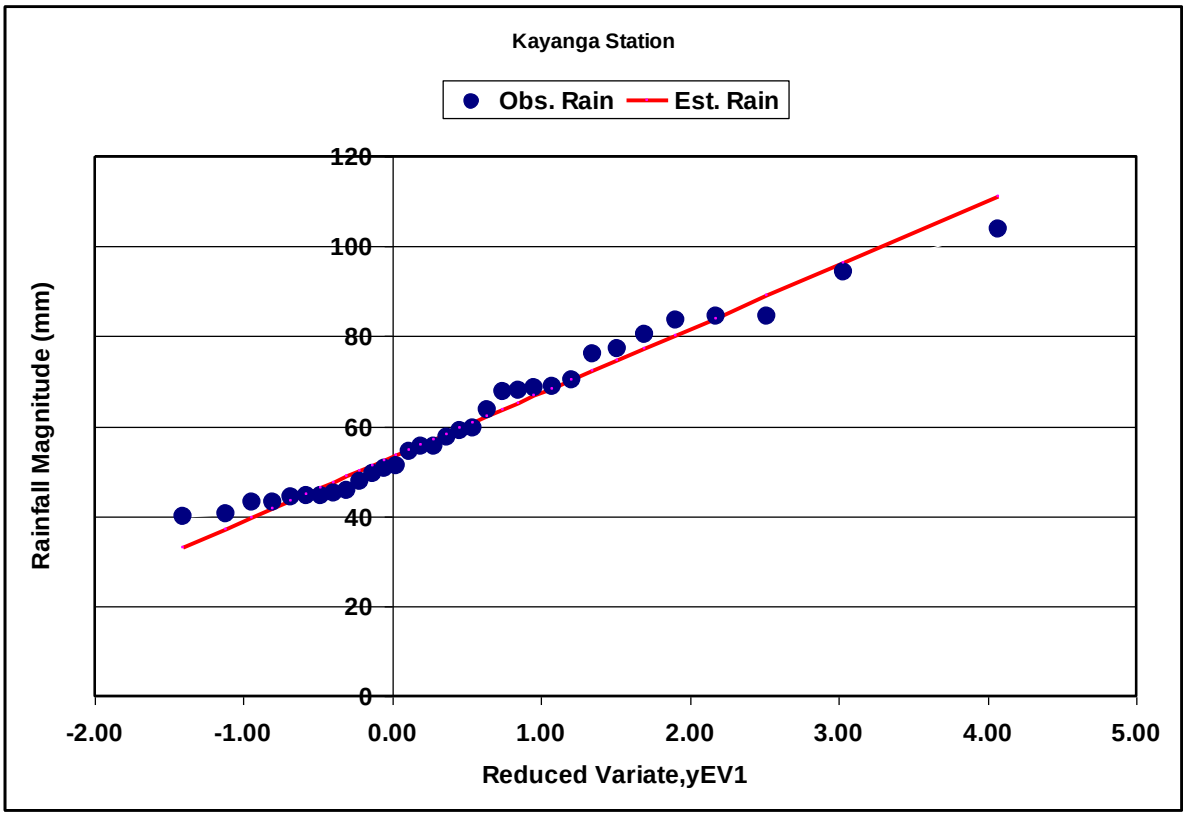


Figure 4-10: Frequency curve of annual maximum rainfall values Kayanga Meteorological station

The 'TRRL Model' developed by the UK Transport and Road Research Laboratory was then applied to generate peak flows from rainfall design storms and information on catchment characteristics such as area, land slope, channel slope, land use, soil type and climatic zone. The catchment characteristics for Karazi dam site mentioned above were extracted from topographical map, soil map and from tables provided in the published TRRL document and field observation. The estimated peak flow values for Karazi site are presented in Table 4-11.

Table 4-11: Estimated Peak Flows at the Proposed Dam Site

S/No.	Dam Site	Area	Return Period in Years		
			T=20	T=50	T=100
		Km^2	m^3/sec	m^3/sec	m^3/sec
	Using TRRL Method				
1	Karazi	210.8	64.6	73.8	80.7

KAYANGA MONTHLY TOTAL RAINFALL (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1969	129.4	150.8	93.7	234.1	158.7	0	0	37.6	50.1	78.6	188.3	75.2
1970	85	76.5	149.3	118.6	127.9	28.8	21.9	55.5	51.8	95	65.6	84

1971	90.5	88.7	113.1	241	59.5	0	13.4	105.1	59.2	90.8	112.9	103.2
1972	124.6	132.8	57.6	250.4	105.6	69.8	1.3	52.7	74.5	121.8	223.1	93.1
1973	70.6	123.7	149.8	250.2	154.7	0.8	0	16.6	74.3	89.3	224.4	63.8
1974	46	78.4	113.4	155.9	98.1	69.3	62.8	25.4	92.4	31.3	151.3	66.4
1975	69.7	158.9	131.7	232	71.6	3.3	24.9	0	96.2	124.7	136.2	56.8
1976	96.5	137.5	58.9	183.9	80.8	0.4	16.1	34.3	37	52	128.4	82.5
1977	39.9	62.9	104.4	167.6	168.6	0.9	0	21.4	68.4	107.8	96.6	52.7
1978	48.3	81.3	123.7	217	52.6	3.5	0	29.5	132.4	70.5	173.2	214.5
1979	169.6	94.5	54.9	198.6	146.2	64.3	0	21.5	57.8	38.9	83.7	184
1980	129.1	69.4	156.8	117.3	128.1	0.5	0	0	106.3	20.2	110	94
1981	44.7	13	239.6	88.5	46.7	0	1.6	35.2	41.8	76.5	94.3	34
1982	97.4	53.3	74.5	161.1	149.9	15.9	7.9	41	67	139.2	129.5	107.6
1983	38.2	29.5	67.9	260	87.3	1.6	26.4	36.7	36.3	98.1	154.1	122.8
1984	83.9	118.2	106.6	135	29.6	1.5	53.3	17.8	8.8	119.4	150.7	141.5
1985	86.3	100.5	83.7	211.4	65.5	2	0	56	121.3	172.5	113.4	102.1
1986	122.4	104	112.7	311.2	165.4	39.5	0	13.4	18.1	92.5	118.7	121.7
1987	127.3	66.6	158.6	106.4	94.3	102.3	5	16.1	59	52.4	148.1	32.5
1988	90.9	60.2	141.5	148.2	35.9	4.4	31.5	63.5	129.2	113.3	109.5	111.4
1989	44.1	19.7	119.1	184.8	52.8	0.3	0	105.8	34.2	113.2	110.7	195.2
1990	78.2	170.2	180.7	176.3	69.2	0	0	39.8	40.6	95.6	62.6	180.8
1991	79.1	111.6	262	181.2	227.8	19.2	11	11.3	65.9	176.4	66.9	73.6
1992	29.5	56.6	100.3	174.8	108.7	3.3	0	3.3	72.7	67.9	41.5	127
1993	27.3	65	155.7	55	198.7	28.3	0	12.5	44.1	79.3	134.3	119.7
1994	49.6	36	159.8	145.1	153.4	7.9	0	50.2	69.3	121.3	95.8	91.5
1995	14.7	42.5	93.1	287.7	39.4	5.7	0	1.3	66.8	75.1	149.3	181.1
1996	66.5	114.7	153.8	126.1	52.1	47.8	4.6	31.7	78.3	67.9	105.6	155.7
1997	74.5	85.8	176.8	180.1	101.8	15.9	9.3	34.0	64.7	89.6	121.9	108.8
1998	74.5	85.8	124.1	180.1	101.8	0	0	0	42.2	89.6	121.9	108.8
1999												
2000												
2001												
2002												
2003	74.5	85.8	124.1	180.1	101.8	15.9	9.3	34.0	73.3	77.7	115.9	33.7
2004	92.4	115.9	96.3	208.6	27.6	0	0	43.4	41.6	66.5	40.8	204
2005	35.2	27.6	146.4	160.5	176.9	4.3	0	40.1	110.1	86.7	67.7	41.1

2006	66.1	35.6	124.1	220.1	48.6	0	8.5	41.5	55.4	104.4	162.7	143.5
2007	52.8	45.4	101.4	108.1	101.8	15.9	15.8	51.1	89.4	127.7	156.7	100.7
2010	31.1	188.8	58.2	126.4	74.1	0	9.3	44.9	0	0.9	121.9	108.8
2011	74.5	85.8	124.1	180.1	101.8	15.9	9.3	34.0	64.7	89.6	120.4	108.8
Mean	**74.5**	**85.8**	**124.1**	**180.1**	**101.8**	**15.9**	**9.3**	**34.0**	**64.7**	**89.6**	**121.9**	**108.8**

4.1.4 Air quality and Noise

Karazi dam site is generally undisturbed natural environment with rich biodiversity. The area may be zoned as a rural setting. Major activities found happening at the proposed dam site were livestock grazing, cultivation of banana, coffee and other crops. Cultivation of crops and livestock keeping are activities that have no impact to the air quality at the project site and its surrounding environment. Air quality is therefore 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. Further, there are no roads to cause dust to rise into the atmosphere, which would modify air quality in addition to vehicles producing carbon monoxide. In this regard the air quality at the project site is generally good. Regarding noise levels, it was observed during the ESIA study that there are no sources of noise pollution close to the project site. The Karazi dam site area is therefore pristine, with LAdn ≤ 55 dB noise levels or less. 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. Therefore, the area may be categorized as quiet and serene.

4.2 BIOLOGICAL ENVIRONMENT

4.2.1 Vegetation

Karagwe District is characterized as semi-arid region subject to regular seasonal dryness and large inter-annual variability in precipitation, this results in variable vegetation cover on annual and inter-annual timescales (Evans and Geerken, 2004; Weiss et al., 2004). Climate-induced variability in semi-arid vegetation is a matter of both ecological interest and economic concern, as strong sensitivity to climate can result in rapid land use change (Vanacker et al., 2005). The Karazi area can be characterised as largely rangeland. (L. Merchant. J. 2000). Rangeland ecosystems are common throughout semi-arid regions of the world and are characterized by their mixed tree-grass composition (Salzmann, 2000). Although fire, herbivore and their combined effects (Cumming, 1997) are often noted as primary factors that maintain the integrity of rangelands, hydrological aspects also play important roles (Todd et al., 2005). This site is covered by extensive short wooded grassland of an average height of 4m high and patches short grass typically of a semi semi-arid zone. This area is subjected to prolonged droughts and high degree of temperatures but also with wetland vegetation within the valley.

Factors that affect plant communities and their diversity in woodlands are many; these are either biotic or abiotic factors but the case of Karazi dam site it is mostly the biotic factor components which includes; high frequency of wild fires from seasonal bush burning for fresh pastures and

the frequent droughts. Some abiotic factors like rainfall, temperature, and moisture, availability of minerals, pH, exposure, humidity, and soil physical properties play a great role in the composition *(Eilu, Hafashimana & Kasenene, 2004).*

Picture 4-3: Acacia trees scattered in the wooded grassland

Picture 4-4: The grassland with scattered trees

Picture 4-5: Seasonal wetland in Karazi dam site

Picture 4-6: Echnochloa and Polygonum in the seasonally wet areas

Typically, ecosystems are differentiated on the basis of dominant vegetation, topography, climate, or some other criteria. Karazi area is characterized by the savannah wooded grassland with scattered wetland patches as a result of water stagnation within the area. The rangelands are used by pastoralists for cattle grazing because of the enormous grass expanses in the seasonal wetland. The site is characterised by distinctive vegetative types that have been influenced by wide range of factors. The plants which have been recorded are shown in **Appendix 5.** The vegetation types include:-

- Savanna woodland, dominated by *Acacia geradii* (Mimosoideae) mixed with *Grewia bicolour* (Tiliaceae), *Albizia* sp, *Markhamia* sp and *Acacia polyacantha* (Mimosoideae) (***Picture 6-7, 6-8, 6-9 & 6-10)***.
- The grassland is dominated by varieties of *Andropogon gayana, Cynodon dactlyon sp, and Sorghum arundineceum.(all in Poaceae).*
- *Mashed areas characterised by Typha domingensis (Typhaceae), Echichnochloa pyramidalis (Poaceae)*

and Cyperus latifolius (Cyperaceae).

Within the Karazi project area a total of 157 plant species from 50 families were recorded. Family *Poaceae* dominated the plants species 20, followed by *Fabaceae* 18, *Mimosaceae* 13, *Acacnthaceae* 12 and *Asteraceae* 9 species. There were several families with an individual species. The most dominant life forms were herbs (25%) followed by shrubs (22%), grasses (20%) and (8%) trees of the total species recorded. The most abundant trees were *Acacia geradii, Acacia polyacantha* and *Markhamia obtisfolia* trees. Most of the plant species recorded are naturally growing within the area.

Picture 4-7: Acacia species forming the wooded grasslands

Picture 4-8: Markhamia obtusifolia in the woodland near the reservoir site

Picture 4-9: Albizia species in the wooded grassland

Picture 4-10: Aeschnomene sp in the wetland

The project implementation will affect only species within the valley while most of the woody plants are on the hills or on sloping ground.

The construction of the Karazi dam will under mind the naturally occurring flooding regime that has been recurring over a very long time and this will affect the ecology of the area. The dam will reduce downstream flooding. This will cause the disappearance of the ecologically important wetland plants in the floodplain below. The initial filling of a reservoir floods the existing plant material, leading to the death and decomposition of the carbon-rich plants and trees. The rotting organic matter will release large amounts of carbon into the atmosphere. The decaying plant matter itself will settle to the non-oxygenated bottom of the reservoir, and the decomposition unmitigated by a flow pattern that would oxygenate the water will produce and eventually releases methane gas.

Although there were no plant species of conservation importance recorded as threatened or endangered in the study area according to the IUCN (2007) red list, the impact of the project on the ecology and conservation of pant species in the Karazi dam area will be **high.**

4.2.2 Fauna

4.2.2.1 Mammals

Tanzania has some 20% of the species of Africa's large mammal population. These are found across its 14 national parks, reserves, conservation areas and marine parks, spread over an area of more than 42,000 km^2 and forming more than one-third of the country's territory. There are 364 mammal species in Tanzania, of which 2 are critically endangered, 13 are endangered, 20 are vulnerable, and 17 are near-threatened (IUCN 2007).

Karazi project site with different vegetation types notably savanna woodland, grassland and marshy areas harbour many species of mammals (rodents, shrews, antelopes, bats and primates). None of the mammal species recorded during the study is globally threatened or near-threatened.

Birds

Tanzania is a very important country for birds with a total of 1108 species of birds, of which 23 are endemic, 4 have been introduced by humans and 36 species are globally threatened (en.wikipedia.org/wiki/List_of_birds_of_Tanzania). 57 species of birds were recorded during the study (**Appendix 6**) including one globally Endangered species (Grey-crowned Crane) and 2 near-threatened **(**Grey Heron *Ardea cinerea*, and Woolly-necked Stork *Ciconia episcopus)*, and 3 restricted range species in the East African region (Spot-flanked Barbet *Tricholaema lachrymose,* Bare-faced go-away-Bird *Corythaixoides personata* and Black-lored Babbler *Turdoides sharpie*) (BirdLife International 2012a). Restricted-range species are species present in only 7.3 million km^2 of remaining natural habitat (about 5% of the world's land area) (Stattersfield, et al 1998).

The Grey Crowned Crane has recently been upgraded from globally Vulnerable to globally endangered threat category because threats such as habitat loss and the illegal removal of birds and eggs from the wild have caused very rapid decline during the past four decades. The Grey Crowned Crane has a global population of 47,000-59,000 individuals in 10 African countries 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.

Because the project will provide more aquatic habitats, the impact of the project activities on the Grey-crowned Cranes will be 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.

Though near-threatened in the East African region, Grey Heron and Woolly-necked Stork have had an extremely large range (62,100,000 km^2 and 18,900,000 km^2 respectively). The restricted range species recorded, on the other hand (Spot-flanked Barbet, Bare-faced go-away-Bird and Black-lored Babbler also have a fairly large range (1,270,000 km^2, 720,000 km^2 and 224,000 km^2 respectively, BirdLife International 2012). Because of their large global range, the impact of the project on the ecology and conservation status of the Grey Heron and the Woolly-necked Storks and other avifauna of Tanzania is expected to be **low.**

4.2.2.2 Fish and aquatic Invertebrates

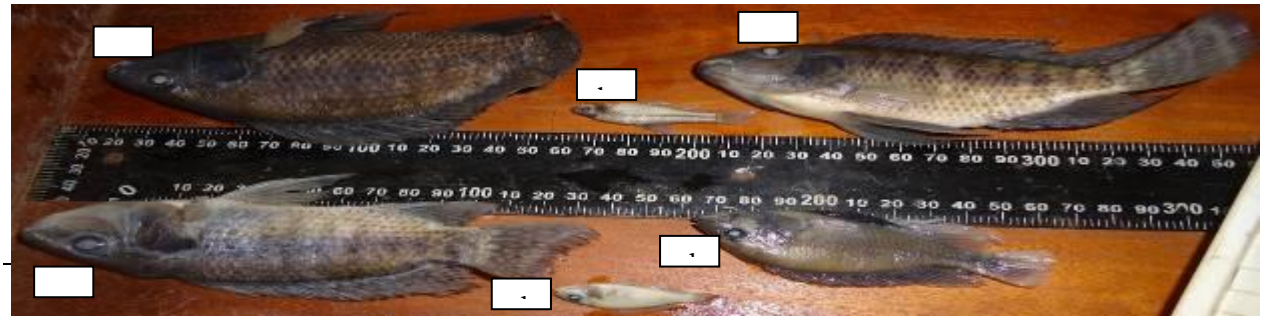
Four fish genera were caught and identified from pools in the Karazi dam site area. These included *Oreochromis niloticus, Thoracochromis* sp, *Hemichromis* sp and several *Barbus* species. These fish are shown in Picture 4-11, Picture 4-12, Picture 4-13and Picture 4-14 below.

Picture 4-11: Oreochromis niloticus (TL: 19 cm)

Picture 4-12: O. niloticus (TL: 16 cm)

Picture 4-13: Thoracochromis sp. (TL: 18 cm)

Picture 4-14: Hemichromis sp. (TL: 10 cm)



Picture 4-15: The 4 fish species at Karazi dam: a) O. niloticus, b) Barbus sp., c) Thoracochromis sp. (left) and d) Hemichromis spp.

The pools where these fish were caught were covered with shrubs and vegetation providing shade to the pools and thereby keeping temperatures from rising too high during the dry season. This could explain why fish including cichlids and *Barbus* species were able to survive in these pools all through the drought. None of these fish species are endangered nor threatened.

Invertebrates from Karazi dam site

Invertebrates caught from Karazi dam site are shown in Table 4-12 below. They included snails (Gastropoda), leeches, may flies, midges, beetles, and bugs. Some of these are shown in Picture 4-16. None of these invertebrates are endangered nor threatened.

Table 4-12: Invertebrates caught from Karazi dam site

1	**Gastropoda**	**Counts**
2	*Pila ovata*	7
3	**Arachnida**	
4	*Gadanameno*	2
5	**Noctuidae- the moths (Order Lepidoptera)**	
6	*Archnara oblonga*	1
7	**Ephemerellidae (Ephemeroptera - the may flies)**	
8	*Ephemerilia*	1
9	**Thaumalidae (the midges) belonging to Diptera**	1
10	*Thaumalea*	1
11	**Georyssidae (Coleoptera, the beetles)**	
12	*Georyssus*	1
13	**Belostomitidae (the bugs), belonging to Hemiptera**	
14	*Belostoma*	1

Picture 4-16: Fish, gastropod snails and other Invertebrates caught using a Mosquito beach seine net at Karazi dam site

Conservation status of the fish and Invertebrates in the Karazi dam site

Four genera were caught and identified from pools in the Karazi dam site area. The 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. In regard to Invertebrates found in the dam site, none of the species seen are in the IUCN Red list of endangered or threatened species.

4.2.2.3 Amphibians

A total of 12 species of frogs (out of the 114 species that occur in Tanzania) were recorded with Mascarene Grass Frog *Ptychadena mascareniensis* being the commonest and Montane reed frog *Hyperolius castaneus* was the only globally threatened species recorded (globally Vulnerable). It is listed as Vulnerable because its extent of occurrence is probably less than 20,000 km^2, its distribution is severely fragmented, and the quality and extent of its montane swamp habitat is declining. The species has been recorded in Burundi, the Democratic Republic of Congo, Rwanda and Uganda. It has not yet been recorded in Tanzania probably because of the limited studies of herpetiles in general and hence little information is available about the species (Schiøtz and Drewes 2004).

Because of the little information available about the species, there is limited information available about the ecology and threats of Montane reed frog. According to Schiøtz and Drewes (2004), the species is likely to be impacted by loss of habitat for agriculture (crops and livestock) and human settlements.

Dragonflies and butterflies

Nine species of dragonflies were recorded from the project area. There are 14 globally threatened dragonflies recorded from Tanzania (Clausnitzer *et al* 2011). In addition, 19 of the 909 butterfly species known from Tanzania were recorded in the project area. Since species of Dragonflies and butterfly recorded did not include any of the ones on threatened or near-threatened species list, the impact of the project on the ecology and conservation of dragonflies and butterflies will

be **low.**

4.2.2.4 Protected Areas

Tanzania has a great potential for natural resources, cultural and tourism attractions. In terms of wildlife, the present network of wildlife Protected Areas (PAs) in Tanzania is comprised of 15 National Parks, 33 Game Reserves and 43 Game Controlled Areas. The wildlife PAs network covers 233,300 Sq. Km (28%) of the total Tanzania's land surface area. Tanzania's 80 Important Bird Areas (IBAs) cover a total of more than 167,000 km^2 or about 18% of the land area with sites varying in size from 3 hectares to 5 million hectares (African Bird Club, 2012).

The nearest PAs to the project site are Biharamulo Game Reserve (13,000,000 ha) and Burigi Game Reserve (22,000,000 ha) that make up the Biharamulo-Burigi IBA (TZ014) (31° 15.00' East 2° 15.00' South) (See figure 2-4). Biharamulo –Burigi IBA has some Biodiversity hot spots. It is located about 35km from the proposed project to the edge of the reserve. The central part of the IBA lies between Bunkwe Bay on Lake Victoria in the east and Kagera swamps (TZ024) to the west, the Biharamulo-Burigi IBA is characterized by a series of north–south ridges, separated by drainage lines and rivers flowing north. The lion *Panthera leo* (VU) occurs while African elephant *Loxodonta africana* (EN) were numerous as recently as 1975, but have suffered from poaching (BirdLife International 2012c).

The African elephant with a very big home range 14-3,120 km² would reach the project area from Biharamulo-Burigi conservation area if there were wildlife corridors. There are settlements, cultivations and other forms of land use between Biharamulo-Burigi conservation area. It is unlikely that the elephants can move from Biharamulo-Burigi conservation area to the project area considering the distance and other barriers**.**

4.3 SOCIO-ECONOMIC ENVIRONMENT

4.3.1 Administrative Structure

Karagwe District Council is one of the eight Councils of Kagera Region and covers an area of 7,716 Km². Out of this 7,558 km² is dry land and 158 km² is water. The Council borders the Republic of Uganda in the North and the Republic of Rwanda in the West. The Kagera River forms the boundary between Karagwe and the Republic of Rwanda and Uganda. The Districts of Ngara and Biharamulo border the District in the South while Muleba and Bukoba Districts to the East. Karagwe has 5 Divisions, 22 Wards, 73 Villages and 725 Vitongoji, and 8 Mitaa in the Kayanga Township Authority. The project area is located in Nyakakika ward between the villages of Chabuhora and Kayungu villages.

The main organization of the village government in Karagwe District is the village Assembly and council. The village Assembly is made up of the adult members of the community and the village council is composed of between 15 to 25 representatives. The village council is responsible for overseeing day-to activities in the village as well as making decisions on matters concerning the whole community. Functions of the village Assembly are the maintenance of peace and order the promotion of social welfare and economic development. The village council manages the village and implements decisions made by the Assembly. Like the district council, the village government is arranged into a series of committees and overseen by the village Chairman, village

Executive officer, and village Leader (members of the council). The main committees include Finance and Planning, Safety and Security, Construction and finally Education and Social Services. The sub-committee of the latter includes the water and sanitation committee, health committee, Environment committee and the school committee.

4.3.2 Demographic characteristics

i) Population

According to the 2002 population census results, Tanzania is projected to have 40 million people by 2012 whereby 49% are male and 51% are women. Karagwe District has a total population of 554,684 people. Out of this 271,891 are males and 282,793 are females. The population growth rate was estimated at 3.1% per year while population density changes regularly due to urbanization and availability of fertile land. Therefore, high population density is found around Kayanga Township and rural areas along the roads and within growing trading centres like Murushaka and Nyaishozi.

In the study area Chabuhora village has a total population of 9,652 of which 4,730 are males and 4,922 are females and it has 1,518 households. Kayungu village has 4,166 people of which 2,047 are males and 2,119 are females and it has 886 households. Nyakakika village has a population of 12,714 of which 6,230 are and are 6,484 female with 2,564 households.

On average household size is 4.8 (approx. 5). The number of children below 18 years is more than 60% of the entire population. Adult population age from 18- 39 years occupies 47.9%, 40 – 64 is 41.7% and 65+ is 10.4%. This shows that in the study area there is enough manpower which the project can hire.

ii) Level of education

The results from the household interviews revealed that 13.8% of the population never attained any education, 80% attained primary education, 5.4% attained secondary level, 5.4% attained tertiary level and 0.4% attained university education. The situation signifies distribution of material alone for disclosure will not cover every one; talking to people directly will be necessary.

iii) Marital Status

According to the results from the household surveys, 89.9% of the household heads were married of which 74.9% had only one wife and 15% had more than one wife. 7.1% of the households were widows, 2.5% were divorced and 0.8% of the households were single. The results signify that the institution of marriage is very much respected in the area.

iv) Ethnic Composition

According to the Karagwe District Profile, the dominant ethnic group in the district is the Nyambo, although there is a small ethnic group of Haya. A lot of people are migrating from neighboring Districts of Muleba, Bukoba and Biharamulo into Karagwe, normally in search of agricultural land. There are also migrants from neighboring countries of Uganda, Burundi and Rwanda moving into Karagwe in search of pastures and agricultural land. The most common languages used in the area are Kiswahili and Runyambo.

4.3.3 Major Economic activities

Analysis of social economic activities was carried to determine income and expenditure pattern

of Chabuhora, Kayungu and Nyakakika people. Although men are still regarded as the family breadwinners, gender relationships reflect the importance of both men and women in the present socio- economic set-up and activities in the area. In regard to access and utilization of production resources, both genders are involved. Both men and women are involved in agriculture, retail business, operating food-vending and casual labour and forestry products. Collection and sale of fuel-wood are mainly youth and women activities. Ownership of means of production such as land, labour, basic capital assets and seasonal inputs such as seed is less balanced. However at the end men are regarded as the owners and final decision makers over the family resources.

v) Agriculture

Agriculture is the primary occupation of the local people living in the project area. Household interviews indicate that agriculture is the first occupation. About 99 % of the interviewed households admitted that about 93 % of their income is from agricultural produce. Even for the households with other sources of income, agriculture contributed more than half of their income and expenditure.

According to the household interviews, the occupation which earns more income in the study area is farming which covers 94.2%, followed by salaried workers 2.1%, trading 1.7%, service provision 1.7% and others occupy 0.4%. Majority of the households are peasant farmers (Figure 4-11).

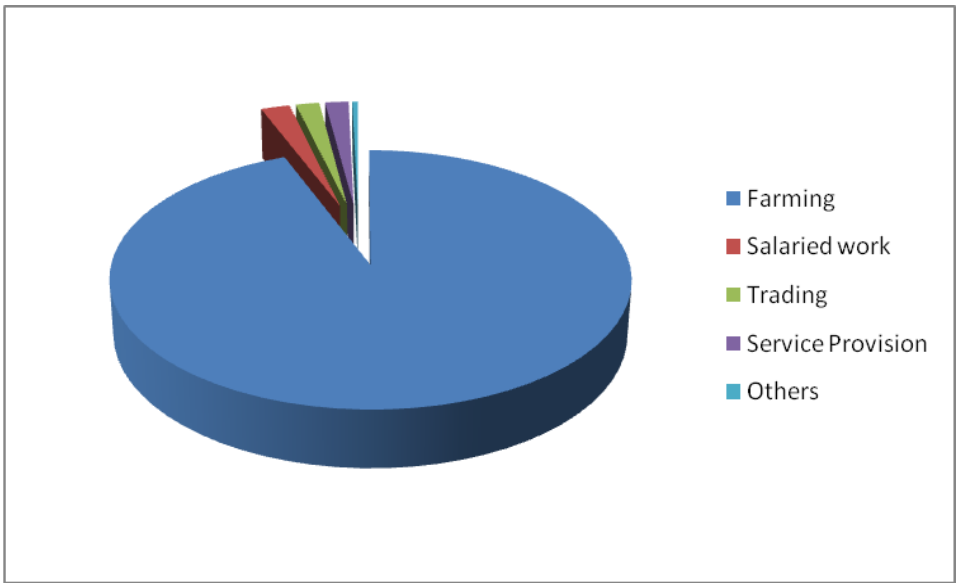


Figure 4-11: Major Occupations of households in the Project Area

Crops grown in the area are broadly categorized into food and cash crops. The main food crops include bananas, maize and beans (Picture 4-17 & Picture 4-18) while Coffee (Robusta), maize and Irish potatoes are the main cash crops. Agriculture is dominated by subsistence farming and average farm size is two (2) hectares per household; the limitation being availability of fertile soils.

Picture 4-17: Beans and Cassava

Picture 4-18:Banana and Coffee plantation

In the study area the agriculture pattern is characterized by mixed farming where two or more crops which are compatible are mixed together in one plot. According to agricultural report from DALDO Office 2012 the main food crop (banana) is cultivated by every household and a total of 3,553.5 hectares were cultivated and yielded 48,543 Tons while other crops also yielded significantly as shown in the Table 4-13.

Table 4-13: Production of food & cash crops

Type of crops	Average hectare cultivated	Average production tons per hectare	Current market price (Tshs.)
Banana	3553.5	14	2000
Maize	755	1.5	30,000 per bag
Beans	585	0.75	60,000 per bag
Cassava	106.4	10	3,000 per tin (debe)
Coffee	294.8	1.5	1,360 per Kg
Sorghum	140	1	36,600 per bag
Groundnuts	120	0.75	1,600 per Kg

Source: DALDO Agricultural Reports, March 2012

As regards the cultivated areas, segregating by gender, anecdotal evidence suggests that, females cultivate less land than males but outputs are on average higher for females than in the male owned plots. Since the cultivated areas are lower for females than males, three possibilities explain the observed situation: (i) productivity of agricultural resources, specifically labour, is higher for female than male (ii) female spend more time (the second resource to land) on their fields thereby raising their productivity, (iii) Basically, there are three main farming systems in Karagwe. These are Kibanja, Kikamba and Rweya. Agricultural production is predominantly based on traditional technology. Agricultural activities employ only household labour unless it becomes necessary to hire additional labour. The agriculture is also characterized by the use of

unimproved seeds saved from the previous crop harvest.

As regards marketing of the agricultural produce, the households sell their produce to local traders who in turn may sell it to the bigger towns like Mwanza, Kahama and Dar es Salaam. However, the farmers are faced with a number of problems when marketing their produce. These include bad roads, fluctuating and low prices and inadequate markets.

As regards food security, the place is well endowed with food and consultations showed that there has not been any shortage of food in the area for a long time. This was attributed to favourable weather.

vi) Livestock rearing

The communities in Karagwe especially in the study area also engage in livestock keeping, (Table 4-14). There are about 9,022 cattle in Nyakakika and Nyakabanga wards. Only a few farmers practice zero grazing mainly Friesian types and F1 & F2 crosses with the Tanzanian shorthorn zebu. The rest of the farmers keep Zebu and Ankole type (the local breed) (Picture 4-19) whose milk production is limited to 1-3 liters/day. In the banana-coffee areas small stock (goats and sheep) and dairy cows are kept. In the low-altitude/basins areas a big numbers of free-grazing cows and goats are kept.

Table 4-14: Number of livestock in the Project Area

Wards	**Types of Livestock**					
	Cattle	Goats	Sheep	Pigs	Chickens	Others
Nyakabanga	4050	970	98	164	2332	316
Nyakakika	4972	5005	225	99	3015	472
Total	**9022**	**5975**	**323**	**263**	**5347**	**788**

Source: Karagwe District Agriculture Department

Picture 4-19: Common type of cattle kept in the area

Arable land for livestock activities in the district is 255,040 hectares. There is an opportunity in this area especially establishment of ranches. The district has 40 qualified veterinary staff. Possible lines of investment may include ranching, milk and meat processing and exportation of cattle. There are 61 units of Primary Cooperatives Societies, 38 SACCOS and 1 cooperative Union (KDCU).

Availability of livestock market at Rukole (Ihanda) and Nyaishozi ward creates opportunity for livestock trading with neighbouring countries of Uganda, Rwanda and Burundi. There are four (4) livestock production systems in Karagwe i.e.

- Indigenous cattle kept on communal land set aside by village government.
- Semi-nomadic system whereby large herds of cattle move around depending on availability of pasture and water.
- Small holder dairy cattle farmers who practice zero grazing mainly Friesian/Boran or Ankole cattle breeds.
- Large scale ranch (currently there is ranch owned by National Ranching Company – NARCO). (Karagwe Investment Profile 2011)

In the project area, the most common types of livestock production systems include indigenous cattle kept on communal land set aside by the village government and the semi nomadic system whereby large herds of cattle move around depending on the availability of pasture and water. Consultations with the area leaders revealed that the land in the project area is demarcated between cultivators and pastoralists though the demarcations are not official.

4.3.4 Micro and small-scale enterprises

This is another important sector; a third main occupation of the interviewed households from agriculture. The activities include retail shops, small restaurants, petty trade and selling of local brew. These are discussed below.

vii) Retail shops

Currently the project area has several retail shops situated in village centres. The shops stock a wide range of goods including foodstuffs, household utensils, school supplies, textiles and minor spare parts for bicycles. Construction materials such as corrugated iron sheets and cement are difficult to sell hence are completely not stocked by the shops in the area but are found in the nearby centres of Nyaishozi, Murushaka and Kabanga.

The shop operations adopt various techniques to keep the operation costs low. For example, shops are often located in one of the rooms within the homestead, and usually attended and managed by members of the household. Procurement of goods to be sold in their shop is done in bulk to optimize transport costs of hiring vehicles; otherwise household members are physically responsible for procuring and transporting small amounts of goods using motorcycles or public transport when available.

viii) Restaurants and food vending

There are few small restaurants and numerous food vendors in the study area. The restaurants serve soft drinks, tea, snacks and meals basically to external visitors and limited number of village residents. Consultations revealed that during the peak of the agricultural season the restaurant operators withdraw temporarily from their restaurant activities to attend to agriculture. Food

vending, snacks and evening coffee/tea selling are also very much affected during this time because the desirable customers migrate to the farm plots.

Selling of local brew (Rubisi) is commonly in village centres where people usually meet in the evening for refreshment. In growing centres like Nyakakika and Nyakabanga bottled beer is also sold in stores and small pubs.

ix) Petty trade

Petty trade includes selling a range of products in small quantities in homes and, in other villages, at the local market or along the streets. The products sold include maize and cassava flour, vegetables, and dry cassava, dried fish, fruits and bananas. Other products handled by petty traders include household utensils and textiles, mainly second hand clothes.

x) Salaried employment

Prominent occupations recognized for salaried employment are found in the sectors of education and local government. These sectors employ teachers, Village Executive Officers (VEO), Ward Executive Officers and medical personnel. The study noted that most of the employees originate from within (Bukoba region) and very few are coming from outside Bukoba. In the project area, very few (2.1%) of the households were employed as salaried workers.

4.3.5 Income and expenditure

xi) Reliability of the data and information

Poverty is an important factor accounting for failure in accessing social services. The widespread income and asset poverty in the villages has negative implications to the livelihood by limiting people's ability to access basic social provisions such as food and health. Household wealth and access to basic needs is impeded by low levels and patterns of household income and expenditure, as well as poor capital assets that the households possess. The two variables were considered important in assessment of household wealth and their capacity in accessing social services. All of these parameters were considered sensitive to the extent that households did not want to reveal such information to strangers.

The following were also noted as limiting factors to reliability of the data and information obtained:

- Absence of written records. The majority of respondents showed strong uncertainty in estimating their incomes and expenditure, even those referring to short duration of time such as a day or two.
- Incomes and expenditure vary strongly with seasons, the tendency being that households spend highly as received while they spend too little or almost nothing when there is no cash flowing in.
- Since the economy is basically subsistent, the households fail to demarcate between amounts of food that come from own production and the market as well as the food that is produced for home consumption and from the market.
- Several transactions and transfers, including remittances from relatives staying away from the villages under study, are in kind or materials rather than cash. Villagers are not able to determine precisely the monetary value of such incomes and expenses.

xii) Income of the households

The per capita income for Karagwe district is estimated at Tshs.450,000. This includes the value of cash and kind production and transfer payments (District Profile, 2011).

The average annual incomes for the interviewed household ranges between Tshs.500, 000/= and Tshs.10,000,000.00. Households earning between 0 to Tshs. 500,000/= is 25.8%, between 600,000/= to 1,000,000/= is 24.2%, between 1,100,000/= and 1,500,000/= is 17.5%, between 1,550,000/= and 2,000,000/= is 10.4%, between 2,100,000/= and 3,000,000/= is 10% and above that is 12.1%. Majority of the population earn between 500,000/= and 1,500,000/= which is 67.5%.

Collected information shows that households and individuals generate their income from Agriculture, animal husbandry, micro and small-scale enterprises, formal and informal employment; in ascending order of importance.

Furthermore it was surprisingly revealed that although a household has common resources for income, the wife (wives) tend to separate their income from that of the household due to uncertainties and insecurities within the marriages caused by polygamous practices. Looking at the gender, anecdotal evidence indicates that incomes from micro enterprise and agriculture, on average, are higher for female than male. The difference in the overall earning among gender is basically attributed to the fact that women in the household are engaged in other multi- income activities (such as casual labour, handcraft, petty trade and foodstuff vending) and have low expenditure as compared to men.

xiii) Households' expenditure

Collected data (Figure 4-12) reflects that annual household expenditures go to food (50.4%) followed by school fees (13.3%), clothing (10.4%), medical bills (10%), water bills (6.7%), transport (3.8%), energy (0.8%) and others take 4.2%. Figure 4-12 below illustrates the ranks.

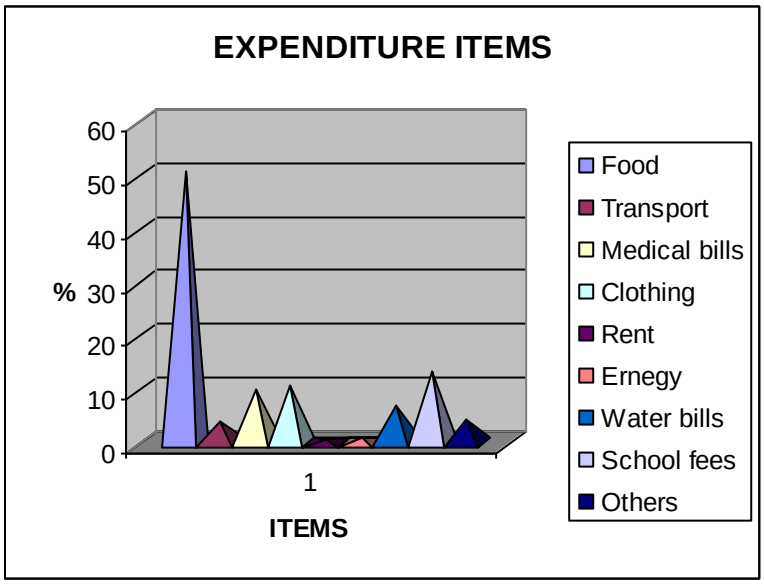


Figure 4-12: Expenditure items at household level

(Source: Field survey data, 2012)

The data revealed that more than 26 % of the interviewed households earn less than Tshs. 50,000 a month. When this is distributed among food and non-food expenditure, access to other basic needs may adversely be affected. The data showed that food expenditure alone takes 50.4 % of the total household expenditure. Food expenditure involves buying of items like meat and milling of the foodstuffs like millet, cassava and sorghum. This implies that less than 50 % is left for non-food expenditure including investments.

Expenditures on water, school fees and clothing take 30.4% of the remaining 49.6 %. Rationally, one would argue that with such low income, if health care expenditure exceeds more than 15 % of the remaining sum of non-food expenditures, then the family would not afford to pay for proper health care. This suggests that majority of low income earning households suffer some kind of inability to afford some basic needs.

The general observation through the analysis of income and expenditure and other observations is that the low income earning households in the area are below the soft-core poverty line of USD 1 per day.

c) Possession of capital assets

The households' capital assets covered are houses and possession of assets such as a car, bicycle, TV, radio, motorcycle animals, cell phone, land and few others. Summary for these indicators are provided in Table 4-15 below:-

Table 4-15: Possession of capital assets at household level

Item	Household with items (in %)	Household without items (in %)
1. Radio	80.4	19.6
2. TV	4.6	95.4
3. Bicycle	45.4	54.6
4. Motorcycle	17.9	82.1
5. Car	3.3	96.7
6. Cell phones	67.7	32.3
7. Land	95.4	4.6
8. House	92.9	7.1
9. Animals	56.7	44.3
10. Others	3.3	96.7

Source: Field survey data, 2012

Possession of capital assets is discussed as part of household wealth and investments for accessing social services. It was noted that only a few households possess capital assets. As a measurement of poverty, owned assets imply that communities in the area are generally moderate income earners. During the discussion it was revealed that due to low income of some households and individuals, they are unable to pay for common problems when they arise. According to them, in extreme cases households have to solve their problems at the expense of

the future productions, selling or pawning of available assets or through some form of loan. Low income and lack of assets shows incapability of the household to cater for its basic needs. Even if the household gets a soft loan it may fail to pay back. Eventually the household would be compelled to sell any of its assets if the loan is not from a close relative. Disposing off of assets to meet contingencies reduces household future productive and earning capacity.

On the other side possession of assets like radios, cell phones and houses indicates the ability to access to information in full time basis. Bicycles and motorcycles guarantee reliable transport within and without the village. Land ownership correlates with food and cash production as well as in income.

4.3.6 Employment opportunities

In the study area, employment opportunities are limited mainly to the agriculture sector. The establishment of small and medium industries is not easy because of unavailability of electricity and therefore this contributes to the low employment opportunities in the area. The statistics reveal that employment opportunities in the formal sector are hard to come by and therefore in regard to this project employment opportunities are given a high value. Human resource is thus available if the project will require such people.

4.3.7 Land use, ownership and tenure

A greater part of the District is cultivated and the remaining is protected areas (forests, game reserves and ranches). Some patches are left uncultivated because they are located on very steep slopes and some are swampy areas. Livestock keeping is also practiced in wooded and open grasslands. Land is more intensively used in the northern part of the District than in the southern part. Deforestation and bush fires are common practices in the District. Tree planting is now becoming common but these efforts are frustrated by bush fires and livestock grazing by agro pastoralists. Natural regeneration is the main reforestation mechanism.

In the proposed area for the dam the area is mainly used for grazing cattle. However, at the periphery of the area observations showed that traces of cultivation mainly beans, maize and a banana plantations.

Due to permanency of settlement by the communities, land ownership has been passed from one generation to another i.e. land has been transformed to family ownership thus customary land tenure is the most common in the area. In most cases women do not own land, due to the patri-lineal inheritance system but have access to the land of husband. Consultations revealed that a few farmers have surveyed their land and have title deeds. Village Governments preserve some land for public uses and provision to landless people.

4.3.8 Housing and settlements

Shelter is one of most important human basic needs. Good housing has a close correlation with good health and other aspects of human dignity and well-being. Though there is lack of a clear-cut definition of a proper and good housing facility, enough and well-ventilated rooms, kitchen and toilets provision were used to determine the quality of the shelter in the study area. Also the type of structures and materials used in construction were also primarily used to determine the quality of the houses in the villages.

The situation of housing in the study area exhibits typical rural infrastructure. About 80 % of houses in the villages are semi-permanent (Picture 4-20) constructed with poles and mud with

galvanized sheets, while the remained 20 % comprise houses made of cement bricks, with cement floors, plaster and roofed with iron sheets (Picture 4-21).

Picture 4-20: Semi-permanent house in the project area

Picture 4-21: Permanent house

The settlements are scattered from each other and this is attributed to the big sizes of land owned by each household. However, in trading centres, the settlements are concentrated and majority of them are used as commercial structures. In the proposed area for the reservoir, there were no houses or settlements were observed.

4.3.9 Health

i) Infrastructure

In the district there are 3 Hospitals, 1 owned by the private sector Evangelical Lutheran Church of Tanzania (ELCT) and 2 owned by (Catholic Diocese), 3 Rural Health Centres, 1 urban health centre and 44 dispensaries and 2 Pharmacies. The government owns 40 dispensaries and 5 are owned by the private sector. There is a shortage of Health facilities including Dispensaries, hospitals in the district. Chabuhora village is served by a government dispensary whose facilities need major rehabilitation.

ii) Health Service delivery

In regard to health staffing, the district faces inadequate qualified personnel including Assistant Medical doctors, dentists, clinical medical officers, nurse-midwives and nurses. Table 4-16 explains the deficit. In addition, to this there is lack of adequate staff housing.

Table 4-16: Number of Health Personnel in the district

Cadre for Health personnel	**Required**	**Available**	**Shortage**	**excess**
District Medical Officer	1	1	0	0
Assistant District Medical Officer	6	2	4	0
Dentist Officer	6	2	4	0
Clinical Medical Officer	99	33	66	0
Assistant Clinical Medical Officer	72	4	68	0
Pharmacist	1	1	0	0
Nurse-Midwife Officer	20	16	4	0

Nurses	147	95	52	0
Other assistants	231	204	47	0

Source: Karagwe Health Report January- December 2011

Access to health facilities in the study area remains to be more than 6km for District hospital and more than 3km for health centres while dispensaries are available within the wards. However, due to the big size of the administrative units including the villages, some households travel a distance of more than 5km to reach a dispensary.

iii) Diseases

The leading diseases are Malaria, Diarrhoea, Pneumonia, Anaemia, ARI, Tuberculosis, STI/Clinical AIDS and Severe Protein energy malnutrition. However in the study area 70.4% of the household members reported not to have suffered any disease for the past six months while 20% of the members suffered from malaria and 9.6% have suffered other diseases like cough and diarrhoea.

As regards disability, it was established from the National Census and Housing of 2002 that 10% of children population in the country have one or more types of disability. Data from the sampled population in the study area shows that 7.5% of the children have a disability. The main type of disability reported was physical disability.

iv) HIV/AIDS

Transmission rate for HIV was 4.8% in 2010 and declined to 4.7% in 2011 while mother to child transmission is 2.4%. The district has established 7 clinics for ARV and 42 for PMTCT. (District Health Report) The HIV/AIDS scourge has also hit the education sector. Consequently, the HIV/AIDS prevalence and awareness has been incorporated in the primary school curriculum and several NGOs such as World Vision, NAPOA provide periodical seminars to help reduce on the disease. It is likely that during the construction phase, HIV/AIDS might be on the increase due to the expected influx of people in the area.

4.3.10 Education infrastructure and service delivery

The district has 211 Primary Schools of which 202 are owned by the government and 9 are owned by the private sector. In addition there are 49 Secondary Schools of which 40 are public and 9 are privately owned. More so, the district has 4 Post Primary Training Centres, 4 Vocation Training Centres, 4 Teacher Resources Centres and 5 Sub Teachers Resource Centres. Table 4-17 below shows the number of primary and secondary schools and the enrolment in the district.

Table 4-17: Primary & Secondary school and, enrolment levels in Karagwe District

	Government aided	**Private**	**Total**	**Enrolment**		**Total**
				Boys	**Girls**	
Primary	202	9	211	56,492	60,076	116,568
Secondary	40	9	49	8,586	9,484	18,070

Source: Karagwe District Education Report 2011

The statistics above show that enrolment of pupils is significantly good. NeR was 99.3% and the dropout rate is minimal in the area and it is caused by early pregnancy. The high enrolment rate

is attributed to the fact that education is free.

Consultations with the District Education Officer revealed that in the project area there were 7 primary schools and 1 secondary school. The primary schools are Nyakabanga Primary School, Bwikiro Primary School, Chabuhora Primary School, Chema Primary School, Nyabweziga Primary School and Unundizo Primary School while the secondary school is Nono Secondary School.

The number of classrooms is relatively sufficient in all schools but textbooks are inadequate for every subject. The District Education report (2011) indicates that the average pupil book ratio is 1:39. This implies that there is acute shortage of textbooks in all primary schools. In secondary schools the average of students- book ratio is 1:11. Secondary education however suffers shortage of furniture like tables, chairs cupboards and alike as shown in Table 4-18 below:-

Table 4-18: Shortage of furniture in Secondary Schools in Karagwe District

Facilities	Students' Tables	Chairs	Teachers' Tables	Teachers' Chairs	Cupboards	Shelves
Required	16,139	16,186	810	873	499	214
Available	14,292	14,814	570	365	115	39
Shortage	1,847	1,372	240	508	384	175

Source: Karagwe District Education Report 2011

In addition, secondary schools also face shortage of laboratory facilities, equipment and chemicals. The graph in Figure 4-13 below illustrates the level of shortage

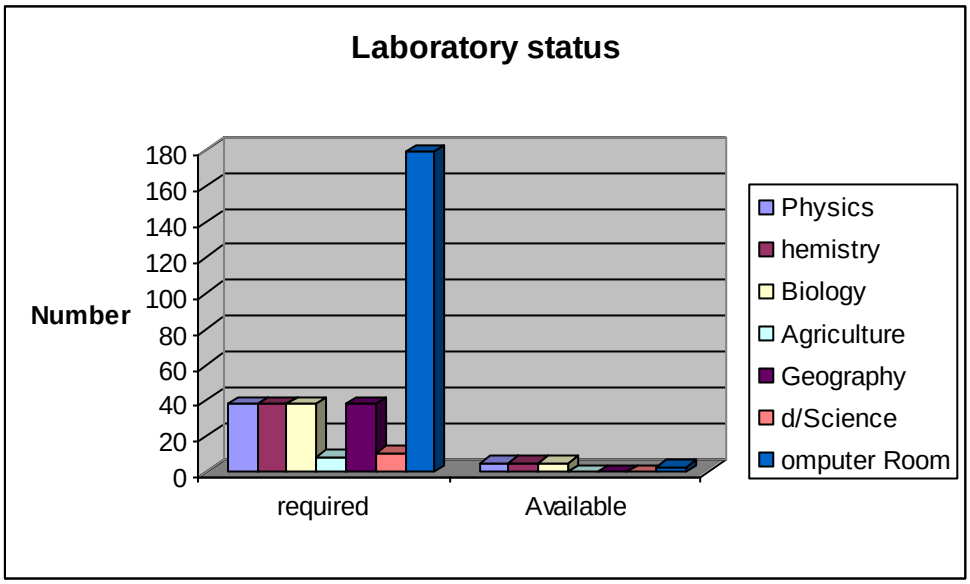


Figure 4-13: Secondary School Laboratory Status
Source: Karagwe District Education Report 2011

Availability of primary teachers in the district is 59% (41% deficit). For example in Nyakabanga ward (in the study area) there are 7 primary schools with pupils 2,961 has 45 teachers and a deficit of 91 teachers (WEO Report 2012).

4.3.11 Water supply

Water supply in Karagwe district is divided into two different authorities one being Urban Water Authority and the other Rural Water Supply. In urban areas with 9,954 citizens only 3,750 citizens get clean and safe water which is equivalent to 38% of the urban total population. Other town dwellers get water from traditional wells and springs as well as hand-dug shallow wells. In rural areas where majority of the population live, the people depend mainly on unprotected shallow wells and ponds. There are 784 shallow wells with pumps from which 515 are functioning and 269 are broken down. In the study area there are 15 shallow wells (water points) which are in use that is Nyakakika 3 points, Kayungu 5 points and Chabuhora 7 water points.

Availability of water sources in the area is mainly ground water and springs. For instance there are 5 spring water sources around Kayanga/Omurushaka Township; Katoma, Omurulongo, Katahoka, Nyakagera and Charuhanga. In the proposed area for the reservoir, there are spring wells that were cited and these will be submerged. These wells are used by the people for both domestic purposes and livestock watering.

Picture 4-22 Water source at the Proposed reservoir

Picture 4-23: Water Pools at the proposed project area

Water from springs and shallow wells is used for domestic purposes such as cooking, construction and general cleanliness while water from ponds is used for construction and animals. Water quality in some shallow wells is fresh and few shallow wells have salinity water. Water from ponds particularly found in low lands and basins is prone for contamination because it is not protected.

Picture 4-24: Local people washing at the project site

Time taken to collect water from the points depends on wet and dry seasons. In the dry season 30 minutes to one hour can be spent at the water point but during the rainy season less time is spent. The supply of water in the entire district is not sufficient to meet the water demand. During dry seasons the average quantity of water use per person is less than 10 litres which is below the standard of 25 litres a day per person. The district with the assistance from World Bank is implementing a water project in ten villages.

Consultations revealed that during the dry season there is scarcity of water and the cattle keepers move long distances of about 5 km in search of water. This was cited as a problem as there is transmission of cattle diseases, overgrazing of available land and stress to the available water sources that have not dried up.

4.3.12 Sanitation

v) Latrine coverage

Hygiene behaviour has a critical influence on the transmission of disease at various stages. This is particularly important in situations where disease risks are acute due to poor hygiene practices, unsafe water and sanitation. The most obvious effects can be observed for the faecal oral or diarrhoea diseases which constantly affect the study area. The most commonly used excreta facility in the study area is temporary pit latrine (Picture 4-25). This kind of latrine is hazardous because it has the potential to contaminate the surrounding ground water that is then used for drinking in the village. Human faeces may contain a range of disease causing organisms including viruses, bacteria and eggs or larvae of parasites such as worms. The micro organisms contained in human faeces may enter the body through contamination of food, water, eating and cooking utensils and by contact with contaminated objects. The lack of permanent toilets in the study area poses a threat to health since people tend to ignore construction of good toilets. More than 80 % of toilets in the study area are of poor quality due to ignorance and habit of not

valuing toilets.

Despite the rampant occurrence of epidemic diseases occurring constantly in the study area like typhoid, dysentery and cholera, majority of population living adjacent to the bushes have no toilets. According to the discussions with the villagers 40 % of the entire population in all villages does not use latrines instead they defecate outdoors in their banana fields or bushes.

Picture 4-25: One of the traditional latrine in Nyakabango Ward

Villagers complained that toilet facilities were problematic with bad smell, unsafe during the wet season when latrines can sink due to poor design and lack of privacy as the main concerns. Mosquitoes and flies were other problems, although villagers generally use ashes to reduce the foul odour. Permanent pit latrines are much safer but require building materials such as bricks or clay.

Looking at primary schools, some toilets are poorly constructed, and some are fairly constructed but both are underutilized due to lack of hygienic facilities such as water, doors fence, buckets/ tins and urinal places. All visited schools take for granted that pit latrines can be used for both urinal and faeces. Lack or inadequate hygienic facilities have inhibited pupils and particularly girls from using the toilets and hence poor attendance at schools (especially during menstruation for matured girls). During the discussion with pupils, they pointed out that they sometimes go to bushes because is safer than using toilets which have no water and privacy.

vi) Solid waste disposal

All villages mentioned solid waste at market squares and business centres as a serious emerging problem since no collection means had been devised to dispose the waste. Solid waste is however produced by individual households and in business centres whereby materials used for packing are disposed in corners of the yards or left to litter in the compound. Some individuals dispose the solid waste in pits (15%) and majority (82%) use banana plots/farms as dumping sites.

vii) Liquid Waste Disposal

Drainage in the study area is a problem as there are no proper drainage facilities to drain storm water from inhabitant settlements. Inadequate drainage poses a threat to latrines since the study area is prone to high soil erosion during rain seasons from which some latrines flood (collection of storm water) and spill out to the water sources.

At household level, drainage of waste water from bathrooms is not significantly practiced since majority of the adults take their bath in the banana fields and in water sources like ponds. This habit of taking bath in water sources/ponds increases the possibility of contamination of drinking water since liquid waste ooze downstream to the sources and pollutes it.

4.3.13 Energy

There is no energy system adequately developed in the District especially in rural areas. There is however electricity in Kayanga Town and the small town of Murshaka. The main supplier of this marginalized service is TANESCO although the power is purchased from Uganda. Other places in demand of electricity supply in the District are villages and small towns far from Kayanga. Inadequate power supply is the limiting factor towards industrial development of the area.

Results from the household survey revealed that majority of the households use firewood for cooking and kerosene for lighting needs.

The lack of electricity in project area has hindered the growth of small scale industries which normally lead to employment opportunities and general growth of the area.

4.3.14 Transport and Communication

Karagwe district is connected by road from Bukoba which is the main means of transport in and out of the district via Bukoba and Kyaka just near the border of Uganda. Karagwe district is served by 903.3 Km of roads. These roads reach 95% of Karagwe population. Karagwe is also served by charter planes. Kyerunga Airstrip (Ihanda) eight kilometer from the District Headquarters facilitates travellers, flying doctors and missionaries traveling to and from Bukoba, Mwanza, Nairobi, Mbarara and Kampala in Uganda. At Rubwera (Kyerwa) there is another airstrip facilitating tin mining operations at Kyerwa. The types of roads and their lengths are indicated in the Table 4-19 below.

Table 4-19: Length of Road netwars in Karagwe Districtistrict Council

Grade	**Types of Road Surface**			
	Tarmac	**Gravel**	**Earth**	**Total**
Trunk	-	-	-	-
Regional	10	253.0	-	263.0
District	-	248.0	-	248.0
Feeder	-	-	384.3	384.3
Township	-	21.2	-	21.2
Total	**10**	**522.2**	**384.3**	**916.5**

Source: Department of works year 2006

About 3% of the district roads are tarmac 25% have gravel wearing course and 72% of the

district roads are earth roads (Picture 4-26). Graveled roads are passable throughout the year. Access to the project area is through gravel which starts at Murshaka to Nyakasumbi and connects earth road to Mkaliro where the project is located.

Picture 4-26: Road to the project site

There are a few footpaths that are used by the community members to fetch water from the proposed area for the reservoir and to cross to other villages.

In regard to communication, Since the 1990s the communication network by Tanzania Telephone & Communication Limited (TTCL) has been operated by landline network and from mid-2003 other telecommunication companies like VODACOM, Airtel, Tigo, and ZANTEL have been providing communication services. Apart from a few areas almost all parts of the district can be reached by mobile telecommunication and 51 Radio calls facilities. Also around the borders there is an access of MTN, Rwanda Cell. This situation has created an opportunity for business growth and reduced unnecessary time taken on traveling and investing the saved time to other productive activities.

4.3.15 Vulnerable Groups

There are quite a number of vulnerable groups in Karagwe District in general and in the project area in particular. These include the women group, the group of children with disability, orphans and the elderly people. Karagwe unlike other districts has no camps for such groups instead the groups are taken care of within respective families. 7.5% of households interviewed had at least a person with disability within their families(From the sampled population). There are organisations in Karagwe that provide assistance to disabled children especially in the field of education at secondary school level. Organizations like TACAIDS, ELCT,SAWAKA and others provide school fees and other supplies and equipment to this group although the assistance does not suffice in hundred %. The project should thus provide special consideration to the vulnerable groups in all stages of the project.

4.3.16 Gender Considerations

i) Ownership and access to resources

The study examined gender relations in terms of access, ownership, and control over household resources and assets, the division of labour, and women's role in the political and economic leadership in villages. According to the respondents, women in Karagwe District have the primary responsibility for agriculture, small business, and household activities. Despite these responsibilities, their participation in decision-making is limited despite occupying about 30% of seats in the village councils.

Thus it is important that construction of the multipurpose dam project takes into account the position of women, even if they are unable to make their voice heard. The presence of women in leadership roles in all villages was limited due to large families without financial resources coupled with some passive traditional cultural and religious beliefs that discriminate against women. They hence have little access to household money and other resources, even though they are the primary providers.

Women particularly within marriage in all three villages surveyed lack access to and control over available resources. For example, although women are responsible for agricultural production, men are generally the legal owners of the land and can block women from carrying out their work. Livestock is another example. Men are responsible for all decisions regarding animals, including when to buy and sell. About 80% of women in FGD reported men as the sole decision maker in financial matters. The remaining reported both husband and wife making the decision together. Men reported that women give good advice regarding money and spending.

Consultations with the women revealed that the women face a problem of lack of access to credit since they do not own resources like land that could be used as collateral. They said that they are thus unable to attain credit in order to expand businesses. Due to the great workload and the lack of access to resources, the women may have little time and/or resources to devote to greater income-generating activities that could potentially benefit them and the whole family.

ii) Division of labour

As has already been mentioned, women are responsible for both home and economic activities. At home, they generally perform cleaning, cooking, washing, clothes, washing dishes, caring for children, collection of cow dung, processing of milk, and collection of water. They are also responsible for sowing, looking after elderly parents, transporting products, storing and preserving produce, and selling milk. Men, on the other hand, are primarily responsible for farming and livestock grazing. This difference gives men in this area much more leisure time than women.

4.3.17 NGOs and CBOs operating in their area

The District recognizes the important role and contribution of NGOs and faith organizations and considers them as important partners in the development process. The District is currently working with Karagwe Network of NGOs (KADENVO) in the implementation of District development activities. The District has also sub contracted other NGOs to undertake District development programs under DDP – 2011/12 where NGOs have comparative advantage and have expressed interest. At the moment the list of NGOs, International organizations and FBOs operating in the district as shown in Table 4-20.

Table 4-20: Development Partners in Karagwe District

ORGANIZATIONS	WORKING AREAS
SDSP, World Vision, ACORD, KCDP, TCRS, Vi Agro-forestry	Agriculture, Lives &Naturaltural Resources
CGTz, VSO-Tz, KCDP, TCRS	Trade and private sector
World Vision, TCRS, VSO-Tz	Education
AYA, MOH/DANIDA, World Vision, ACORD, KCDP, T DanChurchAid, NACP, KADERES, SAWAKA.	Health & Welfare
NAPOA, WORLD VISION, ICAP	HIV/AIDS
World Vision, TCRS, SAWAKA, WOMEDA.	Government & Civil Soc
MAVUNO, WORLD VISION	Water Sector

4.3.18 Tourism

There are different tourist sites in the district ranging from game reserves, historical sites and walking safaris. A part of Burigi game reserve falls in Karagwe District. There are precious animals like impala, water back, buffalo, elephant, zebra, giraffe, leopards, hippos and crocodiles. Kimisi game reserve was established in 2003 and is the potential tourist area if well promoted. Other tourist attractions include:

- The chiefdom palace located at Bweranyange ward about 47 kms from Karagwe town where the German and British explorers met with the traditional rulers;
- The Ibanda Game Reserve is favorable for walking safaris, bird watching is part of tourism and beautiful camping sites for hunters from Europe and United States every year to hunt Lions, Buffaloes, elephants, Zebras, Giraffes being the main attraction
- The Kagera River Waterfalls (Murongo Falls) situated in Murongo ward about 120kms from Karagwe District Headquarters;
- The highest point in the district namely Kamuli hill is about 1500 metres above sea level and there are Hot Springs namely Mtagata which are also located in Kamuli ward about 70 kms from Karagwe Headquarters.
- Furthermore, Karagwe is centred between the Akagera National Park in Rwanda, Queen Elizabeth National Park in Uganda and Rubondo Island National Park to the West of Lake Victoria. There is every reason to justify the establishment of inter-territorial tours between Uganda, Rwanda and Serengeti in Tanzania.

4.3.19 Security

As explained before Karagwe District borders neighbouring countries of Uganda and Rwanda therefore the security is highly organized from the grassroots to the national levels. At grass root level each village (smallest governing unit) has a security committee which is under a village chairperson. At the district level there is also a security committee under the District Commissioner. At national level the Tanzania Peoples Defence Force (TPDF) is responsible for

border security. The roles of committees are to report to the higher authority about any insecurity atmosphere recognized at any level.

On the other hand the police is well distributed from ward level to district, regional and at national levels.

In the study area conflicts which are experienced are between pastoralists and crop farmers. Each village with the mixture of pastoralists and farmers has organized a land use pattern that provides grazing pastures and farming areas. However, there is no clear and obvious official demarcation between the pastoral areas and the cultivation areas. Other conflicts are between family members and individuals. The existing conflicts among the community are influenced by inadequate resources. The main cause of this is lack of enough fertile land that can be used to expand and open new farms.

When a conflict arises, the security committee in each village has a role of solving the dispute. If the conflicting parties are not satisfied with the resolutions passed, they have a chance to appeal to the ward and to the district for further hearing.

4.4 ARCHAEOLOGICAL AND CULTURAL RESOURCES

4.4.1 Cultural Landscapes

The landscape is considered to have encouraged cultural practices which have been practiced over time by the different generation that have lived in the area. These practices are evidenced by; iron smelting, **(**Picture 4-27**)** metal artefacts collected from Karagwe) pottery, shrines, burials, and religious or prayer houses. These traditions have been noted in the Karagwe region with the exception of the project area due to its environmental condition which did not encourage direct human settlement.

Picture 4-27: Metal artefacts collected from Karagwe

4.4.2 Archaeological Sites

The project is located in a wetland environment which at the time of assessment was covered by water and swamps. In this kind of environmental condition, it was not possible to notice any archaeological materials on the surface, so the team located some dry areas and sunk in test pits

at the following locations:

4.4.3 Location 36m 0279216, 9798670

This location was at elevation 1320 m. The trench was characterised by dark humid soils with lot of grass roots forming top soil of about 20 cm, followed by light brown compacted soils of about 30 cm, and the bottom of the trench was characterised by light brown gravels. The trench was dug to 70 cm deep with no archaeological material recovered.

Picture 4-28: Photo of test pit

c) Location 36m 0279474, 9798118

The second test (Picture 4-29*)* pit was sunk at elevation; 1321m in a fairly different environment compared to the first site. The test pit was characterised by dark clayish soil which covered the whole trench to the bottom of it, which ended at 80cm with no archaeological material was recovered.

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

Picture 4-29: Test pit No. 2

4.4.4 Palaeontology of the project area

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

4.4.5 Burials

Burials are sacred sites normally treated with extreme care and respect not only in the local cultures, but world over. There is a general belief that the dead are very much part of the living and that if they are not treated well, they come back to haunt the living, this is true in most parts of the country as people attach to much value to the spirit world, there was no burial recorded in the project area as people in the area burry close to the homes but away from the project area (Picture 4-30).

Picture 4-30: Burial ground in a nearby village

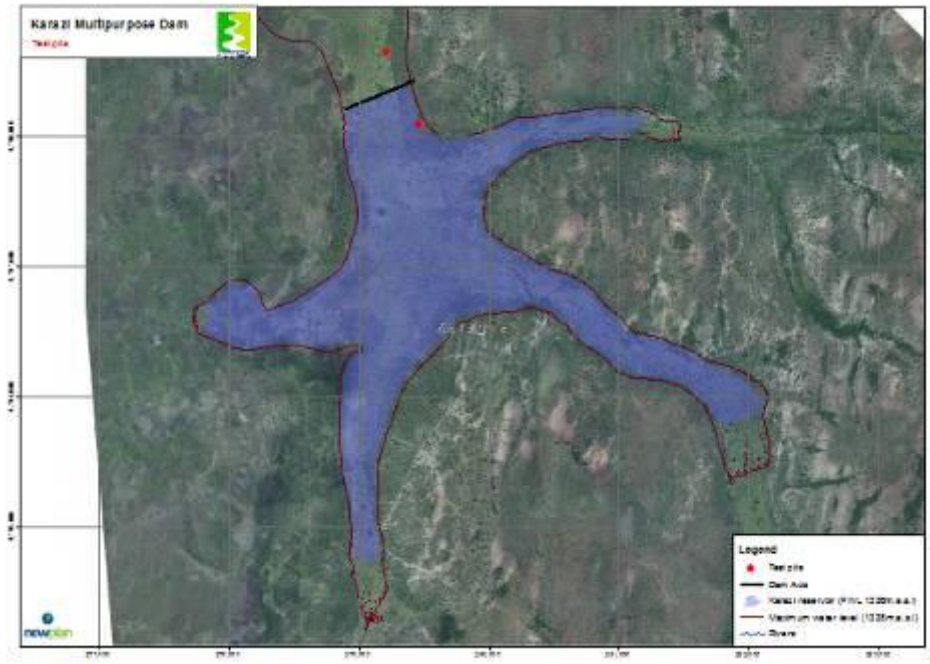


Figure 4-14: Location of test pit sites in the Karazi dam site

5 STAKEHOLDERS CONSULTATIO AND PUBLIC PARTICIPATION

5.1 INTRODUCTION

This chapter describes the process of the public consultation and public participation followed to identify the key issues and impacts of the proposed project. Views from national stakeholders, the local residents and local leaders were sought through interviews and public meetings. The feedback from these consultations has been taken into account when preparing this report. A summary of issues discussed is given below.

5.2 STAKEHOLDER COMPOSITION AND ANALYSIS

Public participation is considered as an important element for fostering a sustainable development process. In this Environment and Social study, various stakeholders participated in providing information related to the project of construction of the multipurpose dam. Simple methods such as networks, literature review and interviews were used in the process of stakeholder identification. From one stakeholder, the team was connected to another and another stakeholder, in a chain like manner (snowball). A number of stakeholders were identified and consulted during the study. These included the following.

National stakeholders

- National Liaison Officer, TAC Members, National Environment Management Council, Ministry of Water, Director Fisheries Division in Ministry of Agriculture and Fisheries (MoAF), Assistant Director Irrigation (MoAF) and Senior Fisheries Officer, Aquaculture

Division (MoAF).

Local Government Stakeholders

- District Director
- District Education Officer, (DEO)
- District Community Development Officer (DCDO)
- District Veterinary Officer (DVO)
- District Agricultural and Livestock Officer (DALDO)
- District Irrigation Officer
- District Primary Education Officer
- District Health Officer
- District Water Engineer
- District Land Officer

Local Communities of Chabuhora, Kayungu and Nyakakika Communities

A full list of the people/stakeholders consulted attendance lists are attached as **Appendix 3**.

The Consultant team conducted community meetings in 3 villages in order to gather relevant information related to the Social and environmental impacts within the project site. Minutes of the community meetings were taken and signed by the responsible leaders

5.3 PUBLIC PARTICIPATION PROCESS

The process of public participation started in the month of January 2012 during the initial planning of the project (inception phase) when different categories of stakeholders were consulted at all levels. **Error! Reference source not found.** shows some of the meetings held with stakeholders in January 2012. A regional workshop to present inception report was held on the 7th February 2012 (**Figure 5-1**) in Burundi as Karazi dam project is part of the Kagera River Multipurpose dams project and the issues raised are incorporated in this report. A second Regional Stakeholder Workshop to present interim report including scoping report was held on 8th at Silver springs in Kampala. The last Regional Stakeholder Workshop to discuss Draft ESIA and Preliminary RAP also held on 26th September in Arusha. Stakeholders provided useful information which forms part of this report. Details of the stakeholder consultations during the inception phase are provided in the scoping report.

Figure 5-1: Regional Workshop in Burundi, March 2012.

Figure 5-2: 2nd Regional Workshop in Arusha, 26th Sept. 2012

The process continued in the months of April when detailed studies were being carried out as shown in the sections below.

Public participation is a process through which different stakeholders influence and share their views regarding development initiatives and the decisions and resources that affect them. The effectiveness of resettlement programs is directly related to the degree of continuing involvement of those affected by a project. Comprehensive planning is required to ensure that local government, NGOs, Project staff and affected men and women interact regularly and purposefully during all stages of the Project.

Broad consultations involving local communities and officials from village, ward and district were carried out. During these consultations, the public had an opportunity to express their concerns. The methodology used in public participation included public meetings, focus group discussions, and individual meetings especially with the local government officials. Use was made of checklists, maps and a camera.

The meetings were conducted in the national language Kiswahili which is understood by all the people in the area. English was mainly used in meetings with the local

government authorities. Mobilization of community meetings and selection of venues was done by the village leaders. Meetings were organized a day or two prior to the meetings. Table 5-1 shows the schedule of community meetings.

Table 5-1: Schedule of Public meetings conducted

Date	Venue	Time	Participants	Nature of the meeting
02/04/2012	Chabuhora village	2.00pm	Chabuhora village members	Public meeting
02/04/2012	Chabuhora village	4.00pm	Women	Public meeting
04/02/2012	Nyakakika village		Nyakakika and Kayungu villages	Public meeting

5.4 MEETINGS WITH KARAGWE COUNCIL DISTRICT LEADERS

The discussions with the local government officials focused on existing water sources, land use pattern in the project site, socio-economic situation, anticipated impacts (both positive and negative) and demographic trend along the project area.

5.5 PUBLIC MEETINGS WITH LOCAL PEOPLE

The meetings were intended to ensure that the local people discussed issues related to the multipurpose dam project in an open manner thus fostering a community participatory approach prior to project implementation. Clarifications and affirmations were made with regard to the expected impacts on individuals and community in general. A total number of 170, male 105 and female 65 attended the meetings. Sessions of these meetings are portrayed in the images shown in Figure 5-1 to 5-2.

Picture 5-1: Public Consultation meeting in Nyakakika village (04/04/12)

Picture 5-2: Consultation meeting in Chabhora village

Picture 5-3: Focus Group Discussion with women

5.6 PARTICIPATION OBJECTIVES

The objectives of stakeholder participation included the following:

- To disseminate and inform the stakeholders about the proposed project.
- To gather comments, suggestions and concerns of the interested and affected parties that will hence help in the formulation and refinement of the project design and the development of effective mitigation measures and management plans.
- To collect all relevant information about the existing social values, practices and norms and socioeconomic characteristics of the people in the project area within which the project will operate

5.7 ISSUES RAISED IN THE MEETINGS

Perceived positive Impacts of the Project

People in the study area are eager to get the dam constructed. Such feelings emanate from their expectation that the dam will bring the following advantages to their localities:

- Constant water supply to the cattle, for irrigation and domestic use.
- Fishing will be introduced which eventually will increase nutritional diet and income generating through fishing and other fishing related activities.
- The project may influence improvement of roads which will reduce transport operating costs of both people and goods from wholesalers at business centres like Kayanga and Murushaka.
- During construction, access roads to the site will be improved and these can be used by the community even after words. Secondly, a lot of services will be required by the workers and the camp followers thus a number of people may be involved in supply of such services like selling of food staffs and other commodities. This will create indirect jobs for some community members.
- During dam construction there will be employment opportunities to local people (youths and women) either directly or indirectly. Through employment local people will acquire capital for further investments.
- Stimulation of technology and skills is another positive impact. There will be interaction and exchange of technology between the local people and the new immigrants hence stimulate the adoption of new technologies.

Generally, the construction of the dam will have tremendous positive impacts on the wards and district economy and the entire nation.

Perceived negative Impacts of the Project

The Consultant also sought concerns and perceptions of the people regarding the project and their major worries include the following:

- Environmental degradation resulting from noises, dust, tree cutting, soil erosion and air pollution.
- Culture interference may cause moral decays among the youth.

- Influx of job speculators from other parts of Kagera and neighboring regions will increase interaction, consequently an increase in HIV/AIDS infections. The presence of HIV/AIDS will likely increase the number of orphans in the project area. Infidelity among job speculators and local people may lead to divorce and separation of some families.
- Destruction and removal of houses and other historical materials
- Little or no compensation of properties destructed.
- Disruption of norms and values of the area due to interaction of new workers who will be working on the site.

Other views in regard to construction of the multipurpose dam

In addition to the above views, stakeholders also proposed the following:

- The size of the dam may attract many fishermen so fishing sites should be considered when designing the project
- Introduce fish farming culture to the surrounding communities
- The government should provide enough area for settlement and relevant social facilities because fishing attracts urbanization.

6 EVALUATION OF IMPACTS AND ANALYSIS OF ALTERNATIVES

6.1 NEGATIVE IMPACTS OF THE ACTION

6.1.1 Preparations Phase/Planning

6.1.1.1 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.

6.1.2 Construction Phase

6.1.2.1 River course Sedimentation

During construction, the clearing of the site for construction, excavation of the dam foundation, excavation of construction material and transportation to the construction site, clearing of campsite and burrow areas will generate considerable amounts of sediments that may eventually be deposited in the river course. However this is expected to be **low-medium** negative because only a few areas will be affected, it is localized and mitigable. .

6.1.2.2 Land acquisition/ Loss of Property/farmland and grazing land

Approximately 371.49 Ha of land will be lost to the project for the reservoir component. Out of this land, 150 Ha is estimated to belong to individuals and 371 Ha are estimated to be government owned. This land is largely used for grazing animals (cattle, goats and sheep). However, a small part of the land is used for crop cultivation and about 20ha of banana plantations will be affected. Although the impact is long term, the cattle keepers can be offered alternative grazing land and the benefit of water supply from the reservoir will solve the problem of scarcity of water. In addition, the affected will be compensated. The magnitude of the impact is thus expected to be **medium negative.**

6.1.2.3 Influx of People in the Area

During construction, there will be a temporary increase in population whereby construction workers will settle in the area for a specific period of time. The expected workforce will include both skilled and non-skilled workers. The influx of people looking for work is a common phenomenon with all development projects since word spreads rapidly of the possibility of work and opportunities for earning money. The population increase and the project activities will have impacts on the

community in the following ways.

a) Increased Risk of Diseases

HIV /AIDS and other STDS

HIV/AIDS transmission rate for Karagwe was reported at 4.7% in 2011 (Karagwe District Report). With an increase in the population during the construction phase, it is likely that HIV/AIDS will increase as there may be risky behaviours among the people. During this phase, project workers from outside the area tend to leave their wives at home and may be tempted to engage in sexual relationships with women and young girls in the area which in turn could lead to spread of STDs including HIV/AIDS. Although, the impact is long term, the level of HIV/AIDS awareness in the district is quite high therefore the magnitude of the impact is expected to be **medium negative.**

Malaria

Malaria was reported to be one of the leading diseases in the project area. Construction activities are characterized by excavations which may be filled with pools of stagnant water especially during the rainy season. Stagnant pools of water could turn into breeding places for mosquitoes which will escalate malaria cases in the area. The magnitude of the impact is expected to be **medium negative**. This is because the problem will be short term as the source of impact will reduce after construction and it is mitigable. However new sources of impact like reservoir creation are expected and are longterm. This longterm impact has been discussed under operation and maintenance.

b) Pressure on Health Infrastructure and Services

According to the baseline findings, there is a shortage of health facilities including dispensaries in Karagwe District. Furthermore, Chabuhora village where the project located is served by a government dispensary whose facilities need major rehabilitation. The available facilities face problems of inadequate qualified personnel, inadequate drugs and inadequate facilities like staff houses and medical equipment. An increase in the population will put more strain on the already strained health facilities and services in the area. The impact will be short term and will cease after the construction period hence the magnitude is expected to be **medium positive.**

c) Pressure on water facilities

The baseline findings showed that people in the rural areas depended mainly on unprotected shallow wells and ponds for their water supply implying that there access to safe water supply is limited. An increase in the population will put pressure to the already strained poor sources of water in the area. Moreover, with poor accessibility to safe water, it is likely that there will be an increase in water related diseases. The magnitude of the impact is expected to be **medium negative.**

d) Deterioration in sanitation

The baseline findings showed that sanitation in the project area was very low as about 40 % of the entire population in all villages does not use latrines but instead defecate outdoors in their banana fields or bushes. In addition, majority of those who own latrines, the facilities are of poor quality and in poor condition. In regard to both solid and liquid wastes disposal, there are no proper means of

disposing off of wastes and most people use their gardens. The increase in population during the construction phase of the project will therefore put a stress on the already inadequate existing sanitation facilities. The magnitude of this impact is expected to be **medium negative** as the lack of adequate of sanitation services can easily lead to diseases like diarrhoea, cholera, dysentery which are life threatening. However, the impact can be controlled.

e) Pressure on wood fuel

The baseline findings indicated majority of the people depend on firewood for most of their energy needs. 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.**

f) Theft of project materials

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.**

g) 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.

h) 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. 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. This could be **low negative** as it will be short term and will fluctuate depending on economic factors of supply and demand.

6.1.2.4 Impact on housing and settlements

a) Vibration

Construction of a dam can use heavy machines which may cause vibration and crack nearby houses. However the dam site is far from community structures so the impact is very **minimal or negligible.** In rare cases if there will explosions the villagers should be notified in advance.

b) Resettlement

There is resettlement or displacement envisaged as there are no houses in the proposed area for the reservoir.

6.1.2.5 Impact on water sources

It is likely that water ponds and wells in the proposed area for the reservoir will be affected. These water sources are used by the community for domestic purposes and for watering animals. During construction there will be shortage of water supply for the people using these water sources. Although the impact will affect a big number of people, it will be short term and will cease after the construction phase. The magnitude of the impact is thus estimated to be **medium positive.**

6.1.2.6 Impact Health and Safety

a) 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 is mitigable thus qualifying it to be **medium negative.**

b) 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. It is therefore likely that in case of any accidents, the local people may be affected. Furthermore, it is likely the local people may be affected by dust as result heavy vehicles carrying materials. The magnitude of the impact of the impact is **medium negative** as it will be temporary and can be avoided.

c) Increased traffic and its associated consequences

Currently the traffic on the existing road to the site is not very heavy but during the construction phase the traffic flow is expected to in terms of humans and vehicles as a result of movement of materials and manpower. There is also a possibility of over speeding by the project drivers thereby leading to accidents. If the traffic is not handled properly, it could lead to accidents and 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 mainly in the construction phase and its extent will be

local.

6.1.2.7 Negative impacts of dam inundation on water characteristics

When the Karazi dam is constructed and inundated, it will flood much of the biomass including plant vegetation material in the dam site. The effect of this swill be that all these materials will decompose, consume all the oxygen and produce gases like carbon dioxide, methane and other acidic gases like sulphides and nitrous oxides. De-oxygenation will of-course kill fish and other aquatic biota. The presence of toxic acidic gases will not favour aquatic life. The good news is that these putrification and decomposition phenomena in the newly flooded dam will be short lived as the water will eventually clear with ample algal growth thereby oxygenating the water column. Any residual toxic gases will be restricted to the bottom layers of the new dam. Hence aquatic life will prosper including fish and its fry. It can be concluded that in terms of fish and invertebrates and other aquatic organisms, there are no long term negative impacts of the construction of the Karazi dam.

Mitigation measures

Capture fisheries production in the Kagera River basin is faced with a number of problems, including uncontrolled fishing methods and lack of proper fishing gear. Immature fish are captured leading to extinction of some species. Often local people use poisoning and dynamite, which leads into complete destruction of the lake ecosystem and extinction of fish and other related organisms from the lake. Continued dependence on one type of species also leads into their extinction and loss of biodiversity. For example, some studies carried out in Lake Ihema (Mughanda, 1989) shows species preference was mainly on *Clarias gariepinus, Haplochromus Group,* and other *Tilapia* species such as *Marcusemus victoriae, Alestes Sp., Synodontis Spp, Gnathonemus longibarbus,* and *Schilbe mystus.* Capture fisheries problems are also compounded by lack of extension services to educate the local community on sustainable fishing methods and lack of infrastructure for fish preservation. There is therefore need to formulate fishing regulations to control access to the new Karazi reservoir when built as well as to control fishing gears and methods to avoid destructive methods. There will be need to educate the local community about fish, fishing methods and best seasons to fish. It will also be necessary to establish and train a cadre of extension staff to guide, monitor and regulate fishing activity and use of dam water resources in general.

6.1.2.8 Impact on Vulnerable Groups

There are quite a number of vulnerable groups in Karagwe District in general and in the project area in particular. These include the women group, the group of children with disability, orphans and the elderly people. Karagwe unlike other districts has no camps for such groups instead the groups are taken care of within respective families. The following are some of the impacts of the project on vulnerable groups in the area:

- Child labour: Construction workers might knowingly or unknowingly employ children below 18 years of age.
- Exploitation of vulnerable people. This could be in form of defilement, rape, sexual

harassment among others.

- Marginalization during the recruitment process.

The magnitude of the impact will be **medium negative** as it can be prevented.

Mitigation

- The developer and the contractor should ensure that women are not marginalized during the employment process.
- The developer and contractor should ensure that persons below 18 years are not employed.
- All cases of exploitation need to be reported to the relevant authorities.

6.1.2.9 Impact by Unfulfilled community expectations

During the consultations the people expressed the desire to be considered for jobs on the project. Naturally, all people within the working age group have the desire for gainful employment. Therefore, it's always almost 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 frustrations 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
- 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.

6.1.2.10 Water pollution

From the assessments made and water quality results obtained from the laboratoy, the water quality

of the river at Karaz site is good and from ecological point of view, the stream where the dam is proposed to be constructed is healthy. However during construction, there is likely to pollution of the water in this stream. During dam construction, the excavation in the river will compromise the water quality. Loose soils from excavation in other areas and activities of the project like clay mining, access roads improvement etc may be a source of water pollution if not cleaned. Furthermore, oils from construction equipment and workshop may also be source of water pollution especially if storm water washes through such areas. This impact is localised, short term as it will last up to end of construction but the probability of its happening is high although mitigable. The magnitude of impact is therefore regarded as **medium negative**.

Loose soils should always be cleaned off from work site at the close of the day Heaped materials should protected in such a way that it cannot be washed away by storm water Regular maintenance of vehicles should be carried out to minimise leakages from equipment Workshops should be paved and equipped with oil interceptor to trap any oils that may leak to the ground

6.1.2.11 Specific impacts of camp sites, material sourcing activities and their mitigation

The ESIA Consultant conducted a baseline survey and analysis on the prospective reservoir as reported in an earlier report on Baseline Studies. However, sites for the workers camp and those for sourcing materials such as stones, aggregate, gravel, murram, soils and clay were not subjected to an environmental and social impact assessment as they had not yet been identified by the Feasibility Consultant. After these were identified by the Feasibility Consultant the ESIA Consultant therefore, proceeded to carry out a survey of these sites including identification of negative impacts of the specific activities on them. Mitigation measures and expected budgets have also been identified. Similarly, the irrigation command areas had not been identified and mapped. These too were surveyed by the ESIA team and the impacts specified. Further, the routes for the water supply transmission lines as well as the location of water supply tanks had not been identified. These have now been provided as approximate routes and locations. The ESIA Consultant, therefore, also conducted spot observations of potential impacts of the irrigation command areas and water supply routes. Hence before implementation of the project, the irrigation command areas and the water supply transmission lines should be subjected to a detailed Environmental and social impact assessment.

Establishment of workers camps and activities related to sourcing of construction materials such as blasting of stones, digging of aggregate, gravel, murram and excavation of soils and clay bear far reaching social and environmental impacts which need to be assessed and mitigated. These have therefore been analyzed and are provided below.

6.1.2.11. 1 Camp site

Ecological Environment

The Feasibility study identified an area of about 0.4 Km² on the main Chanamisi-Kayungu road to the dam site. The area is not geo-referenced but it was calculated to be about 1.75 km from the dam axis and about 0.4 km from the main road. The proposed camp site for Karazi Multipurpose Dam is

located in Chabuhora village and is located in an area covered by wooded grassland vegetation whose dominant tree species are *Acacia* sp, *Grewia* sp and *Euphorbia candelabrum* (Picture 6-1*)*. The diversity of grasses and herbaceous plants is high. The grasses in the area are heavily grazed by cattle and the site is therefore degraded. No plant species of conservation importance were recorded.

The camp site has similar characteristics with the Karazi reservoir. The site has different vegetation types notably savanna woodland, degraded grassland and may harbour species of small mammals like rodents, shrews, antelopes, bats and primates. None of these were seen but they are known to be present in the area. None of these species are globally threatened or near-threatened. The project is therefore expected to have little impact on the ecology and conservation of mammal species. Thus, the proposed project will not be expected to have significant negative impacts on the conservation and survival of these species and hence, its impact will be **low negative.** A total of 57 species of birds were recorded during the earlier study including one globally Endangered species (Grey-crowned Crane) and 2 near-threatened **(**Grey Heron *Ardea cinerea*, and Woolly-necked Stork *Ciconia episcopus)*, and 3 restricted range species in the East African region (Spot-flanked Barbet *Tricholaema lachrymose,* Bare-faced go-away-Bird *Corythaixoides personata* and Black-lored Babbler *Turdoides sharpie*) (BirdLife International 2012a). Because of their large global range, the impact of the project on the ecology and conservation status of the Grey Heron and the Woolly-necked Storks and other avifauna is expected to be **low negative.** Nine species of dragonflies were earlier recorded from the project area. . Since species of Dragonflies and butterfly recorded did not include any of the ones on threatened or near-threatened species list, the impact of the project on the ecology and conservation of dragonflies and butterflies will be **low negative.** The site for the camp is dry and no fish or Amphibians were expected to be present in the camp site area. Thus the negative impacts of the project on the ecology and biological environment of the camp site will be negligible.

Human Environment

The proposed camp site for Karazi Multipurpose Dam is located in Chabuhora village about 400m from the access road. There is no existing access road to the proposed camp site therefore there will be need to create one. The land is mainly used for grazing cattle by the pastoralists. There are no settlements at the proposed site and no cultivation is done. The nearest settlements are located along the existing road (Chanyamisi-Kayungu road). Consultations revealed that the land where the proposed site will be is owned by government. There was no social infrastructure observed in the area. The trading centres in the vicinity are Chanamisa and Kayungu Trading Centres. The proposed area for the camp and one of the homes nearest to the site is shown picture 6-2

	
Picture 6-1 Vegetation around the proposed campsite	*Picture 6-2: one of the nearest homes to the camp site*

Potential negative impacts of the camp site

- Approximately 0.4 Km² of land will be required for the camp site and this will lead to loss of grazing. This is **low negative** as the area is small and the land belongs to the Government;
- Noise is expected to be generated by the different activities at the camp site including the movement of machinery. Noise impact is expected to be **low negative** as it will affect only three households in the vicinity of the camp site.
- Visual impacts resulting from landscape degradation- no human activity**-low negative**
- Damage to cultural heritage sites uncovered by accident- None known to exist- **low negative**
- Liquid wastes and solid wastes will be generated at the camp site but this is **low negative** as it will involve only a few workers at the camp site and there will be guidelines for their proper disposal;
- Some plants will be destroyed but this is **low negative** as the area is small;
- Some animals will be killed and some will be forced out of the area but this is **low negative** as the area is small;
- There will be loss of nesting grounds for birds but this is **low negative** as the birds can migrate;
- Influx of people but this will be **low negative** as the number of people will be few and entry will be restricted;
- Pressures on health services and water supplies- **low negative** as the number of people will be few and better services will be put in place by the Contractor;
- Increase in diseases **low negative** as the number of people will be few and better services will be put in place by the Contractor;
- Conflicts and insecurity- **low negative** as the number of people will be few and tight control mechanisms will be put in place by the Contractor.

Mitigation measures for the camp site

- Areas that will be identified for the camp site must be clearly identified with tape and survey markers and fenced off;
- Noise nuisance will be **low negative** as it can be mitigated by control measures and using national standards like restricting night activities e.g. discos, bars, speed of vehicles;
- Loss of plants is **low negative** as there will be selective felling of trees;
- Loss of animals is **low negative** as the few wildlife including birds can migrate to neighbouring areas;
- Restoration of the land to its former state through grassing and planting trees;
- Proper drainage at the camp site to avoid liquids finding its way to the nearest homesteads and the environment;
- 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.

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6.1.2.11.2 Sites for sourcing construction materials

Quarry for sourcing stones and gravel

Ecological Environment

The Feasibility study identified two areas in Chabuhora village as suitable sites for accessing stones, aggregate and grave. The first site is about 3km from the main access road and the second site is further across the valley some 5 km away from the main road. However, both sites are quite close to the reservoir witch stretches up stream, perhaps less than a kilometer away. The areas are not geo-referenced. The first site is circular and of about 0.6 km². The second site is long and thin about 2 km long and about 0.5 km wide. They both lie to the west/south west of the prospective reservoir. Both areas of the source of stone and gravel are stony with stone boulders and out crops and are covered by grassland wooded vegetation whose dominant tree species are *Acacia* sp, *Grewia* sp and

Euphorbia candelabrum (Picture 6-3). 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 and the project impact on the site will be **low negative.**

The quarry and gravel site has similar characteristics with the Karazi reservoir. The site has different vegetation types notably savanna woodland, degraded grassland and may harbour species of small mammals like rodents, shrews, antelopes, bats and primates. None of these were seen but they are known to be present in the area. None of these species are globally threatened or near-threatened. The project is therefore expected to have little impact on the ecology and conservation of mammal species. Thus, the proposed project will not be expected to have significant negative impacts on the conservation and survival of these species and hence, its impact will be **low negative.** A total of 57 species of birds were recorded during the earlier study including one globally Endangered species (Grey-crowned Crane) and 2 near-threatened **(**Grey Heron *Ardea cinerea*, and Woolly-necked Stork *Ciconia episcopus)*, and 3 restricted range species in the East African region (Spot-flanked Barbet *Tricholaema lachrymose,* Bare-faced go-away-Bird *Corythaixoides personata* and Black-lored Babbler *Turdoides sharpie*) (BirdLife International 2012a). Because of their large global range, the impact of the project on the ecology and conservation status of the Grey Heron and the Woolly-necked Storks and other avifauna is expected to be **low negative.** Nine species of dragonflies were earlier recorded from the project area. Since species of Dragonflies and butterfly recorded did not include any of the ones on threatened or near-threatened species list, the impact of the project on the ecology and conservation of dragonflies and butterflies will be **low negative.** The site for the quarry and gravel is dry and no fish or Amphibians were expected to be present in this site. Thus the negative impacts of the project on the ecology and biological environment of the site will be negligible.

Human environment

There are no settlements at the proposed site and no cultivation is carried out. The land at this site is owned by the government. However, about 200m to site there are about 3 homesteads of temporary and semi-permanent nature (picture 6-4). Cultivation is carried out in this area and the main crops grown are bananas, cassava, beans and vegetables. In addition, there is a residential structure about 300m to the site that is currently unoccupied (Picture 6-5). The structure is of made of semi-permanent materials.

Picture 6-3:Sections of the proposed quarry site

Picture 6-4: Resdiential house and cultivation about 200m from the proposed quarry site

Picture 6-5: An unoccupied about 300m from the proposed quarry site

In regard to the existing access road, a big section of it passes through banana plantations (Picture 6-6). There are settlements along this road. The access road is narrow and slippery during the rainy season. A few meters to the site, the access road passes through grassland and is bushy (Picture 6-7).

Picture 6-6: Sections of the access road to the proposed quarry site

Site No. 2

The second site that is proposed for sourcing stones and aggregates is also located in Chabuhora village. At the site there are no settlements however, there are about 7 homesteads in the vicinity of the site. Four of these homesteads are about 500m away and are of semi-permanent nature while 3 are about 300m and are of temporary nature. Around these homesteads, there is cultivation carried out and the main crops grown are bananas and beans.

Potential negative impacts of the quarry site

- Approximately 1-2 Km² of land will be required for the quarry site and this will lead to loss of grazing land. This is **low negative** as the area is small;

- 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. This impact is expected to be **medium negative** as it will cease after construction and given the location of the source of the stones and aggregates, only a few households will be affected;

- 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. The impact is expected to be **low negative** as it will be short term and not many people live in the area;

- There will be stockpiles of rock and earth materials and there is likely to be ponding and accumulation of still water. This is low negative as the area will be fully restored after the activity;

- Visual impacts resulting from landscape degradation- **low negative**
- Damage to cultural heritage sites uncovered by accident- **low negative**
- Some plants will be destroyed but this is **low negative** as the area is small;
- Some animals will be killed and some will be forced out of the area but this is **low negative** as the area is small;
- There will be loss of nesting grounds for birds but this is **low negative** as the birds can migrate.

Mitigation measures

- All requirements for the approval of earthworks and blasting will have to be 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;
- Consultation with the local population must be conducted to make sure that there are no **sacred** sites;
- The contractor should implement a clear time table for blasting and this should be distributed to the local people in addition to continuous sensitization;
- Loss of plants is **low negative** as the area is small and there are may similar plant species in neighbouring areas;
- Loss of animals is **low negative** as the few wildlife including birds can migrate to neighbouring areas;
- Restoration of the land to its former state through back filling, grassing and planting trees;
- Demobilize work camp, equipment and staff, taking care to prevent adverse impact on the environment.

6.1.2.12 Sites for sourcing soils and clay material

The Feasibility study identified an area surrounding the dam east, west and south as sites where suitable soils for the construction of the earth fill dam embankment are found. These sites are less than one kilometer from the reservoir boundary. 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 grassland vegetation whose dominant tree species are *Acacia* sp, *Grewia* sp and *Euphorbia candelabrum* (Picture 6-8). 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 sites for sourcing soils and clay material have similar characteristics with the Karazi reservoir. The site has different vegetation types notably savanna woodland, degraded grassland and may harbour species of small mammals like rodents, shrews, antelopes, bats and primates. None of these

were seen but they are known to be present in the area. None of these species are globally threatened or near-threatened. The project is therefore expected to have little impact on the ecology and conservation of mammal species. Thus, the proposed project will not be expected to have significant negative impacts on the conservation and survival of these species and hence, its impact will be **low negative.** A total of 57 species of birds were recorded during the earlier study including one globally Endangered species (Grey-crowned Crane) and 2 near-threatened **(**Grey Heron *Ardea cinerea*, and Woolly-necked Stork *Ciconia episcopus)*, and 3 restricted range species in the East African region (Spot-flanked Barbet *Tricholaema lachrymose,* Bare-faced go-away-Bird *Corythaixoides personata* and Black-lored Babbler *Turdoides sharpie*) (BirdLife International 2012a). Because of their large global range, the impact of the project on the ecology and conservation status of the Grey Heron and the Woolly-necked Storks and other avifauna is expected to be **low negative.** Nine species of dragonflies were earlier recorded from the project area. Since species of dragonflies and butterfly recorded did not include any on the threatened or near-threatened species list, the impact of the project on the ecology and conservation of dragonflies and butterflies will be **low negative.** The site for sourcing soils and clay material is dry and no fish or Amphibians were expected to be present in this area. Thus the negative impacts of the project on the ecology and biological environment of the site for sourcing soils and clay material will be negligible.

Picture 6-7: Site for accessing soil and clay seen to the middle right of the picture with cleared cultivated areas

Human environment

The proposed area for sourcing soil and clay is currently used for grazing animals. Sourcing of materials from this area will lead to temporary loss of land to pastoralists and cultivators. There are no settlements in the area. There are some cattle watering points and crushes doted within this area. There are some banana plantations on the periphery. There was no human activity observed at the proposed area for the source of soil and clay. However, in the vicinity there were 2 homesteads of temporary and semi-permanent nature observed.

Potential negative impacts of the action

- Approximately 3 Km² of land will be required for sourcing soils and clay and this will lead to loss of grazing land and farm land. This is **low negative** as the area is small; the loss is only of short term nature and will be adequately compensated;
- Some plants will be destroyed but this is **low negative** as the area is small and loss of trees can be mitigated through selective felling;
- 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 is **low negative** as these structures can be compensated for adequately;
- Destruction of banana plantations and other crops; this is **low negative** as the activity is of a short term duration and the crops can be compensated;
- There will be stockpiles of rock and earth materials- **low negative** as there will be proper restoration works;
- There is likely to be ponding and accumulation of water- **low negative** as there will be proper restoration works;
- Digging and excavation will upset the drainage pattern in the area- **low negative** as there will be proper restoration works;
- The access road will be modified - **low negative** as access roads will be greatly improved by the Contractor;
- Soil erosion will increase- **low negative** as there will be proper restoration works;
- Visual impacts resulting from landscape degradation- **low negative** as there will be proper restoration works;
- Damage to cultural heritage sites uncovered by accident- **low negative** as none are known to exist. If any are found they will be protected and reported to the appropriate Ministry and Departments for due care including safe keeping of artefacts.

Mitigation measures

- All requirements for the approval of earthworks should be met;
- Environmental requirements for restoration works should be met;
- The owners of the land and crops will be adequately compensated;
- There should be selective removal of plants;
- Animals and 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 all round the pits and burrows to avoid soil erosion;
- Removal of all garbage, derelict materials and broken down machinery and materials;
- Demobilize work camp, equipment and staff, taking care to prevent adverse impact on the environment.

6.1.2.13 Irrigation Command Area

The Karazi valley is narrow and it follows a south- north direction. At the dam axis, the valley is 250 meters wide but it widens 400 meters 1-6 kilometers down stream *(Picture No 6-8- to 6-9).*

Further on, the valley becomes very narrow often less than 200 meters wide 7 km downstream from Kayungu village where the valley remains partially flooded most of the time *(Picture No 6-10* At a distance of about 10 km downstream the valley widens to 400 meters and at Kashanda, some 20 km downstream, the valley becomes swampy *(Plate No 6-11.)*

The potential irrigation area extends to Kobondo and Nyabiyonza wards of Karagwe and Kyerwa districts. The irrigation potential area is long and thin and runs downstream for about 20 km and covers an area of about 1,000 ha.

Impact on vegetation

The irrigation command area is covered by extensive short wooded trees and grassland patches of short grass typically of a semi semi-arid zone with wetland vegetation within the valley. . This area is subjected to prolonged droughts.

Picture 6-8: Acacia trees scattered in the wooded grassland

Picture 6-9: The grassland with scattered trees

Picture 6-10: Seasonal wetland in Karazi dam site

Picture 6-11: Echnochloa and Polygonum in the seasonally wet areas

The baseline study revealed that there were some 157 plant species from 50 families recorded in the Karazi project area. The Family *Poaceae* dominated the plants species 20, followed by *Fabaceae* 18, *Mimosaceae* 13, *Acacnthaceae* 12 and *Asteraceae* 9 species. There were several families with an individual species. The most dominant life forms were herbs (25%) followed by shrubs (22%), grasses (20%) and (8%) trees of the total species recorded. The most abundant trees were *Acacia geradii, Acacia polyacantha* and *Markhamia obtisfolia* trees. Most of the plant species recorded are naturally growing within the area. The upper reaches of the valley and more so on the valley periphery savanna woodland occurs dominated by *Acacia geradii* mixed with *Grewia bicolour*, *Albizia* sp, *Markhamia* sp and *Acacia polyacantha* (Pictures 6-12). The grassland is dominated by varieties of *Andropogon gayana, Cynodon dactlyon sp, and Sorghum arundineceum.(all in Poaceae).* The marshy wetland areas characterised by *Typha domingensis (Typhaceae), Echichnochloa pyramidalis (Poaceae)* and *Cyperus latifolius (Cyperaceae)*

Picture 6-12: Acacia species forming the wooded grasslands

Picture 6-13: Markhamia obtusifolia in the woodland near the reservoir site

Picture 6-14: Albizia species in the wooded grassland

Picture 6-15: Aeschnomene sp in the wetland

The irrigation command area will affect mainly species within the valley. This will cause the disappearance of some ecologically important wetland plants in the floodplain below. There were no plant species of conservation importance recorded as threatened or endangered in the irrigation command area. The impact of the project on the ecology and conservation of plant species in the irrigation command area will therefore, be expected to be of **low negative** as the activity will be limited to narrow canals and channels. Besides, the area is full of similar plants which could regenerate the whole area.

Impacts on wildlife

The irrigation command area in the Karazi valley lies in an area of different vegetation types notably savanna woodland, grassland and marsh. These habitats favour many species of mammals including rodents, shrews, antelopes, bats and primates. None of the mammal species recorded during the study is globally threatened or near-threatened. Thus, the proposed project will not be expected to have significant negative impacts on the conservation and survival of these species and hence, its impact will be **low negative.**

Birds

Some 57 species of birds were recorded during the earlier baseline study. These included the globally endangered Grey-crowned Crane and 2 near-threatened speices namely, the Grey Heron *Ardea cinerea*, and the Woolly-necked, Stork *Ciconia episcopus* and 3 restricted range species in the East African region (Spot-flanked Barbet *Tricholaema lachrymose,* Bare-faced go-away-Bird *Corythaixoides personata* and Black-lored Babbler *Turdoides sharpie*). The Grey-crowned Crane prefers wetland habitats and could thrive well in the irrigation command area. However, this area is expected to have intense human activity for irrigation and this will have some negative impact on the Grey-crowned Crane. However, the project will provide more aquatic habitats and this is good for many water loving birds. This is because the birds 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 birds and their nests. Because of their large global range, the impact of the project on the ecology and conservation status of the Grey Heron and the Woolly-necked Storks and other avifauna of Tanzania is expected to be **low negative.**

Fish

Four fish genera were caught and identified from pools in the Karazi valley. These included *Oreochromis niloticus, Thoracochromis* sp, *Hemichromis* sp and several *Barbus* species. Although not caught, it is expected that the African Lung fish, *Protopterus aethiopicus* and the African cat fish *Clarias* spp were present in the marshy wetlands of the valley. The pools where these fish were caught were covered with shrubs and vegetation providing shade to the pools and thereby keeping temperatures from rising too high during the dry season. This could explain why fish including cichlids and *Barbus* species were able to survive in these pools all through the drought. None of these fish species are endangered nor threatened. Invertebrates caught from the Karazi valley area included snails (Gastropoda), leeches, may flies, midges, beetles, and bugs. None of these invertebrates are endangered nor threatened. The wetlands surrounding the irrigation command area in the Karazi valley will be ideal habitats for littoral biota including fish, invertebrates. However, irrigation activity involves intense human activity, stirring of water thus making it murky and full of silt and well as application of pesticide and agrochemicals. This will not favour fish. The overall impact of the activities within the irrigation command area in the Karazi valley will have **high negative** impacts on the naturally occurring fish species particularly the sensitive Cichlids. A viable alternative will be to introduce aquaculture that will make it possible to grow fish in ponds in the irrigation command area in the Karazi valley artificially. Fish species that could be considered for introduction for commercial aquaculture prospects are the ubiquitous Cichlidae, Cyprinidae, *Bagrus* sp., *Protopterus* sp., *Haplochromis* spp and the Clariidae. Fish could also be grown in a combination of aquaculture and irrigation rice growing using a technology called **ricipiculture**.

Amphibia

A total of 12 species of frogs were recorded with Mascarene Grass Frog *Ptychadena mascareniensis* being the commonest. The Montane reed frog *Hyperolius castaneus* was the only globally threatened species recorded. Because of the little information available about the species, there is limited information available about the ecology and threats of Montane reed frog. The species is likely to be impacted by loss of habitat due to irrigation and human activity. The impact on this frog is therefore likely to be **high negative.** Nine species of dragonflies were recorded from the project area. 19 butterfly species known from Tanzania were recorded in the project area. In addition, since species

of Dragonflies and butterfly recorded did not include any of the ones on threatened or near-threatened species list, the impact of the project on the ecology and conservation of dragonflies and butterflies will be **low negative.**

Human environment

The irrigation command area stretches a distance of about 20 km from the dam axis. Within the valley, the main land use is cattle grazing. Cultivation was observed at the slopes of both the western and eastern banks of the valley. However, it was noticed that there was more cultivation on the western bank of the valley as compared to the eastern bank right from the villages of Chabuhoa,Nyakakika, Nyakabanga and Kayungu. The major crops grown are bananas, beans, groundnuts, millet, sorghum, coffee, potatoes, cassava, yams, cocoyam, tomatoes, onions, cabbage and maize. However, banana plantations dominated the area. A few settlements were observed at the slopes of both banks though most of them are on the western (left) bank. The structures are of temporary and semi-permanent nature.

Picture 6-16: Banana plantations in the command area for irrigation – western bank of the valley

Picture 6-17: Cleared area for cultivation at the eastern bank of the valley

Picture 6-18: Goats grazing in the proposed command area for irrigation

In terms of infrastructure, there are a number of roads that cross the irrigation command area (valley). In addition, there were a number of water sources observed and these included spring wells and boreholes. The spring wells are used for both domestic purposes and other uses such as watering animals while the borehole was used to supply mainly domestic water.

Picture 6-19: A watering point for animals in the irrigatin command area immediately after the dam axis

Picture 6-20: A borehole in the irrigation command area about 18-20km from the dam axis

Picture 6-21: The different access roads to the across the proposed irrigation command area

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.

6.1.3.2.4 Water supply

It has been noted that only 23% of the population of Karazi has access to safe water. Most of the communities rely on unprotected wells, traditional wells, rivers and streams. However, there a number of medium and deep boreholes serving villages which are found on top of hills. The distance to fectch water is long, on average about 2-5 km. Water is scarce in the whole of Karagwe district. The location of villages on top of hills makes supplying them with water very difficult. According to the feasibility team, a water intake treatment will be constructed near the proposed dam site and will pump water to a main tank in Nyakasanga village. From the main tank, the water will then be supplied and stored in several tanks in Nyakakika, Nyakabanga, Kayungu, Chanamisa, Ihembe, Nyakayanja, Kashambi and Nyakahanga. Other beneficiary villages include Bisheshe, Nyaishozi, Nyakasimbi and Bisheshe. The Feasibility Consultant has concluded that the issue of

water supply to these hill-top villages needs further investigation. Accordingly, the design, the water supply transmission line will be constructed parallel to the existing road. The land through which the water transmission line will traverse is comprised of cultivation land, settlements and empty land. Cultivated crops include bananas, beans, cassava, maize, coffee, yams and fruit trees such as mangoes. Other types of trees observed in the area are eucalyptus and gravelia trees.

Potential negative impacts of irrigation

- 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;
- Reduction of agricultural land through digging of canals. This is **low negative** as 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 born 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 and ponding due to accumulation of still water. This is **low negative** as there will be adequate restoration;
- Digging and excavation will upset the drainage pattern in the area. This is **low negative** as digging of dykes and canals will be done professionally;
- The access roads and bridges will be destroyed. This is **low negatives** as better bridges and feeder roads will be built.
- Soil erosion will increase. This is **low negative** as proper restoration works will be done;
- Damage to cultural heritage sites uncovered by accident- This is **low negative** as any artefacts will be properly taken care of if found.

Picture 6-22: Banana plantations along the proposed area for the water supply transmission line

Picture 6-23: Eucalyptus trees along the proposed area for the water supply transmission line.

In regard to settlements, the settlements are linear, a bit scattered but concentrated in the trading centres such as Omurushaka, Bisheshe and Chanamisa. The structures are made of both semi-permanent and permanent materials though most of them are of semi-permanent materials. A few schools were also observed and these include Nyakayanja Primary School and Bisheshe Primary School.

Picture 6-24: Structures along the proposed water supply transmission route

Potential negative impacts

Land take

Land will be required for the water supply pipes to the different designated tanks and also for the different tanks. It is estimated that the size of the water supply transmission lines will about 94.1 km long with a width of about 1m. About …Ha of land will be required for the different water storage tanks.

The magnitude of the impact is expected to be **high positive.** This is because the impact is permanent, irreversible and will affect many people due to the length of water supply routes.

Mitigation Measures

- Compensate all affected land

Destruction of crops

There are crops in the proposed area for the water supply transmission route that might be destructed by construction works. The crops that will mainly be affected include bananas, maize, beans, cassava, coffee and yams. In addition, trees like eucalyptus will also be destroyed. The magnitude of the impact is expected to be **medium positive.** Although many families will be affected, the width of the land required is small.

Mitigation Measures

- Compensate all affected property
- Construction activities should time the harvesting period for seasonal crops to enable PAPs harvest their crops.

6.1.3 Operation and maintenance /Post construction stage

6.1.3.1 Attraction of wild animals

There is a game reserve (Burigi Game Rerserve) a few kilometres from the proposed Karazi Multipurpose project. These animals may be attracted to the reservoir and may become harmful to the crops and the people living nearby.

6.1.3.2 Risk of drowning

During this phase there is a risk of drowning by both children and adults in the reservoir. The children or adults may be enticed to swim in the reservoir and may end up drowning or may drown accidentally while passing by. Furthermore, domestic animals may also drown in the reservoir while trying to drink from it. Although this risk leads to loss of lives it can be avoided and mitigated thus the magnitude of the impact is considered to be **medium negative**

6.1.3.3 Risk of increased water and insect-borne diseases

There will be a risk of increased water and insect-borne diseases as a result of the reservoir. The water in the reservoir will be stagnant and will act as a breeding ground for mosquitoes and this will increase the prevalence of malaria in the area. The water in the reservoir may also be contaminated by human activities in the vicinity of the dam, thereby leading water borne diseases.

6.1.3.4 Impact of HIV/AIDS and other STDs

The impact of the sexually transmitted diseases like HIV/AIDS will continue even in the operation phase. Individuals who will have acquired the disease will face its consequences like reduction in productivity, poverty due to the constant spending on medicine among others and an overall negative impact on the welfare of the whole family. It is also likely that with more activities in the area in the operation phase like fishing and recreational activities around the reservoir, more people may be attracted to the area thus increasing the risk of spreading HIV/AIDS. However, with

mitigation measures in place during the construction phase, it is expected that the proportion of affected people will be small, and with continuous awareness programs in the operation phase, the magnitude of the impact is expected to be **medium negative**.

6.1.3.5 Flooding

Poor project designs may lead to dam breakage and therefore flooding that may lead to deaths and destruction of property. Flooding may also be caused by release of excess without warning to the people living downstream. This magnitude of this impact is **medium negative**. Although its occurrence may have far reaching consequences, the impact is mitigable and the probability of its occurrence is medium.

6.1.3.6 Negative Impacts on Fauna

Mammals

Presently in Karazi project area, there are rodents, shrews, antelopes, bats and primates. None of the mammal species recorded during the study is globally threatened or near-threatened. With a reservoir in place, suitable habitats will be created. This is likely to attract some animals from the Burigi Game reserve. Presently the area between the Burigi and the site is being cultivated therefore there are no wild life corridors to the site. However they will always find a way through. This is also likely to be an incentive for poaching as the animals cross the cultivated communities. Poaching is already a problem in Burigi Game reserve where African Elephant has been reduced tremendously. Since there is a barrier between the project site and the game reserve, the impact mitigable but longterm, the impact on mammalian fauna during operation is expected to be **medium negative.**

Mitigation

Build capacity of the local authorities and communities through sensitisation and support so that they can be involved in wildlife conservation and protection.
Project should work with the Game reserve authorities to combat poaching

Dragonflies and Butterflies

9 species of dragonflies were recorded from the project area. There are 14 globally threatened dragonflies recorded from Tanzania (Clausnitzer et al 2011). In addition, 19 of the 909 butterfly species known from Tanzania were recorded in the project area. Since species of Dragonflies and butterfly recorded did not include any of the ones on threatened or near-threatened species list, the impact of the project on the ecology and conservation of dragonflies and butterflies is low.

6.1.3.7 Negative Impacts on Fisheries

Capture fisheries production in the Kagera River basin is faced with a number of problems, including uncontrolled fishing methods and lack of proper fishing gear. Immature fish are captured

leading to extinction of some species. Often local people use poisoning and dynamite, which leads into complete destruction of the lake ecosystem and extinction of fish and other related organisms from the lake. Continued dependence on one type of species also leads to their extinction and loss of biodiversity. For example, some studies carried out in Lake Ihema (Mughanda, 1989) shows species preference was mainly on *Clarias gariepinus, Haplochromus Group,* and other *Tilapia* species such as *Marcusemus victoriae, Alestes Sp., Synodontis Spp, Gnathonemus longibarbus,* and *Schilbe mystus*. Capture fisheries problems are also compounded by lack of extension services to educate the local community on sustainable fishing methods and lack of infrastructure for fish preservation. The following are therefore strategies suggested to enhance fish survival and fisheries in the new Karazi dam.

Strategies to mitigate negative impacts of the Project on the Fish and Fisheries in the new Karazi reservoir

- Institute a Water Use Committee to oversee fishing activities in the dam;
- Formulate and enforce fishing regulations to control access to the dam and fishing grounds;
- Formulate and enforce fishing regulations to control fishing gears and methods to avoid destructive methods;
- Educate the local community about fish, fishing methods and best seasons to fish;
- Establish and train a cadre of extension staff to guide, monitor and regulate fishing activity and use of dam water resources in general;
- Provide access feeder roads to landings on the dam;
- Provide clean fresh water for the communities;
- Provide fish handling and fish processing equipment and facilities in the landings
- Provide fish cooling and chilling facilities at the landings;
- Provide market outlets for fish from the dam;
- Provide good health and sanitation facilities for the communities living in the villages and landings along the dam shores.

6.1.3.8 Negative impacts on Protected Areas (Pas)

There are settlements, cultivations and other forms of land use between Biharamulo-Burigi conservation areas. It is unlikely that the elephants can move from Biharamulo-Burigi conservation area to the project area. There is therefore little likelihood of the dam attracting wildlife which could lead to new conflicts in the region. It is therefore expected that project activities will not impact negatively on the ecology and conservation of many of the wildlife animals and the African elephant populations of Biharamulo-Burigi conservation area and therefore, the impact will be of low magnitude.

6.1.3.9 Negative impacts on vegetation

The construction of the Karazi dam will under mine the naturally occurring flooding regime that has been recurring over a very long time and this will affect the ecology of the area. The dam will reduce downstream flooding. This will cause the disappearance of the ecologically important wetland plants in the floodplain below. Further, the reservoir will destroy over one km^2 of wooded grassland. The initial filling of a reservoir floods the existing plant material, leading to the death and decomposition of the carbon-rich plants and trees. The rotting organic matter will release some carbon into the atmosphere. The decaying plant matter itself will settle to the non-oxygenated bottom of the reservoir, and the decomposition unmitigated by a flow pattern that would oxygenate the water will produce and eventually releases methane gas. This will be short term as vegetation will decay. Hence, the impact of the project on the ecology and conservation of plant species in the Karazi dam area will be of **low magnitude** as there are plenty of similar plants downstream and along the periphery of the reservoir**.**

6.1.3.10 Change in local species composition

The presence of the multipurpose dam and increased volumes of water compared to the existing reservoir and flood plain after impoundment may attract various types of fauna and avifauna and change the local species composition. Some of fauna species that currently visit or have permanent habitat in or near the small reservoir that were encountered in the ecological survey. The multipurpose dam could attract other aquatic and water-dependent fauna, including those that might be deliberately introduced e.g. fish for consumption or commercial purposes. The presence of a permanent water body will also attract hazardous species such as crop pests, dangerous reptiles (crocodiles and water snakes) and disease vectors e.g. malaria mosquitoes, bilharzias snails and invasive species such as water hyacinth. Moreover, some of terrestrial plants could be replaced because of continuous flooding of the area. These impact is considered negative, long term and of high significance

Mitigation

Project owner shall monitor invasive species (algae, water hyacinth, water animals-crocodiles, snakes, etc) and seek professional advice to rectify as appropriate

6.1.3.11 Negative Impacts of noise and vibrations

Noise pollution in the Karazi 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 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 Karazi 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.

Mitigation measures for Noise Pollution

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:

6.1.3.12 Negative Impacts of Air pollution

Air quality in the Karazi 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 Karazi 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 CO2, CO, NOx, SO2 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 **negative low** in qualitative terms and can therefore be considered as negligible and it could be excluded from further analysis.

Mitigation measures against air pollution

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:

It should be noted that the Karazi reservoir when built, will emit Green House Gases (GHG) during its first few years of operation but after this initial period, GHG emissions will decrease

exponentially to reach levels typical of natural lakes. Therefore, there is no need to mitigate GHG.

6.1.3.13 Impacts of the action on archaeology and culture

No direct physical positive effect of the project on archaeological and cultural assets is envisaged. But since archaeology and culture is not only what we see physically, there is a possibly that some other important cultural assets may be discovered in the course of the construction. This therefore calls for careful construction process and thorough involvement of archaeologists during the construction process., the magnitude of the impact could be considered to be **low negative**.

As noted earlier, the project area did not attract much human settlement due to unfavorable environmental condition. This however may not be true archaeologically because other cultural objects may be underneath and could be recovered during construction. Hence, there will be some negative impacts of the action on archaeological and cultural assets. These will include the following.

Some of the heritage resources in the study area include those that have not been detected but these may be impacted (affected, altered, damaged) by the proposed project. There is a high possibility that a number of archaeological sites both in Karazi as well as outside will be encroached upon. The projected sites for acquisition of materials such as stones and murram may lead to destruction of archaeological sites and artifacts. In terms of artifacts, some artifacts may be graded unknowingly and others may be destroyed due to limited skills by some contractors. The overall impact of the project on archaeological assets and culture therefore can be evaluated as **low negative as the sites and value of the assets is currently not known.**

6.1.3.14 Hydrological impacts

The construction of the proposed dams will result in changes in the flow regime downstream of the dams. The reservoirs will store excess water during the rainy season and spillage will occur when the reservoirs are full. Thereafter the reservoirs are filled with water, the inflow flood hydrographs will get modified as they travel through the reservoirs (i.e. from inlet, storage and outlet over the spillway). The modification, which will take place, is that the peak of the inflow hydrograph will be reduced (peak attenuated) and the time base of the inflow hydrograph will be stretched such that there is time lag between the time of the peak of the outflow hydrograph and the time of the peak of the inflow hydrograph.

The amount of outflows from the dam storages will depend on both hydraulic conditions such as the height and width of the spillway and operational rules of the dam. This will most likely affect the ecosystem of the downstream area as they will receive less water especially in the wet season. This is a longterm impact but will only affect areas along the river that have been receiving seasonal floods. It is therefore envisaged that the magnitude of impact will **medium negative.** Due to seasonal nature of the stream at which the dam is to be constructed, firm yield of water flow into the reservoir cannot be guaranteed. In some of the years the water available may not be enough to fill in the reservoir.

Impact on ground water

From Investigations on ground water resources there is no obvious interaction between groundwater and surface runoff. This indicates that there is likely to be little or no impact on ground water downstream of the dam. Furthermore it is expected that there will be ground water recharge in the vicinity once the reservoir is in place. Again since the interaction is not obvious, the impact is not expected be low negative.

6.1.3.15 Dam safety related impacts and Flooding

Poor dam design and maintenance may lead to dam breakage and therefore flooding that may lead to deaths and destruction of property. The probability that this may happen is low because the design team has put in place measures to prevent dam break and the dam is a small dam. In case of dam break, it can have far reaching impacts on the downstream communities. However, emergency plans and procedures have been developed to handle such an incidence. Although its occurrence may have far reaching consequences, the impact is mitigable and the probability of its occurrence has been minimized and thus is the magnitude of this impact is expected to be **medium negative**.

6.1.3.16 Reservoir sedimentation

Agricultural activities taking place on the hilly slopes of the catchment in combination with the steep slopes of the catchment will cause the problem of erosion in the catchment. The end effect of erosion on the catchment will be sedimentation of the reservoir. However, investigations by feasibility study indicated that the rate of sedimentation will be about 1.1% based on the proposed design which is low. Thus impact is regarded as of **low magnitude**. However mitigation measures protection have been proposed especially catchment

6.1.4 Decommissioning Phase

Loss of Dam and associated infrastructure thus Loss livelihoods and increased conflicts over local water resources

As has been mentioned in the preceding sections, a number of socio-economic benefits are expected from operation of the dam. Many people and their families will be depending directly or indirectly on the project for their living. Decommissioning of the project means loss of all socio economic opportunities. Therefore, this impact is considered negative, long term and of high significance.

6.1.5 Summary of measures for mitigation of negative impacts

Preparations Phase/Planning

Social expectations generated by disclosure of information to the Community

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.

Construction Phase

Sedimentation of Reservoir

Mitigation measures

- Minimize the erosion on the catchment by adopting an integrated approach of managing and conserving the dam catchment by the appropriate local institutions. This includes tree planting and other measures
- Identify a suitable site for mining construction material that will not be easily subject to erosion

Land acquisition/ Loss of Property/farmland and grazing land

Mitigation measures

- Project Affected Persons should be fairly compensated.
- Provision of alternative grazing land

Influx of People in the Area

Increased Risk of Diseases

Mitigation

- The project should work with the already established clinics that provide ARV and other HIV/AIDS services to scale up awareness and service delivery
- Voluntary Counselling and Testing services to the workers and community members should constantly be made available.
- There is need for continuous sensitization of the workers and community members about HIV/AIDS and other STDs.
- Project workers should be provided with condoms.
- Condoms should be available at all health centres and should be accessed at no cost by the communities.

Malaria

Mitigation

- The project should put in place strategies to control malaria such as distribution of treated mosquito nets and sensitization of communities in the project area. This

should be done through Health Centres and Non-Government Organizations operating in the area.
- The project can also support some of the health centres in the project area with a view of improving service delivery.
- The Project should have its own health facility, and offer services to its workforce and their families to reduce pressure on existing health facilities.
- Local people should be given priority for employment opportunities.

Pressure on Health Infrastructure and Services

Mitigation measures
- 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.
- The project should support the existing health facilities close proximity of the project through provision of drugs and any other medical equipment.

Pressure on water facilities

Mitigation
- The project should provide water facilities for its staff so that the problem of water scarcity is not faced by the community.
- Given the current problem of low access to safe water, the project should construct a water facility for the communities living in close proximity to the project.

Deterioration in sanitation

Mitigation
- 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.
- Continuous sensitization of the communities on proper sanitation, good hygiene practices and waste disposal

Pressure on wood fuel

Mitigation measures
- Continuous sensitization of the communities about the dangers of deforestation.
- Employment opportunities should be extended to the local people to reduce on the influx of people in the area.

Theft of project materials

Mitigation measures
- Employ private security guards at the construction site

- The developer, 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

Conflicts

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;

Impact on housing and settlements

Vibration

Mitigation

- Baseline conditions of the structures in the vicinity of the earmarked areas for blasting should be undertaken for future monitoring.

Destruction of water sources

Mitigation

Provide alternative water sources for the community

Health and Safety

Occupational Health and Safety:

Mitigation

- Training of workers in safe operating procedures
- Appropriate working gear (such as nose, ear mask and clothing) and good camp management shall be provided
- A well-stocked First Aid kit (administered by medical personnel) shall be maintained at each camp, quarry sites and each active work section along the dam site.

Community Health and Safety

Mitigation measures

- Together with local authorities, enforce restrictions on unnecessary entry into

the project site or even the protected zone
- Constant watering of the road to reduce dust and related diseases

Increased traffic and its associated consequences

Mitigation

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

Impact on Vulnerable Groups

Mitigation
- The developer and the contractor should ensure that women are not marginalized during the employment process.
- The developer and contractor should ensure that persons below 18 years are not employed.
- All cases of exploitation need to be reported to the relevant authorities.

Unfulfilled community expectations

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

Operation and maintenance /Post construction stage

Attraction of wild animals

Mitigation measure

- Project should work together with game reserve authorities to reduce the poaching
- The local authorities and the community should be involved in the conservation activities.
- The wildlife authorities should sensitize the communities on the safety actions to be taken in case of any interface with a wild animal.

Risk of drowning

Mitigation measure

- Trees and other vegetation should be planted around the reservoir to reduce or avoid accidents to the humans and animals
- Surveillance around the dam should be put in place and placing guards at sensitive locations to watch routes from schools, health centers, markets at critical times
- Sensitization of the community of an emergency plan of action in case of a an accident

Risk of increased water and insect-borne diseases

Mitigation measure

- Sensitise communities to constantly sleep under treated mosquito nets
- Distribute treated mosquito nets to communities surrounding the reservoir.
- Clear bushes around the reservoir periodically
- Local authorities should ensure high sanitation levels in the area.

Impact of HIV/AIDS and other STDs

Mitigation measures

- Continuous HIV/AIDS sensitization and awareness programs in the operation phase.
- Condoms should be available at all health centres and should be accessed at no cost by the communities.

Impacts related to Dam Safety and Flooding

Mitigation measures

- In case of the dam break event or any danger, warning systems should be put in place eg communication procedures, radio stations and phone networks to be used, and buffer areas identified and made known should be put in place.
- Any destroyed property as a result of dam breakage should be compensated.
- There should be coordination of the different institutions in case such an event occurs.
- Sensitization of the community of an emergency plan of action in case of a disaster should be done continuously.

Negative Impacts on Fauna

Mitigation measures on Fisheries

Strategies to mitigate negative impacts of the Project on the Fish and Fisheries in the new Karazi reservoir

Mitigation measures

- Institute a Water Use Committee to oversee fishing activities in the Karazi dam;
- Formulate and enforce fishing regulations to control access to the dam and fishing grounds;
- Formulate enforce fishing regulations to control fishing gears and methods to avoid destructive methods;
- Educate the local community about fish, fishing methods and best seasons to fish;
- Establish and train a cadre of extension staff to guide, monitor and regulate fishing activity and use of dam water resources in general;
- Provide access feeder roads to landings on the dam;
- Provide clean fresh water for the communities;
- Provide fish handling and fish processing equipment and facilities in the landings
- Provide fish cooling and chilling facilities at the landings;
- Provide market outlets for fish from the Karazi dam;
- Provide good health and sanitation facilities for the communities living in the villages and landings along the dam shores.

Negative impacts of reservoir on Protected Areas

Mitigation measures

- Institute and enforce good watershed management practices including aforestation, terracing, and good agricultural practices;
- Institute management committees for the over all supervision of all activities in the new Karazi dam; and
- Control livestock access to the dam.

Negative impacts on vegetation

Loss of vegetation cover / Land degradation

Mitigation

- Adjust access road to the project site to avoid high valued features(habitats)
- Open minimal access road
- Avoid unnecessary clearance as much as possible

Inadequacies in Compaction and Resurfacing thus damage to exposed surface and decreased dam capacity

Mitigation

- Conserve natural vegetation in the vicinity of the project area whenever possible to minimize soil erosion.
- Compaction of embankments shall be done to meet the recommended compaction in the design

Change in local species composition

Mitigation

Project owner shall monitor invasive species (algae, water hyacinth, water animals-crocodiles, snakes, etc) and seek professional advice to rectify as appropriate

Mitigation measures for 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

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;
- Ensuring projec t vehicles are in good condition 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 centres 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

Negative Hydrological Impacts

- **Mitigation**
- Operational rules for the dams will take into account the various uses of water downstream of the dam. This includes water for domestic use, agricultural requirements including irrigation and water requirement for aquatic and environmental health.
- An environmental flow **of 0.135m3**/ sec (refer to section 4.1.3 c) has been estimated to cater for this requirement.

Decommissioning Phase
Loss of Dam and associated infrastructure thus Loss livelihoods and increased conflicts over local water resources

Mitigation
Ensuring that alternative sources of water are in place before decommissioning of the project

6.2 POSITIVE IMPACTS OF THE PROJECT AND THEIR ENHANCEMENT

6.2.1 Design, Planning and Preparations phase

Employment and other opportunities

The positive impacts associated with this phase include job opportunities for a few community members. The jobs are in form of casual labourers and data enumerators being hired during the study phase of the project. The magnitude of this impact is expected to be **low positive** as not everyone will benefit from this opportunity at the **Preparations/Planning** stage but its impact will rise at the **Construction** phase as more people will be employed. Further, as a result of opportunities generated by the project in aquaculture, fishing and tourism, there would be a **medium-positive** positive impact during operation.
The local communities will further benefit through: Increased spending of the workforce; Sale of food stuffs, milk and other basic goods to the workers; Creation of market for products; Improvement of incomes and general welfare of the local communities and their families and, Revenue from rent paid by workers.

Generation of ideas and opinions from stakeholders
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.

6.2.2 Construction Phase

Employment opportunities and increased incomes
During construction, employment opportunities for the local communities (both men and women) are anticipated to arise. During stakeholder consultation especially with the Chabuhora community and key informants expressed need for jobs as there are many youth in the trading centre and the surrounding villages who are unemployed. The men will provide mainly unskilled labour while the women especially those settled in the vicinity can benefit from food vending. Others will benefit indirectly by cooking for the site workers, selling commodities and working at the workers camp. Rent will be paid to the owners of the land where the workers' camps will be built. This will be a

source of income to the local people and therefore, improved welfare.

In addition, it is anticipated that the contractor's camps will not accommodate all dam workers so those who will not be accommodated at the contractors' camps will seek accommodation in the nearby residential houses in the area. The landlords in will thus have increased incomes through renting of their houses or apartments

However, a few workers (about 100 both skilled and non-skilled) will be needed as compared to all the people in the project area that expect jobs. Moreover, most of the employment opportunities will phase out after construction and therefore short term (about 1 year) but with mulplier effect related to services like supply of food, sell of other commodities etc, the magnitude of the impact will be considered to be **low -medium positive**.

Enhancement of Positive Impacts

- Sensitization of communities on the existing work opportunities in the project
- Training local residents in entrepreneurship skills
- Adopt Road and transport sector policy strategies on Gender including affirmative action in employment to provide women with an opportunity to earn cash income.

Transfer of skills

During dam construction, local people will be employed for causal labour and in due course there will be transfer of skills and modern technology to the local people. The skills gained and technology will be eventually applied in other productive activities after the completion of the project. The local people who will have benefited from this impact will be in a better position to compete for similar on other projects in the region or the country. The magnitude of the impact is expected to be **medium positive,** this is because although it is a long term benefit, few people will benefit as compared to the many people who would need this opportunity.

Additional infrastructure

During construction, the contractor will establish a water supply system, sanitation facilities and health facilities to the workers. These facilities are also expected to benefit people in the nearby villages. For the case of Karazi, the contractor can improve and upgrade Nyakabanga dispensary to serve both workers and community around. During operational phase the facilities (Water and Health) will remain with the community under the supervision of District council. Given the current problem of water supply and the inadequate health facilities and services in the area coupled with the fact that this is a long term benefit, the magnitude of this impact is expected be **high positive.**

6.2.3 Operation and maintenance /Post construction stage

Positive impacts during this phase are expected to be much higher than other phases because they are the expected outputs of the project. It is thus anticipated that the following impacts will be realized.

The positive impacts can also be on improving biodiversity due to the creation of the open water.

Give reason and examples for aquatic habitats

Improved water supply

Construction of the dam will contribute to improved water supply in the area for both domestic and production purposes like watering of animals. Consultations revealed that during the dry season there is scarcity of water and the cattle keepers move long distances of about 5 km in search of water. This was cited as a problem as there is transmission of cattle diseases, overgrazing of available land and stress to the available water sources that have not dried up. Construction of the dam will not only provide water for animals but also for domestic purposes. This magnitude of the impact is thus expected to be **high positive** as it will be long term, it will benefit many people in the area and it will solve the current problem of scarcity of water especially in the dry season.

Enhancement measures

- Continuous sensitization of the communities in regard to use and maintenance of the water facilities will be required at all levels.
- Regular maintenance programs of the facilities should be put in place.
- Water user and maintenance committees should be put in place

Improved farming and increased production through irrigation

According to the baseline findings, agriculture is the primary occupation of the local people living in the project area. About 99% of the interviewed households admitted that about 93% of their income is from agricultural produce. Even for the households with other sources of income, agriculture contributed more than half of their income and expenditure. Currently, farming is largely rain fed however, with the project in place, there will be possibilities of irrigation and thus production will be throughout the year. With irrigation, vast areas of land will be put under cultivation thus increasing crop production for many people. With increased crop production there will be increased incomes, increased efforts in search of markets for the produce and the general improvement in the standards of living of the people.

The magnitude of this impact is expected to be **high positive** because it will be long term and it will benefit many people.

Enhancement of positive impacts

Capacity building and sensitization of the people in proper irrigation methods

Improved access roads

It is expected that there will be an improvement on the existing access road and new ones will also be created to enable the project transport its equipment and materials. The current access road to the project area is slippery during the rainy season. With an improved access road, there will be improved access to facilities like health centres, education centres to local markets and trading centres like Kayanga and Murushaka. Transport costs for the people will thus be reduced. Although the impact will be long term and will benefit a number of people, the section of the road to be improved may not be very long thus the impact is expected to be **medium positive**.

Enhancement of positive impacts

- Periodic maintenance of the access roads.

Positive impact on Amphibians

During surveys, Montane reed frog *Hyperolius castaneus* was found to be the only globally threatened species recorded (globally Vulnerable).
Because of the little information available about the species, there is limited information available about the ecology and threats of Montane reed frog. According to Schiøtz and Drewes (2004), the species is likely to be impacted by loss of habitat for agriculture (crops and livestock) and human settlements. Because the project will provide more aquatic environment the impact of the project activities on the Montane reed frog and the all the other amphibians species in the project are is positive.

Positive impact on Birds

The grey crowned Crane identified in the project area is globally Endangered but because the project will provide more aquatic environment, the impact of the project activities on the Grey-crowned Cranes is 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. Other birds of low conservation value will also impacted on positively.
Grey Heron and Woolly-necked Stork near-threatened in the East African region have extremely large range and fairly large range respectively. So even if the habitats will improve, the impact will not be significant due to the large range. Therefore the impact on birds by the project during operation of reservoir is regarded as low-medium positive.

Positive impacts for fisheries and aquaculture

The Karazi dam when built will form part of the Kagera River Basin system The creation of the new Karazi reservoir 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.
The Kagera River Basin is known to have the following fish species. Some of these are caught in commercial quantities in the rivers and streams of the basin including its numerous lakes.

	Family	**Species**
1	Mormyridae	*Pollimyrus nigricans*
2	Cyprinidae	*Barbus(Labeobarbus) acuticeps* (e)
3		*Barbus (Labeobarbus) altianalis*
4		*Barbus apleurogramma*
5		*Barbus neumayeri*
6		*Barbus ruasae*
7		*Cyprinus carpio*
8		*Labeo victorianus*
9	Mochokidae	*Synodontis ruandae*
10	Clariidae	*Clarias gariepinus*
11		*Clarias liocephalus*
12	Schilbeidae	*Schilbe intermedius*

13	Poeciliidae	*Lacustricola pumilus*
14	Mastacembelidae	*Mastacembelus frenatus*
15		*Astatoreochromis alluaudi*
16		*Haplochromis burtoni*
17		*Haplochromis sp*
18		*Oreochromis leucosticus*
19		*Oreochromis macrochir*
20		*Oreochromis niloticus*
21		*Tilapia rendalli*
22	Protopteridae	*Protopterus aethiopicus*

The new Karazi reservoir when built could be considered for introduction of fish species with commercial prospects such as the ubiquitous Cichlidae, Cyprinidae and the Clariidae. 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 in Lake Rweru and Cyohoha where Mughanda, 1989 showed that there is potential fish production especially for *Cichlids* (3 species of *Tilapia*) which were introduced in 1950 but have now an average production potential of about 1,500 and 900 metric tons per annum in, respectively. The fish production of other Kagera Basin lakes is shown below.

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 tones per year. There is therefore no reason not to believe that similar fish production levels can be achieved in the Karazi dam as well as in the other small multi-purpose dams in the Kagera River Basin. This would greatly

improve food nutritional capacity of the local communities and offer opportunity for employment. Fisheries can play an important role in ensuring food security, economic development and poverty alleviation among the local community around the Karazi 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.

Aquaculture Fisheries

Capture fisheries in the Kagera River Basin 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 Karazi dam area 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. Given the advantages of fishing farming and the fact that the impact can be long term, the magnitude of the impact is considered to be **high positive.**

Enhancement measures

- Introduce fish farming culture to the surrounding communities through continuous sensitization about fish farming and its advantages
- Training and capacity building in modern fish farming methodologies

Employment opportunities

During the 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, being multipurpose dam it will have multiplier effect; a number of jobs will be created through agricultural development via irrigation potential, tourism, fish farming and other indirect activities. These will be long term activities that will benefit a wide range of people in different areas. Thus the impact is estimated is **expected to be medium positive in the first years but will increase to high positive** as more people participate in these activities**.**

Positive Impacts on archaeology and culture

Enhancement strategy

- Professional archaeologists should be involved right from project planning through to project

implementation and monitoring;
- Sensitization of communities through public/community archaeology so that they can know the importance of preserving and conserving cultural heritage sites and be able to disclose any site known to them;
- Thorough involvement of community members in some of the project areas where they fit;
- Training of the residents in basic skills in cultural heritage management and identification of archaeological sites.

7 ANALYSIS OF PROJECT ALTERNATIVES

7.1 PROPOSED KARAZI DAM SITE

The dam site and the associated reservoir are located in Chabuhora and Kayunguvillagtes in Nyakakiika Ward, Nyabiyonza Division, Karagwe District Tanzania.

This option has a Dam Height of 11m and full supply level at +9m with storage capacity of 9.62 million m^3 (Mm3) Reservoir surface area of 2.36km^2, maximum reservoir length of 3.4 km and reservoir width of 2.11km. This design option will inundate about 236 Ha (583 acres) of land.

However no relocation of any house is envisaged as there is no house that was identified with in the area that is likely to be affected by the project. Some area cultivated with bananas, maize etc is likely to be inundated by the reservoir. Minimal contamination of water from latrines and other activities of surrounding communities because of the hills surrounding the area are vegetated with natural grass and trees. The natural vegetation and associated biodiversity is likely to be reduced but similar vegetation is common in the area. Therefore there seems not be major environmental obstacle to this development as there is a possibility of finding replacement land and a few crops are affected.

7.1.1 Design Alternatives

In addition to the design discussed above, other different design alternatives were considered;

Alternative 1
This was the design provided in the Terms of reference. In this option the dam site is located at the same location as in the above option. It has a dam height of 14m, a storage capacity of 30 Mm^3 and reservoir surface area of 4.5km^2 Construction of dam will create a reservoir which will inundate about 1,780 acres but no structures.

Alternative 2
This option has a Dam Height of 14m and storage capacity of 22.75 million m^3 (Mm3) and a reservoir surface area of 3.71 km^2. The reservoir length is 4km while the reservoir width is 3km. This option would inundate about 371.49 Ha (917.96acres) of land largely used for grazing animals. No residential structures will be affected.

Alternative 1 and 2 would inundate more land, affect more grazing area and more crops and vegetation compared to the proposed option. Furthermore they would be more expensive to

construct as it needs to be stronger to be able to contain more volume compared to proposed option. The proposed option was therefore further studied.

7.2 DO NOTHING SCENARIO

The Nile Basin is characterized by seasonal water scarcity thus water scarcity and growing food insufficiency are some of the issues facing Kagera River Basin where Karazi proposed dam site lies. The situation is expected to get worse as the population increases and as demand by the different water use sectors out-matches the existing supply. Water related conflicts are on the increase and these cause security risks in the catchments. The Nile Basin as a whole is characterized by poverty and rapid population growth (**NELSAP, n.d).**

The people at Karazi usually have a problem of water during the dry season. They have to travel long distances of about 20km to as far as Mwisa River in search of water especially for livestock. During such periods milk production diminishes and the livestock contract a number of diseases as they move from place to place. This generally affects the livelihood of the communities in the area. In the wet season the area has a lot of water leading to floods. A dam at Karazi has been proposed as one of the approaches to address these challenges. This dam is expected to improve water storage in the catchment, and enhancing demand management to minimize wastage of the scarce water resources. If the dam at Karazi is not implemented, then water scarcity of the above provisions of the water policy shall be observed

8 ENVIRONMENT AND SOCIAL MANAGEMENT PLAN (ESMP)

Purpose

The purpose of the Environmental and Social Management Plan (ESMP) is to mitigate and, wherever possible, prevent adverse environmental and social impacts of a project on the communities as well as on the environment. It is also aimed at helping to maximize positive impacts of the project. The ESMP further aims to ensure implementation of mitigation measures whilst identifying the necessary resources and budgets required for its implementation as well as identifying responsibility schedules of various stakeholders who will be involved in its implementation.

Objectives

The ESMP objectives are to ensure:

i) that the activities of the project are carried out following all legal requirements of Tanzania as well as regional (EAC) regulations and guidelines including those of the world Bank and those of other funding partners;

ii) that the health, safety and wellbeing of workers and people living in the neighborhood are taken good care of;

iii) that the environment and ecosystems of the project area and its neighborhood are not harmed but are conserved in every way;

iv) that mitigation measures, corrective and compensation measures are taken quickly whenever needed;

v) that stakeholders are properly identified at Government, district, local, community and agency level to handle appropriate responsibilities during and after implementation of the project;

vi) that there is free flow of information to all stakeholders of the project to enable informed decision making and implementation of projects activities in a timely and coordinated manner;

vii) that the Resettlement Action Plan (RAP) is properly implemented.

Table 8-1 below shows an Environment and Social Mitigation Plan

Table 8-1Environmental and Social Management Mitigation Plan (ESMP) for the Proposed Karazi Dam

Potential Impact	Enhancement measures	Cost Description /unit	Total Cost (USD)	Responsibility
Positive Impact				
Site preparation, Construction and Dam Operation Phase				
Creation of employment opportunities and increase in incomes	• 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. • Community sensitization on the importance and need to protect cultural assets • Training local residents in site protection strategies and handling of valuable cultural assets • Construction of transport and communication networks to the site in order to attract tourists to the site	Meetings for Ministry staff, District staff, ward staff, b) Training of Sub ward staff, communities; c) Training of dam operators, regular and casual workers; d) Stationery and communication	a) During construction 10,000; b) One year after construction and during dam operation 5,000.	Ministry of Water and Environment; Ministry of Culture and Community Development; Ministry of Tourism; Ministry of Education; Consultant and Contractor; Karagwe Local Government;
Skills development and Gender balance	• Training programs for the unskilled and semi-skilled workers	a) Training cost will be included in the Contractor's budget; b) Karagwe District Local Government to work out Annual Budget	Contractor 10,000; Karagwe District 5,0000 in first year	Contractor Karagwe District

Potential Impact	Enhancement measures	Cost Description /unit	Total Cost (USD)	Responsibility
Improved water supply and sanitation facilities	• 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 do their role.	a) Training cost will be included in the Contractor's budget; b) Karagwe District Local Government to work out Annual Budget	Contractor 10,000; Karagwe District 5,0000 in first year	Ministry of Water and Environment/Directorate of Water for Production/ Karagwe Local Government/
	• Continuous sensitizations about fish farming • Potential fish farmers should be provided with fish stocks • Training and capacity building in fish farming methodologies.	Amount to include fish procurement and training	20,000	Ministry of Fisheries/ Karagwe Local Government
Construction phase	• Sharing of the benefits that accrue from the heritage sites with the concerned community • Construction of recreational centres at the cultural heritage sites	Sensitization meetings; Construction of centres; training materials	-	Ministry of Culture and Community Development, Karagwe District Local Govt
Operation and Maintenance phase				
Creation of employment opportunities and increase in income	• 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.	Continuance costs	10,000	Minis Ministry of Culture and Community Development, try of Water,
Skills development and Gender balance	• Training on job for the unskilled and semi-skilled workers	-	-	

Potential Impact	Enhancement measures	Cost Description /unit	Total Cost (USD)	Responsibility
Improvement in capture fisheries, aquaculture and better incomes	• Continuous sensitizations about fish farming • Potential fish farmers should be provided with fish stocks • Training and capacity building in fish farming methodologies.	Amount to include fish procurement and training	20,000	
Creation of tourism potential	• Construction of hotels, restaurants and recreation amenities	Working with the private sector	20,000	Local authorities in Karagwe
Decommissioning				
Influx of tourists	• The local communities should be motivated from time to time through sharing the proceeds that may arise from the use of cultural assets		5,000	Ministry of Culture and Community Development, and Ministry of Wildlife and Tourism, Karagwe District Local Govt
Negative Impact				
Preconstruction phase/Planning				
Social expectations generated by disclosure and information to the community.	• Provide all information regarding the project including aspects of sharing of proceeds from the use of cultural heritage resources • Community sensitization on quarterly basis through public archaeology	Sensitization meetings;	5,000	Consultant and Ministry of Culture and Community Development
Site preparation and Construction				

Potential Impact	Enhancement measures	Cost Description /unit	Total Cost (USD)	Responsibility
Encroachment on the potential cultural heritage sites and mishandling of artifacts	• Contractors need to work hand in hand with professional archaeologists so that any chance findings may be rescued and taken to the Tanzania National Museum • Contractors should also be trained in basic skills of handling artifacts so as to avoid breakage, destruction, and loss of priceless assets • All murram and stone/rock quarry sites need to be first surveyed by archaeologists in order ascertain the intensity of the cultural assets in the place • Any valuable cultural item got in absence of the concerned cultural officials must be reported	Meetings and training of staff and local community	8,000	Consultant and Ministry of Culture and Community, Karagwe District Local Govt., Consultant, and Contractor
Construction phase				
Influx of people	• The Developer in collaboration with the Contractor shall prepare workers recruitment plan and local staff employment percentage shall be determined. • 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.	To be included in Contractors' budget		Developer/Contactor/ Karagwe district/Local Leaders

Potential Impact	Enhancement measures	Cost Description /unit	Total Cost (USD)	Responsibility
Unfulfilled community expectations	• Clear, precise and well defined employment policy and transparent recruitment procedures • Develop a communication strategy between the project and the rest of the stakeholders • Recruitment of local people for the less specialized activities, wherever possible • Encourage sub-contractors and suppliers to prioritize employment of locals wherever possible • Enhancement of community infrastructure should be considered	-	-	Ministry of Water and Environment/Consultant/Developer/ Karagwe Local Government
Increased risk in diseases	• Distributing mosquito nets and sensitization of communities especially the affected villages; Sensitization program targeting the workers and the communities regarding the spread of Sexually Transmitted Diseases (STD) including HIV/AIDS • Local administrative units should be strengthened by 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	Distribute 3000 mosquito nets to about 600 households, (3 nets per household) each nets at UGX 8,000= Boost 2 health centres with testing kits Awareness programs	9,600 10,000 10,000	Developer/Ministry of Health/Consultant/NGOs/Karagwe Local Government/ Contractor

Potential Impact	Enhancement measures	Cost Description /unit	Total Cost (USD)	Responsibility
Pressure on health infrastructure and services	• Where possible the project should support local administrative units 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.	Assistance already included under increased risk of disease		Developer/Ministry of Health/ NGOs/ Karagwe Local Government/ Contractor
Pressure on water and sanitation facilities	• 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.	Included in contractors cost		Developer/ Contractor
Pressure on wood fuel leading to deforestation of trees	• 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.	Tree planting included under catchment protection		District Environmental Office, Contractor
Theft of project materials	• Employ private security guards at each construction site • The developer, 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	Contractor's budget		Contractor/ Karagwe Local Government/ Local Communities

Potential Impact	Enhancement measures	Cost Description /unit	Total Cost (USD)	Responsibility
Occupational Health and Safety:	• Training of workers in safe operating procedures • Provision of appropriate Personal Protective Equipment • 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	Cost to purchase personnel protective equipment to be included in cost under health and safety by the contractor		Developer/ Consultant/ Contractor
Community Health and Safety	• Together with local authorities, enforce restrictions on unnecessary entry into the project site or even the protected zone	Contractor's budget		Developer/ Consultant/ Contractor/ Local authorities
Loss of Land and change in land use	• Project Affected people should be fairly compensated. • Provide alternative land for PAPs who have lost more than 20% of their land • Livelihood restoration programs should be put in place to ensure that PAPs livelihoods are restored	RAP budget		Developer/ Consultant/ Karagwe Local Government
Loss of residential and other structures/Resettlement	• All households losing their 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	RAP budget		Ministry of Water /Developer/Consultant/NGOs

Potential Impact	Enhancement measures	Cost Description /unit	Total Cost (USD)	Responsibility
Increased traffic and its associated consequences	• 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 should be employed by the project in order to control traffic	Contractor's budget		Contractor/Consultant/Developer/Traffic Police
Impact on vulnerable groups	• 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	RAP budget		Ministry of Water and Environment/Developer/Consultant/NGOs
Impact on gender	• 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.	Sensitisation already catered for		Developer, Contractor, NGOS, Consultant
Operation and Maintenance				

Potential Impact	Enhancement measures	Cost Description /unit	Total Cost (USD)	Responsibility
Increased water borne diseases	• Sensitise communities to constantly sleep under treated mosquito nets • Distribute treated mosquito nets to communities surrounding the reservoir. • Clear bushes around the reservoir periodically • Local authorities should ensure high sanitation levels in the area.	Ongoing activity started in construction phase		Developer
Impact of HIV/AIDS and other STDs	• Continuous HIV/AIDS sensitization and awareness programs at all levels and also in schools. • Equip health centres at all levels with HIV/AIDS testing kits and HIV/AIDS Counsellors so as to be able to provide free testing and counselling services to the communities • Condoms should be available at all health centres and should be accessed at no cost by the communities.	Ongoing activity started in construction phase		Developer/Ministry of Health/ Karagwe Local Government
Dam safety related issues and Flooding	• Warning system should be put in place in case of the event of the dam breaking. The actual mobile phone networks will be identified, communication procedures, radio stations to be used etc and the safe havens agreed upon with the host communities. • Any destroyed property as a result of dam breakage should be compensated. • There should be coordination of the different institutions in case such an event occurs. • Sensitization of the community of an emergency plan of action in case of a disaster should be done continuously.	A budget of about USD 10,000 could be put aside for emergency annually	10,000	Ministry of Water, Department of Disaster management (Under the Office of the Prime Minister), Kagera Regional disaster management committee local authorities and community

Potential Impact	Enhancement measures	Cost Description /unit	Total Cost (USD)	Responsibility
Attraction of animals and subsequent poaching	Project should work together with game reserve authorities to reduce the poaching The local authorities and the community should be involved in the conservation activities. • The wildlife authorities should sensitize the communities on the safety actions to be taken in case of any interface with a wild animal.		10,000	Ministry of Water, Game Reserve authorities, local authorities
Risk of drowning	• Trees and other vegetation should be planted around the reservoir to reduce or avoid accidents to the humans and animals • Surveillance around the dam should be put in place and placing guards at sensitive locations to watch routes from schools, health centers, markets at critical times • Sensitization of the community of an emergency plan of action in case of a an accident	-	10,000	Ministry of Water, local authorities and community
Change in local species	Project owner shall monitor invasive species (algae, water hyacinth, water animals-crocodiles, snakes, etc) and seek professional advice to rectify as appropriate	-	-	Ministry of Water & NEMC
Soil erosion and reservoir sedimentation	Catchment projection programme including tree planting be put in place. Project should involve local authorities and the community	Tree planting mitigate soil erosion and to counteract negative impacts on fuel wood. Distributing of seedlings to the communities	20,0000	Ministry of water, Environment and Water officers,
Total Mitigation costs			**202,600**	

Estimated cost of mitigation and enhancement measures for the proposed Karazi multipurpose dam project is .United States Dollars **202,600** excluding the RAP costs which have been handled separately in Preliminary RAP report.

9 PROPOSED ENVIRONMENTAL AND SOCIAL MONITORING PLAN

9.1 DAM MANAGEMENT

The implementation of the Karazi Dam Environmental and Social Monitoring Plan (ESMP) will require the full participation of key players from the Ministry of Water and including the Directorate of Water Resources at the Ministry; Karagwe District Council. The Contractor and the Consultant will of course play major roles in this. It is therefore proposed that a Water Use Management Committees be formed to monitor overall project implementation and use of the water and resources of the Karazi Dam. The composition of these committees is shown graphically in the matrix below.

9.2 ESTABLISHMENT AND RESPONSIBILITIES OF THE COMMITTES

Dam management in Tanzania is governed by part X, Section 86 to 95, of the Water Resources Act no. 11 of 2009. The Act also specifies the structure as follows:

a) The **Client or Dam Owner** (Ministry of Water and Environment);

- Shall apply for dam construction permit and any other legal requirement i.e. environmental permits before and during construction
- Shall be responsible for day to day maintenance, operation and monitoring of the dam.

b) Basin Water Office;

- Shall issue water user permit

c) Director of Water Resources

- Shall issue **construction permits** according to the law
- Shall monitor and regulate dams during and after construction
- Shall register dam specialists
- Shall register dams

d) NEMC

- For environmental issues

9.2.1 Sustainability of Dam Management

i. The irrigation policy recognizes the formation of irrigation committee. The committee is responsible for management of both the water source/dam, and the irrigation infrastructure. The committee has its own financing mechanism and in case of deficit, the Government (Local or Central) subsidizes these committees.

ii. The Water Resource Management Act no. 11 of 2009 recognizes water user associations. Members of these associations are taken from different water users of the same water source and are formed by the directions of the Basin Water Board. The Act also recognizes the Catchment water user committee.

Therefore an irrigation committee and Water User Associations will be formed for the Karazi dam management as indicated above. Figure 9-1 provides the of environmental and social management organisation for the Dam

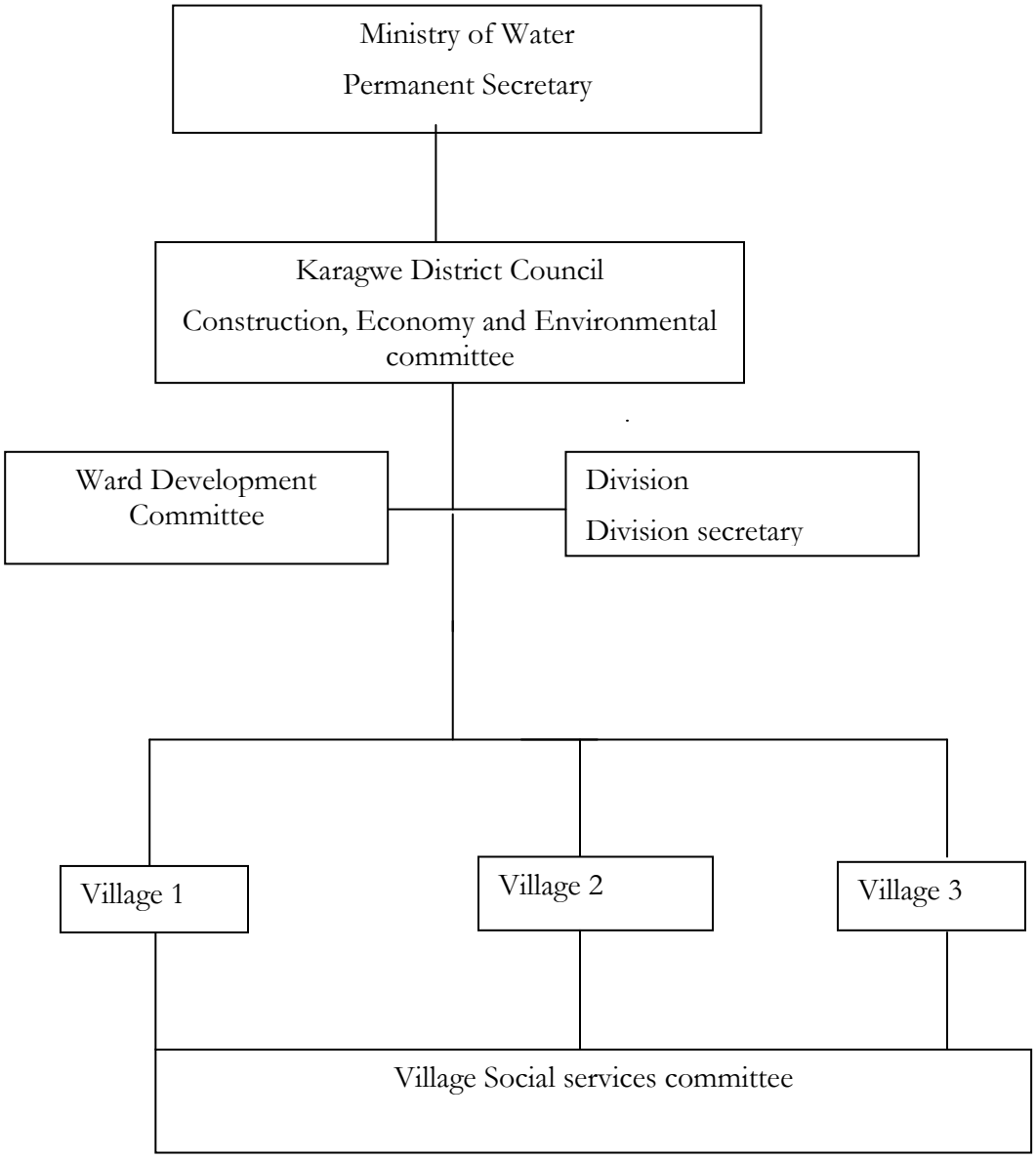

Figure 9-1: Proposed Environmental and Social Monitoring and Management Committee for Karazi Dam

9.3 ENVIRONMENTAL AND SOCIAL MONITORING PLAN AND ESTIMATED COSTS

Table 9-1: Monitoring and Cost Estimates

Negative Impact	Mitigation Measures	Implementation Phase and Time Frame	Responsible Entity	Estimated Costs US$
Loss of Land and change in land use	» Provide adequate compensation for loss of land in the RAP	Planning; 0-1 Years	Consultant; Govt of Tanzania /Client	Costs built into the RAP
Loss of residences and other structures	» Provide adequate compensation for loss of land in the RAP	Planning; 0-1 Years	Consultant; Govt of Tanzania/Client	Costs built into the RAP
Increased traffic and its associated consequences	» Widen transportation access; » Employ skilled and properly trained drivers; » Institute safe speed limits; » Position warning signs in busy places like trading centres; » Employ flag men to control traffic;	Site Clearance; Construction; 1 Year	Contractor; Client; Karagwe Local Govt	Costs built into Construction costs provide 15,000
Influx of people	»The Developer/ Contractor prepare workers recruitment plan; »Project to plan for an increase in infrastructure; » Give priority to local people for jobs;	Planning 0-1 Years; Site Clearance; Construction 1-3 Years	Contractor; Govt of Tanzania; Client; Karagwe Local Govt	Costs built into Construction c but pro 5,000osts
Increase in population	» Local labour should be used for maintenance of the dam site; » Skilled people within the area should be recruited, trained and their capacity built for the operation of the project;	Planning 0-1 Years; Site Clearance; Construction 1 Year	Contractor; Govt of Tanzania; Client; Karagwe Local Govt	Costs built into Construction costs but provide 20,000

Increase in diseases	»Sensitize communities, schools and workers regarding the spread of STD including HIV/AIDS; »Distribute mosquito-nets; »	Planning 0-1 Years; Site Clearance; Construction 1Years	Contractor, Govt of Tanzania; Client, Karagwe Local Govt; Communities	Costs built into Construction costs but provide 20,000
Pressure on health, water and sanitation facilities infrastructure and services	»Sensitize communities, schools and workers on health, sanitation and nutrition; Client and Contractor to build more infrastructure and facilities; »Bins for solid waste and garbage collection should be placed at the workers' camps;	Planning 0-1 Years; Site Clearance; Construction 1 Year	Contractor; Govt of Tanzania, Client; Karagwe Local Govt; Communities	Costs built into Construction costs but provide 10,000
Theft of project materials	»Sensitize communities and workers; » Mark with insignia all project property; Institute tough penalties for thieves;	Planning 0-1 Years; Site Clearance; Construction -1 Year	Contractor; Govt of Tanzania; Client, Karagwe Local Govt, Communities	Costs built into Construction costs 10,000
Occupational Health and Safety issues	»Train workers in safe operating procedures; »Provide appropriate Personal Protective Equipment; »Label all danger zones and hazardous materials; »Restrict and control access to danger zones or usage of hazardous chemicals; »Institute, enforcing and disseminating procedures to be followed when blasting	Site Clearance; Construction 1-3 Years	Contractor; Govt of Tanzania; Client; Karagwe Local Govt; Communities	
Community Health and Safety	»Together with local authorities, enforce restrictions on unnecessary entry into the project site or even the protected zone;	Site Clearance; Construction-1 Year	Contractor, Govt of Tanzania, Client; Karagwe Local Govt; Communities	Costs built into Construction costs 10,000

Impacts on gender vulnerable groups	» Affected households to be compensated adequately;. » Extend Livelihood restoration strategies to women and vulnerable groups; » Women and vulnerable households should be considered for employment and jobs should be equitably distributed to both women and men who are qualified;	Site Clearance; Construction 1-3 Years	Contractor; Govt of Tanzania; Client; Karagwe Local Govt; Communities	Costs built into Construction costs 15,000
Pressure on wood fuel leading to deforestation of trees	» 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; » Introduce and popularize use of energy saving stoves; » Undertake afforestation programs	Site Clearance 1 Year Construction - 1 Years; Post Construction and Operation -25yrs	Contractor; Govt of Tanzania; Client; Karagwe Local Govt; Communities	10,000
Flooding	»Warning signs in case of the event of the dam breaking should be put in place; »Any destroyed property as a result of dam breakage should be compensated; »There should be coordination of the different institutions in case such an event occurs; »Sensitization of the community of an emergency plan of action in case of a disaster should be done continuously.	Construction 1-3 Years Post Construction and Operation 1-3 Years	Contractor; Govt of Tanzania; Client; Karagwe Local Govt; Communities	Costs built into Construction costs 10,000
Total Monitoring Costs				**115,000**

Construction is expected to take about 7 months (Draft Feasibility Report for Karazi), therefore construction period has been estimated at 1 year.

The costs indicated in table 9-1 are for monitoring of construction and operation activities. The cost is therefore mainly for fees and logistical support for the monitoring team. The monitoring costs are estimated **at USD 115,000.** These costs again exclude monitoring costs for implementation of Resettlement Action Plan.

The total costs for ESMP is cost for mitigation plan plus costs for monitoring plan which is USD **202,600+ USD 115,000 = USD 317,600 (**excluding RAP costs)

10 COST BENEFITS ANALYSIS

10.1 INTRODUCTION

The cost-benefit analysis presents a brief comparison of environmental and social costs of implementing the proposed project versus benefits accrued from the project when implementation of the project has been completed. It is a clear fact that, it is not possible to account for all the impacts accrued from the implementation of the project. This is because some of the impacts are direct while others are indirect; others are short-term while others are long-term, some of the impacts are site specific while others cross the boundaries of the project area to affect a larger population, though it may not be necessarily a significant impact. Similarly, valuation of these impacts are more or less dictated by the social group biases tied to the environment to which the project has been subjected. Therefore, methodology used in this cost benefit analysis, will base on comparing between the following:

"The total amount of cash that would be spent by the proponent into the local environment" termed as "BENEFIT"	**Versus**	"the opportunity cost of the items the people and the society will miss when the project is implemented" plus "environmental costs of mitigating any significant impact caused by the project's activities after it is fully implemented to the closure phase". Termed as "COST"

10.2 BENEFITS OF THE PROJECT

The following project items will be termed as "BENEFITS":

- The cost of infrastructure that will benefit target communities in the area
- The cost of infrastructural development on the area that would benefit other users such as improved access roads etc;

- The salaries paid to employed workers, which will be spent in the surrounding environment to raise the economy of the Karagwe district and surrounding areas
- The cost of local supplies to be purchased for project's operations as part of the operating costs of the proponent.

10.2.1 Infrastructural Development

In order for the project to operate, several developments will be undertaken which may directly benefit the communities near the project area as well as other stakeholders of the proposed project.

The Chabuhora village community will benefit from the access roads to be constructed by the developer.

10.2.2 Salaries and Other Employee Benefits

The project will initially employ skilled individuals during the construction phase. Employment of such people will boost trade in the area especially with respect to food vending, domestic consumables, beverages, etc. Consumption of these items will generate further taxes to the government.

New employees will be hired during operation phase of the project. These technical personnel for operation will earn salaries out of which about 30% of what they get will be income taxes to the government. Part of these salaries will be spent within the community of Rwabikagati area as well as neighbouring areas of Kayanga town and other places for purchase of domestic consumables, food, and other necessities of life which will help boost the economy of the area. These salaries will pull food vendors and other merchants into the area, boosting further trade in the area enabling the government to collect taxes even much more from the sold items.

10.2.3 Equipment and Consumables

There will be a number of fishing and farming equipment due to fishing activities on the dam and starting of irrigation agriculture in the area. There will be boats for fishing and power tillers for agriculture which will consume a significant amount of fuel, spare parts during operation of the project.

There are consumables, which will be imported from overseas since they may not be sourced locally but there will be consumables which can be sourced locally; these will boost the local business in the area.

10.3 COSTS OF THE PROJECT

The following project items will be termed as "COST":

- The environmental costs spent as part of the Environmental Management Plan (EMP) and Environmental Monitoring Costs
- The Cost of Decommissioning the project

10.3.1 Environmental and Social Costs

The developer will incur environmental costs during the life of the project as outlined under the Environmental Management Plan. There will be costs of compensating people who may be relocated to other areas.

10.4 BENEFIT – COST COMPARISON

Based on the facts described under Section 10.1 and 10.2, when all the benefits accrued from the project are compared to costs, it is obvious that the project will have more positive impacts to the surrounding community and environment as compared to the costs. Therefore, it may be concluded that the project will have more benefits than environmental and social costs to be incurred during construction and operation phases.

11 DECOMMISSIONING AND RESTORATION

The Table below gives a summary of both positive and negative environmental and social impacts of the proposed project; proposals for enhancement of positive impacts; proposals for mitigation f negative impacts; estimated costs of enhancement and mitigation and the responsibility centre for each activity.

The decommissioning plan establishes feasible decommissioning activities that can be accomplished without undue risk to the health and safety of the public and decommissioning personnel without adverse effects on the environment and within established guidelines and limits of the appropriate regulatory agencies. This plan will serve the purpose of ensuring that the decommissioning and ultimate disposition of structures is considered during the initial design, construction and operation of the project. The plan will remain a "living document," and revisions will be made throughout the operating life of the project. It must be reviewed periodically and revised to reflect any changes in construction or operation that might affect decommissioning. Prior to the initiation of actual decommissioning activities for the project, a detailed final disposition plan will be prepared.

Decommissioning and restoration will take a two fold systematic action as follows:

i) Decommissioning of the construction site is generally rehabilitation by the contractor in which a decommissioning plan will be provided on campsites, temporary access roads, borrow areas, quarry mines if any, crushing plant if any, material stock pile, general site rehabilitation et.

ii) Decommissioning of the dam structure and reservoir at the end of its life.

11.1 PURPOSE AND CONTENT

The preliminary plan serves to establish decommissioning as an important consideration from the inception of the project, during design and throughout the operation of the project and its associated facilities. The plan has the following purposes:

a) The primary purpose of the preliminary plan is to ensure that the dam designers are cognizant of decommissioning during the initial design of the project. Thus, where design choices that would enhance decommissioning are available for types of materials and system components, and location of components, these choices should be made.

b) Another purpose of the decommissioning plan is to identity the ultimate decommissioning options of the dam and its associated facilities status. These options would be evaluated and narrowed to the decommissioning methods and its associated facilities life is approached.

c) The final purpose of the decommissioning plan is to demonstrate to regulatory agencies that important aspects of decommissioning are considered as early as possible during the initial design of the dam. The plan serves as the starting point to demonstrate that areas such as decommissioning methods, costs, schedules, and operating impact on decommissioning will be reviewed and refined

throughout the operating life of dam.

11.2 CONTENT

The decommissioning plan provides a general description of decommissioning methods considered feasible for the dam. The description is intended to demonstrate that the methods considered are practical and that they protect the health and safety of the public and decommissioning personnel.

Design personnel should study the proposed decommissioning methods and take steps to ensure that the design incorporates features that will facilitate decommissioning.

Considerations include:

a) An estimate of manpower, materials, and costs anticipated to support decommissioning.

b) A description of the anticipated final disposition and status of the dam;

c) A discussion demonstrating that adequate financing will be set aside for decommissioning;

d) Identification of records that should be maintained during construction and operation which might facilitate decommissioning, including a set of "as built" drawings.

11.3 PROJECT REMOVAL METHODOLOGY AND SCHEDULE

Kagera District Council shall fund and implement all aspects of Project decommissioning, including but not limited to all engineering, environmental assessment, permits, construction, and mitigation activities associated with the decommissioning in accordance with this Plan and mitigation of Project removal impacts on site. The project owner shall monitor environmental impacts during and after Project removal to respond to defined events during the monitoring phase.

Kagera District Council shall remove all structures safely and in a manner that:

- Minimizes environmental impacts e.g. dust pollution, providing protective gears to decommissioning personnel etc;
- Satisfies project owners' obligations under the Environmental Management Act (2004); and
- Restores the site to a condition suitable for multiple use.

Project decommissioning will begin six months after closure and continue for six months. Within the six months from closure, Kagera District Council will do an inventory of all components that need to be removed and/or disposed. This inventory will include structures to be demolished, debtors and creditors to be settled. Also mode of disposal will have to be finalized. This information will assist in the preparation of the updated final decommissioning plan for approval by NEMC.

After the approval of the updated decommissioning plan the metal parts will be removed first within the first three months (this is important to ensure that they are not vandalized). The second three months of the decommissioning will be used to remove concrete structures. Debris will be used as road fills for rural roads. All disturbed areas will be landscaped and revegetated using indigenous trees.

Project decommissioning has five phases: (1) pre-removal monitoring; (2) permitting; (3) interim protective measures; (4) Project removal and associated protective actions; and (5) post-removal activities, including monitoring of environment and socio economic activities.

The first three phases will occur prior to removal of the Project (i.e. within the first six months). The fourth phase — project removal and associated protective actions — will take place twelve months after closure. The fifth phase will begin after total removal and due to nature of the project (medium scale, with relatively moderate impacts) removal and continue for at least one year.

The description that follows outlines the activities that will occur in each phase:

(1) Pre-removal monitoring: Pre-removal monitoring includes environmental and socio economic status of the project and the surroundings. This monitoring is essential to identify if there is any environmental or social liability which need to be settled before the permit for closure is given. This period will also be used to do an inventory of all assets and facilities that need to be disposed of and to prepare a final updated decommissioning plan for approval by NEMC.

(2) Permitting: Kagera District Council shall obtain all permits required to undertake removal of the Project

(3) Interim Protective Actions: This will take care of any interim protective measure that needs to be implemented to protect human health and environment, if any.

(4) Project Removal: As noted above, the removal of the project will be completed within twelve months.

(5) Post-Removal Activities: Post-Project removal monitoring will continue for one year

The cost of decommissioning of the dam is estimated at US Dollars One hundred thousand.

12 SUMMARY AND CONCLUSIONS

12.1 SUMMARY

The Environmental and social Impact Statement (ESIA) has identified a number of issues pertaining to the proposed Karazi dam in Karagwe district. Identified issues/impacts have been assessed and described in detail to gain an adequate understanding of possible environmental effects of the proposed project – from project construction to decommissioning stages. This has been done in order to formulate appropriate mitigation measures to response to negative impacts. The Environmental Management Plan (EMP) provides a way forward for implementation of the proposed mitigation measures. The EMP shall be implemented as a prerequisite for a positive Record of Decision (RoD) by the appropriate authorities.

The estimated costs for implementing the mitigation measures are just indicative and may be a little less or more than the actual cost to be incurred. The consultant has used informed judgment to come up with the figures in the EMP.

The Environmental Monitoring Plan provides responsible parties for monitoring purposes. The owner of the project shall liaise with all stakeholders for proper coordination of the monitoring activities. This way there will be reduced cost for undertaking the monitoring activities.

12.2 CONCLUSIONS

Given the nature and location of the development, the conclusion is that the potential impacts associated with the proposed development are of a nature and extent that can be reduced, limited and eliminated by the application of appropriate mitigation measures.

The Consultant is of the opinion that most of the potential environmental impacts identified may be reduced, eliminated or mitigated. The proposed environmental management plan and environmental monitoring plan if implemented accordingly during all phases of the project will safeguard the integrity of the environment at the project area.

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APPENDICES

APPENDIX 1: PROJECT BRIEF ACCEPTANCE

NATIONAL ENVIRONMENT MANAGEMENT COUNCIL (NEMC)

BARAZA LA TAIFA LA HIFADHI NA USIMAMIZI WA MAZINGIRA

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In reply please quote:

Ref:.....NEMC/562/1/Vol II/120.....

Date:.....9/7/2012.....

Permanent Secretary,
Ministry of Water,
P.O. Box 9153,
Dar es Salaam.

RE: **PROJECT BRIEF FOR THE PROPOSED KARAZI MULTI-PURPOSE DAM PROJECT AT CHABUHORA AND KAYUNGU VILLAGES IN KAGERA REGION**

The heading above refers,

We acknowledge receipt of your letter dated 4th June 2012 accompanied with Project Brief on the above mentioned project.

We would like to inform you that aforementioned documents have been reviewed and found to have relevant information to allow further Environmental Impact Assessment (EIA) study.

As a first step towards this end; you are required to submit the Scoping Report and Terms of reference (ToRs) before the commencement of an Environmental Impact Assessment study.

Therefore; you will be required to submit five copies of the Scoping report and ToRs to the National Environment Management Council (NEMC) for review and approval before proceeding with an EIA study.

Should you need any further information or clarification on this matter, please contact us through Tel.0756 055 766.

Looking forward to your continued cooperation on this matter.

Yours sincerely,

F.C.N. Rugiga
For: Director General

Cc: Longdare Ojung,
P.O. Box 14466,
Dar es Salaam.

All correspondence should be addressed to the Director - General

APPENDIX 2: TERMS OF REFERENCE

TERMS OF REFERENCE FOR ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT OF THE PROPOSED DAM AT KARAZI SITE, KARAGWE DISTRICT, TANZANIA

1.0 INTRODUCTION

1.1 Project Background

The Nile Basin Initiative (NBI) is a collaborative effort of the Nile riparian countries which aims at developing the River Nile and its resources in an equitable and sustainable way for the benefit of the people of the Nile Basin. The NBI also aims at promoting regional peace and security. The NBI's Strategic Action Program is composed of two complementary programs which include the basin wide Shared Vision Program (SVP), whose objective is to build confidence and capacity throughout the basin, and the Subsidiary Action Programs (SAPs), which initiate concrete investments in the Eastern Nile (ENSAP) and in the Nile Equatorial Lakes sub-basins (NELSAP).

The NELSAP implements three river basin projects, among which the Kagera River Basin Management Project (KRBMP) is one of them. KRBMP objective is to establish a sustainable framework for the joint management of the water resources of the Kagera River Basin and prepare for sustainable development investments, in order to improve the living conditions of the people and to protect the environment. The Kagera River Basin Management Project (KRBMP) is implemented under the NELSAP program of NBI. Its main objective is to establish a sustainable framework for the joint management of the water resources of the Kagera River Basin and prepare for sustainable development which is intended to improve the socio-economic conditions of the people and to protect the environment. The Kagera River Basin Management Project (KRBMP) has therefore completed a study for identification and rapid assessment of potential small dams for the multipurpose uses of agricultural development, hydropower generation, water supply, fisheries, and other ecosystem functions. The study identified 28 new dam sites and made preliminary assessment of 3 previously identified dams from the Rwanda Irrigation master plan. From this "long list" of 31 sites, 11 sites were selected basing on the criteria of: (i) Equity (targeting one site per country), (ii) Dam height (targeting small dams as defined by World Bank OP4.37), and (iii) Reservoir storage capacity and reservoir yield. For these 11 selected sites (3 in Uganda, 3 in Rwanda, 3 in Burundi and 2 in Tanzania). Other criteria were also developed to rank the 11 visited sites, and these included: (iv) site foundation conditions, (v) material availability, (vi) access to proposed sites, (vii) potential

water uses, (viii) environmental and social considerations, and (ix) Government priority or site preference. From the above criteria, four dam sites were selected for feasibility study, with one site per country. From the above criteria, four dam sites were selected for feasibility and these were Taba-Gakomeye in Rwanda, Buyongwe in Burundi, Karazi in Tanzania and Bigasha in Uganda.

Further, the Nile Equatorial Lakes Subsidiary Action Program (NELSAP) of NBI received additional grant from the World Bank Nile Basin Trust Fund (WB NBTF) to undertake an Independent Environmental and Social Impact Assessment (ESIA) for the four identified multipurpose dam sites of which Karazi is one.

The present Terms of Reference are addressing Karazi dam site in Karagwe

The ESIA study will assess the technical, social, economic, financial and environmental viability of the multipurpose dam. The ESIA will run concurrently with the abovementioned feasibility study but will independently evaluate the environmental and social aspects of the multipurpose dam site. The ESIA will be done in accordance with the relevant World Bank's guiding Policy Frameworks and procedures in full cognizance of national policies.

A scoping study has been carried out to which these TORs are an appendix.

During scoping, several key environmental issues were identified after site reconnaissance, holding consultations with stakeholders of the project and reviewing various literatures related to the project. Similarly, expert opinion was sought on various key issues identified as requiring specialized knowledge.

The purpose of Terms of Reference (TOR) therefore, is to provide formal guidance to the Client and design Consultants on the range of issues that must be addressed in the develpment process. They also form a basis for subsequent review process. In these ToR, strategies for addressing issues identified during scoping have been incorporated to make the study focused.

1.2 Objectives of the Environmental and Social Impact Assessment

1.2.1 Overall Objective

The objective of the study is to undertake an environmental and social impact assessment of the proposed dam. It will identify possible positive and negative impacts on the social, physical cultural and biophysical environment prior to, during and after infrastructure construction. Hence, the ESIA study is aimed at improving the environmental design of the multipurpose dam through

elimination/minimizing negative impacts and enhancing the positive impacts of the dams. Environmental and Social Management Plans (ESMPs) will also be prepared.

Development of a multipurpose dam is included in the mandatory list of projects that are required to be subjected under DAM by the Environmental Management Act (2004) of Tanzania. Part IV of the EIA and Audit Regulations (2005) provides the general objectives for carrying out EIA, among others a list include the following:

1.2.2 Specific Objectives

a) to ensure that environmental considerations are explicitly addressed and incorporated into the development decision making process;
b) to anticipate and avoid, minimise or offset the adverse significant biophysical, social and relevant effects of developmental proposal;
c) to protect the productivity and capacity of natural systems and ecological processes which maintain their functions; and
d) to promote development that is sustainable and optimises resources use and management opportunities.

Consequently, the Nile Basin Initiative would like to undertake Environmental and Social Impact Assessment so as to translate the principles of sustainable development and environmental protection into strategies and actions that can be practically applied to the intended project.

The specific objectives of the ESIA are to:

- Establish baseline information on both natural and built environment including socio-economic conditions of the proposed project area;
- Identify, predict and evaluate foreseeable impacts, both beneficial and adverse, of the proposed investment;
- Develop mitigation measures that aim at eliminating or minimising the potential negative impacts and promote positive ones; and
- Develop management plan and monitoring plan for ease of reference during project implementation.

2.0 PROJECT DESCRIPTION

The dam site and the associated reservoir are located in Chabuhora and Kayungu villagtes in Nyakakiika Ward, Nyabiyonza Division, Karagwe District Tanzania.

The proposed dam has a height of 14m with full supply level of 12m (1326masl). The dam is expected to be earth fill with maximum reservoir surface area of about 3.71 km^2, maximum reservoir length of 4.0km and reservoir width of 3.0km. The storage capacity is expected to be about 22.75 million m^3 (Mm^3).

The project area is sparsely inhabited **(Plate 1)**. Existing activity is mainly livestock rearing and peasant agriculture in a few areas. The dam is expected to provide water for domestic use, hydropower, livestock, and irrigation, fisheries, aquaculture and flood control.

3.0 SCOPE OF WORK

The ESIA shall be conducted in accordance with the Terms of reference agreed by the two parties i.e. consultant and client. The main steps to be followed by the Consultant in the environmental impact assessment will involve:

- Identifying, collecting and analyzing information which include:
  - project characteristics and activities;
  - baseline data of the environmental and socio-economic setup;
  - predicting impacts;
  - evaluating impacts' significance;
  - identifying and proposing mitigation measures;
  - preparing the Management and Monitoring Plan and Follow up; and
- Presenting the information which involves writing an environmental Impact Statement (EIS).

The approval process shall also be according to the terms of reference agreed during inception phase of the project. Following the study the Environmental and social Impact Assessment Report will be submitted to the client for review and approval.

During the ESIA, the Consultant shall carry out the following tasks:

4.0 STAKEHOLDERS CONSULTATIONS

Consultations with stakeholders have been undertaken in this scoping stage of the ESIA. Main

stakeholders and their concerns will be elaborated clearly in the ESIA report. The Consultants shall carry this further during the impact assessment phase.

4.1 Baseline Data and Information

4.1.1 Study area

In order to cover assessment of all key issues related to the project, the study area shall be much wider than that covered by the project site where most of the project operations and facilities and services will be located. This is because some of the impacts might have local, regional or national implication. The core area has been determined to be the whole area that will be covered by the dam as well as adjacent land use and environment.

The Consultant shall further determine and set the project boundaries particularly spatial boundaries (i.e. impact area coverage and area of influence).

4.1.2 Description of the project

The Consultant shall give details of:

- Location of all project-related development and operation;
- General layout of facilities at the site - diagrams of facilities, design basis, size, capacity;
- pre-construction activities and construction activities;
- Organizational relationships, mandates and interactions among the different parties to be involved in the project.

4.1.3 Description of the Environment

The Consultant shall:

i. Provide general description of the project environment and sources of information for anyone requiring a more extensive description (especially the EIS reviewers).
ii. Identify those features that are particularly important in the project area – i.e. maps at appropriate scales to illustrate the surrounding areas likely to be environmentally and socially affected.
iii. Identify areas that require special attention in the project implementation. The areas may represent unique or sensitive geomorphologic characteristics, biotopes, or species. (Terrestrial vegetation and their special species composition and threatened or endangered species).

Environmental Impact Assessment shall specifically focus on these ecological components to ensure that the proposed development does not harm the well being or these characteristics.

4.2. Legislative and Regulatory Considerations.

The Consultant shall:

Describe pertinent local, national, regional and international regulations and standards governing environmental quality, health and safety, protection of sensitive areas and endangered species, land use control etc.

4.3 Impact Assessment

To avoid ambiguity in the impact assessment - identifying potential impacts, relevant environmental factors and mitigative measures – Consultants shall make use of the checklist covering the major areas of impact as provided for in the ESIA guidelines.

Using baseline data and information the following tasks shall be carried out by the consultant.

4.3.1 Task 1. Identification and Prediction of Impacts

Under this activity the consultant shall:

i. identify issues and concerns in order to find suitable remedies;
ii. identify linkages among project components and the issues;
iii. identify where project activities or elements interact with social and biophysical environment (direct impacts):
iv. identify indirect impacts of the project on the environment;
v. identify cumulative impacts that may be anticipated;
vi. identify residual impacts if any;
vii. predict probability, magnitude, distribution and timing of expected impacts;
viii. carry out assessment of alternative sites and alternative technologies in order to come out with the best option; and
ix. Forecast what will happen to the affected environmental components if the project is implemented as is or if the alternatives (e.g. sites and technologies) are chosen (a no-project option will also be considered)

4.3.2 Task 2: Estimation of the Significance of the Impacts

The consultant shall:

i. determine which environmental components are mostly affected by the project or its alternatives;
ii. list issues raised by the public and classify them according to the level and frequency of concern whenever possible;

iii. list regulatory standards that need to be met; and
iv. Rank predicted impacts in order of priority for avoidance, mitigation, compensation and monitoring.

4.3.3 Task 3: Development of Management Plan to Mitigate Negative Impacts, and Development of Monitoring Plan

The consultant shall:

i. determine appropriate measures to avoid or mitigate undesirable impacts;
ii. assess and describe the anticipated effectiveness of proposed measures;
iii. ascertain regulatory requirements and expected performance standards;
iv. determine and assess methods to monitor impacts for prediction of pertinent remedial measures for effectiveness;
v. determine and assess methods to monitor for early warning of unexpected effects;
vi. re-assess project plans, design and project management structure;
vii. describe follow-up dam and post-project action plan for achieving ESIA objectives; and
viii. Assess the level of financial commitment by the project proponent for the management and monitoring plan and follow up activities.

The consultant shall be guided by the cost-effectiveness principles in proposing amelioration measures. Estimation of costs of those measures shall be made. The assessment will provide a detailed plan to monitor the implementation of the mitigation measures and impacts of the project during preparatory and operation phases.

4.4.4 Task 4: Identification of Institutional Needs to Implement Recommendations

The Consultant shall review the institutional set-up at community, ward, District/ Regional and national levels - for implementation of the Management and Monitoring Plans recommended in the environmental assessment. The assessment shall identify who should be responsible for what and when.

4.4.5 Task 5: Drawing Recommendations

The consultant shall:

i. highlight key concerns and considerations associated with the acceptance and implementation of recommended actions;
ii. determine resources requirements for implementing recommendations;
iii. determine capacity and resourcefulness of the client to meeting such commitments;
iv. explain rationale for proposed development and benefits and costs vis-à-vis the no-project option;

v. Ascertain degree of public acceptance of or reaction to recommendations.

4.4.6 Task 7: Review

The reviewed report from the client may require further input (data collection, consultation inputs etc.). The consultant shall undertake to provide extra information and inputs until the project review is satisfactorily concluded.

4.4 Peoples' Participation

The assessment shall establish the level of consultation of the affected stakeholders before designing the project, level of involvement in the running and maintenance of the project facilities as this is an important aspect for both environmental and project sustainability.

The assessment will provide a framework:

- for co-ordinating the environmental impact assessment with other government agencies; and
- For obtaining the views of affected groups and in keeping records of meeting and other activities, communications and comments and their disposition.

5.0 STUDY TEAM

The consultants shall deploy consultants/experts with the demonstrable practical experience in conducing ESIA studies. Furthermore, experts with specific experience in, civil engineering, hydrology, environmental engineering, sociology, ecology, botany, land economy, archaeology will be involved in the team.

APPENDIX 3: Consulted Stakeholders

List of Consulted Persons

Name	Designation	Date
Mr. Shuma Walking	NLO Tanzania & Manager Karagwe Water Supply	10 -01-2012
Mr. Arnest Kahabi	Karagwe District	10 -01-2012
Mr. S. M. Stambuli	District Irrigation Officer, Karagwe	10 -01-2012
Mr. R. Christian	Karagwe District	10 -01-2012
Mr. Naseeb Rama Maselle	Karagwe District	10 -01-2012
Salifya Sabuk K.	Karagwe District	10 -01-2012
Mr. Silaji Hussein	Ag. KDC	10 -01-2012
Eng. Kalunde K. Malale	Ministry of Water	28-03- 2012
Mr. Ben Kyaruzi	National Environment Management Council NEMC	28-03- 2012
Mr. Baraka S. M.	Ass. Director Fisheries Development Division - MoAF	28-03- 2012
Eng. Othmah	Ass. Director Irrigation - MoAF	29-03- 2012
Mr. Silas William	Senior Fisheries Officer, Aquaculture Division- MoAF	29-03- 2012
Mr. Godfrey Ssengendo	Deputy Project Manager, Water Resources Kagera Basin	17 -01- 2012
Mr. Innocent Kabenga	Deputy Project Manager, Planning and Management Kagera Basin	17 -01- 2012

Attendance Lists for Community Meetings

LIST OF STAKEHOLDERS CONSULTED

S/N	Name/*Jina*	Position/*Cheo*	Institution/*Taasisi*	Address/*Anuani*	Signature/*Sahihi*
1	VARENTINA JOSEPHAT			NYAKAKIKA	
2	JAKILINI POROSIREL			NYAKAKIKA	
3	KAPATIL KATERA			NYAKAKIKA	
4	PETERONIA KASISI			NGOMAIBARE	
5	METODIA LODOVIK			NGOMAIBARE	
6	VENANT RWIHURA			NGOMAIBARE NYAKAKIKO	
7	SARAFINA PETERO			NYAKAKIKA	
8	DATIVA PAULO			NGOMAIBARE	

9 ERNEST BULINGO M/KITI SKUJI NYAKAKIKA NYAKAKIKA

10 ALFRED B. KARULENDO VEO NYAKAKIKA

AFISA MTENDAJI WA KIJIJI
NYAKAKIKA – KARAGWE

ALFRED B. KARULENDO

LIST OF STAKEHOLDERS CONSULTED

S/N	Name/*Jina*	Position/*Cheo*	Institution/*Taasisi*	Address/*Anuani*	Signature/*Sahihi*
11	Fortunatus Lauliano	Mjumbe		Nyakakika	[signature]
12	Marco Kakuru	Mjumbe		Nyakakika	[signature]
13	R.J. Rweyemamu	A/Kilimo	Kilimo/Mifugo	Box 22 Karagwe	[signature]
14	Gerold Jikagunzi	Mjumbe		Nyakkk	[signature]
15	Benedicto Mashaka	〃		Kanguga	[signature]
16	Fulgent Lauliano	〃		Nyakakika	[signature]
17	Phinias Mbaeli	〃		〃	[signature]
18	Alfred Diadon	〃		〃	[signature]

[signature] AFISA MTENDAJI WA KIJIJ
NYAKAKIKA – KARAGWE
ALFRED B. KARUGENDO

LIST OF STAKEHOLDERS CONSULTED

S/N	Name/*Jina*	Position/*Cheo*	Institution/*Taasisi*	Address/*Anuani*	Signature/*Sahihi*
19	Agnes.	Mjumbe		Kagugo	Agnes.
20	EDITHA VENANT	MJUMBE		NGOMAIBARE	Editha
21	TEOPISIA PERA			NGOMAIBARE	
22	VORONIKA GILI			NGOMAIBARE	
23	JAKILINI DISMISIMI			NGOMAIBARE	
24	AGELINI KAIZA				
25	ALIFULEDIA NSHEKA				
26	NYAMWIZA NIKORA				

AFISA MTENDAJI WA KIJI.
NYAKAKIKA - KARAGWE

ALFRED B. KARUHANGA

LIST OF STAKEHOLDERS CONSULTED

S/N	Name/*Jina*	Position/*Cheo*	Institution/*Taasisi*	Address/*Anuani*	Signature/*Sahihi*
27	C'Josephati Pelegrina Finias				
28	Domina Rugina Floreda				
29	WiniFilida EVODIA				
30	Sikola mali Saly				
31	EPiNES Aminini				
32	Costendini Ruiha	Mkulima		Nyakakika	[illegible]
33	Alfeledina Vedasto	Mkulima		Nyakakika	ALFILEDINA
34	JESDERY David	Mkulima		Nyakakika	[illegible]

AFISA MTENDAJI WA KIJIJI
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ALFRED B. KARUHENDO

LIST OF STAKEHOLDERS CONSULTED

S/N	Name/*Jina*	Position/*Cheo*	Institution/*Taasisi*	Address/*Anuani*	Signature/*Sahihi*
43	CHRISTIAN KATETEGIRWE	MKULIMA	MKULIMA	NYAKAKIKA	[signature]
44	JOSEPHAT KARAGURA	-"-	-"-	-"-	Karagura
45	GAUDENSIA CHRISTIAN	-"-	-"-	-"-	Gaudensia
46	JOHN KAHISI	"	"	OMUKIKUKATO	Kahisi
47	MAKURATA BONIPHACE	-"-	-"-	OMUKIKULATO	Makurata
48	Frederick Lukwakure	-"-	-"-	KANDEGESHO	[signature]
49	Thomas [illegible]	"	"	Omukikulo	Thomas
50	DEOGRATIAS SHAIZA	-"-	-"-	NYAKAKIKA	[signature]

[signature] AFISA MTENDAJI WA KIJIJ
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51	JOSPINA KAHEBU	MKULIMA		NYAKAKIKA	Kahebu
52	LETISIA BAMPATA	MKULIMA		NYAKAKIKA	LETISIA
53	RIBENT · JOER	MKULIMA		NYAKAKIKA	R.JOER
54	TITUS LUDOVICK	MKulima		NYAKAKIKA	[illegible]
55	CHRISIAN·	MKULIMA		NYAKAKIKA	CHRISTIAN
56	AUGUSTINIK	MKULIMA		NYAKAKIKA	A·K·
57	MAGILOHI	SHOLSHOLO		NYAGAGIGA	Ni. Shokoro
58	FELIX [illegible]	Mkulima		NYAKAKIKA	[illegible]

[signature]

AFISA MTENDAJI WA KIJIJ
NYAKAKIKA – KARAGWE

ALFRED B. KARUHENDO

LIST OF STAKEHOLDERS CONSULTED

S/N	Name/*Jina*	Position/*Cheo*	Institution/*Taasisi*	Address/*Anuani*	Signature/*Sahihi*
67	Teosphot Kagaza				
68	SALVATORY KASISI	MKULIMA			Skasisi
69	JASPER N. RWENGOMA	MWALIMU	Elimu	BOX 79 KARAGWE	[signature]
70	Phocas Mushongi	MUKULIMA			Phocas
71	Geofrey Kasisi	Kabibu	Shule	Nyakakika	[signature]
72	Christopher Joseph	Mkulima	Mkitongoji	Nyakakika	[signature]
73	BYAMUNGU BENEDICTO	Mwenyekiti	Chama Cha Mapinduzi	P.O BOX 138 KARAGWE	[signature]
74	FELIX	KAHUGENDA	Mulinzi wa Kijiji	Box 103	Kahugenda

[signature]

AFISA MTENDAJI WA KIJIJI
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ALFRED B. KARUHENDA

NBI/NELSAP – Kagera River Basin Project
Environmental and Social Impact Assessment and Development of Resettlement Policy Framework for 4 proposed small Multi-Purpose Dams – Karazi Dam

ATTENDANCE LIST FOCUSSED GROUP DISCUSSION AT CHABUHORA VILLAGE

No.	Name	Gender		Village	Designation/Occupation	Signature
		M	F			
1.	ASUMPE JACKOB			CHABUHORA	MKULIMA	
2.	RUSIMA JOSHUA			CHABUHORA	MKULIMA	
3.	FURAHISHA SABARIYON			CHABUHORA	MKULIMA	
4.	REVINA MERCHADES			CHABUHORA	MKULIMA	
5.	JUDITH FRIDEUS			CHABUHORA	MKULIMA	
6.	AGROSIA ERUMAN			CHABUHORA	MKULIMA	
7.	TUMSIME SRIVERY			CHABUHORA	MKULIMA	
8.	ANISIA BATUNG			CHABUHORA	MKULIMA	

NBI/NELSAP – Kagera River Basin Project
Environmental and Social Impact Assessment and Development of Resettlement Policy Framework for 4 proposed small Multi-Purpose Dams – Karazi Dam

ATTENDANCE LIST

No.	Name	Gender M	Gender F	Village	Designation/Occupation	Signature
61	WILLYAMU JOSEPH	✓		CHABUHORA	MKULIMA	WILLYAMU
62	Holunyana Agustini	✓		CHABUHORA	MKULIMA	[signature]
63	YOHANA COSITA	✓		CHABUORA	MKURIMA	YOHANA
64	Constantine Cosma	✓		Chabuhora	Mkulima	[signature]
65	EMERICIANA ANDREA		✓	CHABUHORA	MKULIMA	[signature]
66	HAPPY LUCAS		✓	CHABUHORA	MKULIMA	[signature]
67	JOYNESS FOLOLIANI		✓	CHABUHORA	MKULIMA	JOYNESS
68	MALIYA FULUTUNATES		✓	CHABUHORA	MKULIMA	[signature]
69	ELINA KOLONELI		✓	CHABUHORA	MKULIMA	[signature]
70	AGIMENSI SIRIVELI		✓	CHABUHORA	MKULIMA	[signature]
71	GLORIUS CONSTANTINE	✓		CHABUHORA	MKULIMA	[signature]
72	DANIEL GORDIAN	✓		CHABUHORA	MKULIMA	[signature]

NBI/NELSAP – Kagera River Basin Project
Environmental and Social Impact Assessment and Development of Resettlement Policy Framework for 4 proposed small Multi-Purpose Dams – Karazi Dam

ATTENDANCE LIST

No.	Name	Gender		Village	Designation/Occupation	Signature
		M	F			
85	Elivia - CLEOPHACE			CHABUHORA	MWANAFUNZI	E.C
86	CHRISTINA - CLEOPHACE			CHABUHORA	MKULIMA	CC

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Environmental and Social Impact Assessment and Development of Resettlement Policy Framework for 4 proposed small Multi-Purpose Dams – Karazi Dam

ATTENDANCE LIST

No.	Name		Gender M	Gender F	Village	Designation/Occupation	Signature
73	PASTORY	JUSTINIANY	✓		CHABUHORA	MKULIMA	
74	DAU	SOMI RAJABU			CHABUHORA	MKULIMA	
75	GOSBERT	JONATHAN	✓		CHABUHORA	MKULIMA	
76	JUDITH	ANSELD		✓	CHABUHORA	MKULIMA	
77	RENATHA	GLORIUS		✓	CHABUHORA	MKULIMA	
78	FRANSIA	BERNARD		✓	CHABUHORA	MKULIMA	
79	LONGINUS	FULGENCE		✓	CHABUHORA	MKULIMA	
80	CASIANA	CONSTANTINE		✓	CHABUHORA	MKULIMA	
81	GENETURIA	CONSTANTIN		✓	CHABUHORA	MKULIMA	
82	REJINATIA	JACSON		✓	CHABUHORA	MKULIMA	
83	ANASTAZIA	MULOKOZI		✓	CHABUHORA	MKULIMA	
84	DIANA	CLEOPHACE		✓	CHABUHORA	MWANAFUNZI	

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Environmental and Social Impact Assessment and Development of Resettlement Policy Framework for 4 proposed small Multi-Purpose Dams – Karazi Dam

ATTENDANCE LIST

No.	Name	Gender ME	Gender KE	Village	Designation/Occupation	Signature
1	MELTIUS K. BIDUL		✓	CHABUHORA	mkiti shuuli	[signature]
2	WILLISONI M. IBARURA	✓		CHABUHORA	MJUMBE	[signature]
3	ANDERETI RUSAMHURU	✓		CHABUHORA	m/kiti [illegible]	[signature]
4	SEVELIANI SAULO	✓		CHABUHORA	MJUMBE	[signature]
5	LESPICIA DONATH		✓	CHABUHORA	MJUMBE	Donath
6	JASSON BIBUR	✓		CHABUHORA	m/k/kiiji	[signature]
7	Sylivel Balu	✓		CHABUHORA	Balozi	[signature]
8	Cotansi Kelimas	✓		CHABORA	mukulima	C.C.t.
9	Sitewati ANDREA	✓		CHABUHORA	mkulima	Sitewati
10	FAUSTINI AGUSTINI	✓		CHABUHORA	mkulima	Faustini
11	FOLOLIANI FULUTUNATUS	✓		CHABUHORA	mkulima	Fololiani
12	JACKSONI COSTANTINI	✓		CHABUHORA	Mkulima	J. C

NBI/NELSAP – Kagera River Basin Project
Environmental and Social Impact Assessment and Development of Resettlement Policy Framework for 4 proposed small Multi-Purpose Dams – Karazi Dam

ATTENDANCE LIST

No.	Name	Gender M	Gender F	Village	Designation/Occupation	Signature
13	GODLUS MATHIAS	✓		CHABUHORA	MKULIMA	
14.	ELIKI ENERIKO	✓		CHABUHORA	MKULIMA	
15	JEKSI CHRISTIANI	✓		CHABUHORA	MKULIMA	J. CH
16	RUKASI COSTANTINI	✓		CHABUHORA	MKULIMA	
17	FELESIAN CHRISTIAN	✓		CHABUHORA	MKULIMA	F CH.
18	SUMATHIRI MHAMEDI	✓		CHABUHORA	MKULIMA	S M
19	ANDELEA BIMBONA	✓		CHABUHORA	MKULIMA	ANDREA
20	MATALO RUKAS	✓		CHABUHORA	MKULIMA	
21	GASANA KABARE	✓		CHABUHORA	MKULIMA	Kabare.
22	ALBERT ADRIAN	✓		CHABUHORA	MKULIMA	
23	BENENET OBADIA	✓		CHABUHORA	MKULIMA	
24	DONATUSI FULUTUNAUS	✓		CHABUORA	MKULIMA	

ATTENDANCE LIST

No.	Name	Gender M	Gender F	Village	Designation/Occupation	Signature
49.	MUGISHA JOSEPH	✓		CHABUHORA	MKULIMA	[illegible]
50	EMANUEL KABUTURA	✓		Chabuhora	Balozi	EMANUEL
51	THEONES KABUTURA	✓		Chabuhora	mkulima	[illegible]
52	FERDINAND RWAMAHU	✓		CHABUHORA	Mkulima	[illegible]
53.	JOFREY JOSEPH	✓		CHABUHORA	MKULIMA	[illegible]
54	Felix N. Rukiza	✓		Kayungu	fundi uzeri	[illegible]
55	FASTUS FAUSTINE	✓		Katanga	Msemaji	[illegible]
56	FINIAS WILIAM	✓		Mgongore Chabuhora	Mkulima	F W
57	ANASTAZIA FRANCIS		✓	CHABUHORA	Mkulima	[illegible]
58	FRONTILEINE CHRISTOPHER	✓		KATUNGU	mkulima	[illegible]
59	MEDIUS. MELCHADES	✓		CHABUHORA	mkulima	[illegible]
60	Anoli MELCHADES	✓		CHABUHORA	mkulima	[illegible]

APPENDIX 4: Hydrology Report (attached separately)

Appendix 5: List of Plant species recorded in the Karazi

Family	Identification	Epiphyte	Grass	Herb	Liana	Sedge	Shrub	Tree
Acanthaceae	*Acanthus pubescens*						5	
	Asystasia gangetica			1				
	Barleria brownii			2				
	Hygrophila acutisepala			3				
	Hygrophila auriculata			13				
	Hypoestes forskaolii			4				
	Hypoestes triflora			1				
	Justicia heterocarpa			5				
	Justicia striata			1				
	Monechma debile			1				
	Monechma subsessile			2				
	Phaulopsis imbricata			3				
Aloaceae	*Aloe volkensii*			1				
Amaranthaceae	*Achyranthes aspera*			6				
	Celosia globosa			1				
Amaryllidaceae	*Cyrtanthus sanguineus*			7				
	Scadoxus multiflorus			1				
Anacardiaceae	*Lannea barteri*							1
	Ozoroa insignis							1
	Rhus natalensis						5	
Apiaceae	*Anthriscus sylvestris*			1				
Apocynaceae	*Callisa edulis*				2			
Asclepiadaceae	*Asclepias verticillata*				2			
Asparagaceae	*Asparagus africanus*				11			
	Asparagus racemosus				1			
Asteraceae	*Acmella caulirhiza*			1				
	Ageratum conyzoides			1				
	Bidens pilosa			1				
	Bothriocline nyungwensis			5				
	Gutenbergia polycephala			5				
	Laggera alata						1	
	Tagetes minuta			1				

	Vernonia amygdalina				1	
	Vernonia cinerea				1	
Balanitaceae	*Balanites aegyptiaca*	1				
Bignoniaceae	*Kigelia africana*					1
	Markhamia obtusifolia					6
	Spathodea campanulata					1
Boraginaceae	*Lithospermum afromontanum*	1				
Burseraceae	*Commiphora eminii*					1
	Commiphora madagascariensis					1
Caesalpiniaceae	*Bauhinia thonningii*				1	
	Cassia didymobotrya				4	
	Cassia kirkii				3	
Capparidaceae	*Capparis tomentosa*		1			
Celastraceae	*Cassine aethiopica*					1
	Elaeodendron buchananii					1
	Maytenus heterophylla					6
Combretaceae	*Combretum collinum*					1
	Combretum molle					3
Commelinaceae	*Commelina africana*	3				
	Stanfieldiella imperforata	8				
Convolvulaceae	*Ipomoea cairica*		2			
	Ipomoea fulvicaulis		6			
Cucurbitaceae	*Zehneria scabra*		1			
Cyperaceae	*Cyperus dilatatus*			1		
	Cyperus latifolius			6		
	Cyperus renschii			1		
	Kyllinga odorata			7		
Ebenaceae	*Euclea divinorum*					8
Euphorbiaceae	*Acalypha bipartita*				2	
	Erythrococca bongensis				1	
	Euphorbia candelabrum					3
	Flueggea virosa				1	
Fabaceae	*Aeschynomene abyssinica*				5	
	Aeschynomene mimosifolia				1	
	Crotalaria valida				3	
	Desmodium gangeticum				1	
	Erythrina abyssinica					1
	Glycine wightii	1				
	Indigofera arrecta				3	

	Indigofera spicata				7	
	Kotschya aeschynomenoides				9	
	Lathyrus hygrophilus				6	
	Pseudarthria hookeri				1	
	Sesbania sesban				1	
	Tephrosia linearis				2	
	Teramnus unicinatus		5			
	Trifolium purseglovei		2			
	Trifolium usambarense		4			
	Vigna luteola		1			
	Zornia pratensis		1			
Gentianaceae	*Swertia welwitschii*		1			
Labiatae	*Isodyctiphorus defoliatus*				1	
Lamiaceae	*Hoslundia opposita*				1	
	Leucas urundensis				1	
	Orthosiphon suffrutescens		1			
	Plectranthus serrulatus		1			
Leguminosae	*Ormocarpum trichocarpum*					7
Loranthaceae	*Loranthus elegantulus*	1				
Malvaceae	*Abutilon mauritianum*				1	
	Hibiscus canabinus				1	
	Hibiscus ovalifolius				2	
	Sida cordifolia				2	
	Sida rhombifolia				20	
Menispermaceae	*Cissampelos mucronata*			1		
Mimosaceae	*Acacia abyssinica*					9
	Acacia brevispica					2
	Acacia gerrardii					14
	Acacia hockii					2
	Acacia polyacantha					6
	Acacia senegal					2
	Acacia sieberiana					9
	Acacia tortiris					1
	Albizia anthelmintica					8
	Albizia schimperiana					1
	Dichrostachys cinerea					2
	Entada africana					1
	Mimosa pigra				2	
Olacaceae	*Ximenia americana*					4

Oleaceae	*Jasminum pauciflorum*			1		
Orchidaceae	*Eulophia horsfallii*		4			
Phytolaccaceae	*Phytolacca dodecandra*			1		
Poaceae	*Bothriochloa insculpta*	11				
	Brachiaria decumbens	16				
	Chloris gayana	2				
	Cynodon dactylon	12				
	Cynodon nlemfuensis	1				
	Digitaria ternata	2				
	Digitaria thouaresiana	1				
	Echinochloa hapoclada	1				
	Echinochloa pyramidalis	6				
	Eragrostis aspera	14				
	Eriochloa procera	2				
	Hyparrhenia filipendula	16				
	Imperata cylindrica	4				
	Leersia hexandra	6				
	Panicum hochstetteri	1				
	Panicum maximum	3				
	Paspalum scrobiculatum	1				
	Setaria kagerensis	5				
	Setaria sphacelata	13				
	Sporobolus africanus	17				
Polygonaceae	*Polygonum salicifolium*				3	
	Polygonum setosulum				3	
Primulaceae	*Lysimachia ruehmeriana*		1			
Rhamnaceae	*Scutia myrtina*			1		
	Ziziphus pubescens					1
Rubiaceae	*Gardenia ternifolia*				1	
	Vangueria apiculata				1	
Rutaceae	*Clausena anisata*				1	
	Teclea grandifolia					1
Sapindaceae	*Allophylus abyssinicus*					3
	Haplocoelum foliolosum					1
Scrophulariaceae	*Cycnium tubulosum*		1			
Solanaceae	*Solanum incanum*				5	
	Solanum kagehense				4	
Sterculiaceae	*Dombeya burgessiae*				2	
	Dombeya kirkii					8

Tiliaceae	*Grewia bicolor*		1
	Grewia trichocarpa		3
Verbenaceae	*Clerodendrum capitatum*	1	
	Lantana trifolia		1
Vitaceae	*Cissus petiolata*	6	
	Cissus quadrangularis	1	
	Rhoicissus revoilii	1	
	Rhoicissus tridentata	5	

APPENDIX 6: List of Bird species recorded at Karazi Dam site

	Species	HC	TC
1	AFRICAN BLACK-HEADED ORIOLE *Oriolus larvatus*	f	
2	AFRICAN FISH EAGLE *Haliaeetus vocifer*	W	
3	AFRICAN GREEN-PIGEON *Treron calva*	F	
4	AFRICAN GREY HORNBILL *Tockus nasutus*		
5	AFRICAN HARRIER-HAWK *Polyboroides typus*	f	
6	AFRICAN OPEN-BILLED STORK *Anastomus lamelligerus*	wG	
7	AFRICAN OPEN-BILLED STORK *Anastomus lamelligerus*	wG	
8	BARE-FACED GO-AWAY-BIRD *Corythaixoides personata*		R-RR
9	BEARDED WOODPECKER *Dendropicos namaquus*	f	
10	BLACK-AND-WHITE CUCKOO *Oxylophus jacobinus*		
11	BLACK-HEADED WEAVER *Ploceus cucullatus*		
12	BLACK-LORED BABBLER *Turdoides sharpei*		R-RR
13	BLUE-SPOTTED WOOD-DOVE *Turtur afer*	F	
14	BROAD-BILLED ROLLER *Eurystomus glaucurus*	fw	
15	BROWN PARROT *Poicephalus meyeri*		
16	BROWN-THROATED WATTLE-EYE *Platysteira cyanea*	f	
17	CARMINE BEE-EATER *Merops nubicus*	G	

18	CATTLE EGRET *Bubulcus ibis*	G	
19	COMMON BULBUL *Pycnonotus barbatus*	f	
20	COMMON STONECHAT *Saxicola torquata*		
21	DIEDERIK CUCKOO *Chrysococcyx caprius*		
22	EASTERN GREY PLANTAIN-EATER *Crinifer zonurus*		
23	EGYPTIAN GOOSE *Alopochen aegyptiacus*	WG	
24	EURASIAN HOBBY *Falco subbuteo*		
25	FORK-TAILED DRONGO *Dicrurus adsimilis*	f/F	
26	GREATER BLUE-EARED GLOSSY STARLING *Lamprotornis chalybaeus*		
27	GREY CROWNED CRANE *Balearica regulorum*	WG	G-VU
28	GREY HERON *Ardea cinerea*	W	R-NT
29	GREY-BACKED CAMAROPTERA *Camaroptera brachyura*	f	
30	GREY-BACKED FISCAL *Lanius excubitoroides*	fw	
31	HADADA *Bostrychia hagedash*	w	
32	HAMERKOP *Scopus umbretta*	w	
33	KLAAS' CUCKOO *Chrysococcyx klaas*	f	
34	LESSER MASKED WEAVER *Ploceus intermedius*		
35	LILAC-BREASTED ROLLER *Coracias caudata*		
36	MALACHITE KINGFISHER *Alcedo cristata*	W	
37	MARICO SUNBIRD *Cinnyris mariquensis*		
38	RED-CHESTED CUCKOO *Cuculus solitarius*	F	
39	RED-EYED DOVE *Streptopelia semitorquata*	f	
40	RED-HEADED WEAVER *Anaplectes rubriceps*		
41	RING-NECKED DOVE *Streptopelia capicola*	f	
42	ROSS'S TURACO *Musophaga rossae*	F	
43	RÜPPELL'S LONG-TAILED STARLING *Lamprotornis purpuropterus*		
44	SCALY FRANCOLIN *Francolinus squamatus*	F	

45	SPECKLED MOUSEBIRD *Colius striatus*		
46	SPOT-FLANKED BARBET *Tricholaema lachrymose*		R-RR
47	SPUR-WINGED GOOSE *Plectopterus gambensis*	W	
48	TAWNY EAGLE *Aquila rapax*	G	
49	TAWNY-FLANKED PRINIA *Prinia subflava*	fw	
50	TROPICAL BOUBOU *Laniarius aethiopicus*	f	
51	WHITE-BROWED COUCAL *Centropus superciliosus*		
52	WOODLAND KINGFISHER *Halcyon senegalensis*		
53	WOOLLY-NECKED STORK *Ciconia episcopus*	W	R-NT
54	YELLOW-BILLED DUCK *Anas undulata*	W	
55	YELLOW-FRONTED CANARY *Serinus mozambicus*		
56	YELLOW-THROATED GREENBUL *Chlorocichla flavicollis*	f	
57	YELLOW-THROATED LONGCLAW *Macronyx croceus*	G	

KEY

F Forest generalist – less specialised, also occur in small patches of forest
f Forest visitor
W Waterbird, specialist – normally restricted to wetlands or open waters
w Waterbird, no-specialist – often found near water
G Grassland species
R-NT Regionally Near-threatened
R-RR Regionally restricted range species
G-VU Globally Vulnerable

APPENDIX: 7 Socio- economic Tool used in Household Surveys

My name is_____ I am here on behalf of the **Nile Basin Initiative/Nile Equatorial Lakes Subsidiary Action Program (NBI/NELSAP).** This is an organization formed to develop the River Nile and its resources in an equitable and sustainable way for the benefit of the people of the Nile Basin. The NBI also aims at promoting regional peace and security.

We would therefore like to ask you some questions of which the responses will help in the planning, construction and operation phases of the project. The information you will give will be treated with utmost confidentiality.

Socio-Economic Survey Tool

Serial No. ----------

SECTION 1: Locational Details

Country----------District----------

Division----------Ward----------

Village ----------

Name of interviewer----------

Date of interview----------

Start time ----------

End Time----------

Duration of the interview----------

SECTION 2: Demographic Details (*Include all household members starting with the Household head)*

1. Name (use Xtian name only)	2. Sex	3. Age	4. Relationship to HH	5. Educ	6. Marital Status	7. Tribe	8. Religion	9.Income earner (Y/N)	10.Main source of livelihood (occupation)	11. 2nd source Livelihood (occupation)

Code for sex 1-Male 2- Female

Code for relationship with HH head: 1-Household head 2-Wife 3-son 4-Daughter 5-Granchild 6-Sister 7- Brother 8-Nephew/Niece 9-no blood relation 10-Other relations (specify)

Code for education 1-None 2-Primary 3-Secondary 4-Tertiary 5-University 6-Other (specify)

Code for marital status 1-Married monogamous 2-Married polygamous 3-Single 4-Widowed 5-Divorced 6-Cohabiting 7-Other (specify)

Code for religion 1-Protestant 2-Catholic 3-Seventh Day Adventist 4-Moslem 5-No belief6-Traditional 7-Other

Code for income earner 1-Yes 2-No

Code for source of livelihood 1-Peasant farmer 2-Commercial farmer 3-Civil servant 4-Trader 5-Service provision (e.g. salon, hotel, transport) 6- Casual laborer 7--Other (specify)

Is there any member of the household who is disabled? 1 Yes 2 No

If yes, what is the type of disability?

Physical lameness	1
Blind	2
Mental	3
Other (specify)	4

What was the cause of the disability?

……

Are there orphaned children in your household? 1 Yes 2 No

If yes, what was the cause of death of their parents?

……

If farming is a source of income answer questions 19-24

Type of farming (Multiple answers acceptable)

Crop farming	1	
Animal husbandry	2	
Mixed farming	3	
Fish farming	4	
Tree cropping	5	
Hunting	6	
Others (Specify)		7

Type of crops grown
Cash crops……
Food crops……

If you rear animals, what type of animals do you rear? (Multiple responses possible)

Sheep		1	Number……
Goats		2	Number…….
Cattle		3	Number……
Pigs		4	Number……..
Poultry	5	Number…….	
Other (specify other animals)		6	Number…….

Do you sell some of the crops you grow?
Yes 1

No 2

Do you sell some of the animals?
Yes 1
No 2

If you do fish farming, do you sell some of the fish caught?
Yes 1
No 2

If yes to questions 22-24, answer questions 25-27 below

Where do you sell your products?
Crops .....
Animals……
Fish ……..

What is the distance to the main marketing point for your products?
Less than 500ms 1
500-1km 2
Above 1km 3

What problems do you encounter when marketing your commodities?
……
……
……

SECTION 3: LAND OWNERSHIP AND TENURE

Do you own land?
Yes 1
No 2

Under what tenure system is your land? (Only one answer)
Customary 1
Leasehold 2
Freehold 3
Communal 4
Other (specify) 5

Do you own land elsewhere?
Yes 1
No 2

Average land size owned (in acres)……..

SECTION 4: HOUSING

Type of the residential house
Permanent 1
Semi permanent 2
Temporary 3

14. Ownership of the residential house

Self owned	1
Rent	2
Others (specify)	3

SECTION 5: ASSETS OWNED

Assets owned by the household (Multiple answers acceptable)
Radio 1
TV 2
Bicycle 3
Motorcycle 4
Car 5
Cell phone 6
Land 7
House 8
Animals (cattle, pigs, goats, sheep, poultry)9
Others (Specify) 10

SECTION 6: EXPENDITURE

14. What items/services take up most of your expenditure? Please **rank** them in order of highest expenditure by assigning them numbers from 1-9.

Item	**Rank**
Food	
Transport	
Medical bills	
Clothing	

Rent	
Energy	
Water bills	
School fees	
Other (specify)	

On average how much do you spend on the following items/services every month?

Item	**Amount (month)**
Food	
Transport	
Medical bills	
Clothing	
Rent	
Energy	
Water bills	
School fees	
Other (specify)	

SECTION 7: SOURCE OF ENERGY AND FUEL

What kind of fuel do you use for cooking at home? (Multiple responses)

Firewood	1
Charcoal	2
Paraffin/Kerosene	3
Electricity	4
Gas	5
Solar	6
Biogas	7
Others	8

What kind of fuel do you use for lighting at home? (Multiple responses)

Firewood	1
Charcoal	2
Paraffin/Kerosene	3
Electricity	4
Gas	5
Solar	6
Biogas	7
Others	8

SECTION 8: ACCESS TO INFORMATION

How do you access information about different aspects? (Multiple answers acceptable)

Radio	1		
TV	2		
Newspapers	3		
Community meetings	4		
Village public speakers	5		
Telephones	6		
Place of worship		7	
Neighbor	8		
Internet (email)		9	
Other (specify)	10		

SECTION 9: FOOD SECURITY

In the last 12 months, are there days when your household did not have lunch or supper or did not eat to satisfaction because of lack of enough food?

Yes	1
No	2

If yes, what were the reasons for the food shortage (not being enough)? (Multiple answers acceptable)

Land not enough for food production	1
The yield was poor due to poor weather, pest, dieses, soil fertility, rodents, other animals	2
Poor seeds used in planting	3
Sold most of the produce	4
Did not plant enough	5
The crops were destroyed due to too much rain/flooding	6
Other reason (specify)	7

SECTION 10: EDUCATION

Is there any member of your of household who is of school going age but does not go to school?

Yes 1

No 2

If yes, why isn't he/she in school? ……..

What is the distance to the nearest primary school?

Less than 500ms	1
500-1km	2
1-3kms	3
Above 3kms	4

What is the distance to the nearest Secondary school?

Less than 500ms	1
500-1km	2
1-3kms	3
Above 3kms	4

Has any member of this household received any other training (skills)?

Yes	1
No	2

If yes, specify …….

Do you know how to read and write in the following languages?

Official language	Yes	1	No	2
Any local language	Yes	1	No	2

SECTION 11: HEALTH

Which nearest health centre do you go to in case of an emergency?

……

Which referral hospital do you mainly use?

……

What is the distance to the nearest health Center?

Less than 500m	1
500-1km	2
1km- 3kms	3
3-5kms	4
6km+	5

What is the distance to the nearest referral health unit?

Less than 500m	1
500-1km	2
1km- 3kms	3
3-5kms	4
6km+	5

What do you think of the services offered by the nearest health center?

Very good	1
Good	2
Average	3

Poor 4

Give reasons for your answer above

……
……

Have you heard of HIV/AIDS?

Yes 1

No 2

What are the major causes of HIV/AIDS?

.....
.....

SECTION 12: WATER SUPPLY

What is the main source of water for your household?

Public boreholes	1
Privately owned boreholes	2
Rain Water harvesting	3
Protected Spring/well	4
Unprotected Spring/well	5
River, Lake, stream, swamp	6
Valley Tank/Earth dam	7
Stand post	8
Others (specify)	9

Apart from domestic use, what else do you use the water for?

Brick making	1
Watering animals	2
Fish farming	3
Agricultural use / Irrigation	4
Local beer brewing	5
Other (Specify)	6

How sufficient is this water?

Throughout the year	1
Insufficient during dry season	2
Insufficient throughout the year	3
Others (specify)	4

What is the distance from your home to the water source?

Less than 500m	1
500-1km	2
1km- 3kms	3
Above 3kms	4

How much time per day do you spend fetching water on a single trip?

Less than 30 minutes	1
30 minutes to 1 hour	2
1 to 2 hours	3
More than 2 hours	4

How many jerry cans of water do you use per day?

Domestic …….

Other uses ……...

What problems do you encounter with the water source? (multiple responses accepted)

Too steep	1
Expensive	2
It dries up	3
Long distance	4
None	5
Others (Specify)	6

What do you think of the quality of water delivered?

Taste:	1 Good	2 Average	3 Poor
Smell:	1 Good	2 Average	3 Poor
Color:	1 Good	2 Average	3 Poor
Hardness:	1 Good	2 average	3 Poor

SECTION 13: SANITATION

Do you have a toilet/latrine?

Yes	1
No	2

What type of latrine does your household use?

Traditional pit latrine	1
Flush toilet	2
VIP	3
Ecosan	4
Shallow pits	5
Others (specify)	6

If you do not have a toilet, where do you go?

Neighbor	1
Public toilet	2
Bush	3
Others (specify)	4

What are the reasons that inhibit you from owning a latrine?

……
…

If a toilet was constructed in your area, would you use it?

Yes 1

No 2

If no, give reasons

……

How does your household dispose of the solid wastes? (Multiple responses acceptable)

Open dumps 1
Burning 2
Shallow pits 3
Scatter in gardens 4
Others (specify) 5

Are there any public garbage disposal areas in designated by the local authorities or the government?

Yes 1
No 2

SECTION 14: GENDER ISSUES

Does your wife own land?

Yes 1
No 2

Is your wife allowed to make decisions on issues regarding land?

Yes 1
No 2

What are the roles of the women in this household?

What are the roles of men in this household?

What are the roles of children in this household?

Boys ----------

Girls ----------

SECTION 15: EXPECTATIONS AND FEARS FROM THE PROJECT

What are your expectations of the project?

What are your fears in regard to the project?

Please give suggestions on how these fears can be overcome or mitigated

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THANK YOU

APPENDIX 8: Dam Safety Report

This is attached in a separate report.